THREE ESSAYS ON THE FORMATION AND FRAGMENTATION OF STATES

by

Fernando Arteaga González
A Dissertation
Submitted to the
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In Partial fulfillment of
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of
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Committee:

_____ Dissertation Director

_____

_____

_____

_____ Department Chairperson

_____ Program Director

_____ Dean, College of Humanities
and Social Sciences

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Three Essays on the Formation and Fragmentation of States

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By

Fernando Arteaga González
Bachelor of Science
Universidad Nacional Autónoma de México, 2013

Director: Dr. Mark Koyama, Associate Professor
Department of Economics

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Fairfax, VA

Dedication

A solis ortu usque ad occasum

Zan ca tzihuactitlan, mizquititlan, aiyahue Chicomoztocpa, mochiompa yahuitze antla"tohuan ye nican, ohuaya, ohuaya

Acknowledgments

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Abstract

THREE ESSAYS ON THE FORMATION AND FRAGMENTATION OF STATES

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The dissertation explores the economic processes behind the formation and fragmentation of polities with applications to the Spanish Empire. First, I propose a specific theoretical agent-based model of the size of nations, founded upon political economy precepts—in which bargaining relationships between elites and the general population are the norm. Second, I focus on a singular study case of political fragmentation: the Spanish Empire's demise in the late 18th and early 19th centuries. I provide an analytical narrative that emphasizes the role of exogenous shocks in undermining the long-lasting authority of the King across America. Lastly, I focus on the building of a new State (Mexico) and stress how preceding pre-hispanic institutions still have a large effect on Mexico's current political division and in its economic outcomes.

Essay 1 explores how political jurisdictions converge towards a given size. There is a growing literature within social sciences that attempts to find a response: in economics, the problem is interpreted as analogous to that of firm and city's size, where there are centripetal and centrifugal forces that determine the actual size and number of nations; In international relations, the problem is approached as a path-dependent stochastic process that generates specific size distributions. My attempt in this paper is to fuse both perspectives, rendering a path-dependent process that is rooted in an economic rationale. I follow standard political

economy and institutional tenets to do so. The model is founded upon the premise of a division among the population into two classes—a general population and a governing elite—that interact and constrain each other. I explore this framework through an agent-based model that allows me to generate a flexible yet rigorous setup to test different scenarios.

Essay 2 studies how an empire that seemed cohesive for hundreds of years could easily fragment in a decade. I provide an analytical narrative in which I stress the importance of the Spanish Empire's fiscal sociology, one in which certain political enterprises (Miners, merchants, and the Crown) played key roles. I maintain that the empire had an implicit political arrangement; one in which the Crown maximized tax revenue through its power in managing the transatlantic trade. It did so by coopting a small set of local American elites (In Lima and Mexico City), which gained rents from their privileged trade position. It was a stable setting while Spain had sea supremacy. The advent of the British Navy in the late 18th century disrupted everything. Thereafter, the Crown attempted to decentralize its oceanic trade through new routes, and by trying to coopt a larger set of regional elites within the empire. This tactic backfired: it only gave major power to new local elites and created incentives for political fragmentation. I present a simple computational model of Spain's political economy and do some simulations that could help explain the rationale behind such system.

Essay 3 asks: what is the long-term impact of pre-colonial ethnic institutions? I examine the consequences of the fragmentation of local indigenous communities produced by Spanish rule in Mexico. To do this I make use of unique data from 18th-century pueblos—the basis of modern-day counties—to study the institutional impact that the formation of these pueblos had on current development in Mexico. I find that after controlling for alternative mechanisms, counties encompassing more historical pueblos, are more developed, and have less poverty, but are more unequal today. The effects are stronger in places where pre-hispanic roots are deeper (historical Mesoamerica and high altitude areas), suggesting the institutional impact has a pre-colonial basis.

Chapter 1: Exploring the Size of States: A Model of their Political Economy Determinants

1.1 Introduction

The United Nations recognizes 193 states as sovereign independent units (and there is an acknowledgment about other 13 whose sovereignty is disputed). The size of these countries—in terms of territorial size and population—is very diverse; from the very large, like China and India, to the very small, like Andorra and San Marino. The pattern is not unique to modern times. Very large countries have coexisted with very small ones: e.g. in the 5th century BC, the large Persian Achameneid Empire warred the very small Greek city states; in the 3th century AD, the Roman Empire coexisted with several German and Gaelic small tribes; in the Middle Ages, the large seats of power in England and France coincided with the small German and Italian city states; in Asia, in the 13th century, the large Chinese Song empire shared borders with smaller South Asian states; in America, in the 15th century, the Aztec and Inca empires were surrounded by very small antagonist tribes. There is evidence that the distribution of the size of independent polities follows a log-normal distribution; this is true today (Cederman, 2003b) but has also been true for the past centuries (Abramson, 2017). Using Abramson's data, figure 1.1 plots the size-distribution of states—in terms of area—for the 13th to 18th centuries. The left figure shows the whole untransformed histogram (pooling all the data points across the 13th-18th centuries), while the left figure presents a density approximation of the log-transformation—categorized by century.

Is there any underlying mechanism that can explain such log-normal distribution in the size of states? Traditional interpretations in International Relations have relied on mechanisms of stochastic process of war and conquest to do so (Cederman, 2002). Their main insights suggest that geographic conditions constrain the whole process and ultimately

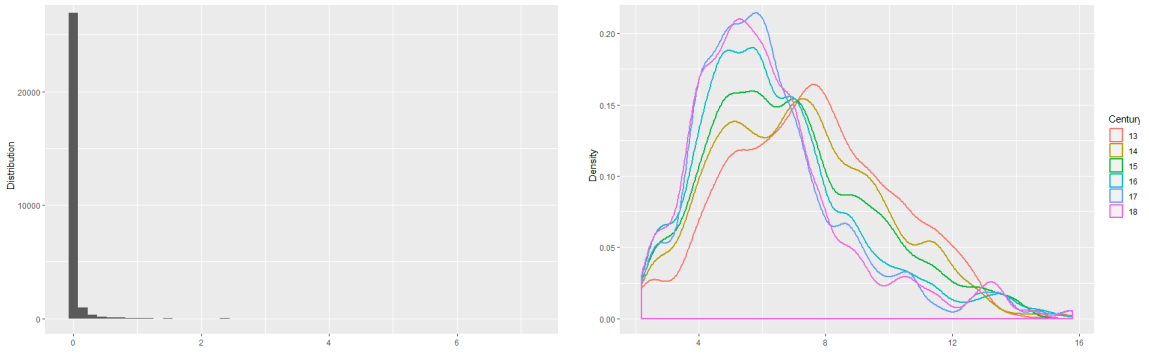
create the distribution we see in real life (Cederman, 2003a). His argument follows that of Diamond (1998), who famously argued that geography is the key factor that explains the cohesion of China compared to that of Europe. And while there is empirical evidence supporting the importance of geography (Kitamura and Lagerloeff, 2019), there is also evidence of alternative factors being relevant as well. For example, Abramson (2017, p.29) states

> observed changes in the number and size of states before the French Revolution were driven by economic factors. In those regions where urban life reclaimed a foothold, where new cities formed and the new social classes that emerged within them were capable of asserting themselves, political life fragmented. These new political actors, by virtue of their material wealth, were capable of resisting the centralizing efforts of the leaders of would-be territorial states. In the continent's periphery, where these groups were weak and incapable of subverting the construction of large states, the earliest national states formed.

In a similar vein, Fernandez-Villaverde et al. (2019) conclude that topography is an important characteristic that helps explain China's political centralization and Europe's fragmentation. Yet, they stress that topography alone is not a sufficient condition; political and economic factors are also important.

In this chapter I want to readdress once more this problem: why polities have the size they have? The contribution I make lies on building an alternative model. In the spirit of Cederman, I aim to replicate the observed patterns in the size-distribution of states; in the spirit of Abramson, I emphasize the relevance of economic factors *vis a vis* the geography/war and conquest models. I do so by calling for the use of an alternative literature in economics (Alesina and Spolaore, 1997) that uses its own methods to resolve the same question. A second contribution of the chapter is to open a bridge between the distinct social sciences.

If we aim to explain a given phenomena, we must not be content on merely replicating



(a) Pooled Histogram (b) Log Transformed Density by Century

Figure 1.1: Size Distribution of States 13th-18th Centuries

patterns, but we need to understand the processes that generate them: over simplistic and unrealistic approaches are not convincing enough. An economic rationale, founded on political economy premises, must be at the core of any explanation behind the size of state. Yet, the question is too relevant to be tackled by a single methodology—it calls for an interdisciplinary venture. Pure equilibrium models are too mechanistic—and by their own doing are unable to replicate world patterns.[1] An agent-based model paradigm is better suited to study complex interactions. The importance of the ABM approach resides in that it focuses on the process itself, rather than on static conditions—and thresholds. As explained by Radax (2009) and Cederman (1997), mathematically tractable models over rely on a very unrealistic assumption: that of uniformity (and homogeneity in characteristics) in the distribution of agents—and in the characteristics agents share.

[1]There is a resemblance to the literature on cities sizes. Economic models are logical interpretations that aim to understand how cities are created. Yet they are unable to replicate the patterns we observe in reality. Stochastic models, however, do replicate the pattern, but they lack any coherence in terms of the explanation of why cities grow—or their explanation is merely that city growth is random and the randomness creates the power law (Zipf's law) distribution we observe.

1.2 What Explains it? War, Economy, or Randomness?

The question is not a new one. We can trace back the discussion to the ancient Greeks. They believed that there was a sort of optimality to strive for in terms of the size of their polis; for them, being small was the key aspect of successful governance. Their argument was based on the premise that all political actors should know each other, which necessarily put a hard constraint on the efficient size of a state. Plato adventured to suggest that the optimal amount of population within a polity was of 5,040 persons (Charbit, 2002). As explained by Dahl and Tufte (1973), the Greek view of the state became the basis for all occidental philosophers and thinkers. It was not up until the enlightenment that the issue was readdressed. Then, the terms of the discussion veered away from a small-is-always-good maxim towards the idea that the optimal size of a nation had to be correlated with the particular form of governance of the polity. In The Social Contract, Rousseau famously associated democracies with small entities, aristocracies with middle sized countries, and monarchies with large ones.[2] By the times of the American War of Independence, the issue became a hotly debated topic. For the new Americans, the optimality of political jurisdictions was a concern of the utmost importance; The Federalist position pushed for a larger centralized state, while the Anti-Federalist preferred the US to be modeled as a confederation of quasi sovereign small states. The outcome of the debate created the US Republic as it is today, with its emphasis in what Weingast (1995) calls market federalism.

In the 20th century, the issue started to be examined in more technical perspective. The subject was no longer a matter political philosophers alone, but began attracting economists and other social scientists as well. The tone of the modern discussion was set by a conference held in 1957, in The Hague, by the International Economic Association. The conference proceedings were published three years later under the title of "Economic Consequences of the Size of Nations." In it , for the first time ever, the ideas of economies of scale and the costs of public good's provision were explored as being contingent to the particular size of

[2]His view still influences our own conceptions of the state. Alesina and Spolaore (2005a) came to a similar conclusion!

a polity (Robinson, 1960). Yet, the scope of this early literature focused on the economic effects of the size of nations, rather than on the economic causes of it. For these scientists, the size of polities was a parameter that was set up exogenously.

The first work that actually posited that the size of nations could be explained by reference to economic factors alone was Friedman (1977). He reversed the causality and asserted that economies of scale and the costs of administration set the size limits of a given country. More importantly, Friedman innovated by providing a political economy argument. He identified nations as being composed by governing elites and a general population. The economic configuration of a polity was the result of a contingent optimization process by these two classes: elites would favor institutions that efficiently tax activities favored by the general population. In Friedman's model this meant that if the general population had preferences towards trade interactions, elites would favor the creation of large nations that maximized the extent of the market— which would maximize trade opportunities, and by corollary the amount of tax-income these elites could extract too. Instead, if the population had more land-rentist preferences, elites would favor smaller states.

The literature exploded in the 90's, but it departed from Friedman's take—leaving out the political economy explanations—by focusing on a more mechanistic approach. Wittman (1991) for example, suggested that the processes of annexation and secession of nations was analogous to the case of acquisition and dissolution of firms. He explicitly called for a theory that rested solely on economies of scale considerations. Casella and Feinstein (2002) and Alesina and Spolaore (1997) are widely considered as the seminal works in this tradition. For them, the size of nations is determined by a process in which economies of scale act as the centripetal force, while heterogeneity in the composition of the nation (where population with diverse set of preference coexist) acts as the centrifugal force. Their specific models vary in their particularities (say, economies of scale can be modeled as gains achieved by access to large markets or by the decrease in the cost of public goods' provision) but they share a similar skeleton: they are all based on Hotelling's firm location model; where there is a finite line populated by uniformly distributed immovable agents (there is no migration).

In their models, distance between the agents sets the conditions that incentivize the union or separation into one or many polities; there is a positive externality of composing a large state, but there are also costs (e.g. because trading between the agents increases with the distance, or because distance itself may imply heterogeneous preferences over the political policies enacted by the state). Optimizing the agent's utility functions provide the given size of a state.

The recent literature builds on these economic models by adding more nuanced mechanisms, which provide more layers of complexity (see Bolton and Roland (1997), Alesina et al. (2004), Alesina and Spolaore (2005a), Haimanko et al. (2005), Spolaore (2007)), but without really affecting the core structure (push and pull forces based on economies of scale). Alternatively, along with the theoretical papers, an empirical literature has arisen with the goal of econometrically testing the theorized propositions (see Alesina et al., 2000; Spolaore and Wacziarg, 2005; Tam, 2004).

Economics is not the only social science that has taken interest in the problem of discerning the mechanisms behind the size of nations. Within the International Relations field there is an alternative literature. Their emphasis, however, lies not in finding economic explanations of the state, but in attempting to replicate the observed distribution of states' sizes, via processes of diplomacy and conquest. Cederman (2002) is the canonical example of this strand of literature. His model is a continuation of the cellular automata model proposed by Bremer and Mihalka (1977). The basic model assumes that elites are the only agents that matter. They inhabit a 2D lattice composed of hexagonal/square grids, then, by a process of stochastic movements of conquest, elites may annex other regions. As simple and unreal as the model may be, Cederman (2003a) provides evidence that it can account for the typical log-normal size distribution of nations that we observe in reality. Notwithstanding the simplicity in Cederman's behavioral premises (conquest is obviously not a realistic account of modern processes of state formation and fragmentation), his model provides an interesting alternative that can explain the size-distribution of states; e.g. randomness is a plausible hypothesis.

Following Cederman (2003a) I also aim to replicate the patterns observed in reality—the log-normal distribution in size-distribution of polities, but I to do so by exploring an alternative more economic-oriented mechanism; one that emphasizes the economic determinants behind the size of states(Abramson, 2017; Alesina and Spolaore, 1997; Friedman, 1977). After all, war and conflicts are not random processes, but are events that beg an explanation of their own. Schelling (1960) showed that conflict can be explained through political economy considerations. Alesina and Spolaore (2005b) incorporate the international conflict dimension by exploring the impact of distinct parameters (e.g. cost of war, defense spending,etc) in the way countries may negotiate annexations—and their fragmentation. Following them, in the model I propose, I assume war is endogenously resolved as well; but through a bargaining process where elites decide based on their circumstances.[3]

1.3 The Underlying Logic: Cities and Elites

The model I propose has two important characteristics that set it apart from the economic models mentioned in the aforementioned literature. First, I assume that the base unit of analysis is a discrete point, which we can describe as a city. Traditional economic models assume a continuously populated line. In my model, however, the topology is composed of discrete geographic regions (as seen in *Figure 3*). The point of assuming a preceding spatial hierarchy is both realistic and theoretically useful. It is realistic because a nation can be thought as been composed of several smaller spatial jurisdictions; whose size could have been determined long before (e.g. the US originally was composed of 13 different colonies, whose own size was determined before the US even existed). The basic unit of human organization historically has been any given sedentary settlement—which I refer hereafter as a city. These settlements , being defined as clusters of population, represent the most basic level of a given distinctive political jurisdiction (e.g. Rome, London, Berlin,

[3]Alesina and Spolaore (2005b) explore different scenarios that can capture the asymmetrical and exogenous circumstances that may play a part in creating conflict. I do not, a further exploration of my model could incorporate these circumstances as well.

Paris were important economic and political hubs long before they became capitals of their current nations). The assumption is useful because it lets us concentrate on the mechanisms behind the building of a meta-level hierarchy, instead of focusing on the establishment of original hierarchies.[4]

Second, I assume a clear distinction between those who are governed and those who are governing. The former I call population, the latter I refer as elites. I follow Friedman (1977) in this regard, and hence I differentiate myself with respect to the most common economic models in the literature, that assume homogeneous inhabitants.[5]

These two fundamental characteristics set the basis of the two main interactions explored in the model: A vertical one, based on the relationship between an elite and its population (in a given city); an horizontal relation, among elites that inhabit distinct cities.

I start by assuming that elites have the monopoly of violence in their cities. As monopolists, I infer they enjoy economic rents. The rents, however, are not unconstrained. Based on Brennan and Buchanan (1980), I assume that the elite's power to tax is constrained by the general willingness to pay of their clients (which is constituted by the general population living in their city). The main incentive for citizens to pay the taxes to their local elites, is the promise of safety and protection against foreign threats. The threat of war is always probable in the eyes of the common citizen. The bigger the threat to them, the more willingness to pay taxes they will have.[6]

The relation between elites is characterized by a process of diplomatic agreements, where a wealthier elite would annex a poorer one (the poorer elite's region would become part of the richer) if and only if both elites are benefited by the arrangement. That is, an annexation will occur only if the economies of scale are large enough to offset the decrease in the potential annexed elite's power to tax (who would then *ipso facto* become a tributary). The

[4]Baker et al. (2010) provides a model of how primitive societies can transcend from amorphy to anarchy and hierarchy at low levels

[5]Some of these recent models do take into consideration the possibility of a dictator being in place. However, the process by which they model it, is explained in an ad hoc manner, where no particular relationship between the dictator and their population is ever established.

[6]Yu Ko et al. (2018) explore a similar idea and arrive at a similar testable implication: States where the threat of conquest was perceived as higher, payed higher taxes.

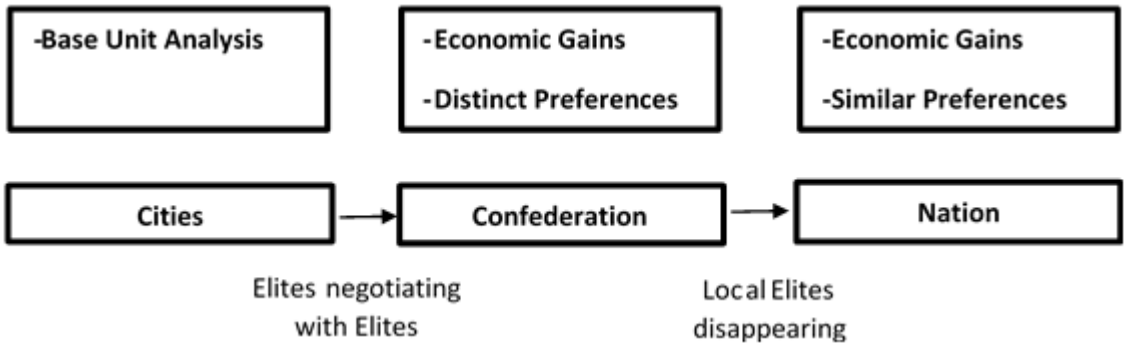


Figure 1.2: The Underlying Logic of the Model

subordinated elite, however, does not disappear with its subordination/annexation/acquisition. It can still tax its local citizens, but at a minor scale compared to what they used to. The protection premium these new subordinated elites would charge, shifts to a distinct arena, which depends not on the threat of invasion, but on the perceived threat—by the local citizens— of interference in local matters by the "federal" elite.[7]

1.4 The Model: Overview, Design and Details

Figure 1.2 summarizes the general process of the model. *Figure 1.3* formally explains the model in Unified Modeling Language. First, a N quantity of contiguous cities are created in a discrete line (as shown in *Figure 3*). Each city has an elite and a given amount of population (randomly created) that pay taxes according to the general level of threat they perceive (the tax rate is the same for all agents).

The process of annexation between elites, one in which a richer elite attempts to annex a poorer one, will be successful only if both parties are benefited by the agreement. If the annexation occurs, we can say that a confederation is born. The motives behind such annexation are solely motivated by economic gains. A second process, one that I will expand more in future versions of the model, signals the consolidation of a country into a nation.

[7] I choose to develop a economic process of annexation instead of a militaristic one, because I believe the latter is always at the core of the former.

Such process can be characterized by the disappearance of local elites in favor of national elites (situated in the "capital" of the state). In the model, the process will occur whenever the randomly-given preferences of citizens are more accommodative to the "federal" elite than to their local elite.

Figure 1.4 shows an example of an initial scenario where only five regions exist. The blocks can be thought of the number of citizens living in each region/city. Hence, the way we would read the figure is the following: In city 1, there are five persons; in city 2 there are three; in city 3 there are four; and in city 5 there are five. Also, very importantly we can note that City 1 is neighbored by City 2, City 2 is neighbored by Cities 1 and 3 , and so on. Initially all cities are independent of each other (each one has their own local governing elites).

The main parameters in the model are four: the quantity of initial regions (how many columns exist in *Figure 1.4*); the amount of initial population in the world (how many blocks exist per column as seen in *Figure 1.4*); the fixed cost of administering a political jurisdiction (the cost of the elites in governing their regions); and a λ parameter that serves as an exponent to control the marginal cost of administering the nation (the potential marginal cost of administering additional regions by any given local "local" elite).

The following section details the specifics of the model, accounting for the agent's characteristics and the step-by-step process followed in the model.

1.4.1 Agent's Description and Attributes

Table 1.1 and Table 1.2 show the particular attributes of the agents within the model, as well as their initialization values.

The population class has eight relevant attributes: *i)* Region denotes the particular city where the agent lives. It is given by a random uniform function that goes from the zero region up to the N region inhabitable in the model. Once it is given, it never changes. There is no migration in the model. Agents can live only in the place they were born ; *ii)* Nation, it refers to the particular allegiance of that city . Initially each region is its own

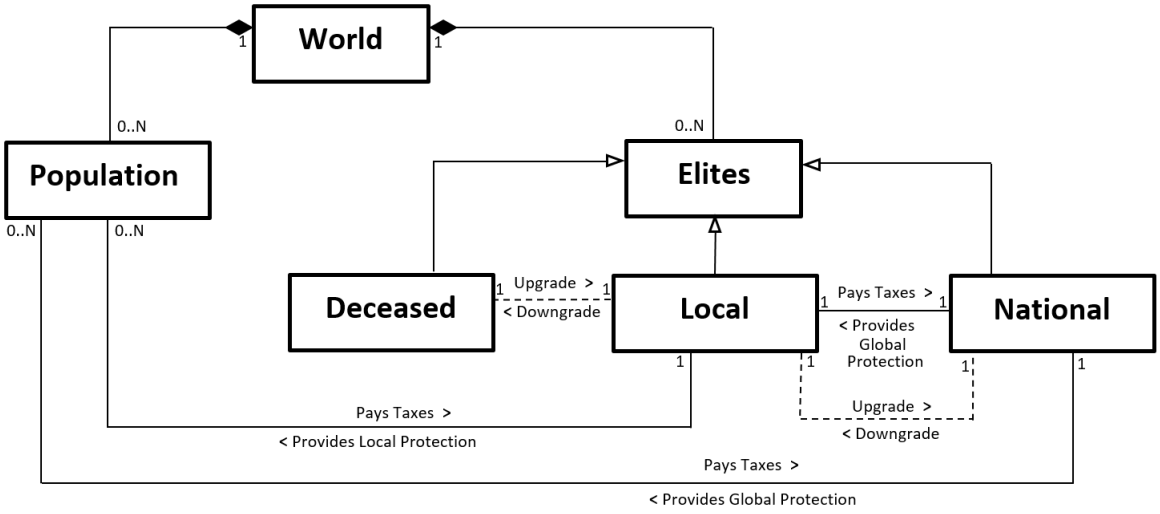


Figure 1.3: Overview of the Model

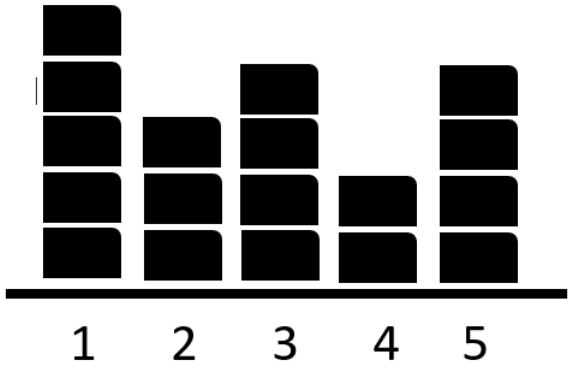


Figure 1.4: Snapshot of the Topology of the Model

Table 1.1: Population's Relevant Attributes and Values

Attributes	**Values**	**Initialization**
Region	$int[0, N]$	Random Uniform
Nation	$int[0, N]$	Same as Region
Preference	$float(0, 1)$	Random Uniform
Violence Discount Rate	$float(0, -)$	Random Exponential
Violence Perception	$float(0, 1)$	VDR * (Agr /Cit)
Production Capability	$float[1, 2]$	Random Uniform
Income	$float(0, \infty)$	$CP * (IPC_I/SumIPC)$
Effort	1	1

nation. Through the process of annexation, however, individuals within a region could lose its independence and become part of other's nation; *iii)* Preference refers to the particular set of policies favored by the individual. It initially is set up to be randomly distributed along a bounded (0,1) set; *iv)* Violence Discount Rate, it signals the particular propensity of every individual to perceive the violence threat. The value is set up to follow a random exponential distribution ($\sim exp(\lambda) = exp(0.2)$). It is initially given and never changes throughout the simulation; *v)* Violence Perception, it is the threat as is really perceived by each individual in a given city. It depends on the subjective Violence Discount Rate of each individual,but also on the ratio between the potential aggressors in the vicinity (in this case each citizen of a neighboring nation represents a potential aggressor) and the defenders of the city (the amount of population the given city has); *vi)* Production Capability, refers to the individual's "human capital." It is uniformly random distributed along a [1,2] set. Once the simulation begins, the attribute stays the same until the end; *vii)* Income, it is given as the proportional contribution of the agent in the overall production of the whole nation. *viii)* Effort, is a percentage value that modifies the individuals productivity. The idea is that depending on the difference between the individual preferences and the policies being enacted by the elite, an individual would put more or less effort. In the current stage of the model, effort is set up to be 1, which means that preference's differences have zero impact on the model as of now.

The elite class is composed of nine relevant attributes: *i)* Region, denotes the city in which the elite lives. The model is constituted as to initially produce an elite for each region in the model; *ii)* Nation, refers to the fact that an elite may be subordinated to a core elite. In the beginning, however, each elite's nation is its own region; *iii)* Preference, it implies the set of public policies enacted by the elite. Elites must seek to maintain their privileged position by enacting policies that go in accord to the preferences of their core citizens. Elites, then, enact the median policy preference of the individuals living in the core city (If the elite annexes other regions, their policy is not modified; elites only need to keep their core supporters happy and no one else);*iv)* Potential Agressors, it refers to the amount of

Table 1.2: Elite's Relevant Attributes and Values

Attributes	**Values**	**Initialization**
Region	$int[0, N]$	-
Nation	$int[0, N]$	Same as Region
Preference	$float(0, 1)$	$Median(Pr_c)$
Potential Agressors	$int[0, N]$	# Neighbors
core citizens	$int[0, N]$	# Citizens in City
citizens	$int[0, N]$	Core Citizens
Tax Rate	$float(0, 1)$	$Median(VP_c)$
Income	$float(-\infty, \infty)$	TaxIncome - Costs
Subordinated	$int(0, 3)$	2

population living in neighboring countries;[8] *v)* core citizens, refers to the number of citizens living in the elite's own region; *vi)* citizens, refers to the number of citizens living in an elite's own nation. Initially, because each region is its own nation, core citizens and citizens are the same, but throughout the simulation the amount of citizens may increase while the amount of core citizens stays the same; *vii)* Tax Rate, is expressed in percentage points and refers to the rate the elite charges its citizens for its protection. As with the public policies, the elite sets up the rate to be equal to the median of the perceived violence threat of the individuals living in their city; *viii)* Income, it is unbounded and can go negative if the costs of administering the region/nation are bigger than the income it derives from taxing its citizens; *ix)* Subordinated refers to a dummy variable that can go from 0 to 3: # 0 means the elite ceased to exist.[9] # 1 refers to a subordinated elite, which is part of a larger confederation. A subordinated elite pays tribute to the core elite, but still remains capable of charging local taxes in its own region. # 2 is the case where the elite remains independent and is not part of any other nation. Because initially all cities are independent, the initial setup is that every elite has a 2 value. # 3 signals that that the respective elite

[8]For example, in *Figure 1.4*, City 1 has three potential agressors, city 2 has nine potential agressors, city 3 has five, city 4 has eight and city 5 has 2

[9]Such scenario may happen when the region becomes absorbed by other elite (a process of transition between Confederation to Nation) or it can occur when the costs of managing the region/nation are greater than the benefits, which means that the elite goes bankrupt

is the core elite in the confederation/nation, which signifies that its region is the capital.

1.4.2 Agents' Behavior—Step by Step Process of the Model

The model initializes according to the initial setup explained in last section. N cities are created, and n amount of agents are localized in those cities. One elite is assigned to each city.

The model is composed of three general phases: 1) A production phase where the nation generates tax income for the elites; 2) An annexation phase, where the elites seek to add more regions to their nation (by subordinating other elites); 3) A bypass phase, where subordinated regions within an established confederation calculate if their preferences are better represented by the core elite instead of their national elite.

The production phase itself can be divided in different stages. First, the elite sets up the optimal tax rate. It does so by considering the profiles of violence perception of each individual living in their nation (δ_{ik}). The violence perception variable is calculated by each individual, and it depends on an **objective perception**—the ratio between the amount of potential aggressors and defenders. Aggressors are defined as the number of citizens living in neighboring countries ($N_l + N_r$), while defenders are the amount of citizens living in the current nation (N_k)—and a **subjective perception**: their own violence discount rate, α_i. To maximize rents, the elite chooses a tax rate (Δ) equal to the median of the perceived violent threat of all the citizens within the nation. If a city is part of a nation, then the local elites retain a power to tax. In those situations, the local tax rate rationale changes from being dependent on foreign threat to a local one; The objective ratio between aggressors and defenders becomes defined as a ratio between the citizens of the capital and citizens of the respective local region.[10]

$$\delta_{ik} = \alpha_i \cdot \frac{N_l + N_r}{N_k} \tag{1.1}$$

[10]Citizens are only taxed once by a respective elite. If they pay to a local elite, then they do not pay the national tax. The national tax is payed by the local elite, from their own income

$$\Delta = median(\delta) \tag{1.2}$$

Second, the model calculates the production of each nation (C_k) , which is given by a multiplicative function where the capabilities of each individual (IPC^{e_i}) interact between them. The function is meant to imply that there are increasing returns to scale in the production process. Effort is the exponent of each individual's production capability. As of now, the model considers that all agents put 100 % effort. In future versions, however, effort will be endogenous to the model.

$$C_k = \prod IPC_i^{e_i} \tag{1.3}$$

The gross individual income (IC_i) is given by the proportional contribution of each agent to the total production of their nation. The net individual income (NIC_i) is given by discounting the tax rate imposed by the local elite.

$$IC_i = C_k \cdot \frac{IPC_i}{\sum IPC_i} \tag{1.4}$$

$$NIC_i = IC_i(1 - \Delta) \tag{1.5}$$

Third, the elite calculates its revenue and income. Its gross revenue depends on the amount of tax income it receives from their core regions—its own core region plus any other regions within the nation that have no local elite (IC_{ic})— and from subordinated regions—regions that have a local elite (E_{ss}).[11] The cost of administrating a nation is composed of a fixed amount K and a variable one, dependent on the amount of total population and the extent of the nation—the distance between the borders of the nation and the capital—all raised to a λ factor ($(N_k D_k)^{\lambda}$)

[11] As explained before, for non core regions, the national tax rates are paid by local elites exclusively (not by their respective citizens). The local elite income is derived from their own taxes imposed on their own city.

$$E_k = Tax_k - Cost_k \tag{1.6}$$

$$Tax_k = (\sum IC_{ic} + \sum E_{ss}) \cdot \Delta \tag{1.7}$$

$$Cost_k = K + \sum (N_k D_k)^{\lambda} \tag{1.8}$$

The second phase of the model begins after all cities have produced and their respective elites have received an income. The annexation order follows a very simple stochastic process: Each time, every available elite (that is, elites that are identified as core or independent) have an opportunity to act; they can even act more than once per turn. The amount of acts in every turn is limited, however. Only up to half of the total amount of available elites can act.[12] For example, in the case exemplified in *Figure 1.4* there are five elites, that means only two acts are permitted in the first turn (an elite has a random chance of acting each time, and hence it is possible that a same elite could act twice in a turn).

The process of annexation is simple too. Once an elite acts, it has a random chance of looking to the right or left neighbor. Whoever chooses, it will attempt to annex it. The process, however, can only be initiated if the acquiring elite has a greater income than the target elite (the one that is intended to become subordinated). Also, it is important to note that as of now, only independent elites can be acquired (A confederation cannot annex other confederation, nor steal a region from other nation. This feature will be implemented in future versions of the model). As mentioned before, the process can only be completed if both elites are benefited by the arrangement. The way in which the elites calculate if they are benefited or not is the same as the one described in the production phase (they compare their current scenario with the perspective scenario and decide). It is important to note that the elites exhibit bounded rationality. They only optimize step by step and lack

[12]The actions per phase are arbitrary. Yet, increasing them only speeds-up the process towards convergence, and adds nothing to the overall mechanics of the model.

the computability capacity of intertemporal optimization (A realistic assumption I say).

The last phase, the bypass phase, is still a work in progress. The idea is that citizens within regions that are subordinated may be better represented by the policies enacted by the national elite rather than the local one. If thats the case, the Local elite will disappear and the region will be fully annexed as part of the core regions.

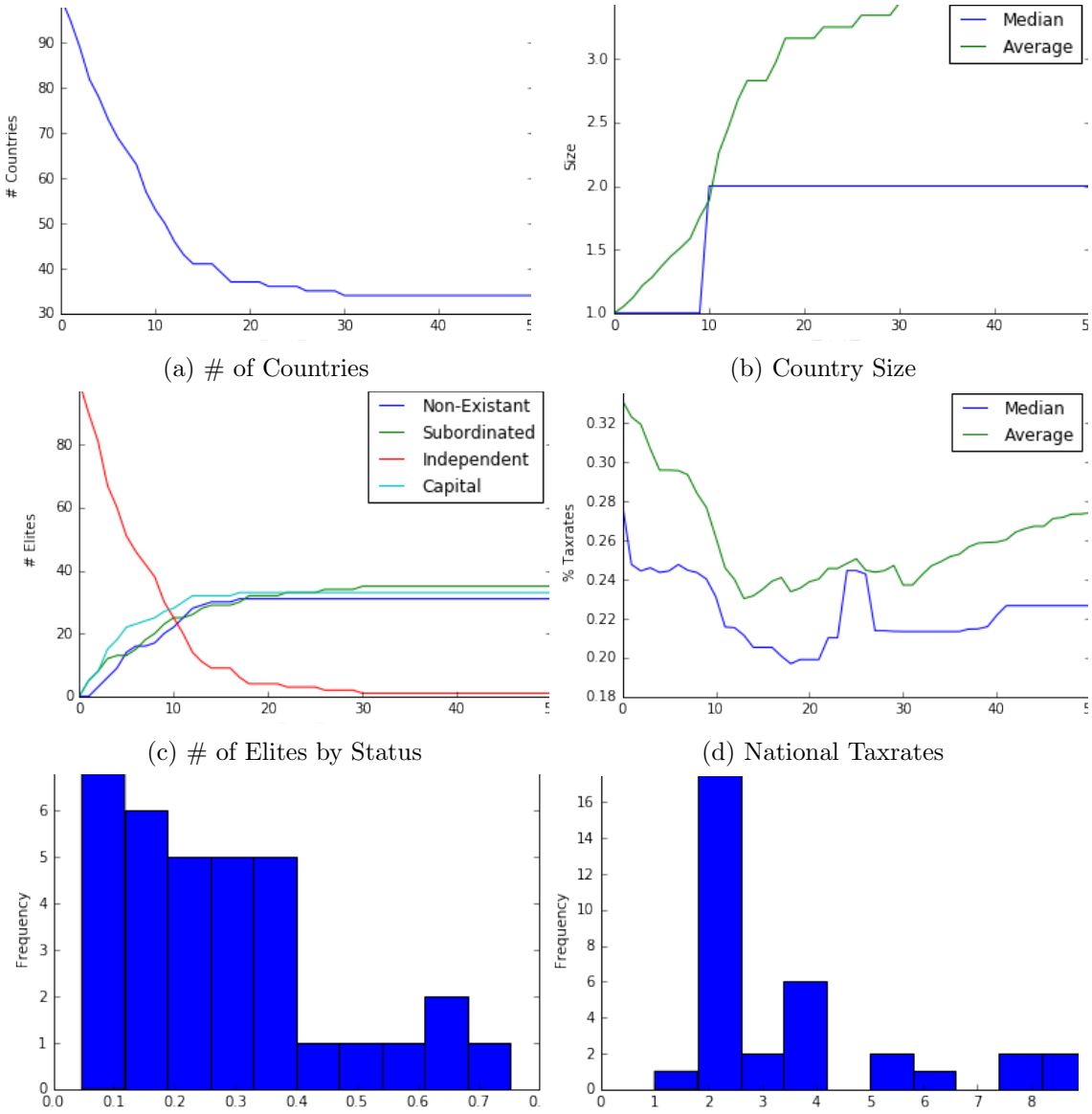
1.5 Experimentation and Results

The model's benchmark scenario is defined by the following parameters: *i)* The amount of cities is set to 100; *ii)* The number of individual agents of the population class is set to be 1,000; *v)*The fixed cost of administering a nation is set to 10; *vi)* The *lambda* value that reflect the marginal cost of adminstering a nation is set to 2; *vii)* The particular set up of population within the cities is randomly given; *viii)* The model runs for 50 turns that replicate each of the three phases mentioned before.

The model was coded in Python 2.7. The results are provisional, as the debugging process is not yet complete. The code is not optimized just yet and requires to be polished even more to be computational efficient (there are many loops that make the simulations slow).

Figure 2.6 shows an example of some variables recorded through a sample run of the model. The basic question the model tries to account for is the number of countries and its size; those are the key variables that I keep track. *Figure 1.5a* shows how the amount of sovereign countries decrease until achieving a steady state of around 35. That is, from the 100 original independent sovereign regions in the simulation, only a third of them continued existing as independent nations. The steady state is achieved pretty fast but has diminishing marginal changes: 60 countries were annexed in the first 15 turns, and after that, only other 5 regions disappeared and had to wait another 15 turns.

The size of the typical country (*Figure 1.5b*) is registered as the amount of regions within a nation. In this case, the typical—the median—country was composed of only two



(a) # of Countries

(b) Country Size

(c) # of Elites by Status

(d) National Taxrates

(e) Distribution of National Tax Rates

(f) Distribution of Countries by Size

Figure 1.5: A Typical Run Results

regions. However, as we see in the figure, the average size of a nation kept increasing up to 3.5. This is because , in this model, the size of nations needs not to be the same for all countries. *Figure 1.5f* shows the size distribution at the end of the simulation (Turn 50).[13] We can clearly see that the typical nation had only two regions, but there were nations that consisted of more regions. Four of them were actually very large (eight and nine). Cederman (2003a) argued that the distribution of nations follows a log-normal distribution. It appears that my simulation does replicate the real macro pattern.[14]

Figure 1.5c shows the destiny of each local elite within the model. Only one elite maintained the original status of being independent (that is, it kept being the elite of a city state, without being annexed or disappearing). The path of the others shared a similar trajectory. A third of the elites become core elites (their regions became the capitals of a nation/confederation); A third ended up disappearing; A third became annexed to other's nations and became subordinated (but kept the power to tax in their respective cities).

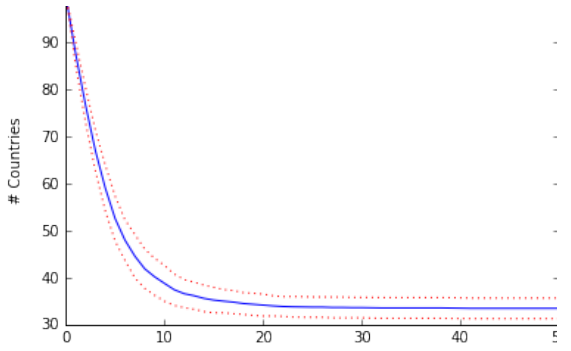
A second related question the model may be able to shed light on, is about the relationship between tax rates and the size of nation. *Figure 1.5d* shows the evolution of the national tax rate (the tax charged by the core elite). It initially decreases and then, it begins to grow again. The results are still very preliminary to really evaluate why this happens. *Figure 1.5e* portraits the tax rate distribution among nations.

The model is able to produce distributions that are not uniform nor normally distributed. Typical measures of central tendency—like average and median—are unable to convey all the information produced in the model. However, one simulation is not enough to evaluate the robustness of results. Many have to be done. *Figure 1.6* and *Figure 1.7* explore two scenarios and show the average results after 30 simulations. The problem, is that final distributions cannot be averaged.[15]

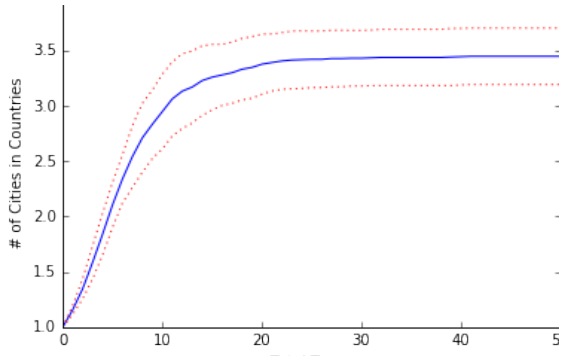
[13] As I have explained elsewhere, initially all regions are independent. That is, all nations are of size one.

[14] Of course this is just a simulation run, and systematic and rigorous tests and analysis need to be made as to be certain. However, the approximation is good enough for a preliminary version

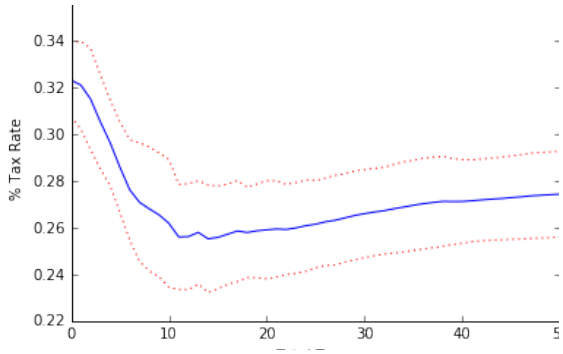
[15] In future versions of the chapter I would estimate the Kernel Density, instead of histograms, and by averaging it through the many simulations we could still end up having an idea of the final end stage distribution of thing in the models



(a) # of Countries

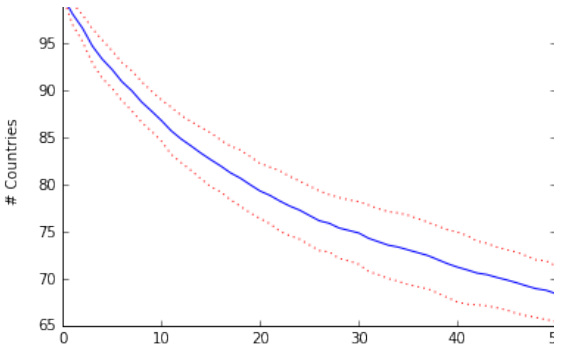


(b) Country Size

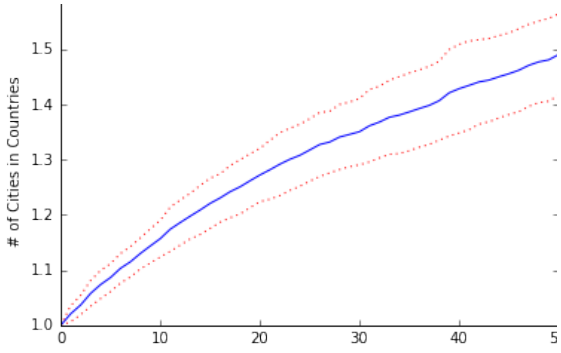


(c) Tax Rates

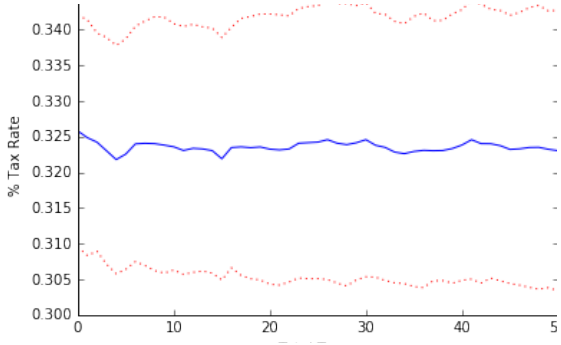
Figure 1.6: Baseline Scenario, Average 30 Runs



(a) # of Countries



(b) Country Size



(c) Tax Rates

Figure 1.7: Case A, Average 30 Runs

Figure 1.6 presents the baseline case scenario. After many runs with different parameters (experiment results are not shown) I can conclude that it is a very robust setting.[16] The number of countries end up achieving a steady state of 33, the average size converges to 3.5 more or less, and the trajectory of the tax rate is one with a rapid decrease and, then, a slower increase after 10, 15 turns.

I know the model is not entirely debugged because increasing the marginal cost parameter does drastically change the final results in expected ways. In the baseline case, the lambda factor is set to two. In the *Figure 1.7* the parameter is set to five. Only by implementing the drastic increase, we can see a palpable effect in the simulation final outcome: the number of countries increases , the average size of nations decreases, and the tax rate stays around the same.

What can we infer from this results? A first possible explanation of the apparent robustness of the model to parameter changes, is that the driving mechanism behind the results is the stochastic process that settles when and who can act in any given turn. As it is now, the model is too simple to recreate more complex problems. The inability of an elite to acquire a non-independent elite[17] presents a very big impasse. Moreover, given that the effort function is not implemented yet, it creates a problem where there is no real scenario where political fragmentation can occur.

1.6 Conclusion

Throughout history, the size-distribution of states has followed a log-normal form. Alternative explanations have been made to address this pattern. Some scholars have emphasized stochastic processes of war and conquest (constrained by geography) as the main explanations(Cederman, 2003a). Alternatively, economic fundamentals have also been proposed as being relevant (Abramson, 2017; Alesina and Spolaore, 1997).

[16] Or maybe there is a bug in my model. The results are very preliminar and need to be taken with a grain of salt.

[17] elites can only acquire independent elites. There is no annexation between confederations or nations

The main aim of the chapter is to provide a model that explain the log-normal distribution of polities. The contribution I make is on rooting the process of creating not in stochastic proccesess of war and conquest, but on economic considerations. Yet, unlike most economic models, which are founded on representative agents and closed-form solutions, I rely on agent based modeling techniques—because the issue at hand requires, almost by definition, the assumption of non-uniform distributions. The behavioral procedure I convey is, nonetheless, rooted on political economy decisions where tax-constrained elites decide when, and if, they want to annex or be annexed.

The model is still in the process of being debugged; some critical features are not implemented just yet (e.g. endogenous effort by the population). A preliminary result, however, is that the economic considerations of taxation—by pure threat of conflict— and the economic profit of it, influence the way elites behave and induce a process of convergence towards a steady state that more-or-less replicates the log-normal distribution in the size of states.

1.7 Appendix: Python Code

```
""" A simple model of State Formation that tries to identify the size of nations
based on Alesina \& Spolaore (2003)  and Cederman (2003)

Procedure begins with independent cities distributed across a line, each with a
set of population and a local elite. Elites dispute each other and merge  between
them giving birth to confoderations. Then confenderations can give rise to nations.


Economics of Scale play the part of the agglomeration force, while elites' rents
political economy  play part on the anti agglomeration force. The key, however,
like most Agent Based Modeling is that  agents are only bounded rational. Their
microtivations are given by heuristics that are short-term based, and not planned
on long term.  This creates a complex scenario of state building.

\#IMPORTANTE NOTE, SUBORDINATED ELITES MAY END UP BEING RICHER THAN NATIONAL ELITES
[which it happens in real life scenarios]
"""
```

```
import random as rd
import numpy as np
import matplotlib.pyplot as plt
from scipy.stats import gaussian\_kde



turn = 50 \#amount of tick simulations

Continent= True \# True implies there are at least two cities that are only bordered
\# by one neighbor city. False implies that every city is bordered by two cities.
\#\#\#\#\#\#FALSE IS NOT WORKING RIGHT NOW\#\#\#\#\#\#

population = 1000    \# The amount of population within the model
Initial\_Regions = 4 \#Number of Discrete regions in the model

Bureocracy\_Cost = 10 \# The fixed cost of managing a nation/confederation
Marginal\_Cost =2 \#Exponent value cost for the Elite, for the managmente of
\# regions beside the core (where distance and number of citizens in the
\# region increase the cost)


def teamproduction(x):    \#Function that calculates the multiplicative production function
        z=1
        for i in x:
        z*=i
        return z


class agent (object):
        def \_\_init\_\_(self,ID):
                self.ID= ID
\#identifies where the agent is located (0,100)
                self.region = rd.randint(0,Initial\_Regions -1)
\#Identifies the political preference value (0,1)
                self.preference = rd.random()
\#Measures the dissatisfaction of the respective population
                self.disutility = 0
\#Identifies the nation of the agent, initially each region is its own region
                self.nation = self.region
\#Identifies the perception of the agent to external threats
                self.violence\_perception = np.random.exponential(.2)
 \#Identifies the production capabilities of each agent [1,2)
                self.production\_capability = ( rd.random()+1 )
\#Identifies the effort put into produtcion by each agent, effort begins as one,
\#but depends on level of disutility
                self.effort = 0
\#Net Production capacity of the agent (discounting Effort)
\#self.production = self.production\_capability * self.effort
                self.income = 0  \#Identifies the income of each agent
```

```
class elite (object):
def \_\_init\_\_(self,ID):
        self.ID= ID
\#Identifies the tax rate imposed by the elite in its region
        self.taxrate = 0
\#variable to keep track
        self.taxrate2= 0
\#Identifies the income that the elite gots from taxation
        self.taxincome = 0
\#variable to keep track
        self.taxincome2= 0
\#Identifies the region of the Elite
        self.region = 0
\#Identifies the policy preferences of the Elite
        self.preference = rd.random()
\#Identifies the nation of the elite, initially each region is its own nation
        self.nation = self.region
\#Boolean variable that serves to identify if the agent has acted in the
\# current turn or not
        \#self.active = False
        self.subordinated = 2 \#Dummy variable:
\#3 means that is a core elite (capital of nation), capital elite protects
\# against external threats (inmediate national neighbors
\#2 means its an independent city,local elite protects against external threats
\#(inmediate neighbors), citizens pay taxes to local elites, local elites
\# are independent
\#1 means its a subordinated elite, local elite protects against internal threats
\#(inmediate local neighbors and core city), citizens pay taxes to local elites,
\# local elites pay taxes to global elite
\#0 means no longer is an elite   no elite, Core city does as he pleases
\#(these regions pay same taxes as the capital), a
\#List of the regions linked to this elite (the ones that compare )
        self.nation\_size=[]
\#Variable that acts as a tracker of past events.
        self.past\_income = 0

\#Identifies the level of production each elite commands
        \#self.total\_production = 0
\#Variable that acts as a tracker of past events.
        \#self.past\_total\_production = 0

\#Identifies the production capabilities that each Elite commands
        self.production\_possibility = []
\#Variable to keep track [Acquisition of elites, optimzation algorithm]
        self.production\_possibility2 = []
\#Identifies the spectrum of citizens' preferences
        self.preference\_position = []
\#Identifies the violence threat perceived by the common citizenry
        self.violence\_perception = []
\#Variable to keep track[Acquisition of elites, optimzation algorithm]
        self.violence\_perception2 = []
\#Identifies the number of citizens each border nation has
```

```
        self.agressors = 0
\#Variable to keep track[Acquisition of elites, optimzation algorithm]
        self.agressors2= 0
\#Variable that identifies the number of core citizens living under the elite
\# protection (citizens living in the capital, and in regions without elite)
        self.Core\_Citizens = 0
\#Identifies the number of people living under the Elites protection
        self.citizens =   self.Core\_Citizens
\#Variable to keep track[Acquisition of elites, optimzation algorithm]
        self.citizens2 = 0


class play (object):
def \_\_init\_\_(self):
\#agents (aka general population) are created
        self.number\_agents = [agent(x)for x in range(population)]
        pos = []
        for i in self.number\_agents:
                pos.append(i.region)
                unique\_pos = set(pos)
\#Elites are created, one per each region
                self.number\_elites = [elite(y) for y in range (len(unique\_pos))]
                self.ids = [i.ID for i in self.number\_elites]

        t=0
\#Elites are established (they are linked) to a region
        for i in self.number\_elites:
                i.region= t
                i.nation = i.region
                t+=1
\#Procedure to identify production capacity and number of citizens in a region
        for i in self.number\_elites:
                for j in self.number\_agents:
                        if i.region == j.region:
\#Production capabilities are identified
                                i.production\_possibility.append(float\\
                                (j.production\_capability)**(1-j.effort))
\#Number of citizens under an Elite is identified
                                i.citizens += 1
\#Number of core citizens under an Elite is identified
                                i.Core\_Citizens += 1

 \#Procedure to identifiy violence threat. 1st Step
                for i in self.number\_elites:
\#Continent means that the rightest and leftest regions are bordered from one side only
                        if Continent == True:
\#General procedure that identify regions borders
                                for j in self.number\_elites:
                                        if j.region == i.region +1 or j.region== i.region-1:
                                                i.agressors += j.citizens

\#Procedure to identify violence threat, 2nd step
```

```
                for i in self.number\_elites:
                        for j in self.number\_agents:
                                if i.region== j.region:
                                        i.violence\_perception.append\\
                                        (j.violence\_perception * (float(i.agressors)\\
                                         / i.citizens))
\#Violence equals number of potential agressors/number of citizens multiplied
\#by individual perception
                                        i.preference\_position.append(j.preference)

                for i in self.number\_elites:
\#Regional tax is set up depending violence threat conditions
                        i.taxrate = np.median(i.violence\_perception)
\#TaxRate can never be 100\%
                        if i.taxrate >.99:
                                i.taxrate=.99
\#Elites implement the median preferred policies of their core region
                                i.preference = np.median (i.preference\_position)

\#Procedure to quantify Population and Elites income and Populations disatisfaction
\#with implemented policies
                for i in self.number\_elites:
                for j in self.number\_agents:
                        if i.region == j.region:
                                \#i.total\_production = teamproduction(i.production\_possibility)
                                j.income = (teamproduction(i.production\_possibility)\\
                                 * (float(j.production\_capability)\\
                                 / sum(i.production\_possibility))) *(1 - i.taxrate)
                                i.taxincome += (teamproduction(i.production\_possibility)\\
                                * (float(j.production\_capability)\\
                                / sum(i.production\_possibility)))*(i.taxrate)
                                j.disutility = abs(j.preference - i.preference)
                                \#j.effort = j.disutility

\#Estimating Elite's net income,
                for i in self.number\_elites:
                        i.taxincome-= Bureocracy\_Cost
                        i.past\_income = i.taxincome
                        \#i.past\_total\_production = i.total\_production


                for i in self.number\_elites:
                        for j in self.number\_elites:
                                if i.nation == j.nation:
\#Recognizing the regions that are part of a nation/confederation
                                        i.nation\_size.append(j.region)

\#Recognizing the regions that are either core cities or independent ones
                self.ids =[]
                        for i in self.number\_elites:
                                if i.taxincome>0:
                                        if i.subordinated == 2 or i.subordinated == 3:
```

```
                                                    self.ids.append(i.ID)


def step(self):



\#\#\#\#\#\#\#\#        ACQUISITION PHASE \#\#\#\#\#
\#Only 50 \% chance of activiation within a turn
size\_prob = round((len(self.ids) / 2) , 0)

\#Order of operation is random with repetition possibility.
\#(An Elite can act twice or more times per turn)
active = np.random.choice(self.ids,size= size\_prob ,replace=True)
\#List that includes inmediate right and left neighbors
\#Max\_Min = [min(self.number\_elites[i].nation\_size)-1,\\
\# max(self.number\_elites[i].nation\_size+1)
\#Random choose either left or right neighbor to acquire
\#Left\_Right = np.random.choice( Max\_Min, size=1)

\#\#\#\#\#\# ONLY CORE AND INDEPENDENT ELITES CAN ACQUIRE OTHER REGIONS AND
\#ALSO ONLY THEY CAN BE ACQUIRED [E.G. CORE ELITE (A) CANNOT ACQUIRE A
\#SUBORDINATED REGION OF CORE ELITE (B)] \#\#\#\#\#\#\#\#\#
\#\#\#\#\#\# RICH NATIONS CAN CONSUME POOR NATIONS, BUT NOT OTHERWISE


for i in active:
\#EXTRA INDENTATION AFTER HERE[NOT HERE DUE TO PAGE CONSTRAINTS]
if Continent== True:
\#EXTRA INDENTATION AFTER HERE[NOT HERE DUE TO PAGE CONSTRAINTS]
for j in self.number\_elites:
        RDM = rd.random()
\#The elite randomly chooses to survey his left or right nation looking to
\#be absorbed by them
        if RDM > 0.5:                [CHANGE!!!!!]
\#Region to the left of the nation, where i elite is richer than j
                if j.region == max(self.number\_elites[i].nation\_size) +1\\
                and self.number\_elites[i].taxincome > j.taxincome:
\#Case where the target city is an independent city without other regions
                if j.subordinated == 2:
\#Acquring elite needs to evaluate if merger is profitable, if it is,
\# it acquires the region; if it is not, it doesnt.
                Cit\_Dist =[]
                for q in self.number\_elites[i].nation\_size:
                                Cit = self.number\_elites[q].Core\_Citizens
                                Dist= abs(self.number\_elites[q].region - \\
                                self.number\_elites[i].region)
                                Cit\_Dist.append(Cit*Dist)
\#Calculating Distance between core city and potential new acquired city
                                Distance\_Ac = abs(j.region - self.number\_elites[i].region)
\#Calculating the Marginal Cost of acquiring the new city with its citizens
```

```
                                    Cost\_Ac = (Distance\_Ac*j.citizens)  \#**(Marginal\_Cost)
                                    Cost\_Ac+= sum(Cit\_Dist)
                                    Cost\_Ac = Cost\_Ac**(Marginal\_Cost)


\#Calculating the projective total income acquired by Core Elite if it gets the new city
\# Calculating Production Capabilities
                for k in self.number\_agents:
\#Agents that belong to the already established Nation plus the new
\# prospective ages
                        if k.nation == self.number\_elites[i].nation \\
                                or k.region==j.region:
                                self.number\_elites[i].production\_possibility2.append\\
                                (float(k.production\_capability)**(1-k.effort))
                                self.number\_elites[i].citizens2 += 1

\#Next I calculate External Violence Threat that determines Global tax rates.
\#1st by knowing the number of citizens in border Nations
\#Assure that the region to be acquired has a border with a third nation
                        if j.region +1 < Initial\_Regions-1:
                                z = self.number\_elites[j.region+1].nation
                                self.number\_elites[i].agressors2 += self.number\_elites\\
                                [z].citizens

                        if min(self.number\_elites[i].nation\_size) > 0:
                                y = self.number\_elites[min(self.number\_elites[i].\\
                                nation\_size)-1].nation
                                self.number\_elites[i].agressors2 += self.number\_\\
                                elites[y].citizens

\#Procedure to identify violence threat, 2nd step (I calculate the exact
\#Violence Perception of each individual within the Nation/Confederation)

for w in self.number\_agents:
if w.nation == self.number\_elites[i].nation or w.region==j.region:
self.number\_elites[i].violence\_perception2.append(w.violence\_perception\\
 * (float(self.number\_elites[i].agressors2) / self.number\_elites[i].citizens2))
\#Violence equals number of potential agressors/number of citizens
\# multiplied by individual perception

\#National tax is set up depending external violence threat conditions
self.number\_elites[i].taxrate2 = np.median(self.number\_elites[i].violence\_perception2)
 \#TaxRate can never be 100\%
if self.number\_elites[i].taxrate2 >.99:
self.number\_elites[i].taxrate2=.99

\#If the target city has an elite with negtive income (no capacity to negotiate)
\# then it can be acquired inmediately

if j.past\_income <= 0:
```

```
for u in self.number\_elites[i].nation\_size:
if self.number\_elites[u].subordinated == 1:  \#Region with a subordinated Elite
for p in self.number\_agents:
if p.region==u:

\#\#\#\#Calculating tax rates charged by local elites, then the Core
\#Elite charges the Local Elite another tax  \#\#\#

Expected\_Payoff\_Local\_Elite = \\
(teamproduction(self.number\_elites[i].production\_possibility2)\\
*  (float(p.production\_capability) / \\
sum(self.number\_elites[i].production\_possibility2)))\\
*(self.number\_elites[u].taxrate)
\#\#\#attention, local elites cease to have a cost when becoming subordinated,
\#think if this can change future\#\#\#

self.number\_elites[i].taxincome2 += Expected\_Payoff\_Local\_\\
Elite*self.number\_elites[i].taxrate2

 \#Capital Region or Province wihtin the nation without local elite
if self.number\_elites[u].subordinated == 3 or self.number\_elites[u].subordinated ==0 \\
or self.number\_elites[u].subordinated ==2:
for p in self.number\_agents:
if p.region == u:
self.number\_elites[i].taxincome2 += \\

(teamproduction(self.number\_elites[i].production\_possibility2) * \\
(float(p.production\_capability) / \\
sum(self.number\_elites[i].production\_possibility2)))*(self.number\_elites[i].taxrate2 )


self.number\_elites[i].taxincome2 -= (Cost\_Ac + Bureocracy\_Cost)
Benefit =  self.number\_elites[i].taxincome2 - self.number\_elites[i].taxincome
\#If the acquiring elite gains a benefit from incorporating the new region, then it does
if Benefit > 0:

self.number\_elites[i].subordinated = 3   \#The Acquring Elite becomes Core Capital

for a in self.number\_agents:
if a.nation == j.nation:
\#Agents become part of the annexing Nation
a.nation = self.number\_elites[i].nation
\#The acquired region becomes part of the targeting nation
j.nation = self.number\_elites[i].nation
j.subordinated = 0  \#Local elite ceases to exist
\# Region is annexed to Core's Elite zone of influence
self.number\_elites[i].nation\_size.append(j.region)
\#Region adapts taxrate from Core
j.taxrate = self.number\_elites[i].taxrate2
j.taxrate2 = 0
j.taxincome = 0  \#Local region elite gets zero income
j.taxincome2 = 0
```

```
j.citizens += self.number\_elites[i].citizens
j.agressors = 0
j.violence\_perception = []
j.violence\_perception2 =[]

  \#Reseting Tracking Variables
self.number\_elites[i].taxrate2 =0
self.number\_elites[i].taxincome2 =0
self.number\_elites[i].violence\_perception2 = []
self.number\_elites[i].citizens2=0
self.number\_elites[i].agressors2 =0
self.number\_elites[i].production\_possibility2 = []



break
 \#If the target city has an acting elite, then the elite must approve the merger too
if j.past\_income > 0:

\#Next I calculate Violence Threat that determines tax rates in the potential acquired region

j.agressors2= self.number\_elites[i].Core\_Citizens

for q in self.number\_agents:
if q.region == j.region:
j.violence\_perception2.append(q.violence\_perception\\
 * (float(j.agressors2) / j.Core\_Citizens))
\#Regional tax is set up depending local violence threat
j.taxrate2 = np.median (j.violence\_perception2)  conditions
if j.taxrate2 >.99:  \#TaxRate can never be 100\%
j.taxrate2=.99

for q in self.number\_agents:
if q.region == j.region:
\#print q.ID, j.taxincome, j.taxincome2
\#print q.production\_capability, sum(self.number\_elites[i].production\_possibility2)
j.taxincome2 += (teamproduction(self.number\_elites[i].production\_possibility2)\\
 * (float(q.production\_capability)/\\
  sum(self.number\_elites[i].production\_possibility2)))*(j.taxrate2)
\#print q.ID, j.taxincome, j.taxincome2


for u in self.number\_elites[i].nation\_size:
\#Region with a subordinated Elite
if self.number\_elites[u].subordinated == 1:
for p in self.number\_agents:
if p.region==u:

\#\#\#\#Calculating tax rates charged by local elites,
\#then the Core Elite charges the Local Elite another tax  \#\#\#

Expected\_Payoff\_Local\_Elite = (teamproduction(self.number\\
```

```
\_elites[i].production\_possibility2) *(float(p.production\_capability) /\\ sum(self.number\_elites
(self.number\_elites[u].taxrate)
\#\#\#attention, local elites cease to have a cost when becoming
\#subordinated, think if this can change future\#\#\#

self.number\_elites[i].taxincome2 += \\
Expected\_Payoff\_Local\_Elite*self.number\_elites[i].taxrate2

 \#Capital Region or Province wihtin the nation without local elite
if self.number\_elites[u].subordinated == 3 \\
or self.number\_elites[u].subordinated ==0 or \\
self.number\_elites[u].subordinated ==2:
for p in self.number\_agents:
if p.region == u:
self.number\_elites[i].taxincome2 += \\
(teamproduction(self.number\_elites[i].production\_possibility2)\\
 *(float(p.production\_capability) / \\
 sum(self.number\_elites[i].production\_possibility2)))*\\
 (self.number\_elites[i].taxrate2 )

self.number\_elites[i].taxincome2 += j.taxincome2*self.number\_elites[i].taxrate2
j.taxincome2= j.taxincome2*(1 - self.number\_elites[i].taxrate2)

self.number\_elites[i].taxincome2 -=(Cost\_Ac + Bureocracy\_Cost)

Benefit =  self.number\_elites[i].taxincome2 - self.number\_elites[i].taxincome
Benefit2 = j.taxincome2 - j.taxincome

if Benefit > 0 and  Benefit2 > 0:


\#The Acquring Elite becomes Core Capital
self.number\_elites[i].subordinated = 3
for a in self.number\_agents:
if a.nation == j.nation:
\#Agents become part of the annexing Nation
a.nation = self.number\_elites[i].nation
\#The acquired region becomes part of the targeting nation
j.nation = self.number\_elites[i].nation
j.subordinated = 1  \#Local elite becomes subordinated
\# Region is annexed to Core's Elite zone of influence
self.number\_elites[i].nation\_size.append(j.region)
j.taxrate = j.taxrate2
j.taxincome2 = 0
j.citizens += self.number\_elites[i].citizens
j.agressors = 0
j.violence\_perception = []
j.violence\_perception2 =[]

  \#Reseting Tracking Variables
self.number\_elites[i].taxrate2 =0
self.number\_elites[i].taxincome2 =0
```

```
self.number\_elites[i].violence\_perception2 = []
self.number\_elites[i].citizens2=0
self.number\_elites[i].agressors2 =0
self.number\_elites[i].production\_possibility2 = []

\#Removing the annexed region from the available regions to get a turn
self.ids.remove(j.ID)

break

\#The elite randomly chooses to survey his left or right nation
\#looking to be absorbed by them
elif RDM <= 0.5:

 \#Region to the left of the nation, where i elite is richer than
if j.region == min(self.number\_elites[i].nation\_size) -1 \\
 and self.number\_elites[i].taxincome > j.taxincome:

\#Case where the target city is an independent city without other regions
if j.subordinated == 2:

\#Acquring elite needs to evaluate if merger is profitable,
\#if it is, it acquires the region; if it is not, it doesnt.

Cit\_Dist =[]

for q in self.number\_elites[i].nation\_size:
Cit = self.number\_elites[q].Core\_Citizens
Dist= abs(self.number\_elites[q].region - self.number\_elites[i].region)
Cit\_Dist.append(Cit*Dist)

\#Calculating Distance between core city and potential new acquired city
Distance\_Ac = abs(j.region - self.number\_elites[i].region)
\#Calculating the Marginal Cost of acquiring the new city with its citizens
Cost\_Ac = (Distance\_Ac*j.citizens)  \#**(Marginal\_Cost)
\#print Cost\_Ac
Cost\_Ac+= sum(Cit\_Dist)
\#print Cost\_Ac
Cost\_Ac = Cost\_Ac**(Marginal\_Cost)
\#print Cost\_Ac



\#print Cost\_Ac

\#Calculating the projective total income acquired by Core Elite if
\#it gets the new city
\# Calculating Production Capabilities
for k in self.number\_agents:
\#Agents that belong to the already established Nation plus
\# the new prospective ages
if k.nation == self.number\_elites[i].nation or k.region==j.region:
```

```
self.number\_elites[i].production\_possibility2.append\\
(float(k.production\_capability)**(1-k.effort))
self.number\_elites[i].citizens2 += 1

\#Next I calculate External Violence Threat that determines Global tax rates.
\# 1st by knowing the number of citizens in border Nations

 \#Assure that the region to be acquired has a border with a third nation
if j.region -1 >= 0:
z = self.number\_elites[j.region-1].nation
self.number\_elites[i].agressors2 += self.number\_elites[z].citizens

if max(self.number\_elites[i].nation\_size) <  Initial\_Regions -1:
y = self.number\_elites[max(self.number\_elites[i].nation\_size)+1].nation
self.number\_elites[i].agressors2 += self.number\_elites[y].citizens


\#\#\#\#POTENTIAL PROBLEM, IF ONE NATION GROWS ALL BIG\#\#\#

\#Procedure to identify violence threat, 2nd step
\#(I calculate the exact Violence Perception of each
\#individual within the Nation/Confederation)

for w in self.number\_agents:
if w.nation == self.number\_elites[i].nation or w.region==j.region:
self.number\_elites[i].violence\_perception2.append(w.violence\_perception\\
 * (float(self.number\_elites[i].agressors2) / self.number\_elites[i].citizens2))
\#Violence equals number of potential agressors/number of citizens
\#multiplied by individual perception

 \#National tax is set up depending external violence threat conditions
self.number\_elites[i].taxrate2 = np.median(self.number\_elites[i].violence\_perception2)
\#TaxRate can never be 100\%
if self.number\_elites[i].taxrate2 >.99:
self.number\_elites[i].taxrate2=.99

\#If the target city has an elite with negtive income
\#(no capacity to negotiate) then it can be acquired inmediately

if j.past\_income <= 0:

for u in self.number\_elites[i].nation\_size:
\#Region with a subordinated Elite
if self.number\_elites[u].subordinated == 1:
for p in self.number\_agents:
if p.region==u:

\#\#\#\#Calculating tax rates charged by local elites,
\#then the Core Elite charges the Local Elite another tax  \#\#\#

Expected\_Payoff\_Local\_Elite = (teamproduction(self.number\\
\_elites[i].production\_possibility2) *(float(p.production\_capability) / \\ sum(self.number\_elites
```

```
\#\#\#attention, local elites cease to have a cost when becoming subordinated,
\# think if this can change future\#\#\#

self.number\_elites[i].taxincome2 +=\\
 Expected\_Payoff\_Local\_Elite*self.number\_elites[i].taxrate2

\#Capital Region or Province wihtin the nation without local elite
if self.number\_elites[u].subordinated == 3 or self.number\_elites[u].subordinated ==0\\
 or self.number\_elites[u].subordinated ==2:
for p in self.number\_agents:
if p.region == u:
self.number\_elites[i].taxincome2 += (teamproduction(self.number\_elites[i].production\_possibility2
 *   (float(p.production\_capability) /\\ sum(self.number\_elites[i].production\_possibility2)))*(s


self.number\_elites[i].taxincome2 -= (Cost\_Ac + Bureocracy\_Cost)

Benefit =  self.number\_elites[i].taxincome2 - self.number\_elites[i].taxincome
 \#If the acquiring elite gains a benefit from incorporating the new region, then it does
if Benefit > 0:
self.number\_elites[i].subordinated = 3   \#The Acquring Elite becomes Core Capital
for a in self.number\_agents:
if a.nation == j.nation:
\#Agents become part of the annexing Nation
a.nation = self.number\_elites[i].nation
 \#The acquired region becomes part of the targeting nation
j.nation = self.number\_elites[i].nation
j.subordinated = 0  \#Local elite ceases to exist
\# Region is annexed to Core's Elite zone of influence
self.number\_elites[i].nation\_size.append(j.region)
\#Region adapts taxrate from Core
j.taxrate = self.number\_elites[i].taxrate2
j.taxrate2 = 0
j.taxincome = 0  \#Local region elite gets zero income
j.taxincome2 = 0
j.citizens += self.number\_elites[i].citizens
j.agressors = 0
j.violence\_perception = []
j.violence\_perception2 =[]

\#Reseting Tracking Variables
self.number\_elites[i].taxrate2 =0
self.number\_elites[i].taxincome2 =0
self.number\_elites[i].violence\_perception2 = []
self.number\_elites[i].citizens2=0
self.number\_elites[i].agressors2 =0
self.number\_elites[i].production\_possibility2 = []


break
\#If the target city has an acting elite, then the elite must approve the merger too
if j.past\_income > 0:
```

```
\#Next I calculate Violence Threat that determines tax rates
\#in the potential acquired region

j.agressors2= self.number\_elites[i].Core\_Citizens

for q in self.number\_agents:
if q.region == j.region:
j.violence\_perception2.append(q.violence\_perception\\
 * (float(j.agressors2) / j.Core\_Citizens))
\#Regional tax is set up depending local violence threat
j.taxrate2 = np.median (j.violence\_perception2)  conditions
if j.taxrate2 >.99:          \#TaxRate can never be 100\%
j.taxrate2=.99

for q in self.number\_agents:
if q.region == j.region:
\#print q.ID, j.taxincome, j.taxincome2
\#print q.production\_capability, sum(self.number\_elites[i].production\_possibility2)
j.taxincome2 += (teamproduction(self.number\_elites[i].production\_possibility2)\\
 * (float(q.production\_capability)/ \\
 sum(self.number\_elites[i].production\_possibility2)))*(j.taxrate2)
\#print q.ID, j.taxincome, j.taxincome2


for u in self.number\_elites[i].nation\_size:
if self.number\_elites[u].subordinated == 1:  \#Region with a subordinated Elite
for p in self.number\_agents:
if p.region==u:

\#\#\#\#Calculating tax rates charged by local elites, then the
\#Core Elite charges the Local Elite another tax  \#\#\#

Expected\_Payoff\_Local\_Elite =\\
 (teamproduction(self.number\_elites[i].production\_possibility2)\\
  *(float(p.production\_capability) /\\
 sum(self.number\_elites[i].production\_possibility2)))*(self.number\_elites[u].taxrate)
\#\#\#attention, local elites cease to have a cost when becoming subordinated,
\#think if this can change future\#\#\#

self.number\_elites[i].taxincome2 +=\\
 Expected\_Payoff\_Local\_Elite*self.number\_elites[i].taxrate2


if self.number\_elites[u].subordinated == 3 or self.number\_elites[u]\\
.subordinated ==0 or self.number\_elites[u].subordinated ==2:  \\
\#Capital Region or Province wihtin the nation without local elite
for p in self.number\_agents:
if p.region == u:
self.number\_elites[i].taxincome2 += \\
(teamproduction(self.number\_elites[i].production\_possibility2) \\
*(float(p.production\_capability/ sum(self.number\\
```

```
\_elites[i].production\_possibility2)))*(self.number\_elites[i].taxrate2 )

 self.number\_elites[i].taxrate2, j.taxincome2

self.number\_elites[i].taxincome2 += j.taxincome2*self.number\_elites[i].taxrate2
j.taxincome2= j.taxincome2*(1 - self.number\_elites[i].taxrate2)


self.number\_elites[i].taxincome2 -=(Cost\_Ac + Bureocracy\_Cost)


Benefit =  self.number\_elites[i].taxincome2 - self.number\_elites[i].taxincome
Benefit2 = j.taxincome2 - j.taxincome


 \#The Acquring Elite becomes Core Capital
self.number\_elites[i].subordinated = 3
for a in self.number\_agents:
if a.nation == j.nation:
 \#Agents become part of the annexing Nation
a.nation = self.number\_elites[i].nation
 \#The acquired region becomes part of the targeting nation
j.nation = self.number\_elites[i].nation
j.subordinated = 1  \#Local elite becomes subordinated
\# Region is annexed to Core's Elite zone of influence
self.number\_elites[i].nation\_size.append(j.region)
j.taxrate = j.taxrate2
j.taxincome2 = 0
j.citizens += self.number\_elites[i].citizens
j.agressors = 0
j.violence\_perception = []
j.violence\_perception2 =[]


self.number\_elites[i].taxrate2 =0        \#Reseting Tracking Variables
self.number\_elites[i].taxincome2 =0
self.number\_elites[i].violence\_perception2 = []
self.number\_elites[i].citizens2=0
self.number\_elites[i].agressors2 =0
self.number\_elites[i].production\_possibility2 = []
\#Removing the annexed region from the available regions to get a turn
self.ids.remove(j.ID)


break



\#\#\#     PRODUCTION PHASE  \#\#\#

 \#Recognizing the regions that are either core citie independent ones
self.ids =[]
```

```
 \#Only Core  and Independent Countries produce as unit
for i in self.number\_elites:
if i.subordinated ==2 or i.subordinated==3:
self.ids.append(i.ID)
if i.subordinated==0:  \#Recognizing the independent regions that have no current elite
if i.nation == i.region:
self.ids.append(i.ID)

\#subordinated elite and decesead elite under control, records must not be ereased


for i in self.number\_elites:                  \#Erase Past records
if i.subordinated ==2 or i.subordinated == 3:
i.nation\_size=[]
i.citizens = 0
i.citizens2 =0
i.agressors = 0
i.agressors2=0
i.taxrate = 0
i.taxrate2 = 0
i.taxincome = 0
i.taxincome2 = 0
i.production\_possibility =[]
i.production\_possibility2 =[]
\#self.preference\_position = [] \#Identifies the spectrum of citizens' preferences
\#Identifies the violence threat perceived by the common citizenry
self.violence\_perception = []
\#Variable to keep track[Acquisition of elites, optimzation algorithm]
self.violence\_perception2 = []
if i.subordinated == 0 and i.nation ==  i.region:
i.nation\_size=[]
i.citizens = 0
i.citizens2 =0
i.agressors = 0
i.agressors2=0
i.taxrate = 0
i.taxrate2 = 0
i.taxincome = 0
i.taxincome2 = 0
i.production\_possibility =[]
i.production\_possibility2 =[]
\#self.preference\_position = [] \#Identifies the spectrum of citizens' preferences
\#Identifies the violence threat perceived by the common citizenry
self.violence\_perception = []
\#Variable to keep track[Acquisition of elites, optimzation algorithm]
self.violence\_perception2 = []
   \#Recognition of new acquisitions by Core Elites (rearrenge the size of the nation)
for i in self.number\_elites:
for j in self.number\_elites:
if i.nation == j.nation:
 \#Recognizing the regions that are part of a nation/confederation
i.nation\_size.append(j.region)
```

```
active2 = np.random.choice(self.ids,size= len(self.ids) ,replace=False)
\#Calculating Production Possibility and \# of Citizens
for i in active2:
\#Procedure to identify production capacity and number of citizens in a region
for j in self.number\_agents:
if self.number\_elites[i].nation == j.nation:
self.number\_elites[i].production\_possibility.append\\
 ((j.production\_capability)**(1-j.effort))
self.number\_elites[i].citizens += 1 \#Number of citizens under an Elite is identified
for i in active2:          \#Calculating Costs and \# of Neighbors
for k in self.number\_elites:\#Procedure to identifiy violence threat. 1st Step
if k.region  == (self.number\_elites[max(self.number\_elites[i].nation\_size)].region) + 1:
self.number\_elites[i].agressors +=  self.number\_elites[k.region].citizens
if k.region  == (self.number\_elites[min(self.number\_elites[i].nation\_size)].region) -1 :
self.number\_elites[i].agressors +=  self.number\_elites[k.region].citizens




for i in active2:
\#print self.number\_elites[i].ID
\#Independent Cities calculate their production
if self.number\_elites[i].subordinated == 2 or self.number\_elites[i].subordinated==0:
Cit\_Dist =[]
for q in self.number\_elites[i].nation\_size:
Cit = self.number\_elites[q].Core\_Citizens
Dist= abs(self.number\_elites[q].region - self.number\_elites[i].region)
Cit\_Dist.append(Cit*Dist)

Cost\_Ac= (sum(Cit\_Dist))** Marginal\_Cost


for j in self.number\_agents:
if self.number\_elites[i].nation == j.nation:
self.number\_elites[i].violence\_perception.append\\
( j.violence\_perception *(float(self.number\_elites[i].agressors)\\
 / self.number\_elites[i].citizens))
\#i.preference\_position.append(j.preference) \#\# PREFERENCE DOES NOT CHANGE

self.number\_elites[i].taxrate = np.median(self.number\_elites[i].violence\_perception)
if self.number\_elites[i].taxrate > .99:
self.number\_elites[i].taxrate = .99
\#Elites implement the median preferred policies of their core region
\#i.preference = np.median (i.preference\_position)
for j in self.number\_agents:
if self.number\_elites[i].nation == j.nation:
j.income = (teamproduction(self.number\_elites[i].production\_possibility)*\\
 (float(j.production\_capability) /sum(self.number\_elites[i].production\_possibility)))\\
  *(1 - self.number\_elites[i].taxrate)
```

```
self.number\_elites[i].taxincome+=(teamproduction\\
(self.number\_elites[i].production\_possibility)*\\
 (float(j.production\_capability)\\
  /sum(self.number\_elites[i].production\_possibility)))\\
 *(self.number\_elites[i].taxrate)
\#\#\#THINK ABOUT EFFORT AND DISUTILITY
\#j.disutility = abs(j.preference - i.preference)
\#j.effort = j.disutility


self.number\_elites[i].taxincome-= (Cost\_Ac + Bureocracy\_Cost)
self.number\_elites[i].past\_income = self.number\_elites[i].taxincome


\#IF THE Elite is national, core elite, they too calculate their incomes
elif self.number\_elites[i].subordinated==3:
Cit\_Dist =[]
for q in self.number\_elites[i].nation\_size:
Cit = self.number\_elites[q].Core\_Citizens
Dist= abs(self.number\_elites[q].region - self.number\_elites[i].region)
Cit\_Dist.append(Cit*Dist)

Cost\_Ac= (sum(Cit\_Dist))** Marginal\_Cost



for j in self.number\_agents:
if self.number\_elites[i].nation == j.nation:
self.number\_elites[i].violence\_perception.append( j.violence\_perception\\
 * (float(self.number\_elites[i].agressors) / self.number\_elites[i].citizens))
\#i.preference\_position.append(j.preference) \#\# PREFERENCE DOES NOT CHANGE

self.number\_elites[i].taxrate = np.median (self.number\_elites[i].violence\_perception)
if self.number\_elites[i].taxrate > .99:
self.number\_elites[i].taxrate = .99
\#Elites implement the median preferred policies of their core region
\#i.preference = np.median (i.preference\_position)


\#\#\#\#\# subordinated elites must calculate their own tax rate\#\#\#\#\#
for u in self.number\_elites[i].nation\_size:
if self.number\_elites[u].subordinated ==1:
for z in self.number\_agents:
if z.region == self.number\_elites[u].region:
self.number\_elites[u].violence\_perception.append(z.violence\_perception\\
 * (float( self.number\_elites[i].Core\_Citizens)/ self.number\_elites[u].Core\_Citizens))
self.number\_elites[u].taxrate= np.median(self.number\_elites[u].violence\_perception)



for u in self.number\_elites[i].nation\_size:
if self.number\_elites[u].subordinated == 1:  \#Region with a subordinated Elite
```

```
for p in self.number\_agents:
if p.region==u:
\#\#\#\#Calculating tax rates charged by local elites, then the Core
\#Elite charges the Local Elite another tax  \#\#\#
self.number\_elites[u].taxincome +=\\
 (teamproduction(self.number\_elites[i].production\_possibility)*\\
(float(p.production\_capability)/sum(self.number\_elites[i].production\_possibility)))\\
*(self.number\_elites[u].taxrate)
\#\#\#attention, local elites cease to have a cost when becoming subordinated,
\#think if this can change future\#\#\#
self.number\_elites[i].taxincome +=\\
 self.number\_elites[u].taxincome*self.number\_elites[i].taxrate


if self.number\_elites[u].subordinated == 3 or self.number\\
\_elites[u].subordinated ==0 or self.number\_elites[u].subordinated ==2:
\#Capital Region or Province wihtin the nation without local elite
for p in self.number\_agents:
if p.region == u:
p.income = (teamproduction(self.number\_elites[i].production\_possibility)*\\
(float(p.production\_capability)/sum(self.number\_elites[i].production\_possibility)))\\
*(1 - self.number\_elites[i].taxrate )
self.number\_elites[i].taxincome += (teamproduction\\
(self.number\_elites[i].production\_possibility)*(float(p.production\_capability) \\
/ sum(self.number\_elites[i].production\_possibility)))\\
*(self.number\_elites[i].taxrate )


\#\#\#THINK ABOUT EFFORT AND DISUTILITY
\#j.disutility = abs(j.preference - i.preference)
\#j.effort = j.disutility

\#\#      BYPASS PHASE  \#\#\#\#\

\#\#\#\#Checking if preferences of Newly Acquired Regions are better
\# represented by Capitals than by local elites
for i in active2:
for j in self.number\_elites[i].nation\_size:
if self.number\_elites[j].subordinated == 1:
aa = 0
bb= 0
for z in self.number\_elites[j].preference\_position:
aa += abs(z - np.median(self.number\_elites[j].preference\_position))
bb += abs(z - np.median(self.number\_elites[i].preference\_position))

if bb < aa:
self.number\_elites[j].subordinated = 0



\#\#\#\       RESULTS PHASE  \#\#\#\#
```

```
class Sim(object):
def \_\_init\_\_(self):
\#Records the National Taxrate ate the beginning of the Model
self.national\_taxrate\_turn\_1 = [  ]
 \#Records the Number of Countries at the beginning of the Model
self.country\_size\_turn\_1 = []
 \#Records the National Taxrates within in each turn
self.national\_taxrate\_turn =[]
\#Records the Median National Taxrate imposed in the Model
self.National\_taxrate\_Med =[]
 \#Records the Avg National Taxrate imposed in the Model
self.National\_taxrate\_Avg =[]
\#Records the Local Taxrates imposed in the Model
\#self.Local\_taxrate =[]
\#Records the Income of National Elites
\#self.TaxIncome =[]
\#Records the Total Production in a Nation
\#self.Production =[]
\#Records Number of Independent Countries in current Turn
self.country = 0
\#Records the Number of Independent Countries within the Model
self.Countries =[]
\#Records the size of each independent countriy in the current turn
self.country\_size\_turn=[]
\#Records the Median Size of each Independent country within the model
self.Country\_Size\_Med=[]
\#Records the Avg Size of each Independent country within the model
self.Country\_Size\_Avg=[]
\#Records Current Turns status of Elites
self.El\_0=0
self.El\_1=0
self.El\_2=0
self.El\_3 =0
\#Records the Number of All Elites in the model (0,1,2,3)
self.Elite\_0 =[]
self.Elite\_1 = []
self.Elite\_2 =[]
self.Elite\_3 =[]


\#self.defectrate = []   \# Defect Rate of the model
self.aplay= play()   \#Simulation method

def Run(self):

for i in self.aplay.number\_elites:
self.national\_taxrate\_turn.append(i.taxrate)
self.national\_taxrate\_turn\_1.append(i.taxrate)
self.country\_size\_turn\_1.append(1)
```

```
\#Counting Initial Tax Rates
self.National\_taxrate\_Med.append (np.median(self.national\_taxrate\_turn))
self.National\_taxrate\_Avg.append(np.mean(self.national\_taxrate\_turn))
\#Counting Size of countries, which initially is one
self.Country\_Size\_Med.append(1)
self.Country\_Size\_Avg.append(1)
\#Counting Initial Elites, everyone is independent
self.Elite\_0.append(0)
self.Elite\_1.append(0)
self.Elite\_2.append(Initial\_Regions)
self.Elite\_3.append(0)
\#Counting Number of countries, which is equal to the number of initial regions
self.Countries.append(Initial\_Regions)
self.national\_taxrate\_turn =[]
for w in range(turn):
self.aplay.step()
\#Calculating the number of elites in each turn, the number of independent
\#countries in the turn and the size
for i in self.aplay.number\_elites:
if i.subordinated == 0:
self.El\_0 += 1
if i.region == i.nation:
self.country += 1
self.country\_size\_turn.append(1)
if i.subordinated == 1:
self.El\_1 += 1
if i.subordinated == 2:
self.El\_2 += 1
self.country += 1
self.country\_size\_turn.append(1)
self.national\_taxrate\_turn.append(i.taxrate)
if i.subordinated == 3:
self.El\_3 += 1
self.country += 1
self.national\_taxrate\_turn.append(i.taxrate)
self.country\_size\_turn.append(len(i.nation\_size))

self.National\_taxrate\_Med.append (np.median(self.national\_taxrate\_turn))
self.National\_taxrate\_Avg.append(np.mean(self.national\_taxrate\_turn))

self.Country\_Size\_Med.append( np.median(self.country\_size\_turn))
self.Country\_Size\_Avg.append( np.mean(self.country\_size\_turn))

self.Elite\_0.append(self.El\_0)
self.Elite\_1.append(self.El\_1)
self.Elite\_2.append(self.El\_2)
self.Elite\_3.append(self.El\_3)

self.Countries.append(self.country)

self.El\_0 =0
self.El\_1 = 0
```

```
self.El\_2 = 0
self.El\_3 = 0

self.country = 0

if w < turn - 1:
self.country\_size\_turn=[]
self.national\_taxrate\_turn=[]

Results\_Countries=[]
Results\_Taxrate =[]
Results\_Country\_Size =[]

\#if \_\_name\_\_ == '\_\_main\_\_':
for i in range(30):
aSim = 0
aSim = Sim()
aSim.Run()
Results\_Countries.append(aSim.Countries)
Results\_Country\_Size.append(aSim.Country\_Size\_Avg)
Results\_Taxrate.append(aSim.National\_taxrate\_Avg)

\#self.National\_taxrate\_Medself.National\_taxrate\_Med
\#self.National\_taxrate\_Avg
\#self.Countries
\#self.Country\_Size\_Med
\#self.Country\_Size\_Avg

\#self.Elite\_0
\#self.Elite\_1
\#self.Elite\_2
\#self.Elite\_3

Turnoss =[]
for i in range(turn+1):
Turnoss.append(i+1)


for i in range(len(Results\_Countries)):
\#plt.figure()
plt.plot(Turnoss,Results\_Countries[i])

plt.xlabel('Total Turns')
plt.ylabel('\# Countries')
plt.title(' Numbber of Countries, 30 Simulations')
plt.xlim([0,50])
plt.show()

for i in range(len(Results\_Taxrate)):
plt.plot(Turnoss,Results\_Taxrate[i])
plt.xlabel('Total Turns')
plt.ylabel('\% Tax')
```

```
plt.title('Average Tax Rate, 30 Simulations')
plt.xlim([0,50])
plt.show()

for i in range(len(Results\_Country\_Size)):
plt.plot(Turnoss,Results\_Country\_Size[i])
plt.xlabel('Total Turns')
plt.ylabel('\# Cities in a Country')
plt.title('Average Country Size, 30 Simulations')
plt.xlim([0,50])
plt.show()

COUNTRY\_AVG= []
COUNTRY\_STDEV=[]
COUNTRY\_PLUS=[]
COUNTRY\_MINUS =[]

SIZE\_AVG =[]
SIZE\_STDEV =[]
SIZE\_PLUS =[]
SIZE\_MINUS=[]

TAXRATE\_AVG =[]
TAXRATE\_STDEV =[]
TAXRATE\_PLUS=[]
TAXRATE\_MINUS=[]

t=0
g=0
for i in range(len(Results\_Countries[0])):
lista=[]
for j in range(len(Results\_Countries)):
lista.append(Results\_Countries[t][g])
\#print t,g
t+=1
COUNTRY\_AVG.append(np.mean(lista))
COUNTRY\_STDEV.append(np.std(lista))
g+=1
t=0


t=0
g=0
for i in range(len(Results\_Country\_Size [0])):
lista2=[]
for j in range(len(Results\_Country\_Size)):
lista2.append(Results\_Country\_Size[t][g])
\#print Results\_Country\_Size[t][g]
\#print t,g
t+=1
SIZE\_AVG.append(np.mean(lista2))
SIZE\_STDEV.append(np.std(lista2))
```

```
g+=1
t=0

w=0
u=0
for i in range(len(Results\_Taxrate [0])):
lista3=[]
for j in range(len(Results\_Taxrate)):
lista3.append(Results\_Taxrate[w][u])
\#print t,g
w+=1
TAXRATE\_AVG.append(np.mean(lista3))
TAXRATE\_STDEV.append(np.std(lista3))
u+=1
w=0

COUNTRY\_PLUS = [ x for x in COUNTRY\_AVG]
COUNTRY\_MINUS =[ x for x in COUNTRY\_AVG]
SIZE\_PLUS =[x for x in SIZE\_AVG]
SIZE\_MINUS =[x for x in SIZE\_AVG]
TAXRATE\_PLUS=[x for x in TAXRATE\_AVG]
TAXRATE\_MINUS=[x for x in TAXRATE\_AVG]

q=0
for i in COUNTRY\_AVG:
COUNTRY\_PLUS[q]= COUNTRY\_AVG[q] + COUNTRY\_STDEV[q]
COUNTRY\_MINUS[q]= COUNTRY\_AVG[q] - COUNTRY\_STDEV[q]
q +=1
q=0
for i in SIZE\_AVG:
SIZE\_PLUS[q]= SIZE\_AVG[q] + SIZE\_STDEV[q]
SIZE\_MINUS[q]= SIZE\_AVG[q] - SIZE\_STDEV[q]
q +=1

q=0
for i in TAXRATE\_AVG:
TAXRATE\_PLUS[q]= TAXRATE\_AVG[q] + TAXRATE\_STDEV[q]
TAXRATE\_MINUS[q]= TAXRATE\_AVG[q] - TAXRATE\_STDEV[q]
q +=1


plt.plot(COUNTRY\_AVG, color = "blue")
plt.plot(COUNTRY\_PLUS, color='red',linestyle='dotted')
plt.plot(COUNTRY\_MINUS, color='red',linestyle='dotted')
plt.xlabel('Total Turns')
plt.ylabel('\# Countries')
plt.title(' Countries, 30 Simulations')
plt.show()

plt.plot(SIZE\_AVG,color='blue')
plt.plot(SIZE\_PLUS,color='red',linestyle='dotted')
plt.plot(SIZE\_MINUS,color='red',linestyle='dotted')
```

```
plt.xlabel('Total Turns')
plt.ylabel('\# of Cities in Countries')
plt.title(' Country Size, 30 Simulations')
plt.show()

plt.plot(TAXRATE\_AVG,color='blue')
plt.plot(TAXRATE\_PLUS,color='red',linestyle='dotted')
plt.plot(TAXRATE\_MINUS,color='red',linestyle='dotted')
plt.xlabel('Total Turns')
plt.ylabel('\% Tax Rate')
plt.title(' Tax Rate, 30 Simulations')
plt.show()
```

Chapter 2: Seeds of Secession: The Political Economy of Spain and its Colonies in the Late Bourbon Period

2.1 Introduction

Two of the most perennial questions within the social sciences have been why and how states are created and why and how they collapse. It was Edward Gibbon's famous account of the Roman Empire that popularized the notion that states have a lifespan of their own: a rise and a fall. Interesting enough, Gibbon's work was published in the late 18^{th} century, a period of turmoil that ended up signifying both the rise and collapse of two global empires: the accession of the British and the decay of the Spanish state. The chapter attempts to dwell on the question of why political fragmentation may occur based on the study case of the Spanish Empire; The text analyzes the underlying weaknesses in the Spanish Empire that led to its ulterior implosion in the early 19th century.

How did an empire that was cohesive for hundreds of years, could fragment in less than a decade? Most of historical literature treats the Spanish American wars of independence as being the result of unexpected contingencies that arose out of France's invasion of Spain in 1808—which resulted in a crisis of legitimacy in the Americas.[1] But what were the preconditions that set the opportunity for the impetus toward secession? This chapter is an exploration of the economic origins, set in the late 18th century, of the Spanish Empire's fragmentation.[2] I contend that understanding the particular fiscal sociology of the empire is the key to solve the conundrum; the political enterprises that inhabited the Empire (Miners, merchants, Crown) played pivotal roles in determining its fate. Although I present a general hypothesis for the whole of the Spanish influence area, I mostly focus on New Spain because of two reasons: it was the most important colony of the empire in the period being studied

[1] The most cited work in this tradition is Lynch (1973)

[2] A complementary take that emphasizes the political origins is Rodriguez (1998)

(late 18^{th} century); and it has been understudied in terms of its significance *vis a vis* South America.

I address the large literature on the political and economic reforms of the late 18th century, reinterpreting them in light of a new institutional economics framework. The argument I present is very simple: a political equilibrium is stable only while the necessary conditions to sustain it, prevail. However, the state can lack robustness and be vulnerable to exogenous shocks that may change the conditions and incentives of the involved actors. I argue that this was the case in the Spanish Empire: A trade shock due to the increasing threat of the British Navy undermined the old Spanish institutional setting and created the rationale for a new one.

I argue the empire was governed via intercolonial collusion among local elites and the Crown. The political elites were interested in maintaining its status while profiting from the arrangement. The Crown wanted to maximize its own income through its taxing prerogative. Mining was the main source of income in the empire; The most important mining zones were located in northern Mexico and in Potosí, Bolivia. Mining was treated in the most liberal way possible and had a competitive industry—that was even subsided by the crown *via* the state's monopoly of mercury, which was a necessary input in the silver extraction process.

The rents were derived from the specific arrangement in which the transatlantic trade was organized. Initially only three guilds were responsible of managing it all, which assured windfall rents for them. The merchant guild of Mexico City oversaw trade in New Spain, the guild in Lima oversaw it in South America and the guild in Seville oversaw it in Spain. The Seville guild had several problems with their American counterparts, and so the Crown acted as an arbiter. The Crown profited from this arrangement because it made feasible its *de jure* political control over the colonies and because it maximized its tax revenue.[3]

[3]Most historical literature acknowledges the importance of Atlantic Trade in the sustainment of the empire, however the emphasis is always put on the monetary fluxes from America to Europe. My argument is that the trade fluxes from Europe to America were as important as the former. The merchant guilds that sustained political order in the vice royalties depended on such trade.

Before the 18^{th} century, the greatest threat to the organizational scheme was the occasional trade disruption driven by pirates and buccaneers. The Spanish Empire, however, was well equipped to counteract such mishaps. It devised a stratagem that minimized losses: it centralized trade in key ports in America (mainly Veracruz in Mexico and Portobello in Panama) and consolidated it through few but periodical shipments that were well protected by the navy—the so called Flotillas. Because of it, individual pirate ships were mostly of no concern to the bulk of the Spanish trade. The situation changed in the second half of the 18^{th} century when Britain became a world maritime power. In 1762, in the context of the Seven Years' War, Britain captured the ports of Manila and Havana and blockaded other important Spanish ports in the Caribbean and Central America, making it clear that a new era of British power had begun.

The exogenous change in the status of Britain prompted a Spanish response in the form of the famous Bourbon Reforms that, on paper, tried to modernize the governing of the empire via a centralization of the Crown's bureaucracy. I argue that, in reality, the reforms were aimed to decentralize. Given the new scenario, one in which Britain dominated the Atlantic, the silver and commodity trade between Spain and its colonies was at danger, and so too were the rents and incomes of both the local elites and the Crown. What followed was a slow but steady liberalization of the transatlantic trade: more ports and more cities were allowed to trade. Alternative local elites—besides the ones in Mexico City, Lima and Seville—started gaining power and commercial experience. It also meant that, in general, Spanish Atlantic trade became less riskier.

The liberalization attempt was at first cautious and measured, but due to subsequent shocks that affected the Crown in the 1790's—Spain was in a constant state of war against France and England—it was rushed. In order to sustain its war efforts, the Crown prioritized short term gains and hastened its liberalization policy. The Crown tried to co-opt local elites in diverse cities, for example, by offering to some of them the status of official trading guilds (In New Spain, new guilds were created in Guadalajara, Veracruz, Havana, Guatemala. In South America, merchant guilds were created in Buenos Aires, Cartagena, and Caracas.

See 2.8).

The plan backfired for the Crown. The new privileges given to regional elites made them more independent of Madrid and warier of the power held by the traditional capital guilds of Mexico City and Lima. When Napoleon deposed the king Ferdinand I in favor of his brother José, the Crown as an institution of Imperial organization was terminated; hence the wars of independence began in all over Latin America around the 1808–1810 period. The state capacity problems of the newly created Latin American countries—which characterized the whole region for the 19^{th} century—had its origins in the way in which the fragmentation of the Spanish Empire occurred: It was not a war of independence in a traditionalist sense, but a civil war among local elites that wanted to maximize the area under their influence. So , even if the regional warlords didn't end up being *de jure* independent, they acquired an important level of *de facto* independency. The case of New Spain is an important and clear example of this.[4] Unlike South America, where the fragmentation was clear, New Spain's implosion was contained—only Central America *de jure* seceded, while the Caribbean and Philippines kept under Spanish control—yet, the level of *de facto* control of Mexico City was undermined throughout the rest of the former New Spanish territory.

In summary, the Spanish Crown never held absolute power over its dominions; it governed through local elites. While trade flourished, it was a stable equilibrium, but once trade was disrupted the incentives changed. Moreover, the later actions of the Crown actually exacerbated the problem by empowering factions that ultimately prompted the fragmentation of the empire.

The aforementioned line of argument, where trade has an impact on the political coalition of a country, has been explored by historians and economists for other historical periods. Samson (1963) who explains Japan's trade closure to the rest of the world in the Tokugawa period as being motivated by political reasons in order to deny an important source of income to potential regional competitors of the Shogunate, and hence it was a policy measure that attempted to consolidate the Japanese state around the centralized bureaucracy in Edo

[4] And so is the case of Colombia.

(Tokyo); Barkan (1975) who studies the stagnation and *de facto* decentralization within the Ottoman Empire by reference to the change of trade routes in the late 16^{th} century, where the Iberian voyages of discovery made obsolete the traditional middle east trade routes. The exogenous trade change wrecked the internal Ottoman institutions and weakened the Ottoman central bureaucracy; Adelman (2009) who's work dwells precisely on the causes of Spanish America fragmentation, which he explains in a very similar way as I do—by reference to the empowerment of local elites after the Bourbon Reforms. Adelman's work, however, focuses only on South America, trough the study of the elites within Caracas and Buenos Aires, and not New Spain. More importantly, he does not formalize the causal mechanisms behind his premises. This chapter provides a formal and parsimonious account of the fragmentation of the empire.

In the following section I attempt to formalize the Spanish empire's institutional setting via a model that illuminates the underlying mechanisms behind the merchant guilds, their reliance on safe trade, and their relationship with the Crown. I show how trade shocks can undermine the institutional setting where only few merchant guilds dominate, towards one where many are granted commerce licenses by the Crown. I use an agent-based methodology not merely because its more evident properties (allowing for heterogeneous agents to be influenced, but also influence, the macro world they inhabit), but also because it permits a great deal of customization of particularities in the institutional environment; my particular goal within this chapter is to incorporate several different parameters, and layers of interacting agents, that can create counterfactual worlds derived from the concrete case of the Spanish Empire in the 16th century. Although abm's have failed to attract attention within economics, they have proved invaluable in more policy-oriented enterprises, like impact analysis. In this chapter, my approach is similar to those disciplines: I attempt to evaluate the impact of an exogenous shock to distinct agents, that can react in different ways. In the last section of the chapter, I dwell on the historical evidence for my argument, where I detail the part played by the merchants guilds in preserving political power in the

Americas, and the problems created after the Crown started granting licenses to form competing merchant guilds across the Empire. I end with a discussion about prospects of future research on the matter.

2.2 The Model: Overview, Design and Details

The model is build to replicate the core trade political economy mechanisms in the Spanish Empire. Due to necessity, some simplifications are made. Instead of devising the entirety of the Atlantic trade-network,[5] I focus on an abstract triadic interaction between the Seville merchant guild, the American merchants, and the Crown—who plays the part of the self-interested arbitrager of the institutional setting. Hence, the model is composed of three types of agents: general population, merchants and the Crown. The merchant class itself is divided in three subcategories: supplier, wholesalers and general retailers. The structure of the model attempts to replicate, in an abstract manner, historical patterns of trade: *i)* the supplier—assumed to be the Spanish merchant guild—produces N quantity of a single homogeneous good X, and trades directly with the American wholesalers—assumed to be the American merchant guilds. *ii)* the wholesalers then, after acquiring the goods from the Spanish supplier, proceed to sell them to minor retailers—assumed to be the local regional American merchants. *iii)* The small retailers then sell the goods to the general population. The model's core mechanism, however, depends on the way in which the Crown, the institutional overseer, acts: The Crown collects a general sales tax that is derived from the retailers-population trade. It also has the ability to give mercantile privileges to the retailers so they can transcend their mercantile status and become wholesalers; that is, the Crown has the power to create alternative competing merchant guilds within the system.

The model formalizes the hypothesis that trade disruptions in the late 18^{th} century were the culprits of disrupting the political economy entanglement within the empire, and hence, that they were the principal cause behind the creation of an increased amount of competing merchant guilds in the 19^{th} century—which ultimately proved to be the motors behind

[5]Which involves other important sectors as mining and Native American products and it is contingent on the size of the domestic trade within the colonies

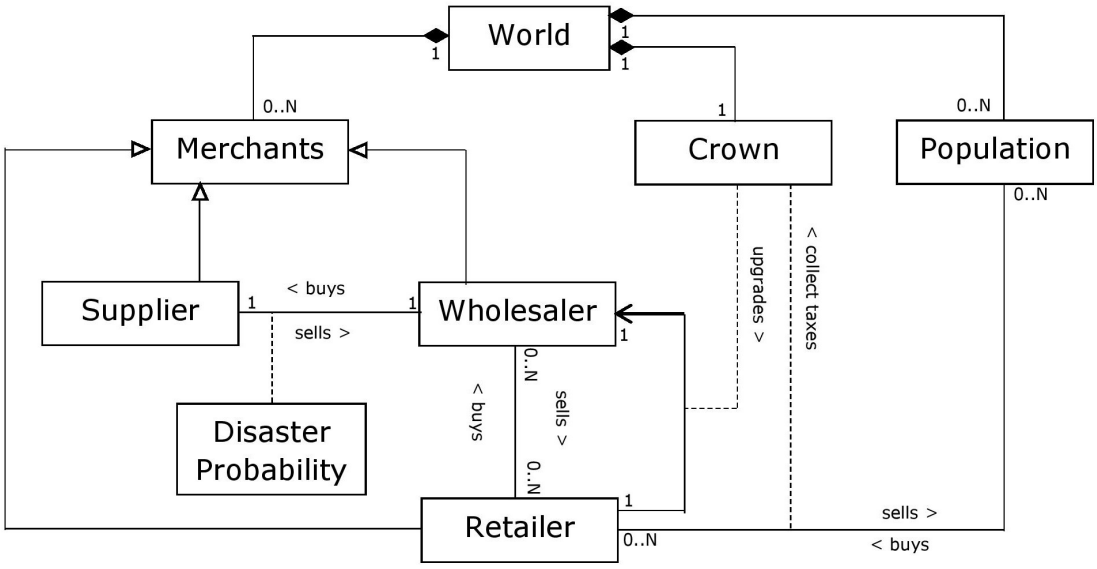


Figure 2.1: Model Overview

the demise of the Empire. *Figure 2.1* portraits the basics of the model in *UML* language. The hypothesis is tested by recreating the trade shocks as exogenous artifacts; the model operates within three distinctive risk scenarios: *i)* Initially, at the beginning of the 18th century, the economy has low risk of trade disruption—Pirates existed but were a minimum threat; *ii)* In the 1760's, in the context of the Seven Year's war, the British naval superiority over the Atlantic was assured and hence the risk scenario for the Spanish Empire shifted to the right; *iii)* In the 1780's a period of constant war between Spain, France and England meant that trade risk increased even further. These three scenarios are replicated in the model by three different risk profiles,[6] as seen in *Figure 2.2*. The scenarios are represented as chi-squared distributions $\chi^2(k)$ where k is 10,40,70 respectively.

[6]Risk scenarios are represented as 'Disaster probability' in the *Figure 2.2*, which means that they only affect the commerce between the supplier and the wholesalers—between the Seville merchant guild and the American merchant guild(s). The particulars are explained in the next pages. For the third scenario, after the second shock, the risk probability is bounded at the level of 95% damage

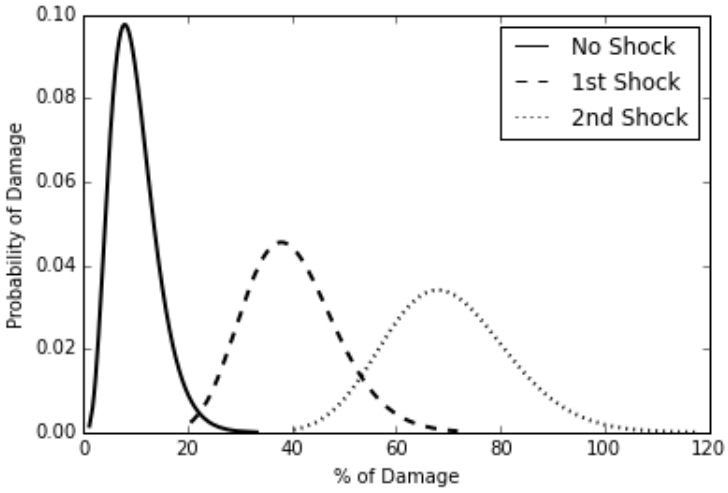


Figure 2.2: Three Risk Scenarios

2.2.1 Agent's Description and Attributes

Table 2.1 shows the particular attributes of the agents within the model, as well as their initialization values. The population class has only an income attribute, which can take values from zero up to infinite. The initial values are set by an exogenous random exponential distribution ($\sim exp(\lambda) = exp(1)$) multiplied by ten—as to replicate the idea that income and wealth are unequal within societies. The model is not a general equilibrium one, so the amount of total income the population holds is independent of the amount of goods available in the economy. It would be possible to complicate the model by implementing the mining sector as the source of the income, which then could be affected by the Spanish Crown's policies. Yet It adds little to the core mechanics I am interested in: the relations between the merchant guilds, trade, and the Crown.[7]

The merchant class is characterized by six attributes: *i)* Income, which can go from zero to infinite. It is also initialized by an exogenously-given random exponential distribution

[7]The idea is that the goods are produced in Spain and imported to the Americas, hence the disjoint. It is possible to create a connecting nexus between goods and income by implementing the American mining sector and by recreating the particular fiscal policies of the Spanish Crown—which involved subsidized inputs.

($\sim exp(\lambda) = exp(1)$) multiplied by one hundred; *ii)* Goods, which are the amount of the good X that any merchant holds during the simulation. Just like population income does not depend on goods available, the quantity of goods is also not dependent on the population income. At the beginning of the simulation, the initial quantity is set to be 50—which is allotted to the supplier, the Spanish merchant guild; *iii)* Profit, an unbounded attribute, is calculated as the difference between the sell and buy prices that each merchant faces during each period in the simulation; *iv)* There are two binary attributes—being a supplier or a wholesaler – that allows to distinguish between the three different set of merchant subclasses in the model. At the initialization of the model, one supplier and one wholesaler are identified; *v)* A third boolean attribute serves to identify if any merchant has become bankrupt during the simulation—bankruptcy is defined as the case in which the income of the merchant goes to zero.

The Crown class has three attributes: *i)* The Trade Risk attribute serves as an identifier of the three risk scenarios; It begins with the lowest risk profile, hence its initialization value is zero; *ii)* Tax rate, which is the sales tax that the Crown applies to each population-retailer transaction. The value is set to be 5%;[8] *iii)* Tax Revenue, which records the amount of taxes collected each period during the simulation. The value can go from zero up to infinite.

2.2.2 Agents' Behavior

The agents in the model follow simple heuristics. Merchants, population and their interactions are modeled under the premise that they constitute zero intelligence traders. Following Becker (1962) and Gode and Sunder (1993), it is possible to recreate simple partial markets—where supply and demand exist—by acknowledging that income constraints are sufficient condition for markets to behave as basic price theory predicts. The Crown acts as the mayor agent that optimizes the rent it gets, out of the political mechanisms already described.

[8]In future versions of the model I will implement a more dynamic setting in which tax rates can vary. And, most importantly, a way to differentiate the distinct taxes the Crown collected within its empire

Table 2.1: Agent's Attributes and Values

Agents	Attributes	Values	Initialization
Population	Income	$float[0, \infty)$	Random Exponential
Crown	Trade Risk	$Int[0, 2]$	0
	Tax Rate	$float(.05)$	.05
	Tax Revenue	$float[0, \infty)$	0
Merchants	Income	$float[0, \infty)$	Random Exponential
	Goods	$float[0, \infty)$	—
	Profit	$float[(-\infty, \infty)$	0
	Supplier	Boolean	—
	Wholesaler	Boolean	—
	Bankrupt	Boolean	False

First Market: Supplier-Wholesaler

By construction, only one supplier of good X exists within the model—it is assumed to be the Spanish Seville merchant guild. It initializes with 50 X goods that intends to distribute to the Americas. Each period, the supplier increases/decreases the amount of produced goods that it has to sell. The growth rate comes from a random normal distribution ($\sim N(\mu, \sigma) = N(.25, .5)$). The idea is to approximate the growth of a precapitalist economy, which tended to be characterized by a small positive growth trend but subject to big potential variations from time to time.

After the good X is produced, the supplier ships it towards the Americas to be sold to the American wholsalers. Is at this moment where the supplier can lose part of its cargo, and the three different risk scenarios may apply (first, with pirates as threat, then with the British and French Navy as potential harassers). It is important to note that before making the trip to America, the Spanish supplier calculates its potential demand according to the amount of costumers it has (the wholesalers) and so, it sends distinct shipments to the Americas. This is important because when only one wholesaler exists, only one shipment is made, and the probability of losing all the cargo is clustered on that shipment. Whereas when two or more wholesalers exist, two or more shipments are made and the probability of losing cargo is diluted over the total shipments (the assumption is that the events are

independent of each other).

After arriving to the Americas, the supplier negotiates with the American wholesalers. Initially there is only one wholesaler, so the negotiation is one to one. However, during the course of the simulation more wholesalers can arise. The Spanish supplier acts as a perfect discriminator, and hence it optimizes its income by selling at different prices/quantities to each wholesaler—according to the wholesaler's income.[9] A more realistic approach towards modeling the negotiations between Spanish supplier and American wholesalers would resemble a kind of 'tug of war' between both merchant guilds.[10] However, given that the model is primarily interested in explaining the difficulties in transatlantic trade—rather than on the definitive winners of the windfall rents between the American and Spanish merchant guilds— the scenario is simplified and it is assumed that economic rents are totally captured by the American wholesalers. So, even though the supplier can discriminate, it does only so for accounting purposes within the model.

Second Market: Wholesalers-Retailers

After the wholesalers acquire the goods from the Spanish supplier, they redistribute it to the rest of the American merchants: the regional and local retailers. It is important to acknowledge that the main difference between wholesalers and retailers derives from the political privileges enjoyed by the first. For that reason, as we will see in the following sections, it is possible for the Crown to grant wholesaler concessions to other competing merchants.

The wholesalers also discriminate among retailers in order to make the most profit out of the operation. So basically, the same market pattern as the First Market is repeated: The wholesalers exchange all of their goods for retailers' money/income.[11]

[9]The income of the supplier i is given by the sum of all j wholesaler's income $I_i = \sum I_j$. Alternatively, the quantity of goods received by the j wholesalers for their payment is given by $Q_j = \frac{Q_i * I_j}{\sum I_j}$

[10]In historical terms, the bargaining positions—arbitraged by the Crown—did matter in deciding which side could profit the most from the rents generated in the Atlantic trade

[11]The income of the wholesaler i is given by $I_i = \frac{\sum I_j * Q_i}{\sum Q_i}$. Alternatively, the quantity of goods received by the j retailer for their payment is given by $Q_j = \frac{\sum Q_i * I_j}{\sum I_j}$

Figure 2.3: Retailer Market

Third Market: Retailers-Population

Given the greater amount of agents involved and its less rentist features—in comparison with the intermediary markets—I proceed to model the consumer market as in *Figure 2.3*. Following common practices among computational representations of partial markets—and given that there is only one good in the model—Income relates one-to-one to the willingness to pay of the population. And given that initial population's income is set by an exponential distribution, it is possible to derive a downward sloped demand curve. The supply curve is set by the total amount of goods available in the American economy; it is equal to the Spanish supplier production minus the amount lost in the transatlantic trade. I assume it to be totally inelastic because the disconnection between its European production process and its demand in the Americas.[12] The other key assumption is that the population satisfies their demand by consuming only one good. The Crown imposes a sale tax of 5%[13] on the price, and derives its own income from it.

[12]I could build a positive sloped curve by taking into account the different 'willingness to sell' prices of the retailers given their costs – the price they payed to the wholesalers. I didn't do it to simplify the market process.

[13]Admittedly, the tax rate is arbitrary. Yet the relevance is not on the specific number, but on the trends it produces

The competitive price in the consumer market arises out of the interaction between the supply of goods and the population's income. It is important to stress that just like the Spanish supplier production grew through time in an exogenous manner, just as well the population's income grows exogenously too. The individual rate is given by a normal distribution ($\sim N(\mu, \sigma) = N(.25, .5)$).

It is important to stress two corollaries derived from the model's assumptions: *i)* The retailer and wholesaler's profitability do not necessarily positively correlate with total goods availability. It all depends on the particular convexity of the demand curve—which varies from simulation to simulation due to random initialization settings and random growth rates;[14] *ii)* The retailers face a fixed sell price, while buying at differentiated prices. Hence, the model may generate industry concentration.

A second relevant thing to note is the model's assumption of limiting one-good per person. It creates shortages that leave people with unmet demand. Historical literature has stressed the potential political problems arising out of this—out of political uncertainty.

Crown's Behavior

As explained in *Figure 2.1*, the Crown acquires revenue by taxing the retailer's market. The Crown also has the prerogative to give trade privileges to the retailers. To do so, the Crown follows a particular heuristic that requires three factors to be activated: *i)* There must be a potential individual retailer with enough industry power as to bargain for its inclusion as a new wholesaler. I define that such event happens whenever a unique retailer owns at least 66% of all the retailers' income;[15] *ii)* The Crown's revenue must appear to be following a decreasing trend. I quantify such scenario by making the Crown remember their ten immediate predecessor income data-points, and by estimating the trend by a simple OLS regression; iii) The Crown must face increasing uncertainty in their income revenue. I estimate this by quantifying the difference between the coefficient of variances of the ten

[14] The aggregate demand curve in the retailer market arises out of the income constraints of the population. The curve is always negatively sloped, but its particular shape differs in-between simulations.

[15] In posterior versions I will modify this decision process by supplanting it with a measure of Herfindahl Index within the model.

recent income data-points *vis a vis* the ten to second-last income data-points.

In short, the Crown will grant trade privileges whenever it has perspective of decreasing income, increasing uncertainty and when there is at least one potential retailer big enough to become a wholesaler. The first two requirements provide venue for exogenous Crown change, while the last one allows the potential endogenous emergence of wholesalers. This resembles the historical case as I will argue more in detail in the next section; the idea is that competing merchant guilds were granted licenses only when they themselves became large enough as to have a voice and demand recognition from the Crown, and only after the trade opportunities of normal trade with the initial existing merchant guild was exhausted.

It is important to stress that the aforementioned privilege granting process is delimited in an *ad hoc* way, by expecting it to happen only every five turns.[16]

The model's benchmark scenario is defined by the following parameters: *i)* At any point in time, only one Crown and one supplier exists; *ii)* At the beginning of the simulation, there is only one wholesaler; *iii)* There are 18 retailers; *iv)* There are 300 inhabitants of the population class; *v)*The model runs for 50 periods only. Each model's period—a tick in computational social science jargon—is meant to replicate two years of the historical process;[17] *vi)* The Spanish supplier has an initial endowment of good X of an arbitrary amount of 50—the growth rate in the production of the good X follows the aforementioned random distributions with positive mean; *vii)* Wholesalers and retailers' income are initially given by an exponential distribution—set randomly at the beginning of the simulation; *viii)* The population's income is also initially set by an exponential distribution, while its growth rate comes from a random normal distribution with positive mean. *ix)* Risk scenarios are implemented at period number 30 and 40 to resemble the historical incidents in 1760's and 1780's that increased British threat.

The model was simulated 50 times and the results are shown in *Figure 2.6*. *Figure 2.8* plots the main relationship between quantity of goods available in the retailers market

[16]The limitation is set up to avoid a natural pitfall in the modeling design: whenever the conditions exist in time t, it is probable that they will continue to do so in time $t+1$ and hence the need for a time limit.

[17]As rule, which was frequently disobeyed, the Atlantic Trade occurred in biannual terms; Trade convoys sailed from Spain every two years

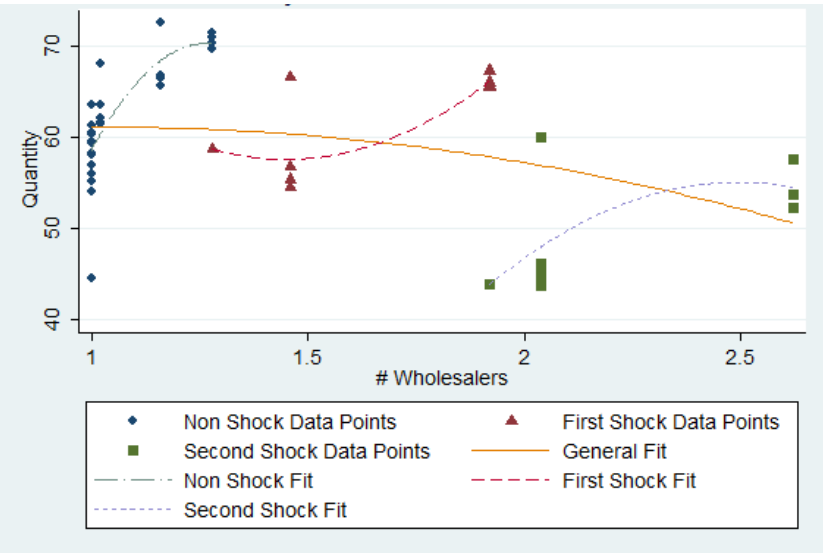


Figure 2.4: Trade Shocks & Number of Privileged Merchants

and the total number of privileged wholesalers in the model. Risk shocks in the Atlantic trade shift the relationship to the right: supply shocks are positively correlated with a larger quantity of wholesalers (i.e. when the risk of losing cargo[good X] increases, the Crown gives more wholesaler licenses to retailers). This is the main mechanic the model is interested in understanding: one in which the risk of trade creates incentives for the Crown to grant competing guild licenses.

Figure 2.6 shows other output variables' time series produced by the model that can be of interest in an attempt to understand the political economy of the Empire. *Figure 2.7a* shows the price trend: There is a general stability in price up until the risk shocks trigger in the 30 and 40 periods. The relationship resembles the scattered historical evidence of increasing inflation in the late 18th century. *Figure 2.5* plots the model's price output *vis a vis* the global Maize prize in New Spain—admittedly not a totally reliable way of approximating inflation, but one commonly used in the historical literature—at the time. The maize data has more volatility and presents a differing trend at the beginning. However, in the second half they are very similar.[18] In any case, most of the historical literature agrees

[18]The maize data is taken from Garner and Stefanou (1993). The historical data is expressed in annual

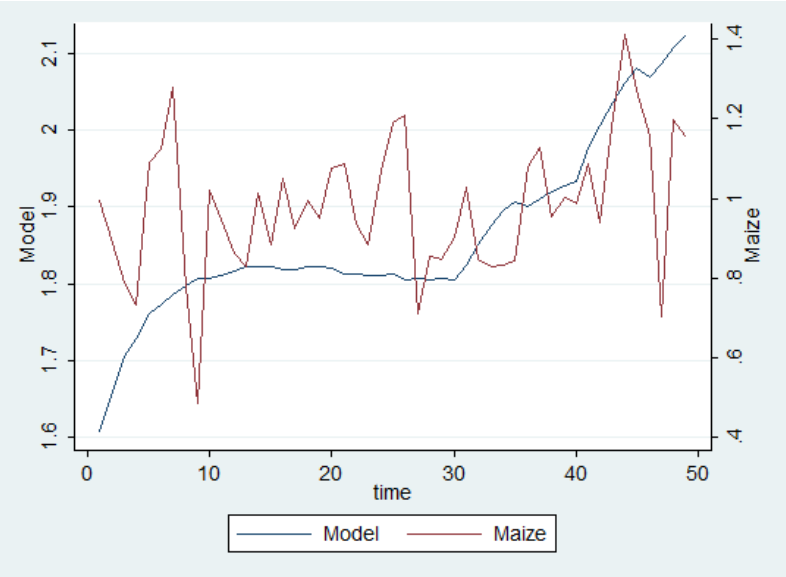


Figure 2.5: Price Trends in the Model and in Reality

The maize figures are taken from Garner and Stefanou (1993). Both variables are expressed in Log 10 terms

that inflation was a problem in the late 18th century. However, the focus in the literature is mostly on monetary aspects—the production of silver and its price against gold. In this chapter, however, I show a potential alternative transmission channel, a real one: simple goods' shortages.

Figure 2.7b shows the amount of goods being sold in the retailer market. It has a positive trend up to the first shock in period 30, then it recovers at approximately period 35. Another dip occurs after the second shock in period 40 with another rebound happening a few periods later. The rebounds happen in the model because the amount of privileged wholesalers is increasing, as seen in*Figure 2.7f*, and so the total probability of disaster in the Atlantic sea decreases with it. There is no historical time series of the exact amount of goods traded in the Americas at the time[19] to make a comparison. However, we can

terms. Given that my model is expressed in biannual terms, I proceeded to average every two terms from the original data to make the comparison.

[19]Especially since smuggling was unaccounted. In the model smuggling is unaccounted too, but as I will argue later, we can safely assume that the same privileged people that traded formally within the empire were also the ones that smuggled the most, so the institutional relationship between privileged merchants and the rest of retailers is maintained.

Table 2.2: Some Fleet Arrivals to New Spain and Tonnage

Arrival	**Tonnage**
1732	4,458
1736	3,141
1757	7,070
1760	8,493
1765	8,013
1769	5,588
1772	7,675
1776	8,176

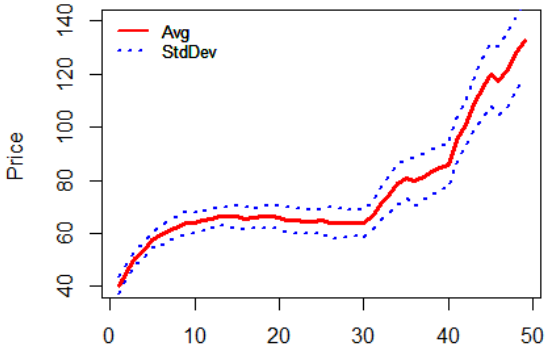
get some rough approximation of the trends by looking at the *Table 2.2* which shows some records of the quantity of goods arriving into New Spain by tonnage[20] A decline occurs in the 1760s with a recovery in the 1770s just like in the model. However, it is important to note that the exact mechanisms at hand were different. In the model is the increase in privileged wholesalers that makes up for the rebound. In reality, however, it was not until 1778 that "free trade" was implemented for most of the empire—and just in 1789 for New Spain. So, Atlantic trade was still greatly centralized. What is clear, however, is that the local merchants—the retailers in the model—did increase its position *vis a vis* the Mexico City merchant guild—the wholesalers in the model—in the late $18t^{th}$ century just as the model predicts.

Figure 2.7e shows the Crown's Tax Revenue. Not surprising, it shares the same pattern as the average profit of the retailers (shown in Figure 2.7d) given that it's revenue comes from the same source (the consumer market). Risk shocks tend to decrease Crown's revenue, but the increasing number of privileged wholesalers corrects the trend.

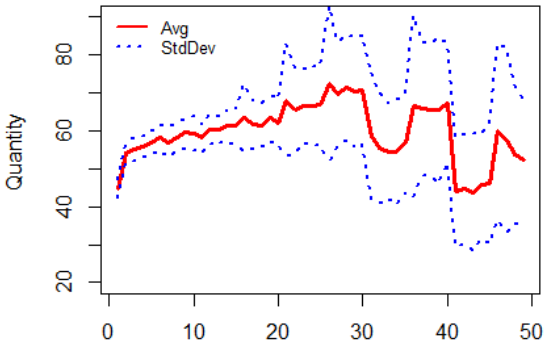
Tax revenues is one of the spheres in which more historical data is available. However, the tax pattern is at odds with that of the model. As noted by Marichal (2007), in the late 18th century taxes increased almost exponentially because the Crown sought more and more resources to fund its wars against England and France. Yet, the literature also suggests that official tax records may be unreliable: the Spanish Crown had incentives to

[20]Data comes from Garner and Stefanou (1993, p.171)

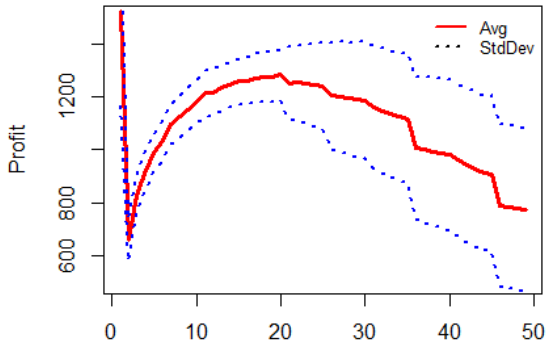
(a) Price in Retailer Market



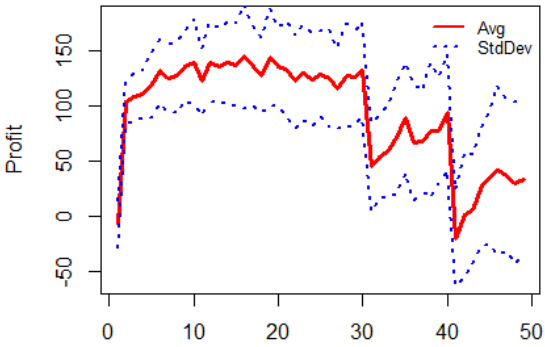
(b) Quantity in the Market



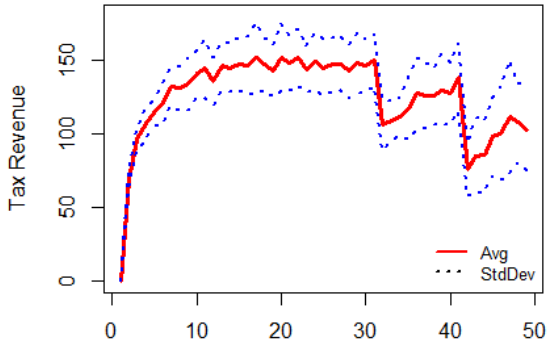
(c) Avg Wholesalers' Profit



(d) Avg Retailers' Profit



(e) Crown's Tax Revenue



(f) Amount of Privileged Wholesalers

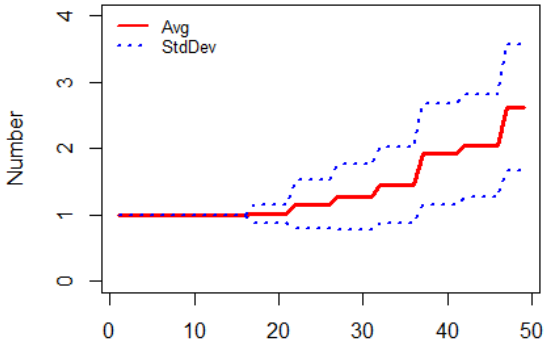


Figure 2.6: Model Simulation Runs

overestimate and exagerate their own resources. The model may provide a more accurate portrayal of tax income patterns at the time—One that may merit future historical work. In any case, the model focuses on just one aspect of the Imperial fiscal system. The Crown had a different sets of taxes that are not modeled.[21]

For the rest of the output variables provided by model, there is no reliable data to make comparisons. It is then, a fertile ground of potential research that I plan to follow up in the future.[22]

2.3 Historical Evidence

The model shows how the institutional threat of trade-disruption—starting with the Seven Years' War—ended up creating incentives towards an increase in the number of American merchant guilds. I proceed to argue why these merchant guilds were important; why they were the key corporations by which the political stability of the Empire was maintained—and hence how the changes in their number ended up disestablishing the region. The discussion is inserted in a larger theme where I explore the political economy entanglement of trade—and hoe the so-called Bourbon Reforms were part of the attempt to reform this arrangement.

2.3.1 New Spain's Political Economy Arrangements

The Bourbon Reforms are the set of administrative modifications introduced by the Spanish Crown after the Bourbon family became the ruling house of Spain in 1714, after the War of Spanish Succession. The reforms have been traditionally interpreted as an enlightened attempt to modernize the Spanish Empire (Paquette, 2008). Although the reforms began as soon as the Bourbons became established, the relevant changes for the Americas were only made after the end of the Seven Years' War. The war made Spain aware of its vulnerable position, and the decay of its empire, *vis a vis* England and other European powers. The

[21] Non taxable sources, in the form of forced loans, became very important for the late 18^{th} century as we will see later.

[22] In the appendix , *Figure 2.10a* has other relevant scatterplots with model's data.

realization set a chain of reforms that tried to rectify such weakness (Marichal, 2007, pp.22-29).[23]

The several interpretations one can make of the political economy's functioning of the Spanish Empire, and of the nature of the Bourbon Reforms, depend on the distinct potential accounts of the colonies' fiscal apparatus. There are at least two major strands in the literature:[24]

- The traditional interpretation argues in favor of an interpretative framework that emphasizes the Crown's coercion against the American elites and non-elites. It posits that the reforms were a partially successful attempt to centralize the whole empire administration in the Crown's hands. The intensification of tax collection is underscored as the key aspect. As advanced by Marichal (2007), the idea is that the coercive nature of the reforms became evident with the extraction of funds in the late 18^{th} century via forced loans and expropriations.

- A second type of literature argues that the reforms were less centralizing and less coercive than is commonly thought. That is so, because the success of the reforms depended on a *de facto* coalition between the Crown and local elite groups. The arrangement is described by Grafe and Irigoin (2012) as being composed of stakeholders, where both the Crown and the elites had aligned interests and hence had stakes in maintaining the consented *status quo*. The Crown's borrowing of extensive funds could only have happened with the complicitness of the elites; Grafe and Irigoin contend that the intra and inter colonial transfers weren't set up to merely satisfy the Crown's interests, but they followed the interests of local elites too. Furthermore, the Crown's mentality was not one that had revenue extraction as its most important goal, it was just a means to achieve the real end: the maximization of the "aggrandizement of the empire." The confusion, they argue, led the literature to a false path

[23] In the war, England launched a successful naval campaign against key strategic Spanish possessions: it captured Havana and Manila. At the end of the war, with the Treaty of Paris being signed in 1763, Spain regained those territories but ended ceding Florida to England.

[24] There may be a third which hasn't received as much attention as the other two. It is based on the idea that, at least for some periods, the local elites benefited at the expense of the Crown (Perez, 1991)

that found coerciveness as the only explanation for the Crown's behavior. (Grafe and Irigoin, 2006, 2012; Irigoin and Grafe, 2008a,b)

My argument aims to connect both strands of the literature into a one general meta-narrative of the collapse of the empire. I argue, on tandem, with Grafe and Irigoin, that the elites and Crown had an interdependent relationship where they both benefited—at the expense of other actors within the Empire. However, I also recognize that their interdependence was anchored in a very specific context; one that was fundamentally asymmetrical and hierarchical in its structure. The bargaining process was stable only up to a point. Passing certain threshold, the stability of the empire could unravel—as it did. My argument, then, is that the increase in the number of merchant guilds—and other rent-seeking corporations—proved to be the main underlying mechanism by which local elites got empowered and started demanding autonomy and independence. Last section's model showed how and why did merchant guilds increased. In this section I will detail the relevance of such result.

Mining as the Motor of the Economy

New Spain's economy is generally described as being a regular backwards *ancién regime* economy with a crucial peculiarity: it had an important endowment of silver; which is nearly tantamount of saying that it had the world's money as a natural resource. Ever since the conquest, and up to the final days of the Spanish Empire, the Mexico City's mint house produced a sizable share of world's money. As Marichal (2006b) and Findlay and O'Rourke (2007) explore, Mexican Spanish Pesos circulated all around the world. It is to be expected, then, that New Spain's economy became anchored around silver extraction.

Throughout the 16^{th} and 17^{th} centuries, New Spain lagged behind Peru, as the principal source of silver in the Americas. The situation was reversed in the 18^{th} century. As analyzed by Garner (1988), New Spain's advantages over Peru lay in its better extracting opportunities: it enjoyed lower operational costs and its silver was of higher quality. Moreover, Peru's industry was circumscribed to the produce of the Potosí mine only, with no other

alternatives. Mexico, in contrast, boasted of several mines dispersed through the center and northern parts of the country. Such differences created a significant distinct mining industry: Mexico enjoyed of a denser capital market that could support a better network of investors. Also, unlike Peru, which had the slave *mita* system, Mexico's mines were mainly worked by free individuals.

Traditional historiography assumes that American mining had great dynamism based on nominal silver extraction data. Although Coatsworth (1982) has challenged such narrative, the most recent examinations by Dobado (2002) and Dobado and Marrero (2011) have defended the original argument. They studied the impact of silver production in New Spain's fiscal revenue. What they found is a clear correlation between both. Even though mining taxes *per se* contributed a relatively small share of the total of New Spain's income—approximately an average of 15% for the 18^{th} century according to Klein (1998)—they set the trend of most of its behavior. Hence, they argue, their result gives credit to the traditional narratives that speak of the supreme importance of the mining industry in New Spain's economy; Dobado has termed the relationship between mining and the general economy as one of mining-led growth.

For Dobado and Marrero (2011) the crucial aspect of their paper , however, was not the rehabilitation of the traditional thesis of the dynamism of mining, but to underscore the role played by the Crown in the attainment of such result. They conclude that the monarchy participated in an active promotion of silver mining and was responsible for its boom. Dobado (2002, p.715) identifies three instruments that were used as policy tools: i) *Mercury Price.* The Crown had a monopoly on mercury, which served as the leading input for the silver extraction process. Through time, the crown proceeded to decrease its price: In the beginning of the 18^{th} century mercury price was fixed at 82.5 pesos per 100 kilograms, in 1768 it was decreased to 62 pesos and in 1777 it was 41.25 pesos. There is a strict causality between such downward changes in price and the increase in silver extraction; ii) *Tax incentives.* It was a common policy of the crown to give tax credits to incentivize mining investment in certain areas (*e,g*, to invest in old mines which were

thought depleted), or to certain groups, see Brading (1971); iii) *Institutional changes.* In 1776 the mining industry gained a corporate body that could better represent their interests in the form of the *Cuerpo de Minería*, a mining guild. In 1783 a liberal Viceregal Mining Code was enacted with the explicit goal of being more efficient in enforcing property rights.

Although mining was the motor behind New Spain's economy, miners were not New Spain's prominent elite group. As Dobado mentions, it was not until very late in the 18^{th} that they actually gained the privilege of having a full-fledged corporate body. Why was that so? given that the Crown's aim was to improve the market efficiency within the mining industry, it also meant that it couldn't fully exploit its ability to coopt the miners through its rent making capabilities (say, by manipulating the mercury price [25]). The monarchy's prime interest in spurring silver extraction lay in the direct incidence over its goal of revenue maximization—through an expansion of the taxing base. Political control wasn't exercised through the mining sector, but it was found in the key natural ally of the Crown: the Mexico City's trade guild. As lengthily explored by Brading (1971) and Walker (1979, pp.119-132), miners themselves depended heavily on the merchants: The latter were the prime sources of credit investment that financed mining, and they also controlled the trade opportunities—necessary for silver to be exchanged into goods.

The first piece of the main argument is then that mining was a dynamic industry that propelled the New Spaniard economy. It was relatively competitive and by definition it was not consolidated through a guild that could capture rents[26]

Ocean Trade as the Source of the Rents

The *Consulado de México*—Mexico City's trade guild—was established in 1594 to be a corporation that consolidated the interests of the wholesaler merchants in New Spain and

[25] Dobado (2002) and Dobado and Marrero (2011) interpret their results as *prima facie* evidence of the good will of the Crown in promoting New Spain's growth. By doing so, they commit a recurrent mistake: Given that they prove that the mining industry was the key dynamic sector and given that they prove that the Crown promoted mining growth, then they conclude that *ipso facto* the Crown's policies were overall good for the wellbeing of New Spain's economy. The fault lies in assuming that by necessity the economically important sector is also the politically important sector.

[26] At least not until the end of the 18th century as I will argue later on.

had the aim of acquiring a piece of the transcontinental trade pie; it was founded with the premise of being an American counterpart to the Seville's trade guild, which had dominated all the transatlantic trade since its creation in 1554. As succinctly explained by Studnicki-Gizbert (2000), the Mexican Consulado operation was entirely founded upon three internal roles: i) to set and enforce the formal rules that would govern all commerce in New Spain; ii) to provide institutionalized support to its members, aiding them in improving their businesses; iii) to act as a key lobbying group that could push for their members commercial interests. The Mexico City's trade guild also enjoyed a monopoly on the *alcabala* tax collection up to 1754 and continued to collect the New Spain's *avería* tax up to the last days of the empire.

From 1566 to 1776 the main structure of the Spanish oceanic trade was centered around the so called *Flota System*: a scheme that consolidated all commerce around the shipment of periodic convoys from Seville to key designated docks in the Americas: Veracruz in New Spain, and Portobello, Panama for South America. While, Havana, Cuba, and Cartagena, Colombia acted as potential resupply harbors. Similarly, in the Pacific, the trade route connected the ports of Acapulco, New Spain and Manila, Philippines. The idea of centralizing trade around certain routes and in a unique and very heavy guarded convoy fleet arose as a measure of protection against pirate raids. Independently of the presumed purpose of the system, it is important to underscore that it must also have acted as a rent making mechanism, because it consolidated trade in the hands of the trade guilds. All traditional historiography has emphasized such *dictum* (Brading, 1971; Garner and Stefanou, 1993; Walker, 1979). However, one recent argument against it comes from Baskes (2005), who argues that if we take the distinct risks and uncertainties involved in oceanic trade into consideration, guilds weren't actually enjoying monopolist profits from international trade at all. It may be true that in terms of direct exclusive money profiting, the guilds weren't gaining an extra benefit from its privileged position. However, this doesn't mean they didn't profit in other ways.[27] In the case of New Spain, by Baskes' own estimations, the Mexico

[27]See Ogilvie (2011) for an exhaustive analysis of how merchant guilds took advantage of their position

City's trade guild controlled up to 50% of all the commerce of imported goods—a high amount if we consider that, by Altman et al. (2003, p.296) estimates, in the late 18^{th} century, the guild had only about 200 members. The hypothesis hereby presented is that even though the ocean trade may have not been as economically lucrative as previously thought, it still was very politically profitable. By controlling the influx of goods that entered and circulated across the country,[28] the guild maintained preponderance on the settlement of political disputes in New Spain. In that sense a symbiotic alliance between the Crown and the guilds was born: the Crown granted monopolistic power to the guilds, which gave them economic and political power, which then was used to politically control the territories in favor of the Crown. It was in this context, that the Mexico City trade guild became the key ally of the Crown in the governance of New Spain.[29]

Originally, all metropolis-colony trade was settled at Trade Fairs—which occurred each time the fleet arrived into the New World[30]—held in Mexico City first, and subsequently in Jalapa for New Spaniards and in Portobello, Panama for South Americans. Conflict among the American guilds[31] and the Seville one was common, and the Crown acted as a third party that settled disputes. As Walker (1979) explains, the 18^{th} century can be described as the period in which the Seville guild lost power and influence with respect to the American guilds (Mexico and Lima primarily). The latter had a privileged position derived not from its control of ocean trade *per se*, but from their control of the dealings that happened in their American ports. Spaniards arrived with a selling price, but it was the Americans who had the better bargaining position. As described by Walker (1979, pp.75-80), they had the "home advantage", and by just being patient, they could force Spanish traders to lower

[28] One possible objection to such assertion is that it was not true because of the importance of illegal trade—that although unquantifiable, is thought to be pretty big. Most historiography has taken the view that it acted against the American's guilds interests. However, the plausibility of that argument is low. Likely it was the other way around: precisely because the guilds controlled internal commerce, the probability of them controlling the smuggling was high too

[29] Alternatively, the guild gained economic power by using its political prerogative through other means. They were the main financiers of the mining projects, and also the most important financiers of the government

[30] According to Brading (1971, p.95) the European products most demanded where textiles, iron, steel, paper, wine, olives and brandy.

[31] The Lima Trade Guild acted as the Mexico City counterpart for the viceroyalty of Peru. It was established in 1614.

their selling price[32]—in expectation that the Seville suppliers were eager to return to Spain.

Starting in 1765 the fleet system started to collapse. Given the military capture of Habana and Manila by the English in the Seven Years' War, the Crown became aware of the necessity to change its system. The scheme had initiated as a safe keep mechanism against pirate attacks, but times had changed. Pirates were no longer a threat, rival imperial navies were. Hence, the Crown started to diversify trade connections by allowing for a greater participation of other regional mercantile sectors in the intra imperial trade: That is, other ports and routes were added to the system. This trade arrangement formally yielded with the proclamation of the *Reglamento y aranceles reales para el comercio libre de españa a indias* in 1778, which *de facto* ended the Cadiz monopoly on American trade—Cadiz had supplanted Seville as privileged port in 1717—by enabling other Spanish merchants, from other regions, to enter the transatlantic trade;[33] it also increased the number of American ports sanctioned to receive European goods and allowed for some inter-colonial trade. Most notoriously, it eliminated the fleet transporting arrangement; it allowed for register ships to trade freely between imperial ports at any point in time.

The new scheme is referred in the literature as the "Free Trade" reforms. The name makes reference to the fact that it was the first true important relaxation in trade rules in the Empire for centuries. But by no circumstance was trade truly free. Also, the reform was not uniformly applied across all territories of the Empire at once. In New Spain it was delayed until 1789. The Mexico City's trade guild initially disputed the arrangement under the explicit grounds that it was detrimental to their interest(Stein and Stein, 2009, pp.91-129). After the reforms, the Mexico City guild faced several problems: they started losing the grip they had on the merchandises being imported, and so they also started losing political power as the key redistributors / controllers of internal commerce (del Valle, 1997, pp.222-225). The reasons and consequences of this, will be discussed more amply in the next section.

[32]Spanish merchants were in charge, for the most part, with delivering the goods to the New World. New Spaniard merchants had only to buy their goods, stock them in warehouses to resale later. That's why the Mexico City Traders were also known as *almaceneros* (warehousemen).

[33]Except for Basque merchants, which received a special treatment from the Castilian courts and were deprived of participating in this new arrangement.

It is important to underscore that, notwithstanding the problems generated by the reforms, the Mexico City's trade guild still remained a key ally of the Crown. The guild lost one of his key assets in 1754—the privilege of collecting the alcabala sales tax—due to the Bourbon reforms, but still managed to cope because it remained the largest mercantile corporation in the realm—and unlike the new elites, they still had better bargaining positions because of their close connections with Crown. In the next subsection I will deal with the generalities of the Bourbon reforms; and how these were they implemented in order to preserve the Empire. What I want to stress here, is that the Mexico City's trade guild had an interest in protecting the empire too: Ocean routes and control of the imports were the source of its political power and disruptions compromised their position.

The second piece of the main argument is then that merchant guilds were the key Crown allies in the administration of the Empire—both benefited politically and economically. Yet, just as I specified in my model, the Seven Year's War, modified the institutional status quo. The Crown was incentivized to increase the scope of trade by allowing certain competing elites to become alternative merchant guilds as well—which *de facto* meant the constitution of new rent-seeking groups. The problem that followed is that these new groups competed with the traditional ones (in Mexico City and Lima) and had less incentives to cooperate with the Crown.

Bourbon Reforms as Dynamic Tax Maximization through Local Negotiations

It is traditionally asserted that the Bourbon reforms were an attempt by the Crown to build its own state capacity and consolidate its power via the centralization of its administration. Even if we concede that such was the intended goal, the actual effectiveness of the endeavor is disputable. The Crown still had to negotiate with local elites and compensate them. For example, in the first decades after the War of Spanish Succession, the King tried to unify the tax system within Spain itself (mainly by adhering Aragon, Catalonia and Basque country to the Castilian system). However, as Grafe (2012, pp.116-164) and Grafe and Irigoin (2006) assert, such measures were forcefully resisted by regional jurisdictions and were never fully implemented. Instead, the King had to cede and negotiate in order to try

to coopt the local elites.

In the case of the colonies a similar story ensued. In New Spain, for example, the Mexico City's merchant guild had historically acted as the main tax farmer of the *alcabala* tax. Yet, the prerogative was terminated in 1754 in order for the state to became the sole administrator; the rationale used to terminate the accord was the same as the one used in the Metropolis: the need to professionalize the state's bureocracy (del Valle, 1997, pp.133-139). As in Spain, the reform created uneasiness between the guild and the Crown. The period between 1750 and 1759 marked the lowest point in the century for the Mexico City guild's financial contributions to the Crown. Although the Crown retained the tax collection prerogative for the remainder of the century, it still had to concede on other grounds and readjust prior arrangements. As described by del Valle (1997, pp.140-152), the guild lobbied for a decrease in the payment of its own tax rates, and for the restructuring of other responsibilities—lowering their contribution to the payment of salaries and the maintenance of commerce and law enforcement bureaucracy. In all those cases, the King had to negotiate new arrangements with the guild.[34]

The traditional historical literature assumes the Bourbon reforms were tantamount to imperial centralization mostly because the official rethoric of the Crown justifies its actions as if that were the case. The Crown's statization of the *alcabala* collection is a mere example of many reforms that were enacted on the grounds of building greater state capacity. Other noteworthy acts are: In 1765 the Crown established its monopolist authority over tobacco trading; In 1767 the King expelled the Jesuits from the empire—At the time they were the most powerful and wealthy religious society in operation and were seen as competitors in the provision of governance; the several political reforms in 1771 and 1776 gave legal preponderance to first generation Spaniards in the occupation of local political posts—which assured their aligned loyalty to the Crown rather than on the local elites; and most

[34]This is not to say that the breakup between guild and Crown was total. Nothing farther from the truth. The merchant guild kept its privileged position as the sole trade body in New Spain and still had the monopoly on *avería* tax collection—The avería taxes were an international trade tax. When Spain entered the Seven Years' War in 1762, even though the guild still held resentment for having lost the *alcabala* collection ability, it still contributed financially towards the military mobilization in the Caribbean (del Valle, 1997, p.147). The contribution exemplifies the aforementioned linked interest between the merchant elite and the Crown in the preservation of safe and constant trade.

importantly, in 1786 it enacted the *Intendente* regime, which restructured the internal administration of the colonies by creating new political jurisdictions and new administrative positions. In the new regime, even the figure of the Viceroy lost influence; the newly created figure of *Superintendente* was in charge in all matters of tax collection and revenue in New Spain, and answered directly to the King.

Any historian that has done archival research can testify that most of the records show that the Crown's goal was to increase tax revenue through the improvement of imperial administration. However, one thing is to read what the actors involved were saying at the time, and other much differently is to attribute meaningfulness to their words. My argument is that the interpretation framework can be shifted, and that the above mentioned events can be interpreted in a different and more cohesive light. There are several inconsistencies with the pure " building state capacity" thesis. Irigoin and Grafe (2008a), Grafe and Irigoin (2006, 2012) have carefully studied the imperial finances in the Americas by revising the transfers that occurred in the local *cajas*—local treasuries. They have found that the imperial financial transfers—in between the local treasuries—were not mandated in a top-down fashion by the Crown, but can be attributed to a bottom-up decision process dictated by local commercial elites. Furthermore, by assessing which local *cajas* had surplus and deficits, they found a pattern: Harbors and frontier zones were the main destinies for the transfers, which they interpret as direct evidence of co-alignment of interests between elites and the Crown—in their mutual goal of preserving peace and stability across the Empire.

The Bourbon reforms may have tried to increase state capacity and maximize revenue by means of centralizing its imperial administration,[35]. Yet, my argument is that the reforms succeeded in this endeavor only because they failed to fully implement the stated

[35]As previously described, Irigoin and Grafe dispute the notion of the empire as a tax maximizer, and prefer to describe it as an "empire aggrandizer." They think it makes more sense to see it that way because taxing was only means to an end: the procurement of the empire. However, it is still theoretically sounder to assume income maximization. Mostly because otherwise one would have to explain the "parochial" nature of the King—and why would he have a distinct utility function than the rest of the involved agents? Grafe and Irigoin are making the same mistake that Public Choice theorists found in modern public finance literature: By assuming that the "governor" has a different utility function than the rest of population they introduce a cognitive bias in their implicit model. Besides, assuming income maximization explains just as well the political economy behavior of the crown.

means. There is a clear example of a case that illustrates the potential range of backfiring that could have happened if they actually had achieved full centralization. One of the most debated topics in the 18th century was the "barbarism" in the governance of *repúblicas de indias*—indigenous settlements; especially due to the notorious *repartimento system*: An arrangement in which external non-indigenous merchants provided capital goods and/or credit to the *Alcalde*, the local mayor of the indigenous communities, in exchange of a promise of future payment in the form of output of a given good. Such mechanism has and had traditionally been depicted in a negative light as a way of forcing Indians to buy merchandises and become indebted. However, such interpretation neglects the political economy behind the system. Baskes (2000) studied the *repartimento* in Oaxaca, a southerner state in Mexico, which enabled the production of the second most important exportation commodity in New Spain after silver: cochineal.[36] Baskes concluded that the *repartimento* was an effective credit mechanism: Merchants provided funds to the *Alcalde Mayor* who then proceeded to allocate them to the indigenous population, which, because of that, were then able to finance the cochineal production. The system functioned as a social mechanism that maximized the production of the output good in the indigenous communities, in a context of high risk and uncertainty. The *repartimento* was, nonetheless, abolished with the *Intendente act* in 1786, because it was considered barbaric and posited much power around the local elites. As the Baske's story tells, this proved ruinous to both the cochineal trade and to the indigenous communities: it effectively destroyed their connections to the outer world and their ways of financing the capital goods needed for the production of cochineal. Merino (2000) confirms this narrative: even though the Bourbon reforms successfully restructured the indian administration—by severing the role of local elite merchants, and by improving the top-down decision making power of the Crown— they nevertheless failed in increasing the efficiency of the tribute tax collection. Fruitful centralization didn't translate into economic success for neither the indigenous communities nor for the Crown itself—which

[36] Cochineal is an indigenous insect that when finely crushed it can be used as a luxury red dye for textiles. As explored by Marichal (2006a), the commodity was very important in the 18^{th} century due to its high quality *vis a vis* other competing dyes. It was highly demanded by European elites. And due to its great value per weight, it was very profitable.

gathered less taxes than before.

Alternatively, my argument is that there are some historical facts that cannot be entirely understood through the "Bourbon Reforms as Imperial Centralization" narrative: The King's resolution approving the creation of the mining guild in 1776, or the enactment of the Free Trade Act in 1777/1789 appear as paradoxical in the traditional fiscal literature—because they effectively enabled local elites to gain power *vis a vis* the state. Yet, they can be reconciled if we interpret the Bourbon reforms in a political economy perspective; the Crown's motive were far simpler and mundane: to optimize the extraction of rents by improving the mechanisms of co-option it already used.[37] The Crown's strategy lay in trying to create alternate bodies within the colonies that could be coopted by the Crown's own interests, just as the traditional ones had. In New Spain, the creation of the mining guild is an example of this attempt; the existence of a core body of miners who could acknowledge the economic prospects and advantages promoted by Crown's official policies meant, in the eyes of the King, a more lucrative opportunity to extract rents from it. [38] In America, the great attempt at compartmentalizing functions between distinct bodies was the Free Trade Agreement of 1777, which ended the *de jure* Trade Monopoly of Cadiz and allowed several other corporate bodies to gain recognition all across the Empire. The only place were the reforms were delayed in its application was New Spain; precisely because the Mexico City's trade guild was more powerful and had greater bargaining position with respect to the state—and so it could better resist the reforms. Unlike South America, New Spain was closer to Spain, had a greater mining industry, and was a more important imperial node—it connected Spain with Philippines. The Mexico City's merchant guild had a greater leverage, against the Crown, *vis a vis* the other important South American trade guild: The one in Lima, Peru, which had never controlled the economic life in South America as the Mexico City's merchant guild had in New Spain. This also explains why, unlike the viceroyalties in

[37] Garfias (2018) develops a similar argument, where he finds that the Mining Guild was created as a way to coopt them. Arias (2013) argues that centralization actually was enabled and supported by the elite, due to the intertwined interests. Her story fits the first part of my argument, but she obviates the problems that were created afterwards, when the elites didn't share the Crowns interest anymore.

[38] As explained before, this goal antagonized the maximization of efficiency in the mining industry.

South America, New Spain became the financial backbone of the Empire in the late 18th century, explaining why the Mexico's city merchant guild financed—via greater taxation, loans and contributions to the Crown. The political order of New Spain, and the fortune of the the Mexico City's merchant guild depended on the Crown.

In summary: Up to the 1770's Spain organized its empire as to extract more revenue from it, both by making the mining industry more competitive and efficient and by a better collusion of its interests around those of the Mexico City's trade guild, which held the political control around New Spain. The result was an economic boom in silver extraction and exportation and the increase of the *situados* expenditures towards the protection of key imperial commerce posts in the Caribbean and the Pacific. The Crown tried to empower alternate political organisms in an attempt to capture them too. The third part of my argument is to stress how these changes impacted the governance of the Empire. As I stressed in the model, after the institutional shocks—starting with the Seven Years' War—the incentives were for the Crown to increase the number of guilds. However, as I've emphasized through this sections, the benefit to the Crown was conditional on the co-option of these new guilds. In the next section I will detail how these new elites were not successfully co-opted.

2.3.2 European Warfare and the Collapse of the Empire

The *status quo* period, which was characterized by the initial implementation of the Bourbon reforms, was one of relative peace. After the Seven Years' War ended in 1763, Spain didn't enter any great conflict until its involvement in the American War of Independence in 1779.[39] After it, ten years passed until Spain became embroiled in a continuous period of warfare set in the context of the French Revolution and the Napoleonic Wars. The wars not only depleted Spain's coffers, requiring it to demand resources with extreme urgency from their colonies, but also incentivized a radicalization of the reforms as to avoid trade collapse—as my model could illustrate. These two factors radicalized the Crown's interests

[39]The only exception was a minor conflict with Portugal in 1776-1777 over some territorial disputes in the Rio de la Plata region in South America.

and hasted its trade liberalization policy in order to acquire larger rents from the rest of the local elites within the Empire. It was a new non-stable equilibrium setting. The newly empowered elites were never fully co-opted by the scheme. This situation became even more ruinous after the Napoleonic invasion of Spain.

Spain's Finances and Its Bankruptcy

Brewer (1988) stresses that England's success in building a strong fiscal military state in the 18^{th} century was grounded on a combination of intertwined incidences such as : i) A professional and efficient taxing bureaucracy; ii) The reliance on increasing, but manageable, long-term public debt; and iii) A military focus on navy investment, to establish England's sea superiority. There is a growing historical literature that aims to understand the nature of the Spanish Bourbon reforms in light of the contrasting English case. In that sense, as we have seen, Spain's reforms were very effective in increasing tax revenue all across the empire; but not merely through improvements in centralization and bureacratization of the administration, but by mediation of governance with the key regional elite corporate figures. Moreover, as Torres (2007) notes, the reforms didn't modify the underlying political economy structure of Empire, but exploited it even more: to finance Spain's numerous wars, the Crown's policy was based on short-term debt contracts that could be promptly liquidated. Another deviation *vis a vis* the English scenario, is that Spain's military budget was mostly assigned to sustain land armies rather than in navies. Even though Spain was very dependent on colonial remittances and sea trade, it still preferred not to invest on their protection. Why? A potential solution to the paradox is that historically, the flota system had been sufficient enough. And in the late 18th century, the diversification of sea trade routes was naturally seen as the cheapest solution possible. Moroever, the regional political economy was such that aimed to instill the local elites to protect their own investments in a private manner.

This broad narrative portrays Spain as a white elephant that on the outside looked strong, but in the inside was very vulnerable to exogenous shocks. Torres (2007) studied

the case of the American War of Independence precisely as an "acid test" of the imperial Bourbon reforms. Even though Spain ended up on the winners side—after all, the US did achieve its independence—Torres concludes that it highlighted the weakness of the Spanish government. The war bankrupted the imperial treasury and obliged the Crown to increasingly finance itself through debt: In 1782, the *Banco de San Carlos* was created in Madrid because of the need of a more professional body that could act as an intermediary and guarantor the Crown's debt—yet, as I've described, the Crown still relied on short-term debt provided by small elites. The French Revolution and the posterior Napoleonic Wars ended up being the last straw that undermined the fragile Spanish finances. In 1798 the Crown implemented the *Consolidación de Vales Reales* reform in Spain, [40] which expropriated all the non-essential assets of the Church to pay for past public debt and to back up the issuance of new one. The new debt, as Marichal (2007) describes, was also backed up by New Spain's silver remittances.

Hence, after 1780's the Crown became financially weakened by the war. The exogenous shock changed the monarchical perspective towards its American colonies. As I discussed in the previous sections, the prior Crown's rationale was founded on the premise of dynamic tax maximization. After the war, however, the Crown came to be in such a deteriorated position that it now had to use its colonies as a source of short term liquidity, which meant that it needed to extract revenue from them in all manners possible as soon as possible.

War Modified the Trading Schemes

North (1968) famously argued that the piracy prevented the full realization of trade opportunities in the Atlantic trade between England and its colonies. However, piracy as institution depended on raiding Spanish cities and ships. What was the impact of piracy on Spain's political structure? As expressed before, the rationale of flota system lied on the advantages it had as a defense mechanism of the Spanish ocean trade. For most of the 16^{th} and 17^{th} century it succeeded in its protective endeavor, but by the 18^{th} century the

[40] In 1804 the reform was extended through all the empire, as we will see.

conditions had changed. The golden years of piracy ended around 1730, and, at least since the Seven Years' War, the proper English Navy became Spain's most important threat. In Douglass North's story, the demise of piracy implied better trading conditions for England; in the Spanish case, however, the demise of piracy, given that it was linked to England's rise, meant the opposite: worse opportunities.

The institutional exogenous shock obliged the Spanish Crown to rethink its political organization—at least in what concerns the Atlantic trade, and its protection. As told in the last sections, the Bourbon reforms were implemented as a response to this new setting. The liberalization of the flota system—that started in 1765—made trade more flexible and empowered alternative regional elites that could be coopted by the Crown. The liberalization was opposed by both the Lima and Mexico City's trade guilds, but only the latter—which had a better bargaining position—was able to successfully block the reforms. Yet, the last decade of the 18th century weakened the Empire's situation and obliged the Crown to diversify its trade routes as the only possible way to survive. The "'free trade" system officially started in New Spain in 1789. Moreover, alternative elites across the region were able to corporatize; effectively diminishing the power of Mexico City's merchant guild. Between the years of 1793 and 1795, merchants in the cities of Guadalajara, Veracruz, Havana, and Guatemala were recognized as official licensed merchant guilds.

Stein and Stein (2009, pp.130-140) detail the process by which the Veracruz trade guild was constituted. A first petition was send to the Crown in 1781. However, it was not until the early 1790's that the government seriously heard the petition. The Mexico City's trade guild fought it vigorously across this span of time, and though at the end it wasn't able to block it—Veracruz established its own merchant guild in 1795—it was able to constraint the area of operation of the competing guild to a small specific area. Why did the Crown ended up licensing a Veracruz's guild? The whole sudden appearance of trade guilds all around America in the 1790's can be explained by the Crown's urgency in creating opportunities that would fund its own enterprises; by hastening its rent-making policy of creating alternate corporations, the Crown also augmented the possibilities of getting short-term loans and donations.

How could the Crown act against the Mexico City trade guild's interests without fear of losing it as political partner? The answer is paradoxical: the state of constant war, which initially had caused the abrupt reforms, also made the transition easier to accept for the guild. Not only it itself still kept many trade privileges, but it retained political power due to its status as the Crown's official financial intermediary in New Spain.In the past the Crown had required the Mexico City trade guild to perform such role—as the official collector of loans and donations from all New Spain—but the new conditions of continuous warfare made the assignment even more lucrative (del Valle, 1995, 1997).

The Collapse

The new administrative scheme hinged on the success of the alternate corporate bodies in performing as the Crown expected; that is, by being an inexhaustible source of resources from which the Crown could rely. With the increase of the financial demands in the 1790's and 1800's, the system collapsed. Mexico City's trade guild remained as the prime financial supporter of the Crown, but the rest of corporations (the Church, the mining guild, the Veracruz and Guadalajara trade guilds). were alienated by the government.

Spain's role in the American War of Independence was financed mainly by New Spaniards. The Crown increased the amount of taxes and required forced loans in the region (Chavez, 2002). Mexico City's merchant guild was the main financial intermediary in the endeavor and its merchants themselves were the main financiers. Initially, all corporations and elite groups contributed: the mining guild, the Church and several private individuals loaned and even donated money. del Valle (1997, pp.205-206) argues the reason they did so, was mainly because there was a lack of investment opportunities within New Spain. It implicitly means that the corporations thought they could profit by lending to the Crown. By later dates, however, the Crown's demands increased and New Spain's elites initial impetus towards funding the Crown diminished. With the advent of the French Revolution and the posterior French-Spanish war, a new call of loans was made in 1793 by the Spanish King. Yet, most corporations were not so willing to provide resources anymore. Mexico City's

merchant guild did so, but only by negotiating better privileges (i.e the Crown allowed them to continue being tax farmers for the *avería* tax). Other corporations were much reluctant. The mining guild barely contributed; it refused to provide funding because the Crown had yet to paid back the 1780's loans.

Several additional loan calls were made in the 1790's with the same pattern: The Mexico City's trade guild acting as the official financial intermediary, providing some funding—and gaining small concessions—while the other New Spain's corporations stalled on its compromises and reluctantly cooperated the bare minimum. The situation complicated even more after 1798 when Spain started warring England. Because of the English dominance was a real threat, the Spanish Crown enacted in 1797 what was called the Neutral Commerce Act which enabled non warring countries to engage legally in commercial trade within the Spanish Empire. As explained by Marichal (2007, pp.176-212), the complexities involved in such endeavor were enormous: Different merchant consortiums across Spain, France, Netherlands, England, United States and Mexico intervened. In the short term, this was a necessary measure to avoid trade collapse. In the long term, however, neutral commerce eroded the traditional trading control exercised by the Mexico City's trade guild and empowered competing elites that would not want to return to the previous *status quo*.

In 1804, the Crown extended the *Consolidación de Vales Reales Act* to all America, seizing the assets of the Church. The measure was highly criticized and resisted by the mining guild and other sectors of New Spain, which highlighted its negative consequences over all the colonial economy: Given that most of the Church's wealth was invested in private loans—the Church was the prime credit institution in New Spain (von Wobeser, 1990)—the enactment required all unsettled debts to be immediately recalled to be paid up. It meant that many productive industries became instantly bankrupt; credit in the country quickly dried up. As von Wobeser (2006) states, the *Consolidación* act created bitterness among most New Spain's society.

The deposition of King Ferdinand VII by Napoleon in 1808 created a vacuum of power in all of America: Were the colonies supposed to obey Joseph Bonaparte—which Napoleon

instituted as the new King—or were they supposed to support the Spanish resistance? or even more striking, was independence a third viable alternative? The absence of a legitimate King meant that the last bastion that sustained the old political establishment was now gone. In New Spain, as explained by del Valle (1997, pp.420-422), the Mexico City's merchant guild mobilized all of its influences to preserve its interests; it went so far to stage a coup, deposing a former Viceroy Iturrigaray—which had ruled against the guild while in power, and had expressed sympathy t towards making New Spain autonomous of the Metropolis. The merchant guild depended very much on a privileged position legitimized by the Spanish Crown and, so, it couldn't allow New Spain to achieve full autonomy.[41] Moreover, the guild became the financial backbone of the Spanish Resistance in Spain against the French invaders. Mexico's merchant guild freely provided what are known as patriotic loans—financed partially by the merchant's own resources, but also by coercing other groups. The financial support was interrupted in 1811, but only because the Mexico City merchants faced a local revolt of their own—Mexico's war of independence.

The many regional elites that had gained freedom and power through the last decades of the 18^{th} century, by the Crown's own doing , now were empowered to oppose Mexico City's merchant guild traditional authority. Most historians underscore the importance of the 1808 Napoleonic invasion to Spain as the trigger of the Spanish Empire's political fragmentation. However, such assessment is incomplete at best. As argued throughout the chapter, the origins of the political fragmentation is to be found in the Bourbon reforms; in the Crown's attempt to liberalize trade in its empire by creating new alternate regional corporations. The Crown aimed to control those new groups just as they had done with the traditional one. They were not coopted however, and because of the war, they actually became rather opposed to the Crown itself.

New Spain became *de facto* independent in 1821—after the royalists realized the impossibility of returning to the old *status quo*. The royalist general Iturbide became Mexico's

[41]Something similar happened in Peru, where elites deposed the Viceroy Pezuela in 1821/ What is clear is that the traditional elites of Mexico City and Lima where the ones that supported the original Spanish arrangement the most, as they were the ones that would lost the most with independence.

first emperor. Such arrangement, was unstable and didn't last. New Spain ended up fragmenting just as South America did. The Central American provinces seceded from Mexico two years after the Independence. The Mexican Empire collapsed and was reorganized as a Federal Republic—an attempt to provide a platform for all regional elites to have a voice. Yet, the deep fragmentation—ignited by the Bourbon reforms and amplified by Mexico's Independence—was not solved: regional elites consolidated around regional warlords that surpassed the federal government state capacity to govern. It was not until the presidency of Porfirio Díaz, almost 70 years later, that the Mexican central government was able to create a real national bureaucracy. And it only did so by implementing a militarized state that prevented dissent.

Even though New Spain didn't fragment as South America,[42] the mechanisms that affected both regions were the same: the Bourbon reforms empowered regional elites that were never coopted by the Crown. The constant period of war in the late 18th century demanded more of them than they were willing to provide. And so the basis of institutional dissent was planted by these reforms—which themselves were the result of the economic changes the Empire face due to the increasing naval threat of Spain's enemies.

2.4 Conclusion

I've provided an alternative explanation behind the break up of the Spanish Empire in the early 18th century, one structured around the political economy foundations in which the Crown and the Merchant Guilds interacted. My argument relies on the way in which trade occurred across the Atlantic—where the Guilds exchanged political affinity to the Crown in exchange for exclusive licenses of trade. The intertwined relation between the Crown and the Guilds in Seville, Mexico City, and Lima was stable for more than two hundred years. Its success rested on the assumption that Spain had the uncontested supremacy over the Atlantic—and the Pacific. I have constructed a simple computational model to emulate the

[42]Central America left the Mexican Empire in 1824, and the Caribbean and the Phillipines kept being Spanish until the end of the 19^{th} century. Internal conflict within Mexico was common though. Besides the known Independence of Texas in 1836, Yucatan too became independent from 1840 until 1848.

institutional framework at operation. I show how exogenous shocks, in the potential risk of trading, can incentivize the Crown towards a more permissive policy allowing competing elites to be consolidated in new Merchant Guilds. I construct a narrative that posits that the increased English threat after the Seven Years' War can bee seen as such an exogenous shock—and hence that my model successfully replicates the behavior of the Crown in attempting to implement the so called Bourbon Reforms after the war.

Originally, the Crown's mentality was one that tried to dynamically maximize its revenue. The Crown supported policies that could potentially increase silver extraction in the Americas, because in the long term it was the means to increase its own revenue. But mining was not the source of rents. Trade routes that linked the empire (Philippines - America - Spain) were. Starting in the 1760's the riskiness and complexity of Atlantic trade increased. The Crown's policy of trade liberalization (allowing new merchant guilds to be created) can be understood as an adaptive strategy that tried to maintain the old political economy entanglement, which hinged on the unconstrained connection through the Atlantic. After the 1780's, Spain became embroiled in expensive wars against France and/or England. The Crown had to modify its priorities in order to fund these endeavors. It started demanding more resources from its colonies, and aimed to create alternative groups, that could support the Crown and could be coopted as the traditional ones had. Such measures, allowed the Crown to improve its short-term access to funds. Yet, in the long-term these policies became the seed of discord that allowed alternative elites to be empowered; elites that were never fully aligned with the monarchy's interest. These groups consolidated its power in the last decades of the 18th century and were the ones interested in demanding greater autonomy and independence.

2.5 Appendix A: Other Relevant Figures

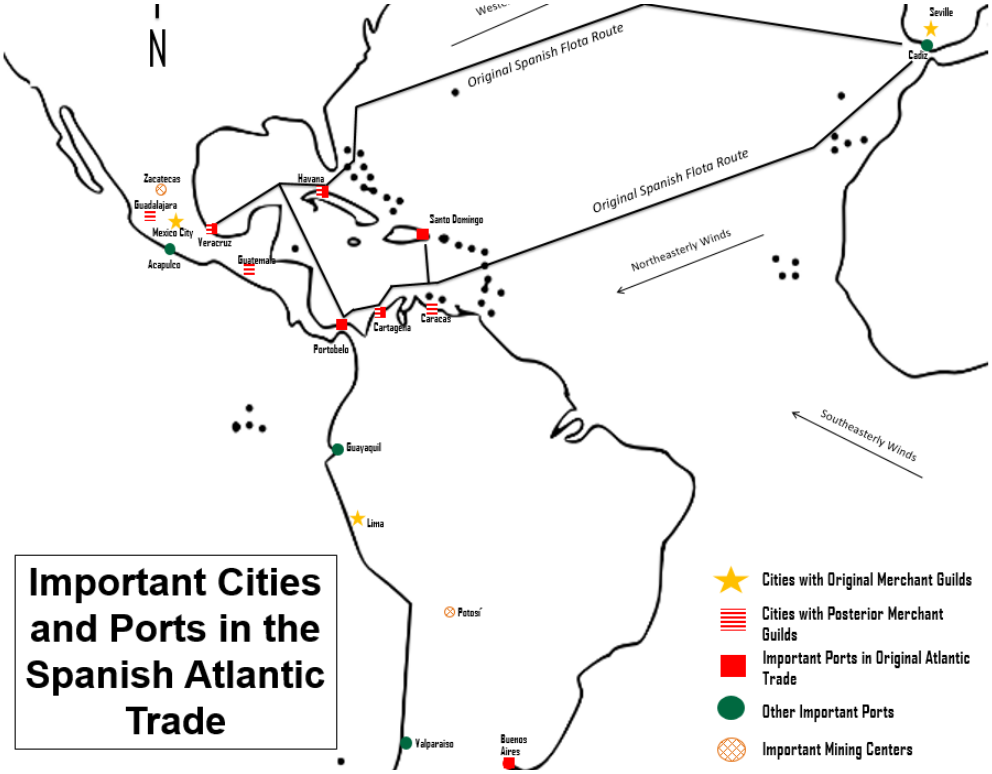
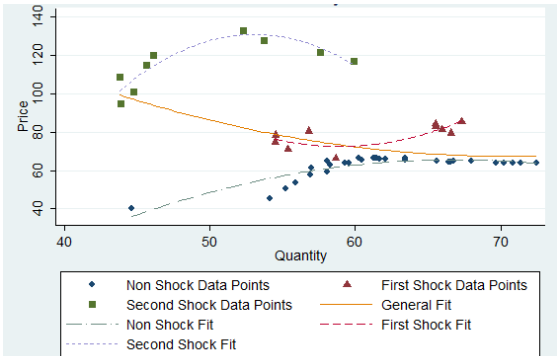
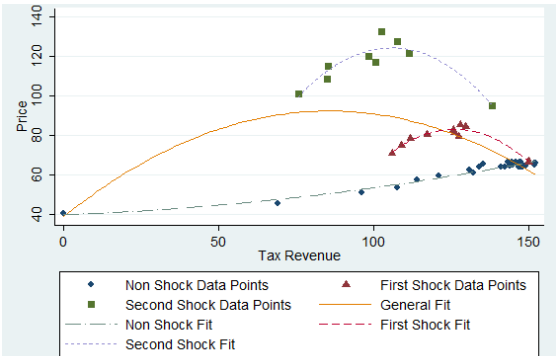


Figure 2.8: Spanish America Map

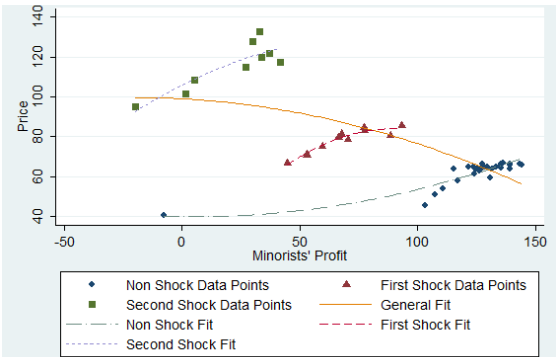
(a) Price and Quantity



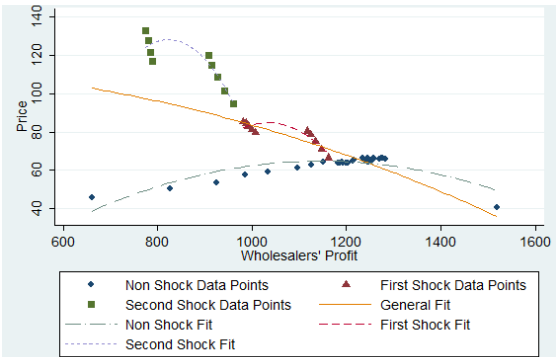
(b) Price and Tax Revenue



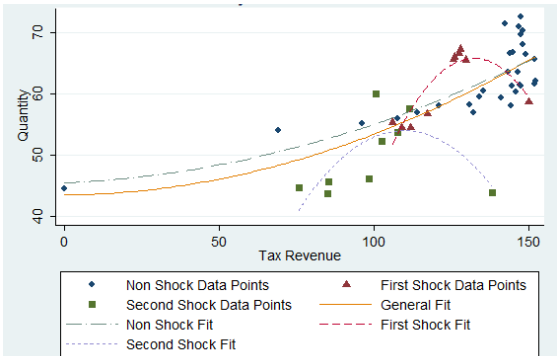
(c) Price and Retailers' Profit



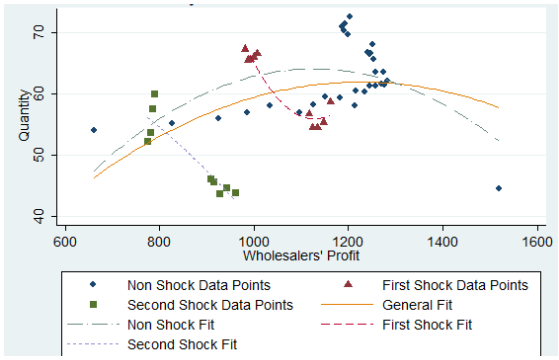
(d) Price and Wholesalers' Profit



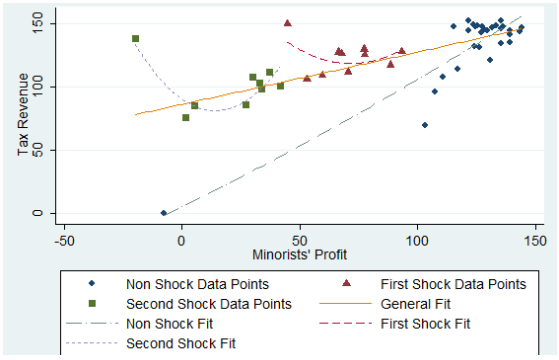
(e) Quantity and Crown's Tax Revenue



(f) Quantity and Wholesalers' Profit



(g) Crown's Tax Revenue and Retailers Profit



(h) Crown's Tax Revenue and W Profit

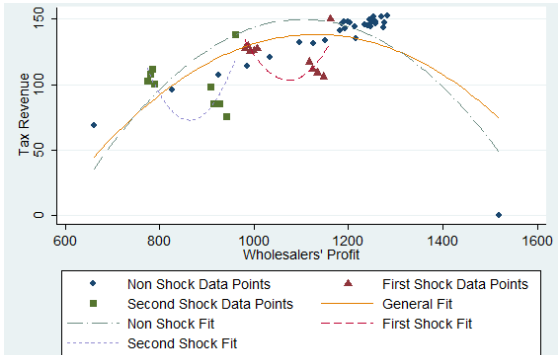


Figure 2.9: Scatter Plots from the Simulation Results

2.6 Appendix B: Python Code

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""" A simple model of Institutional Reform in the Spanish Empire, 18th Century
Author: Arteaga, Fernando
"""

import random as rd
import numpy as np
import matplotlib.pyplot as plt
import math as mt

time = 0
Price=0
Quantity=0
Quantity_List=[]
Price_list=[]
Crown_Revenue_List=[]
Avg_Wholesaler_Profit_List =[]
Avg_Minorist_Profit_List=[]
Number_Wholesalers_List =[]
Number_Minorists_List=[]
Her_Index=[]
Pop_Initial_Distribution =[]
Pop_Final_Distribution = []
Merch_Initial_Distribution =[]
Merch_Final_Distribution=[]

def GenBoundedRandomNormal(meanVal,stdDev,lowerBound,upperBound):
aRand = rd.gauss(meanVal,stdDev)
while (aRand < lowerBound or aRand > upperBound):
aRand = rd.gauss(meanVal,stdDev)
return aRand


class Population(object):

def __init__(self,ID):
self.ID = ID
self.income =mt.log(1 - rd.uniform(0, 1))/(-1)*10
self.past_income = self.income
self.consumption = False

def Step(self):
self.income = self.income + (self.past_income * (1 + \
(GenBoundedRandomNormal(.25,.5,-1.5,1.5) /100)))
self.consumption = 0


class Merchant(object):
```

```
def __init__(self,ID):
self.ID = ID
self.income = (mt.log(1 - rd.uniform(0, 1))/(-1))*100
self.past_income = 0
self.goods = 0
self.potential_goods = 0
self.total_goods=0
self.accounting_goods =[]
self.Wholesaler = False
self.Spanish_Merchant= False
self.profit = 0
self.bankrupt= False
self.Mkt_Powe = 0

def Step(self):
if self.income<= 0:
self.bankrupt=True


class Crown(object):

def __init__(self):
self.population_pool = [Population(x)for x in range(300)]
self.merchant_pool = [Merchant(y)for y in range(20)]
self.Trade_Risk = 0
self.tax_revenue = 0
self.tax_rates= 5

for i in self.merchant_pool:
if i.ID == 0:
i.Spanish_Merchant = True
i.income = 0
i.goods = 50
if i == max(self.merchant_pool, key=lambda p: p.income) and \
i.Spanish_Merchant == False:
i.Wholesaler = True
break

Tot_Income= []
for i in self.merchant_pool:
if i.Spanish_Merchant==False and i.Wholesaler==False:
Tot_Income.append(i.income)
for i in self.merchant_pool:
if i.Spanish_Merchant==False and i.Wholesaler==False:
i.Mkt_Powe= i.income/sum(Tot_Income)

def Step(self):

if time==2:
for i in self.population_pool:
Pop_Initial_Distribution.append(i.income)
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for i in self.merchant_pool:
if i.Wholesaler ==False and i.Spanish_Merchant == False:
Merch_Initial_Distribution.append(i.income)

if time == 49:
for i in self.population_pool:
Pop_Final_Distribution.append(i.income)
for i in self.merchant_pool:
if i.Wholesaler ==False and i.Spanish_Merchant == False:
Merch_Final_Distribution.append(i.income)

self.tax_revenue = 0

if time >= 1:
for i in self.population_pool:
i.Step()

#1st, Spanish Merchant trades with Wholasalers
for i in self.merchant_pool:
if i.Spanish_Merchant==False and i.Wholesaler==False and \
i.bankrupt==False:
i.Step()

Tot_Income= []
for i in self.merchant_pool:
if i.Spanish_Merchant==False and i.Wholesaler==False:
Tot_Income.append(i.income)
for i in self.merchant_pool:
if i.Spanish_Merchant==False and i.Wholesaler==False:
i.Mkt_Powe= i.income/sum(Tot_Income)

for i in self.merchant_pool:
if i.Spanish_Merchant == True:
i.goods *= (1 + (GenBoundedRandomNormal(.25,.5,-1.5,1.5) /100))
Lista0=[]
for j in self.merchant_pool:
if j.Wholesaler==True:
if j.income !=0:
Lista0.append(j.income)
if j.income ==0:
print "mistake"
Lista0.append(1000)

for j in self.merchant_pool:
if j.Wholesaler==True:
j.past_income = 0
j.potential_goods = i.goods * \
((j.income) / float(sum(Lista0)))
j.income = 0
Lista1=[]
for j in self.merchant_pool:
if j.Wholesaler==True:
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if self.Trade_Risk == 0:
z= np.random.chisquare(10, size=None)
if z >95:
z=95
j.goods = j.potential_goods * (1-(z/100))
j.total_goods = j.goods
Lista1.append(j.goods)
if self.Trade_Risk== 1:
z= np.random.chisquare(40, size=None)
if z >95:
z=95
j.goods = j.potential_goods * (1-(z/100))
j.total_goods = j.goods
Lista1.append(j.goods)
if self.Trade_Risk== 2:
z= np.random.chisquare(70, size=None)
if z >95:
z=95
j.goods = j.potential_goods * (1-(z/100))
j.total_goods = j.goods
Lista1.append(j.goods)

#2nd, Wholesalers trade with the rest of the Merchants
ProfitList1=[]
Lista2=[]
Lista3=[]
for i in self.merchant_pool:
if i.Wholesaler==False and i.Spanish_Merchant==False and \
i.bankrupt==False:
Lista2.append(i.income)

for i in self.merchant_pool:
if  i.Wholesaler == True:
for j in self.merchant_pool:
if j.Wholesaler == False and \
j.Spanish_Merchant== False and i.bankrupt==False:
j.goods += i.total_goods * \
((j.income) / float(sum(Lista2)))
i.goods -= i.total_goods * \
((j.income) / float(sum(Lista2)))
j.accounting_goods.append(i.total_goods * \
((j.income) / float(sum(Lista2))))
j.past_income = j.income
Lista3.append(j.goods)

for j in self.merchant_pool:
if j.Wholesaler==False and j.Spanish_Merchant==False and i.bankrupt==False:
pos=0
for i in self.merchant_pool:
if i.Wholesaler==True:
i.income+= (j.accounting_goods[pos]/  \
sum(j.accounting_goods) )*j.income
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j.income-= (j.accounting_goods[pos]/  \
sum(j.accounting_goods) )*j.income
pos+=1

for i in self.merchant_pool:
if i.Wholesaler==True:
i.profit = i.income -i.past_income
ProfitList1.append(i.profit)

global Quantity
Quantity = sum(Lista3)
Quantity_List.append(sum(Lista3))
Avg_Wholesaler_Profit_List.append(np.mean(ProfitList1))

#3rd, Minorist Merchants sell to the Population
Price_Before_Tax = 0
Sorted_Pop_Income = sorted(self.population_pool, key=lambda \
p: p.income, reverse=True)
if len(Sorted_Pop_Income) < Quantity: # Price base limit is 1
global Price
Price = 1
Price_list.append(Price)
else:
P = Sorted_Pop_Income[int(Quantity)-1]
global Price
Price_Before_Tax = P.income
Price = Price_Before_Tax * 1.05
Price_list.append(Price)

ProfitList2=[]
for i in self.merchant_pool:
if i.Wholesaler == False and i.Spanish_Merchant== False and \
i.bankrupt==False:
for j in self.population_pool:
if j.income >= Price:
while j.consumption == False and i.goods>=1:
i.income += Price_Before_Tax
j.income -= Price_Before_Tax
self.tax_revenue += Price - Price_Before_Tax
i.goods-= 1
j.consumption=True
i.profit = i.income - i.past_income
if i.bankrupt == False:
ProfitList2.append(i.profit)
Avg_Minorist_Profit_List.append(np.mean(ProfitList2))

Crown_Revenue_List.append(self.tax_revenue)
z= []
LL=[]
XL=[]
for i in self.merchant_pool:
if i.Spanish_Merchant == False and i.Wholesaler == True and \
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i.bankrupt == False:
XL.append(i)
i.accounting_goods=[]
if i.Spanish_Merchant == False and i.Wholesaler == False:
z.append(i)
if i.bankrupt == False:
LL.append(i)
Number_Minorists_List.append(len(LL))
Number_Wholesalers_List.append(len(XL))
Bounded_Revenue_List = Crown_Revenue_List[len(Crown_Revenue_List)-11: \
len(Crown_Revenue_List)-1]
Bounded_Revenue_list2= Crown_Revenue_List[len(Crown_Revenue_List)-11: \
len(Crown_Revenue_List)-2]
WW=0
if time >10:
XX = np.arange(0, len(Bounded_Revenue_List) )
YY = np.array(Bounded_Revenue_List)
zz = np.polyfit(XX,YY,1)
WW= float("{0}".format(*zz))
Coef_Var_A = np.std(Bounded_Revenue_List)/ \
abs(np.mean(Bounded_Revenue_List))
Coef_Var_B = np.std(Bounded_Revenue_list2)/ \
abs(np.mean(Bounded_Revenue_list2))

HIU=[]
for i in z:
HIU.append(i.Mkt_Powe**2)
Herf_Ind_Una= sum(HIU)
Her_Index.append(Herf_Ind_Una)

"""
Potential Use of Herfindahl Index - CURRENTLY NOT IN THE MODEL
if Herf_Ind_Una > .20:
if WW<0:
if Coef_Var_A > Coef_Var_B:
for i in z:
if i==max(z,key=lambda p: p.income):
i.Wholesaler = True
"""

if time % 5 ==0:
GG = (sum(i.income for i in z)/1.5)
if max(z,key=lambda p:p.income)> GG:
if WW<0:
if Coef_Var_A> Coef_Var_B:
for i in z:
if i==max(z,key=lambda p: p.income):
i.Wholesaler = True

if time>=30: #First Shock, 1760's
self.Trade_Risk = 1
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```
if time>=40: #Second Shock, 1780s onwards,
self.Trade_Risk = 2

def SaveReport2File(self,fileName):

fileObj=open(fileName, 'w')
lineList = []
lineList.append("Quantity; Price Crown_Revenue;Avg_Wholesaler_Profit;Avg_Minorist_Profit \
;Number_Wholesalers;Number_Minorists;\n")
numSteps = len(Quantity_List)
for i in range(numSteps):
oneLine = "%s;%0.2f;%0.2f;%0.2f;%0.2f;%0.2f;\n" %(Quantity_List[i],Price_list[i], \
Crown_Revenue_List[i],Avg_Wholesaler_Profit_List[i],Avg_Minorist_Profit_List[i], \
Number_Wholesalers_List[i], Number_Minorists_List[i])
lineList.append(oneLine)
fileObj.writelines(lineList)
fileObj.close()


class Sim(object):

def __init__(self):
self.acrown= Crown()
def Run(self):
global time
for i in range(50):
self.acrown.Step()
time += 1
self.acrown.SaveReport2File("SpanishEmpire.txt")

if __name__ == '__main__':
aSim = Sim()
aSim.Run()
```

Chapter 3: The Historical Legacy of (Pre?) Colonial Indigenous Settlements in Mexico

3.1 Introduction

On January first of 1994, the Zapatistas—a local pro-indigenous armed group—seized control of San Cristobal de las Casas, the third largest county in Mexico's state of Chiapas (its poorest and southernmost state). The uprising gained worldwide coverage as Mexico had just signed NAFTA and had conceded the need to privatize vast amount of locally held communal lands. The proposed reforms were an affront to indigenous communities across the country, whose traditions centered around communal property. The rebellion never went beyond the state of Chiapas, but its message resonated across the country. It led to a renewal of interest in the problems indigenous people face, and the impact these communities have had in shaping Mexico.

Mexico's troubled history with its indigenous communities has deep roots. When the Spaniards arrived, they found a complex geopolitical environment of alliances and enmities, which they exploited to topple the Aztecs. The conquest of Mesoamerica relied on courting allies as much as on violence. By the time of independence, the indigenous population still surpassed that of the non-indigenous. Mexico's national unification under liberal auspices set the tone for recent history, where the country was portrayed as being neither indigenous nor European, but both. The new national agenda meant that indigenous communities *de jure* became Mexican. Yet, their political jurisdictions and their local ways of governance remained the same. Mexico's current political problems reflect this past, and the endurance of local institutions.

In this chapter I examine the long-term impact of these indigenous institutions. At the time of Spanish arrival, the political economy of Mesoamerica centered around tribute flows

that united smaller and larger communities in a hierarchical tree-like network (Figure 3.1). Starting in the 18th century, the smaller localities, called *pueblos sujetos*, began to demand recognition as independent indigenous communities so they could become *pueblos cabeceras*, which would give them full autonomy. It is possible to observe a general trend of localized fragmentation within indigenous communities (that actually was intensified after Mexico's independence). Given that Mexican counties today were based, for the most part, in these indigenous communities (Garcia Martinez and Martinez Mendoza, 2012), it is possible to exploit the level of fragmentation to assess the institutional impact pueblos have had in Mexico. My hypothesis is that counties that today encompass more historical pueblos are more political cohesive because they inherited the institutional capacity of the historical pueblos and have better economic prospects. One large potential problem, however, is that of intermediate cofounders which may affect the legacy of these indigenous institutions through non-institutional channels: one of the large predictors of poverty in Mexico—and generally in the world—is being indigenous (Hall and Patrinos, 2012; Pereira and Soloaga, 2017), yet, there is a general consensus that the mechanisms, by which being indigenous correlates with poverty, is through racial discrimination (Arceo-Gomez and Campos-Vazquez, 2014; Flores and Telles, 2012; Trejo and Altamirano, 2016). The main working hypothesis is that, once we control for these other mechanisms, the institutional channel—political cohesiveness measured by the amount of historical counties that remained one single polity—would be positive.

I use data on the georeferenced position of local indigenous settlements (as they were in the 18th century), and their populations, to quantitatively asses the impact historical pueblos have had through their legacy of self-organization. After controlling for alternative transmission channels, I find that an increase of one standard deviation in the number of historical pueblos encompassed in a modern county (roughly 2.5 pueblos) is correlated with a $360-440 increase in 2010 per capita income. This is a sizable figure, given that Mexico's GDP per capita in 2010 was $7,966—the impact of a SD increase in pueblos is about 4.5-5.5% of this. The results are robust to alternative and broader dependent variables,

such as the Human Development Index, a Marginalization Index and the density of night-time light. Additionally, I found that pueblo resiliency is also positively correlated with larger inequality (measured through Gini Index at local level). Importantly, the impact of pueblos is highly conditional on them being in places where pre-hispanic legacy is expected to be larger (areas in central and southern Mexico, and in high altitude zones). Hence, a potential conclusion is that the effects are not the result of colonial institutions (originated from the resettlement of indigenous pueblos according to Spanish desires) nor of modern mechanisms, but arise out of the pervasiveness of pre-Columbian societal arrangements (indigenous towns became pueblos which latter became *municipios*). The analysis may of course be affected by several potential confounding factors, which I try to account for via the quantification of unobservable bias (Oster, 2017) and an IV strategy. The results are difficult to explain without attending the relevance of the indigenous communities and their institutional capacity throughout history.

The chapter builds on several points made in the large empirical literature about the long-run determinants of development. One important contribution I make is that of attempting to differentiate between two channels of transmission and path dependence: the institutional and the pure increasing returns to scale story. The institutional literature, points to the stickiness of political institutions (Acemoglu et al., 2001; Banerjee and Iyer, 2005; Easterly and Levine, 2003; Sokoloff and Engerman, 2000) that where adopted long time ago, for very particular reasons, and that can still shape economic and political outcomes today.[1] The pure economies of agglomeration story, exemplified through seminal papers by Davis and Weinstein (2002), Bleakley and Lin (2012), Michaels Guy and Rauch Ferdinand (2016), Kocornik-Mina et al. (2016), and Deryugina et al. (2018) show that inertia can have a simpler explanation due to pure lock-in effects (Arthur et al., 1987): densely populated areas will create economies of scale that are then self-reinforcing.

The empirical strategy I employ to identify the impact of Mexico's indigenous past uses

[1] For instance, levels of broad political participation and respect of individual property rights. See (Boettke et al., 2008) for a discussion of institutional stickiness in political economy.

two distinct measures that can illustrate the importance of these two channels: 1) I use the number of historical indigenous pueblos within a given modern county as a proxy for their level of complexity and endurance. The rationale is that clusters of pueblos were linked hierarchically since pre-hispanic times (see Figure 3.1). The historical literature emphasizes that through time, a fragmentation process ensued (the indigenous pueblo clusters broke up, and out of one cohesive group, two distinct emerged). Current counties were mostly formed out of the pueblos (Garcia Martinez, 2005; Garcia Martinez and Martinez Mendoza, 2012). Therefore, the number of pueblos is a potentially reliable measure of the resilience of institutions. 2) I use information on the population these pueblos had in the 18th century. It provides an obvious measure about the importance of persistence due to agglomeration effects (See Maloney and Caicedo, 2015). I exploit historical circumstances in the regional development in Mexico to asses the importance of the two channels. I show that population density in 1800 still predicts higher income in counties today, (but more so in the south and middle Mexico). The relation is robust across a lot of specifications, corroborating the notion that agglomeration mechanisms would affect independently of other factors (such as geography, culture, or institutions). The number of pueblos affects positively income across Mexican counties today, as well, but its relevance is highly dependent on them being located on historical Mesoamerica and on high altitude; places that favor the stickiness of local forms of organization.[2]

My analysis contributes to the literature that studies the developmental paths of nations across time. Acemoglu et al. (2002) famously identified a reversal of fortune within former colonies: places that used to be rich are now poor. Maloney and Caicedo (2015) showed that while cross-country analysis may favor such hypothesis, if we look specifically into countries, we can find that fortunes do carry on: places that were rich in the past are still rich. I show that within Mexico, a North-South divide process ensued (a kind of subnational reversal of fortune where the North, which was poor in the past, became rich). Yet, if we

[2]Pueblos in traditional middle Mexico had a long historical tradition of complex self-organization, while colonial pueblos in Northern Mexico were mainly created *ad hoc* by the Spaniards; pueblos in higher altitude areas were more isolated and their ways could endure far easily.

look into Central and Southern Mexico alone, persistence is strong (places rich in the past are still rich today).

The chapter builds on the large empirical literature that assesses the impact of colonial institutions in America. Dell (2010) shows how the extractive colonial Mita system within Peru, where locals were forced to work in mines, predicts worse economic indicators today; Garcia Jimeno (2005) concludes that Colombia's regional development is highly correlated with the presence of colonial institutions like the *encomienda* (which forced indigenous Americans to either work/pay tribute to determined individual Spaniards), colonial state capacity and the levels of slavery; Guardado (2017) shows how the colonial practice of office-selling led to the establishment of an extractive bureaucracy that perpetuated through time and still affects negatively Peru; Waldinger (2017) and Caicedo (2019) show, for Mexico and Paraguay respectively, how the presence of mendicant orders (like the jesuits) in the colonial period, predict better economic outcomes today (by incentivizing the attainment of larger human capital at the time).

Finally, this chapter builds on a small but growing literature, which emphasize the importance of pre-colonial institutions as determinants of colonial/modern institutions, and of political and economic outcomes today. For a global cross-sectional study: Bentzen et al. (2017) conclude that democracy levels across current countries are a reflection of their indigenous democratic practices, but only when indigenous communities where strong enough (as to survive exogenous shocks like colonization.). For the African case: Gennaioli and Rainer (2007) and Michalopoulos and Papaioannou (2013) show that larger and more centralized pre-colonial ethnic communities are correlated with African regions that are more developed today. For the American case in a national and macro-regional perspective: Arias and Girod (2014) suggest that colonial institutions where themselves the result of the interplay between geography and pre-hispanic institutions.[3] Angeles and Elizalde (2017) estimate the level of complexity of pre-Columbian indigenous communities and assess that

[3]They show African slavery was only important in places where two conditions applied: no complex indigenous settlement had existed before and no relevant natural resources were present.

it is correlated with regional development in Latin America today. Juif and Baten (2013) compare the human capital levels of Incas and Spanish at the time of the conquest of Peru, concluding that it was much lower for the former and suggesting it as the root cause of underdevelopment in the Andes; Finally, there is only one study I am aware of that focuses on pre-colonial persistence at a granular subnational level: Diaz-Cayeros and Jha (2018) show how indigenous communities, in Mexico's state of Oaxaca, that historically produced Cochineal—a highly sought red dye in colonial period—are currently more developed but also more unequal.

3.2 Colonial Pueblos

Mexico's political division reflects the complex historical process it experienced. States' borders are almost in its entirety inherited from the country's colonial subdivisions. At least as they were in the late 18th century when Spanish imperial reforms introduced a top-down reform, the *intendente* system, that tried to centralize the power of the King's bureaucracy in detriment of the local elites (O'Gorman, 1937). Mexico's counties, however, arose out of a more organic process of bottom-up fragmentation that goes back to precolumbian times. Mexico's indigenous communities were conquered, but their local ways persisted (Garcia Martinez and Martinez Mendoza, 2012). An important preamble for the following discussion is to stress that the argument I make hinges on the way these settlements evolved, and not on its specific demographics. In the almost 500 years that have passed since the Spanish conquest, pueblos became less indigenous, migration did occur and intermarriages did happen: pueblo's *caciques* and inhabitants became mestizos. Yet, the structures by which people governed the given territories were kept.

3.2.1 Pre-Hispanic Origins

The political map of Mesoamerica at the time of arrival of the Spaniards is complicated: Aztecs dominated, but they were one of several ethnicities distributed among hundreds of settlements. These communities were so different between each other, as the Spaniards

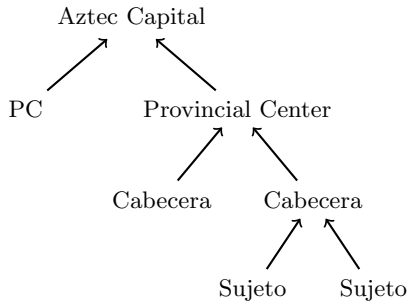


Figure 3.1: Hierarchical Tribute Flow Between Polities in the Aztec Empire

were compared to them.[4] Enmities were common: war, conquest, tribute, and violence were expected. The Aztec empire relied on a loose network of conquered, but self-governed, polities to sustain itself (Hassig, 1985). Figure 3.1 shows how the system was organized: At the bottom of the pyramid were the *Sujetos*: polities that paid tribute to larger communities called *Cabeceras*, which themselves paid tribute to Aztec provincial centers, who also paid tribute to Tenochtitlan (the Aztec capital).

When Spanish Conqueror Hernan Cortés arrived in what was to be Mexico, he took advantage of these political divisions; the conquest of the Aztecs would have been impossible without the help of other Mesoamerican societies. After Tenochtitlan's conquest was achieved, the alliances forged to uptake the Aztecs served as the foundations of the new political organization—of what became the Viceroyalty of New Spain. As such, Cortes' greatest achievement was not the conquest, but the building of a new stable state.[5] The Spanish substituted the Aztecs at the top of the political hierarchy in Mesoamerica, yet the main divisions among the local communities (and the enmities between them) remained. Mexico City supplanted Tenochtitlan, and newly formed Spanish cities became the new provincial centers. But the preexisting pre-hispanic hierarchical structures were maintained: the vertical relationships between *cabeceras* and *sujetos* persisted. In order to maintain control

[4]Today there are 65 native American languages being spoken in Mexico, which makes Mexico the most linguistically diverse country in the Americas, in terms of Native American languages.

[5]Compare it with the Conquest of Peru where the fall of the Inca Empire was followed by a civil war fought between the distinct factions of the Spanish conquerors and their respective indigenous allies.

and continue the expansion process,[6] Spaniards combined the threats of violence (just as the Aztecs had before them) with subtler mechanisms in the form of soft power: e.g. Local indigenous elites were granted noble titles, and relative autonomy over their own territories was given (Kellogg, 1995; Lockhart, 1992; Rojas, 2010).[7]

The foundation of the Spanish state in the Americas relied on a grand subdivision between what was known as the *Republic of Spaniards* and the *Republic of Indians*. The former included the newly formed Spanish territories and cities within the Americas, while the latter encompassed the preserved territories of the original native American communities. The Crown delegated important levels of autonomy to both but gave them distinctive duties and rights.[8] The notion of a *Republic of Indians*—in contrast to that of Spaniards—refers to the collection of *pueblos* that were juridically different from the rest of the Empire, but in which each one of them enjoyed autonomy with respect to Spaniards and other indigenous communities as well. Overall, however, we can find a pattern in the way pueblos were nominally organized: they relied on local elites (*caciques*) for practical governmental purposes (say a council of elders, or an autocratic royal family) and had collectivist leanings in their economic organization, where communal property of land was the norm (each community member was allotted some land in concession only, for him to live and to procure their living).

Republics of Indians were initially constituted by respecting most of the pre-hispanic

[6]The Spanish expanded throughout the 16th century from central Mexico to territories that are now in Central America and Southern United States.

[7]The most striking example of how the Spanish ruled is Tlaxcala, a territory whose population supported the war against the Aztecs the most. It was given special privileges that consolidated the local elite's sovereignty more than any other indigenous group. Tlaxcala's legacy is evident even today, as its political jurisdiction transcended like no other: Tlaxcala's borders were kept intact and survived Mexico's independence as it became one of its 31 states (Portillo Valdez, 2015). The same power-play mechanisms can be seen all across Mexico, but at a lesser scale than in Tlaxcala, where Spaniards bargained their position through concessions with Indigenous populations. (Dehouve, 1990; Farriss, 1984; Horn, 1997; Lopez Sarrelangue, 1965; Martinez Baracs, 2005).

[8]For example, in terms of the judiciary system, if a crime was committed by an Indian, he could not have been processed by a Spanish court but had to be judged by its own community. Economically, there were important differences as well, as both jurisdictions were expected to pay a different set of taxes. A significant economic contrast is that Spaniard's taxes were assessed individually, while Indian's contributions were collectively determined. Spain's most important income source was the *alcabala*, an indirect tax on sales, who was exclusively paid by inhabitants of the Republic of Spaniards. Indian's largest contribution was in the form of a tribute, who was assessed in communal terms, and whose recollection was organized by the pueblo.

borders as they were before the conquest.[9] The historical debate centers on how many of these settlements were actually preserved through time, how many were destroyed and how many were "artificially" created afterwards. The literature dwells on three arguments:

a) The Spanish expansion towards places located far away from Central Mexico implied the conquest of more nomadic societies who, unlike those of Mesoamerica, lacked the historical legacy of political organization that their Mesoamerican counterparts had (Cramaussel, 2000).[10] Hence, the colonial pueblos we see in those parts, were most likely established in an *ad hoc* manner by the Spaniards to facilitate the payment of tribute in an organized manner.

b) The epidemics of the late 16th century decimated the indigenous population. There is a debate around how much persons died, based on the lack of information over how many people had lived in pre-hispanic times. A conservative figure posits that Mesoamerican indigenous population went from 8 million people in the 15th century to less than three million in the 18th century (Sanchez-Albornoz, 2014). The demographic shock fractured many original pueblos. The Spanish response was to congregate these into new ones. As such, many Indians were artificially gathered into places they were not originally related to. The extent of this process is unknown and subject to tremendous debate. Fernandez Christlieb and Urquijo Torres (2006) provide a lead by suggesting geographical patterns that could help distinguish the nature of the pueblos: original native settlers preferred their settlements to be located on hills because it gave easy access to water from rain, cover from wind, and an ideal location to observe celestial bodies to plan for harvests. Spaniard administrators preferred settlements to be located on valleys because of their plane surface that favored a European urban layout.

[9] *Altepetl* is the Nahua name given to these polities, but we can find direct translations in other indigenous languages such as Mayan *Cah* and Mixtec *Ñuu*.

[10] For example, the *Chichimeca War* on the late 16th century, was a conflict that faced the Spanish and its allies against the indigenous population that currently conform the *Bajío* region in central-north Mexico. The name *Chichimeca* was the derogatory term used by Aztecs (and Nahua Mesoamericans) to denote the inhabitants of these regions, and the direct English translation is "barbarians" (because they lacked the organizational self-capacity that southerner societies had).

c) Beginning the 18th century, a process of fragmentation ensued among the indigenous governance structures; a continuous wave of secession of pueblos (*sujetos*) from their *cabeceras*. The demands for separation were based on the unjust treatment by the head-towns' elites whom the *sujetos* owed tribute payment, and on the increasing costs of bureaucracy (Dehouve, 1984). Perhaps more important were the disputes over land distribution, as some pueblos actually lacked land and were permanent lessees from their *cabeceras*. Being recognized by the Spanish Crown as an independent entity implied *de facto* land redistribution to them (Ouweneel, 1995). The Spanish were receptive to fragmentation because, by the 1700s, they were attempting a governance restructure of their own (known as Bourbon reforms). The Crown attempted to centralize its power and backed policies that diminished the power of local elites (Cuello, 1988).

These three factors help formulate my empirical strategy (seen in section five through seven) for studying the economic impact indigenous settlements may have had on Mexico's developmental trajectory. The first two assertions define the conditions by which institutional continuity (from pre-hispanic to colonial times) was present: 1) Pueblos in frontier territories were more likely to be a Spanish colonial invention, and hence lack the institutional tradition of pueblos in the rest of Mexico; 2) Pueblos in remote high altitude zones likely remained more autonomous with respect to Spanish intervention, and hence their institutional heritage survived the most. The third assertion gives us the specific mechanism from which we can assert institutional impact: a large fragmentation as a result of large costs of cooperation and a breakup of institutional capacity.

3.2.2 Pueblo's Configuration into *Municipios*

The transformation from colonial pueblos to Mexican *municipios* (Mexico's counties) is less contested than that of pre-hispanic *señorios* to colonial pueblos. The explanation centers on the same path dependency process where, after gaining independence, the newly created Mexican government had to recognize the preexisting political and administrative figures.

Just as Spanish conquerors did not build their Empire out of nothing, Mexican independentists had to rely on the divisions that preceded them as well. In fact, the most relevant structural changes these communities suffered, occurred before the Independence was consumed. As expressed above, pueblo fragmentation was a phenomenon that started in the late 18th century. In the early 19th century, the Spanish abolished the Indigenous/Spanish distinction and recognized both as belonging to a "Spanish Nation." Politically, this meant that pueblos—along with Spanish towns—were reorganized into *Ayuntamientos*, which became the basis of the Mexican counties (Annino, 2002; Ortiz Escamilla and Serrano Ortega, 2007).

Mexico's independence was achieved in 1821, but the immediate effects it brought were negative: it eroded the state's capacity to govern over the whole territory.[11] In tandem with the political instability, and perhaps as a response to it, Mexico's political leaders embarked in a rhetorical campaign to unify the country into a nation—to provide a justification for its existence. In order to do so, indigenous populations would have to surrender their local identities and become Mexican (Gomez Izquierdo and Sanchez Dias de Rivera, 2011). Mexico's demographic shift (from being mostly indigenous to becoming mestizo) started in the 19th century. The changes meant that the old indigenous pueblos shifted too, from being identified as indigenous to being defined as Mexican and mestizo. The organizational structure of the pueblos and its legacy, however, was maintained (Garcia Martinez and Martinez Mendoza, 2012).

It was not until the dictatorship of Porfirio Diaz (1871–1911) that the federal government regained the level of control it lost after the independence. Within Porfirio's government, municipios/ayuntamientos disappeared as independent political jurisdictions in favor of more aggregated and centralized jurisdictions (called districts, cantons or *Departamentos* depending on the State). Yet, local forms of organization remained important as the Mexican Revolution (1910–1920) showed. Quintana Roldan (2010) argues that one of the

[11] A processes of fragmentation occurred at all levels. The provinces of Texas and Yucatan seceded in 1835 and 1841 respectively (Yucatan reincorporated to Mexico in 1848). Local *caciques* emerged across all the country.

prime causes of the revolution was the discontent of *Ayuntamientos* and its people with their centrally-appointed leaders.[12]

The problems of the Zapatista uprising in 1994 (173 years after the *de facto* independence) are not a mere manifestation of Mexico's indigenous problems, but more broadly, can be defined as reverberations of historical disputes on governance at local levels. The Mexican government has, more or less, succeeded at the task of unifying the country, but only because of the compromises it had to make: leaving ample autonomy to local jurisdictions. Out of the 2,460 current municipalities that conform Mexico today, 1,814 have a historical heritage linked with indigenous settlements. That is, 73.7% of current Mexican municipalities had a past where at least one pueblo existed before becoming a county. The goal in the following sections is to provide a theoretical framework that explains how did these communities survived, why did they fragment, and how this fragmentation can be thought as a proxy for institutional resiliency (or lack of).

3.3 Pueblo Survival and Fragmentation

The process of creation of the Spanish state in the Americas (and the Aztec empire before that) can be understood as a particular case of a general model of the size of nations (for details see Alesina and Spolaore, 1997; Casella and Feinstein, 2002), in which the size of a polity depends on the equilibrium between two forces: a) a centripetal one which incorporates the benefits of having economies of scale in the provision of public goods, and; b) a centrifugal force that involves the increasing marginal costs associated with population heterogeneity. Totalitarian and democratic states alike are bounded by the same pressures, even though they may face specific conditions and constraints. Historically, states ruled by elites have acted primarily based on attempting to maximize their rents rather than on optimizing global social welfare. As such, the main constraint these states face is centripetal,

[12]One common goal, almost all revolutionaries shared (southerners and northerners, aristocrats and bourgeoisie, farmers and workers), was on the importance of reconstituting the judicial figure of the *Municipio Libre* (free county) as the political basis of Mexico's territorial division.[13] In 1914, the then official Mexican President Venustiano Carranza enacted a decree that recognized each local entity had a right to govern itself independently of the provincial and federal governments (Carranza, 1914).

in the form of costs of potential rebellions that could fragment it.[14] One potential leeway these states have, in their quest to maximize rents while maintaining the size of its borders (which means minimizing costs of rebellion) is to opt for processes of decentralization; allowing locals to remain semi-autonomous. I argue this kind of model applies to pre and post hispanic Mesoamerica and can help explain how ethnic settlements survived, and maintained large levels of autonomy.

A basic model for the decentralization of polities as an alternative to secession is presented in Alesina and Spolaore (2005a, pp.144–152), Spolaore (2010) and Koyama et al. (2018). I present a simplification of their framework. The main constraint a non-democratic state faces is a δ parameter, which symbolizes the proportion of persons (as a percentage of the total amount of population) that the state must appease. It means, that even though it may not care about global welfare, it must care about maintaining a base level μ of welfare for a given portion of its population. The implication is that when δ is high enough, the non-democratic state would tend to act as if it cared about social welfare.[15] Yet, an alternative to reducing its size is available: If the consumption of public goods is the measure by which citizens keep together, allowing local provision of them may improve their utility limiting their incentives to secede. In this case, given that the state is analyzed as a rent maximizer, it would prefer to extend decentralization instead of reducing taxes (which, if decreased, would tend to increase the population's utility level at the cost of the state's rents). The problem is that providing a public good locally may cost more than doing centrally, and would tend to reduce the state's rents. The optimization process the state would follow in order to decide to either centralize or decentralize involves estimating the benefits of reducing the cost of rebellion δ constrained on the cost of provisioning a decentralized public good K.

The basic setup involves a Hotelling-like location model where people are distributed within a line that represents the preferences of the population; For example, a line that

[14] This statement predicts that non-democratic states would be larger than the optimal, given that they don't care about social welfare.

[15] And its size would approximate that of a democratic state as well

goes from zero to one, implies that the person that lives in point 0 has the most differences with the person that lives in the point 1. The distance can be interpreted geographically or ideologically.[16] The state locates itself on the line, enacting policies that favor the preference where it is located. Assume that a state can provide two public goods: say, defense against external encroaches, identified by α; and an administrative role providing local organization, defined as β. Assume good α is always provided centrally by a central state, but it must decide whether to provide public good β as well or create a sub-jurisdiction that provides the good in a local manner. A key aspect of the model is that it assumes that the costs of provisioning β in a decentralized manner will also be incurred by the central state. The following equation[17] expresses the inequality that needs to be satisfied for a state to decentralize:

$$\delta \geq \lambda + \frac{K_\beta}{\theta}$$

Here, λ represents the amount of persons that enjoy a utility high enough, that the decision being made by the state to decentralize or not is irrelevant to them. K_β is the median cost of provisioning public good β to each individual living in the model, and θ exemplifies the marginal cost that the median individual faces for being at a distance l from the provisioning of the public goods. The quotient of K_β and θ reflects on the costs of appeasing at a base level μ a given subset of the population.

The prediction is that, ceteris paribus, decentralization is more likely when: a) the amount of people that must be appeased δ is high; b) the amount of people that enjoys a sufficiently large utility as not to care about decentralization λ is low; c) the heterogeneity costs θ are high; d) the cost of provisioning β public good K_β is low.

Applying this simple framework to the Mesoamerican context can shed light on why small ethnic settlements remained semi autonomous for long time, and why (even in the face of *de jure* actions against them) they remain an important aspect of the local political

[16] Imagine a North/South difference or a political left/right distinction.
[17] An extended version of the model that clarifies the process is in Alesina and Spolaore (2005a).

life within Mexico (being determinants of the foundation of current counties). First of all, the diverse cultural landscape of Mesoamerica (where a plethora of languages and cultures coexist) means that heterogeneity costs were high for any potential conqueror. Second, Mesoamerican indigenous cultures are very collectivist, and when conquered, the appeasement of their local elites is itself constrained on the respect of their own collectivist ways of organization;[18] λ can be assessed as being typically low. Third, and related to the second point, the conflicting nature of political arrangements in Mesoamerica meant that the amount of population that must have been appeased was high nonetheless (δ was high).[19] Fourth, the Aztec and Spanish strength relied on the provision of only one large public good α, defense and security, but nothing else. Neither government financed directly the construction of roads, temples, hospitals but relied on third parties to do so. It implies the cost of providing K_β was almost null for them. All these characteristics help explain why both Aztecs and Spaniards built their own states in a decentralized manner: they needed it so in order to maintain control while maximizing rents.[20]

A second-related inquiry that arises out of investigating how local indigenous populations achieved a level of autonomy in their self-governance, is why did they fragment? Why did the ancient ties that united the pueblo *cabeceras* with their smaller subjects weakened with the pass of time. The process can be captured better by assuming the Spanish away and focusing on the relationships between pueblos. The process can be interpreted as being a special case of the general model of the size of nations. In that regard, the explanation becomes simple: fragmentation ensues when the marginal costs of heterogeneous preferences of the inhabitants become larger than the benefits associated with the economies of scale of being united. In as much as the Spanish pacified the territory and provided security against other indigenous pueblos (we assumed the Spaniards did provide public good α, which relates to defense and security), they diminished the costs of separation and so fragmentation was the

[18]The legitimacy of local elites depended on the respect of their traditions.

[19]Within the model is possible to diminish δ by investing in a second good that tries to create homogeneity in the population. The Spanish heavy emphasis on religious union through evangelization can be seen as an investment of that sort.

[20]Hassig (1985) describes the Aztec political economy as being "hegemonic", where "Seizure and exclusive control of territory was not an Aztec goal; tapping into economic local productivity was" (p.100).

likelier result.

Unlike the Spanish, who were at the top of the pyramid, pueblos *cabecera* could not overly rely on the mechanisms above-mentioned. Decentralization was not an option to them because they lacked bargaining power: Spanish advantage was derived from their monopolistic provision of a basic service: security and defense. Pueblos *cabecera* couldn't offer what the Spanish already provided. The only initial advantage a *cabecera* pueblo enjoyed over a *sujeto* was that of being a political intermediary. Through time, as it is expected, that function became less important. Hence, the expected outcome is that the number of pueblos tended to increase up to the point where the heterogeneity costs were low enough. Pueblos that were able to overcome such costs avoided total fragmentation, while those that couldn't, ended up forming several small entities. The empirical strategy I follow in the following sections derives from this important assessment. Pueblos that kept tied between each other, imply *ipso facto* they solved the cooperative problem by overcoming heterogeneity.[21] A proxy for this measure of "institutional complexity" is the amount of pueblos that are encompassed within a county today.

3.4 Data

The main explanatory variable comes from Tanck de Estrada (2005), who compiled and georeferenced the location of pueblos (*sujetos* and *caberceras* alike)[22] in the 18th century across all territory that would become Mexico.[23] In total 4,469 colonial indigenous pueblos are identified. 3,190 of them (71%) have additional information regarding the amount of population living in them. The location of Spanish cities in the 18th century comes from two sources that capture different settings: First, Abad and Zanden (2016) identify the Spanish localities that had more than 5,000 inhabitants at the time; Second, Rojas (2016) distinguishes the towns that, indistinctly of the amount of population they had, were

[21] I am not proposing a specific mechanism by which pueblos solved collective action problems. There are tons of micro-histories of pueblos that all tell different stories depending on the context. What matters, for the purpose of the chapter, is that they solved the problem.

[22] Unfortunately is difficult to asses the status of each pueblo, as their status changed through time.

[23] She also collected data on the pueblos in the current Mexican state of Chiapas, which in colonial times was a region that belonged to the General Captaincy of Guatemala.

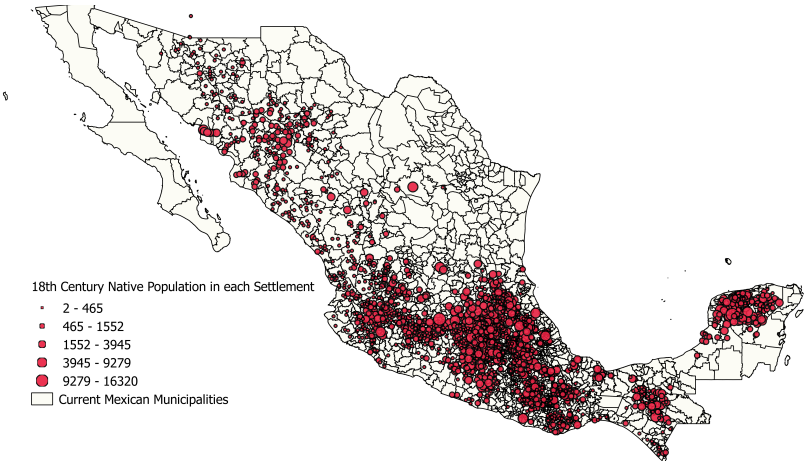


Figure 3.2: Location of 18th Century Pueblos

officially recognized by the Spanish Crown as cities. The distinction is relevant because the former captures real urbanized locations, and the latter identifies a more politically oriented vision of the places that were relevant for the spatial organization of the territory. There is a small overlap between the cities and indigenous pueblo dataset as some pueblos were considered cities as well. Either because they had large populations and/or because they enjoyed more privileges that made them politically distinct from other smaller pueblos. Given that I am interested in contrasting Spanish and Indigenous, I only consider the Spanish inhabited localities as cities. After editing, the city dataset I use consists of 20 locations for the Abad and Van Zanden data (henceforth City AvZ) and 22 locations for the Rojas one (City R). The population data for the cities was gathered from Buringh (2013). The main explanatory variable I use is constructed by assessing the number of historical pueblos and cities encompassed within a modern county. The geographical boundaries of Mexican counties today are taken from INEGI (*Insituto Nacional de Estadśtica y Geografía*) and reflect the country as it was divided in 2010.

Figure 3.2 shows the location of pueblos across Mexico. There are several regional clusters. Most of the pueblos are located in central Mexico, in the area known as Mesoamerica.

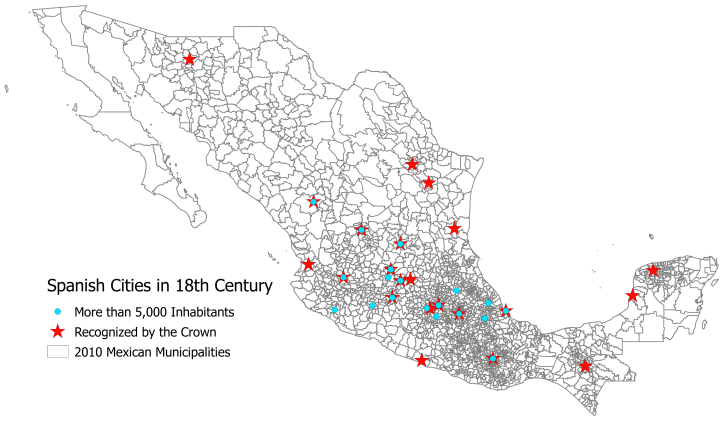


Figure 3.3: Location of 18th Century Spanish Cities

There are also large pockets in the south (Mixtec/Zapotec areas), in the Yucatan peninsula (Mayan territory), in the west (around current Guadalajara city, where the Chichimeca tribes were located), and in the northwestern part (current state of Sonora, where the Yaquis lived). Figure 3.3 shows the city locations from the two sources above described. Although both data sates mostly overlap, the difference between them is evident: true urbanized cities are centered around middle Mexico, while officially recognized cities spread all across the territory; it signals the political attempts in trying to incentivize the settlement of border and frontier zones.

Income and inequality data at the county level for the year 2010 are gathered from SNIM (*Sistema Nacional de Información Municipal*). The HDI (*Human Development Index*) is taken from Oficina de Investigacin en Desarrollo Humano del PNUD (2014). The marginalization indicator is an index constructed by CONEVAL (*Comisión Nacional de la Política de Desarrollo Social*)[24] which measures non-income development levels (access to education, health, basic services, and housing) by county within Mexico. Income is estimated in 2005 PPP Dollars, and inequality is measured through county-level Gini Index. The HDI is a composite index of income, schooling and health indicators. For night-time

[24] An independent government agency that measures poverty levels across Mexico in order to asses the impact of public policies.

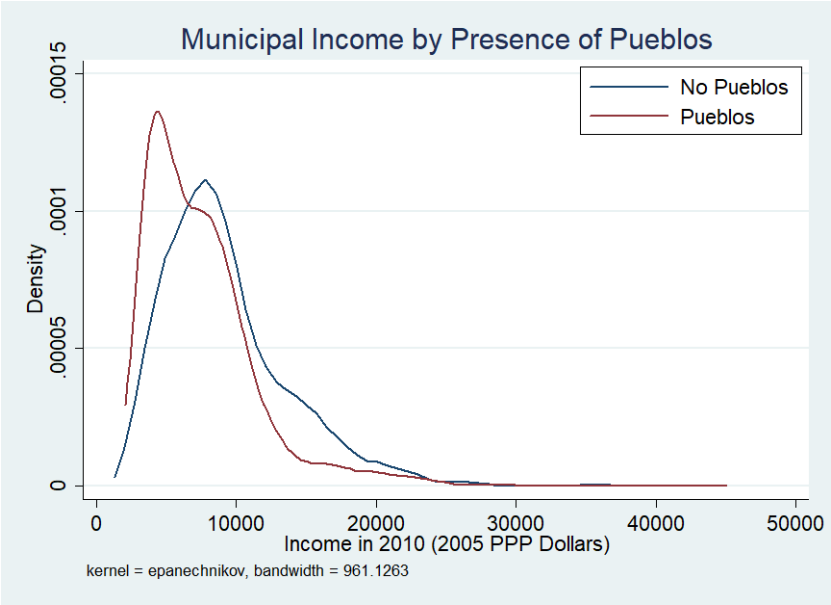
light, I use NOOA's database (National Oceanic and Atmospheric Administration) and construct an unweighted average of night luminosity from 1993 to 2013 for all Mexico. The original data reports values from 0 to 63, where 0 is total darkness and 63 corresponds to the brightest area. The unit of analysis is presented at a resolution of 30 arcsec (0.00833°), which corresponds to nearly 1 km at the equator. I calculate the luminosity at a county level (the sum of night-light values in a given county) and then I divide it by the county's population density (population per km) to create a variable that assesses the light intensity per county adjusted by population and area. Figures in the appendix show the map distribution of these data. Geographic (altitude, latitude and terrain roughness[25]), demographic (total and indigenous populations) and urban controls (rural dummy for counties where more than 50% of population live in localities that have less than 2,500 inhabitants) are taken (or constructed based on)from SNIM and INEGI as well. A statistical summary of all the variables used is presented in the appendix.

3.5 Empirical Strategy

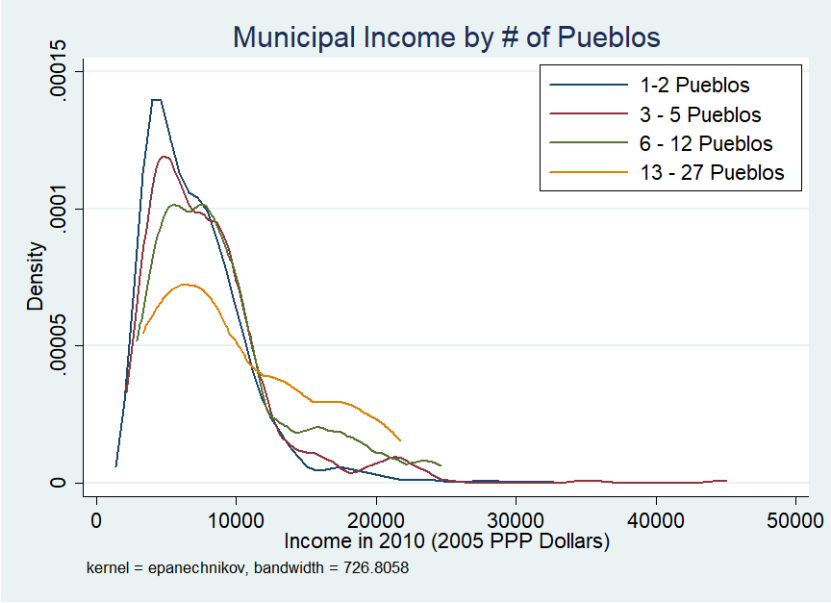
The goal of the chapter is to identify the long-term impact indigenous pueblos have had in Mexico's economic well-being. A first approximation is to compare the income of counties conditioning on the presence of pueblos. Figures 3.4a and 3.4b serve as the first way to asses the relationships. Figure 3.4a plots the income distribution of Mexican counties in 2010 that had a pueblo past and those that didn't; Figure 3.4b plots the current income distribution according to the number of historical pueblos encompassed in a given county, conditional on having at least one pueblo.

The comparison shown in Figure 3.4a reflects the layman understanding that having an indigenous heritage is associated with negative economic results today. Yet, when we look into Figure 3.4b, the increase in the number of historical pueblos per county is correlated

[25]I estimate ruggedness as the standard deviation of the altitude of the urban blocks within a county. Urban blocks are reported within INEGI data.



(a) Presence of Pueblos



(b) Number of Pueblos

Figure 3.4: Income Distribution in Counties According to Number of Historical Pueblos

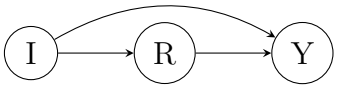


Figure 3.5: Identification from Past Settlements (I) to Current Outcomes(Y), direct and through mediators (R)

with a rightward shift in the income distribution (see Table 3.12 in the appendix for details). The existence of a pueblo is negatively correlated with economic opportunities, yet encompassing an increasing amount of them is associated with better economic outcomes. How can this potential contradiction be explained? Is having a pueblo bad for development? Or , conditional on having a pueblo past, having more pueblos is associated with better outcomes? In order to solve the dilemma, I need to stress the positive correlation that exists in current counties between having a pueblo past and having a large amount of population that classifies as indigenous (see Table 3.13). The correlation is important, because there is an extensive literature that emphasizes how Mexico's most underdeveloped areas are also correlated with being categorized as indigenous. (Hall and Patrinos, 2012; Pereira and Soloaga, 2017). The causal mechanisms responsible for that latter correlation, however, points towards modern transmission channels that are found in Mexico's current practices of racism and classism (Arceo-Gomez and Campos-Vazquez, 2014; Flores and Telles, 2012; Trejo and Altamirano, 2016). The dis-aggregation of the pueblo past by the number of pueblos that are encompassed in a given county improves the identification strategy by exploiting the heterogeneity in its distribution—which helps identifying the institutional heritage rather than alternative mechanisms.

Figure 3.5 details the potential causal relations between past indigenous settlements (I) and current economic outcomes (Y). The mechanism I am interested is the institutional legacy of organization left by pre-hispanic communities. Yet, there are different channels that obfuscate the vanilla comparison between counties with historical pueblos (which is seen in Figure 3.4a). There are several mediators (M) that are unrelated to the organizational past and operate through modern mechanisms. The most important one being the process

of structural racism that can be attested in Mexico's society today. Yet, there are other several potential mechanisms that may be at work (see Esquivel, 2000; Moreno-Estrada et al., 2014). The arguments I made in the preceding sections emphasize the narrative of a positive institutional legacy that is more salient in counties which were formed out of many pueblos. An assessment that a simple pueblo/no pueblo comparison cannot entirely capture.

The empirical strategy I follow then, exploits the variation between the amount of pueblos a county has had, to assess per capita income of the county today (as seen in Figure 3.4b). The premise being modern counties encompassing more historical pueblos were better able to solve collective action problems (hence they continue to be tied into a unified political jurisdiction today), either because they inherited a greater tradition of local self-organization[26] and/or because they were able to solve ethnic rivalries and cooperate in subsequent periods of time. Alternatively, I also use population data in the 18th century to test for an alternate transmission channel: pure economies of agglomeration, through increasing returns, could create a path dependence process by which larger towns in the past can explain (without the need of institutional mechanisms) better economic outcomes in the present. I use Spanish city data as a baseline standard to which the relevance of indigenous settlements can be compared. Although one can dispute the impact of small historical pueblos in Mexico today, the influence of colonial cities is undoubtedly relevant: Most of the largest and most important Mexican cities today, were also the largest and most important cities in 18th Century New Spain. The process and channels that made these cities relevant are complex and beyond the prospect of this study, yet the presence of a city variables serves as a comparative benchmark of the relevance of pueblos.

A first scenario to be tested follows the vanilla comparison shown in Figure 3.4a. It focuses on the potential impact of the mere presence of a pueblo within a county. The

[26] A direct nexus between being a precolonial *altepetl* that became an autonomous pueblo in colonial times, and then constituted a county after Mexico's independence.

baseline OLS regression is the following:

$$Y_i = \alpha + \beta_0 Pueblo_i + \beta_1 PuebDensity_i + \beta_2 CityD_i + \beta_3 CityDensity_i + \mathbf{X}_i'\chi + e_i \quad (3.1)$$

Where Y_i is the outcome variable in county i (income in 2010 in PPP dollars, the Human Development Index, the Marginalization Index or Gini Index), *PuebloD* is a dummy variable that takes value 0 when a county does not encompass any historical pueblo, and 1 when it does, *PuebDensity* is the indigenous density relative to the modern municipal jurisdiction (total amount of population living in pueblos in the 18th century divided by the county area where they would be located today), *CityD* is the presence of an 18th century city in a given county today, *CityDensity* follows the same idea as the pueblo density but for the population living in the 18t century Spanish cities, $\mathbf{X}$ is a vector of control variables, and e is the error term.

The second and most relevant scenario follows Figure 3.4b. It incorporates our main empirical strategy. It has the same specifications as the baseline scenario, but it substitutes the pueblo dummy for the actual number of pueblos that are encompassed in a given county. It also adds an interaction term between the number of pueblos and the pueblo density; the idea being that the potential relevance of a pueblo may be dependent on the population that the pueblo had in the past.

$$\begin{aligned} Y_i = \alpha &+ \beta_0 \#Pueblos_i + \beta_1 PuebDensity_i \\ &+ \beta_2 CityD_i + \beta_3 CityDensity_i \\ &+ \beta_4 (\#Pueblos \,\mathrm{x}\, PuebDensity) + \mathbf{X}_i'\chi + e_i \end{aligned} \quad (3.2)$$

The OLS specification leaves ample room for endogeneity problems due to potential correlations between the main explanatory variables and the error term. As mentioned in the preceeding paragraphs there are several mechanisms at hand that may bias the results—because different channels may be operating. A first problem that could bias the results is the omission of variables that, while being correlated with a pueblo, have an impact today, but only through modern channels. It is well-established, in the empirical literature, that

being indigenous and living in rural areas are among the two main predictors of poverty within Mexico today(Arceo-Gomez and Campos-Vazquez, 2014; Pereira and Soloaga, 2017). It is the case—as it is to be expected—that the location of 18th century indigenous pueblos is correlated with municipalities that are predominately indigenous today (see Table 3.13 in the appendix). The literature also maintains that current discrimination and geographic isolation are the two main explanations of why this is so (Esquivel, 2000). Controlling for them will show a more correct identification of the past-to-present channels.[27]

The geographical problem may be the most important as the original establishment of pueblos was not random, it was self-selected. The coefficients of the pueblo variable can be confounding the relevance of the pueblo with other non-observed variables. The historical literature can help minimize the problem by selecting the main potential confounders: It is known that the first colonial pueblos were conformed out of the preexisting pre-hispanic polities, *altepetls* in Nahua language; it is also known that after the late 16th century epidemics, the indigenous population was heavily decimated and the pueblo system was exogenously reconfigured by the Spaniards. What are the main potential variables that could explain the original place of settlement and its posterior reconfiguration? Geographical variables. Controlling for these factors is therefore important. I include three relevant geographical controls: the average latitude, altitude and terrain ruggedness of the county that encompass the pueblos. The ruggedness is constructed as the standard deviation of the altitude of the several localities—as defined by Mexico's statistical agency—that compose a given county in Mexico. Altitude and terrain ruggedness control for the fact that most Mesoamerican towns were settled in hills and not valleys (Fernandez Christlieb and Urquijo Torres, 2006).

A third set of controls is added to account for localized effects. The Mexican census of 1990 gathered data on the number of speakers of a given native American language by county within Mexico (shown in Table 3.14 in the Appendix). I use the percentage of speakers of these languages per county, to control for the potential heterogeneous variations that could be derived (which could come from alternative channels of transmission such as

[27]I'm working on improving the analysis by using Acharya et al. (2016); VanderWeele (2011) methodologies.

cultural or genetic variations between the indigenous populations that live in Mexico).

Adding particular controls doesn't entirely solve all the aforementioned problems. It always leaves open the possibility of omitted variable problems. To provide robustness to my results I apply Altonji et al. (2005) and Oster (2017)'s framework to asses how large an unobservable would have to be, compared to the base observables, to nullify the main effects I get from my main dependent variables. Alternatively, I employ an IV strategy. A 100% valid instrument is particularly difficult to find in this case. Most of the historical studies use geographical factors as the exogenous instruments, yet I cannot: geography is potentially endogenous to the location of a pueblo. Moreover, the main model has at least two potential endogenous variables (the pueblos and the population of those pueblos), which would require more than one suitable instrument to avoid underidentification. I concentrate my efforts to study just the amount of pueblos (dropping the other variable) and propose one instrument that could potentially be valid and non-weak: the number of neighboring counties a given county has today.

Colonial pueblos became the basis for modern Mexican municipalities. Pueblo fragmentation throughout the centuries affected the size of the counties. In a macro perspective, fragmentation at the national level also modified the amount of neighbors a given county would have: A correlation between pueblo fragmentation and the amount of neighbors a given county has, is expected. I suggest the number of neighboring counties a modern Mexican municipality has could potentially be a viable valid instrument for the effect of pueblo fragmentation on income. Once we net out the effects of geography (already specified in the OLS model), there are few other explanations by which we could think the number of neighbors could end up affecting the income of a given county. I propose an IV regression of the following form:

$$Y_i = \alpha + \beta \#Pueblos + + \mathbf{X}_i' \chi + e_i \tag{3.3}$$

$$\#Pueblos_i = \gamma + \omega \#Neighbors + \mathbf{X}_i' \psi + \upsilon_i \tag{3.4}$$

The process of formation of neighboring counties correlates with the experienced fragmentation of the pueblos, yet it doesn't have any obvious relationship with the economic outcome by itself or through alternative means. Nonetheless, the IV results should be taken with caution given the considerations I just referred.

Notwithstanding the controls and strategies employed in the attempt to minimize the problem of a potential omitted variable bias, one can still be apprehensive of the results. I cannot make definite statements on the causality from historical pueblos to current Mexican counties' economic outcomes. Yet, the qualitative evidence supports my case: It would be very difficult to explain the relation between historical pueblos and the county's economic development without attending the institutional heritage that pueblos may have had in shaping the *municipio* (the lowest-level political jurisdiction in Mexico).

3.6 Results

The results I present use Rojas (2016) data as the main variable of Spanish cities—instead of Abad and Zanden (2016)—because it allows for a fairer comparison between indigenous pueblos and Spanish cities through institutional channels.[28] However, the results are pretty robust to the inclusion of Abad and Zanden (2016)data; after all, there is a big overlap in both datasets.

Table 3.1 shows the baseline scenario results, using the pueblo dummy as our main independent variable. Specification [1] replicates the comparison made in Figure 3.4a, which shows a strong negative effect of having a pueblo past. Specification [2] controls for historical populations (both in colonial pueblos and cities). The decrease in the number of observations (from 2456 to 1992) is because the information on the historical population is limited to a portion of the total amount of historical pueblos—whenever there is no info, observations are dropped.[29] The interpretation is the same as with specification [1]: the effects of a

[28] As described in section four, Rojas' data characterizes a location as a city, only if it was officially recognized by the Crown as such (Even if their urban characteristics may be considered to be rather rural). Using Rojas data, I am able to better compare institutional channels between indigenous and non-indigenous settlements.

[29] The decrease in [5] and [7] is because, for the language controls, I used an early 90's census which had a

pueblo are negative. Regressions [3-5] add controls for geography and, most importantly, percentage of persons identified as indigenous today. The result in [4-5] is important as it shows how the expected effect of having a pueblo becomes positive after controlling for alternative channels of transmission. As stated in the previous section, there is a consensus on the association between being indigenous today, being discriminated because of it, and being poor. That is a channel I am not interested in assessing. Once we condition for it, the importance of pueblos—as legacy of organization— becomes relevant. Yet, the coefficient for the pueblo dummy is not statistically significant. This is due to the lack of variation in the comparison of counties with historical pueblos vs counties without them.

A relevant result we get from Table 3.1 alone is the acknowledgment that colonial indigenous density is a strong predictor of larger incomes today—its coefficient is robust through all specifications and it is more than half of the impact through colonial city density. The New Spanish economy in the 18th century (and earlier) just like any pre-industrial revolution society, operated under Malthusian constraints. Moreover, the market was really fragmented, most of settlements operated under self-subsistence mechanisms. Therefore it is possible to assess the prosperity of a given pueblo through the amount of population it sustained. Consequently, we can interpret the results as evidence of the importance of agglomeration effects; it supports the intra-national persistence of fortune literature (Maloney and Caicedo, 2015): Regions that were rich in the past are still richer today. Evidence of a reversal of fortune is discussed in section 3.7.2 when differences between and Northern and Southern Mexico are discussed.

Table 3.2 shows results for the second, and the relevant scenario for testing our hypothesis, which exploits variation in the number of pueblos a county had. The # Pueblo coefficient is insignificant for the vanilla regression (specifications[1–2]), yet it becomes positive, larger and more robust for the rest of specifications[3–7]. The introduction of geographical and other controls in [3-4] has a huge impact on the way pueblo's effect on income is assessed. For the geographic controls it is so because there is a relationship between the location of

different organization of counties as that in 2010. For those counties that were reorganized, the observations were dropped

Table 3.1: Income Impact in Current Counties of Having a Colonial Settlement as Historical Heritage

	(1) Income	(2) Income	(3) Income	(4) Income	(5) Income
Pueblo Dummy	-1749.5***	-1740.97***	-479.35**	195.6	261.4
	(200.19)	(218.28)	(198.57)	(70.44)	(170.65)
Pueblo Density (Pop/km2)		24.91***	19.13**	24.95***	11.96**
		(8.81)	(8.36)	(7.12)	(5.3)
City R Dummy	9071.5***	6177.5***	5554.68***	4104.8***	3912.1***
	(1170.55)	(1304.9)	(1229.67)	(1158.13)	(1132.13)
City Density (Pop/km2)		39.60***	44.66***	43.33***	14.13
		(9.78)	(9.57)	(9.84)	(16.75)
Latitude (Degrees)			440.7***	407.3***	439.3***
			(23.86)	(21.02)	(22.68)
Altitude (Km)			156.8	-424.5***	-692.5***
			(104.94)	(88.31)	(92.68)
Ruggedness(SD Alt per Loc)			-7.16***	-3.42***	-2.778***
			(0.61)	(0.52)	(0.517)
Rural Dummy				-3071.4***	-2917.0***
				(131.42)	(142.97)
% Indigenous				-5734.95***	-5787.3***
				(199.07)	(457.98)
2010 County Density(Pop/Km2)					1.397***
					(0.28)
Language Controls	No	No	No	No	Yes
N	2456	1992	1992	1992	1943
$Adj.R^2$	0.069	0.073	0.248	0.471	0.569

Note: Heteroskedasdicity robust standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported. Language Controls are variables indicating the percentage of speakers within a county that speak one of the 62 languages reported in the appendix. Pueblo dummy refers to the presence of an 18th century pueblo in the current county. Pueblo density is the population reported in those pueblos in terms of the area of the county as it exists today. City and City density are the same as the pueblo variables but for 18th century Spanish cities. Latitude is measured in degrees.= and Altitude in kilometers above the sea. Ruggedness measures the standard deviation of the altitude by locality within a county (localities are sub-municipal areas defined by Mexico's statistical agency). The rural dummy considers if the county is considered to be rural by Mexico's statistical agency. % Indigenous refers to the percentage of people within the county that are considered indigenous. And 2010 Density refers to the population density at the county as it was reported in 2010.

Table 3.2: Income Impact in Current Counties of Having a Colonial Settlement as Historical Heritage

	(1) Income	(2) Income	(3) Income	(4) Income	(5) Income	(6) Income	(7) Income
# of Pueblos	12.21	-8.058	148.0***	181.4***	169.3***	53.90	103.2***
	(40.96)	(43.47)	(40.27)	(32.37)	(31.98)	(4067)	(38.14)
Pueblo Density (Pop/Km2)		12.36*	12.87*	22.36***	9.999**	-2.402	-3.146
		(6.91)	(7.08)	(6.36)	(4.88)	(7.19)	(5.56)
#Pueblos X Pueblo Density						12.93***	6.652**
						(2.8)	(2.58)
City R Dummy	8981.0***	6132.7***	5192.5***	3726.1***	3557.2***	3888.7***	3649.8***
	(1172.29)	(1331.17)	(1205.56)	(1130.47)	(1101.25)	(1196.46)	(1135.3)
City Density (Pop/km2)		37.99***	42.41***	40.84***	12.60	41.60***	13.52
		(9.85)	(10.02)	(10.49)	(16.16)	(1059)	(16.29)
Latitude (Degrees)			462.1***	410.3***	445.2***	408.1***	441.9***
			(24.04)	(20.86)	(21.94)	(20.67)	(21.94)
Altitude (Km)			75.93	-483.0***	-737.7***	-505.4***	-743.7***
			(103.26)	(88.21)	(93.05)	(88.61)	(93.53)
Ruggedness (SD Alt per Loc)			-7.97***	-3.964***	-3.238***	-3.667***	-3.119***
			(0.63)	(0.525)	(0.52)	(0.521)	(0.52)
% Indigenous				-5747.0***	-6051.4***	-5571.8***	-6079.5***
				(198.51)	(466.8)	(191.04)	(472.4)
Rural Dummy				-3082.9***	-2908.2***	-3090.8***	-2912.0***
				(131.83)	(142.01)	(131.12)	(141.7)
2010 County Density(Pop/Km2)					1.367***		1.341***
					(0.242)		(0.241)
Languages Controls	No	No	No	No	Yes	No	Yes
N	2456	1992	1992	1992	1943	1992	1943
$Adj.R^2$	0.038	0.039	0.253	0.481	0.577	0.490	0.578

Note: Heteroskedasdicity robust standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported. All the independent variables are the same as in Table 3.1 except for the main exploratory variable which used to be a dummy on the presence of a pueblo in the past, and here it quantifies the number of historical pueblos encompassed in a county.

pueblos and the specific places in which they were established. Controlling for geography is relevant to correctly asses the historical impact of pueblos. But most importantly, conditioning on the percentage of indigenous population per county—as a way to control for alternative transmission channels—results in a positive, statistically significant, and robust # Pueblo coefficient. This, again, is so because counties that had more pueblos are correlated with more indigenous population today, which we know is a strong predictor of poverty today. It is necessary to control for it, to find the legacy of historical organization between a pueblo past and income today—through historical persistence channels. Specifications [3–5] show that having one more pueblo is associated with a direct increase of 148–181 dollars in per capita income. The figure is quite relevant if we put it into perspective: A one standard deviation increase in the number of pueblos (roughly 2.5 pueblos) is correlated with a 360–440 dollar increase in 2010 per capita income. Comparing with the national per capita GDP, which in 2010 was 7,966 dollars, implies the impact of a SD increase in pueblos is about 4.5–5.5% of that amount. Comparing it to the GDP per capita of regions classified as indigenous only,[30] the importance is larger, as a SD increase in the number of pueblos amounts for 7–9% of their GDP per capita. A sizable amount. Pueblo's population density effects [2–5] are comparable to the baseline scenario.

Specifications [6–7] add an interaction term. The impact of the pueblos on income may depend not merely on the political cohesiveness of the pueblos, but on the population density these pueblos had (a plausible hypothesis). For example, we may find that a county that encompasses three pueblos that were very large (had a lot of population) were not the same as counties that encompass also three pueblos, but in which the pueblos very small (low population). So it may be that the way in which the legacy of pueblos is expressed is not merely through the amount of pueblos, but through the composition between the amount of pueblos and the population they held. The coefficient for the interaction effect is positive and significant. Its interpretation is not directly intuitive, given that both variables are

[30]Defined as those places where 50% of their population is classified as indigenous, and where the per capita income is of 4,948 dollars.

Table 3.3: Broad Development and Inequality: Impact of Colonial Settlements in Current Counties

	(1) Marg Index	(2) Marg Index	(3) HDI	(4) HDI	(5) Night Light	(6) Night Light	(7) Gini	(8) Gini
# Pueblos	-.01626***	-.01013**	.00346***	.00284***	.0825***	.087***	.21125***	.19089***
	(.0046)	(.0058)	(.0005)	(.0005)	(.0117)	(.0146)	(.0372)	(.0454)
Pueblo Density (Pop/Km2)	-.00273***	-.00151***	.00038***	.00026**	-.0211***	-.0223***	-.00303	-.00708
	(.0007)	(.0008)	(0.000)	(.0001)	(.0032)	(.0045)	(0045)	(.0067)
#Pueblos X Pueblo Density		-.00061**		.00006*		-.0016*		.00205
		(.0003)		(0.000)		.0008		(.00221)
City R Dummy	-.40186**	-.41045***	.05272***	.05359***	.5139**	.5245*	2.7525***	2.78107***
	(.1081)	(.1098)	(.0132)	(.0134)	(.2436)	(.31)	(8222)	(.8167)
City Density (Pop/Km2)	-.0001	-.0002	0.000	.00007	-.0029	-.0118***	.00093	.00121
	(.0012)	(.0012)	(.0002)	(.0002)	(.0021)	(.0035) ***	(.0095)	(.0095)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indigenous % Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Language Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1943	1943	1943	1943	1942	1942	1941	1941
$Adj.R^2$	0.701	0.707	0.577	0.577	0.655	0.608	0.196	0.196

Note: Heteroskedasdicity robust standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported. All the independent variables are the same as in Table 3.2. Night Lights are estimated as the natural logarithm of light intensity per county constrained on the area and population of the county. HDI, Gini and the Marginalization Index are used as reported by Mexico's statistical institutions.

continuous.[31] Both variables are positively related, and they both have a positive correlation with income today. The results suggest that disentangling between potential transmission channels (of the importance of past indigenous communities) is hard to asses: there is a complementarity between the number of pueblos and the total amount of population living in them. Both operate in tandem as a predictor of larger income today. Yet, the fully specified regression [7] still shows a significant and positive impact of the # of pueblos' coefficient by itself, while the pueblo density coefficient loses statistical significance and its impact becomes ambiguous (the standard error becomes larger than the coefficient). It presents credence to the hypothesis that while both elements (# of pueblos and its populations) may matter in conjunction, it is the structural figure of the pueblos that is preponderant.

[31] Shown in the appendix is Figure 3.10, which provides a graphical visualization of the result. It plots the predicted effect of pueblos on income given a set of pueblo densities.

Income is not the only dependent variable I use. It could be that the shown results are capturing a spurious relation between pueblos and income out of coincidence. I use three other alternative measures of development. One that builds on income measurements, but adds other qualitative characteristics: the Human Development Index. One that was specifically built to address non-income development concerns by assessing the quality of life of the population by their access to basic services: The Marginalization Index.[32] And a last one which was specifically thought as an alternative measure of economic development for places where data is non-existent or sketchy: night-time light (Donaldson and Storeygard, 2016). Additionally, I use the Gini Index per county to asses the impact of pueblos in inequality. The results (Shown in Table 3.3) are harder to interpret individually, given the nuanced nature of how they were built. Yet, they do confirm that the relationships found in Table 3.2 are not a coincidence. Pueblos are positively correlated with HDI and negatively correlated with marginalization. And the relationship is also positive between past historical pueblos in a county and the light density of the county. There is also a positive association between pueblos and inequality, which is worth noticing. It corroborates the relation found by Magaloni et al. (2018).[33] It can also be considered as additional evidence in favor of interpreting the variable I use—number of pueblos—as a proxy for differences in the trajectory of the hierarchical relations between indigenous communities (the relationship of pueblos as *cabeceras* and *sujetos*): The presence of more pueblos, being interpreted as a legacy of more hierarchical societies, can also help explain a tradition of larger inequality.

3.7 Robustness

The OLS results may fail to capture the true effects a pueblo has, given potential omitted variable biases. A technique, developed by Altonji et al. (2005) and Oster (2017), can help to evaluate the magnitude of the problem. Suppose that all of our controls are captured

[32]The marginalization index captures qualitative measures of access to education, health, social security, housing, and nourishment.

[33]The authors test the long-term impact of cochineal producing pueblos in the Oaxaca region and found, similarly as I do, that they positively correlate with inequality.

by an index $W1$, and all of the unobservables are summarized by an index $W2$—which is correlated with our main dependent variable (income) and with our main independent variable (% of historical pueblos in a current county). The assumption is that W1 and W2 are orthogonal; $Cov(W1, W2 = 0)$ and $Var(\#Pueblos = 1)$. The model would be expressed as follows:

$$Y = \beta \#Pueblos + W1 + W2 \tag{3.5}$$

Altonji et al. (2005) showed that if we treat W1 and W2 as the true model explaining Y (implying that equation's [5] $R^2 = 1$), we can estimate a ratio δ by which the role of our $W2$ unobservables would damp the effect of our target independent variable (# of pueblos) given the rest of our observables $W1$.[34] In other words, we are looking for a value of δ that would make $\beta = 0$. In summary:

$$\frac{Cov(W2, \#Pueblos)}{Var(W2)} = \delta * \frac{Cov(W1, \#Pueblos)}{Var(W1)} \tag{3.6}$$

For example, a value of $\delta = 1$ implies that the unobservables would have to be as important as the observables to eliminate the effect of # Pueblos on income. The sign of δ depends on model [5]. A negative sign would imply that if W1 is positively correlated with #Pueblos, W2 would need to be negatively correlated with #Pueblos to make $\beta = 0$. Both Altonji et al. (2005) and Oster (2017) agree that $\delta = \pm 1$ is an acceptable upper bound to assess the robustness of the main OLS specification (specification [2], $y = \#Pueblos + W1 + e$).

Oster (2017) suggests that the framework would be better applied if instead of focusing on identifying δ with stringent conditions, we reported a bounded set of parameters that affect [6]. First, she recommends relaxing the R-squared assumption. A fully explained model would imply $R^2 = 1$, but we can think of a R_{max} that is proportional (at a Π level) to changes in the R^2 of the baseline model, introduced by our observables W1. That is, our

[34] It is important to highlight that the relevance of W2 is always dependent on our observables W1. If the controls within the model fail to capture at all the relationship between β and Y, the problem of OVB would not be solved by this technique. Yet, the whole point of choosing controls is that we have an educated guess of what really explains Y, so the presumption is that W1 is important.

unobservables W2 need not to fully explain the model, but instead explain a proportional amount of what our observables W1 explain. After analyzing several prominent empirical papers in the field, she suggests $\Pi = 1.3$ is a suitable scale.

Oster (2017) proposes we could report a bias-adjusted coefficient $\hat{\beta}$ that depends on suitable values of δ and R_{max}. It would show the expected effect of # Pueblos, after accounting for potential OVB; after making educated assumptions on how large the unobservables are, and how much they impact the R^2.

$$\hat{\beta} = \tilde{\beta} - \delta * \frac{(\dot{\beta} - \tilde{\beta})(R_{max} - \tilde{R})}{\tilde{R} - \dot{R}} \tag{3.7}$$

Where $\dot{\beta}$ is the point estimate of the vanilla OLS regression without control variables, $\tilde{\beta}$ is the estimate of the fully controlled regression, and $\dot{R}$ and $\tilde{R}$ are the R^2 from the estimated regressions, respectively.

Table 3.4 reports the results of the above-mentioned analysis using Oster (2017)'s psacalc STATA package. Following her suggestion, I set $R_{max} = 1.3 * \tilde{R}$ and $\delta = \pm 1$. For each main dependent variable (Income, Night Lights, Marginalization Index, HDI, and Gini Index) I estimate the bias-adjusted coefficient of # Pueblos and of Pueblo Density. Alternatively, in the tradition of Altonji et al. (2005), I estimate the value of δ that would make the β coefficients zero (assuming $R_{max} = 1.3 * \tilde{R}$). I consider two OLS specifications as the baseline scenarios, one that includes interaction effects between # Pueblos and Pueblo density, and one that doesn't.

The first row shows the results of our main specification. Even controlling for OVB problems, the effect of # pueblos is still positive and not that different to the OLS'results shown in Table 3.2. One historical pueblo more, encompassed in a current county, correlates with an increase in their GDP per capita in the amount of 77-128 dollars. For the effect to be nullified, the severity of OVB would have to be large: the magnitude of the unobservables would have to be five to twenty times larger than the observables. The pueblo density variable, however, is less robust: its impact diminishes when our specification considers

Table 3.4: Robustness to Omitted Variable Bias

		OLS Coefficients (SE)[R2]		Bias-adjusted coefficient with $R_{max} = 1.3 * \tilde{R}^2$, $\delta = \pm 1$		δ for coeff =0 if $R_{max} = 1.3 * \tilde{R}^2$	
		(1) No Interaction Effects	(2) Interaction Effects	(3) No Interaction Effects	(4) Interaction Effects	(5) No Interaction Effects	(6) Interaction Effects
Income	# Pueblos	169.3 (31.98)[.577]	103.2 (38.14)[0.578]	128.362	77.343	-5.144	-19.658
	Pueblo Density	9.999 (4.88)[.577]	-3.146 (5.56)[.578]	9.955	3.378	10.077	-0.392
Night Light	# Pueblos	0.0825 (0.0117)[.655]	0.087 (0.0146)[0.608]	0.0322	0.0304	-1.928	-1.752
	Pueblo Density	-0.0211 (0.0032)[.655]	-0.0223 (.0045)[0.608]	-0.0153	0.0186	1.975	0.698
Marg Ind	# Pueblos	-0.1626 (.0046)[.701]	-0.0103 (0.0058)[0.707]	0.00095	0.00963	-0.941	-0.454
	Pueblo Density	-0.00273 (0.007)[.701]	-0.00151 (.0008)[0.707]	-0.00183	-0.00012	-3.735	-4.519
HDI	# Pueblos	0.00346 (0.0005)[.577]	0.00284 (0.0005)[0.577]	0.00258	0.00194	-4.705	-7.292
	Pueblo Density	0.00038 (0.00)[.577]	.00026 (.0001)[0.577]	0.00034	0.00025	-22.964	2.513
Gini	# Pueblos	0.211 (0.0372)[.196]	0.19089 (0.0454)[0.196]	0.20249	0.169	8.461	3.576
	Pueblo Density	-0.00303 (.0045)[.196]	-.00708 (.007)[0.196]	-0.00065	-0.003	1.259	1.509

Note: The table reports results using the Stata package psacalc provided by Oster (2017). The first two columns report the results of the OLS coefficients as they were estimated in the original regressions, along with their standard errors and their $\tilde{R}^2$. Columns 3 and 4 estimate the adjusted coefficients after assuming the unobservables are of the same magnitude as the observables ($\delta = \pm 1$) and assuming that their impact is 1.3 times the original $\tilde{R}^2$. Columns 5 and 6 report how large would the unobservables have to be in comparison to the observables in order to nullify the effect of the estimated variable.

interaction effects (the δ is -.392). The OLS specifications on Night Lights, HDI and Gini Index (Table 3.3) are also robust to OVB problems (at least for our main dependent variable: the # of pueblos). But not that of the Marginalization Index, at least not entirely. If we don't consider interaction effects, the δ for # Pueblos variable is almost one, but when we consider interaction effects, the estimated delta is of less than -0.5. How can the lack of robustness explained? It may imply the marginalization index captures a set of factors that need a fuller explanation, *vis a vis* that of income, for example.

3.7.1 IV Estimation

The most common way to solve endogeneity problems is to instrument the main dependent variable. I rely on the number of neighbors a county has, as an instrument for the level of fragmentation of pueblos. As explored in section 5, there are several problems with the IV strategy, but estimating it provides a comparison to evaluate the OLS results. Table 3.5 shows the outcome of the IV regression[35]. Specification [1] drops other potential endogenous variables to avoid under identification ([2–3] add them for comparison purposes). Through the instrument, the effect of pueblo actually increases in almost 100 dollars. Omitted variables had been negatively biasing the OLS results. It makes intuitive sense given the narrative I presented in section 2: If colonial pueblos are a mere recognition of pre-hispanic towns, the self-selection process by which pre-hispanic native chose the localities where they established, is actually negatively correlated with economic outcomes today. It brings support to our preceding section, where we asses that our OLS results are robust to OVB problems. Native Americans preferred inaccessible spots at the top of hills, locations that may have been optimal centuries ago, but today obstruct their access and integration into the national market. The next section addresses these concerns in detail by focusing on the geographical determinants behind a pueblo and the conditional impact of it in their income. In what follows, I will use the OLS estimations as they allow for a cleaner interpretation compared to those of the IV.

[35]Results for the first stage, that corroborate the correlation between the number of pueblos and of the instrument, are shown in Table 3.15 in the appendix.

Table 3.5: IV Estimation: Current Number of Neighboring Counties as Instrument

	(1) Income	(2) Income	(3) Income
# Pueblos	263.4**	257.2**	207.8*
	(87.71)	(88.00)	(89.62)
Pueblo Density (Pop/Km2)		7.322	9.213*
		(4.352)	(4.347)
City R Dummy			3467.9***
			(770.0)
City R Density (Pop/Km2)			12.24
			(8.449)
Geographic Controls	Yes	Yes	Yes
Indigenous % Controls	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes
Language Controls	Yes	Yes	Yes
N	2403	1943	1943
R^2	0.564	0.582	0.592

Note: Standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported. All the independent variables are the same as in Table 3.2..

3.7.2 Geographical Patterns

To add detail into the mechanisms behind the organizational impact of pueblos on income today, I follow two strategies: First, I assess the main geographical determinants of the pueblo locations. Given the potential for self-selection, it is important to understand the effects geography may have had in incentivizing the establishment of settlements in particular places (either by the old pre-hispanic tribes, and/or by the Spaniards). The results can provide information on the biases that geography may be adding into the main results. Second, following the insights from the historical literature presented in section 2, I rerun the main regression specifications subdividing the data into different geographical subsets: according to their location in Mesoamerica/Aridamerica[36] and on high/low altitude areas[37]. Pre-columbian Mesoamerican indigenous communities, being more sedentary

[36]The geographical discrimination is proxied by the ancient colonial divisions: I consider Mesoamerica to be composed of the Kingdoms of Mexico, Galicia, and the regions of Yucatan and Soconusco. Aridamerica are all territories that are above. Figure 3.9 in the Appendix shows the map.

[37]The high/low distinction is centered around being larger or smaller than the median altitude for Mexican counties.

Table 3.6: Geographical Determinants of Pueblos

	(1) # Pueblos	(2) # Pueblos	(3) Pueblo Density	(4) Pueblo Density
Latitude (Degrees)	-0.0593***	-0.00182	-0.753***	-0.412**
	(0.0101)	(0.0298)	(0.0659)	(0.1851)
Altitude (Km)	0.415***	0.422***	5.341***	5.626***
	(0.0596)	(0.0638)	(0..4761)	(0.5101)
Ruggedness (SD Alt per Loc)	0.00280***	0.00357***	-0.0273***	-0.0235***
	(0.0004)	(0.0004)	(0.0029)	(0.0030)
Mexico Dummy		1.541***		3.500***
		(0.2564)		(1.284)
New Galicia Dummy		0.750**		-4.656***
		(0.1882)		(1.0220)
Yucatan Dummy		2.506***		5.157***
		(0.2798)		(1.3657)
New Vizcaya Dummy		1.030***		-3.360 ***
		(0.3013)		(.7952)
New Navarra Dummy		1.285***		2.097***
		(0.2461)		(.6832)
Guatemala Dummy		0.281		-0.911
		(0.2945)		(1.708)
N	2460	2460	1996	1996
$Adj.R^2$	0.061	0.102	0.115	0.136

Heteroskedasdicity robust standard errors are reported in parentheses

Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels

than those in Aridamerica, have a greater institutional legacy which may reflect into larger organizational capacity today. Pueblos located in high altitude areas are more inaccessible, improving their chance of surviving as their own public entity, which may then reflect into larger self-organization capabilities.

Table 3.6 provides a general overview of the main geographical correlates of the number of pueblos per current county.[38] As expected, latitude shows a negative relation, confirming that most colonial pueblos were located in the central-southerner parts of Mexico. Altitude and ruggedness are positively correlated. These results give evidence to the hypothesis that in general, pueblos' locations in the 18th century are mostly true descendants of old pre-hispanic towns[39]. Specification [2,4] add a dummy variable according to Colonial Mexico's

[38]Table 3.17 in the appendix provides a negative binomial regression that respects the characteristic that the main dependent variable is count date and is skewed.

[39]See section 2 for the arguments.

specific regions. Mayan and Nahua territory (Mexico and Yucatan regions respectively) show the largest positive effect, signaling their strongest institutional legacy. To be noted is the Guatemala dummy coefficient (that refers to the area of the current state of Chiapas that used to be part of Guatemala), which is very low (compared with the rest of all the Mexican regions, including those of Aridamerica).[40] The most important corollary of these results is that it confirms pueblos may have self-selected into geographical areas that today are correlated with bad prospects for growth. This implies that the OLS results could actually be understating the importance of the pueblo legacy (which is why the IV results show larger effects.)[41]

The second relevant robustness scenario is to look for the differentiated impact of colonial pueblos on income if we discriminate between regions (Mesoamerica/Aridamerica) and altitude zones (below/above the median). Table 3.7 shows the results for the former. Although the pueblo coefficient is similar for both regions, it is only accurately identified for Mesoamerica. Moreover, the impact of population is positive in central Mexico while negative in the North (which signals the major reversal of fortune shift that occurred in Mexico from south to north). The results suggest an interesting scenario: although there is persistence dynamics from pueblos and pueblo densities within Mesoamerica, a notorious North-South "reversal of fortune" story can be perceived. The narrative confirms Maloney and Caicedo (2015) insight that Mexicos' northern regions trajectory cannot be explained by Mexican intra-national dynamics alone—its development could be better explained by their closeness to the US.[42]

[40]This may beg the question of why this is so. Answering in a definitive manner requires a more detailed study, but one hypothesis that stems from the historical literature is to note that process of conquest was different from that of rest of Mexico and hence their institutional legacy is distinct. It could also help explain why Chiapas' indigenous communities are the most rebellious within Mexico today, as they may have been the more oppressed. It is an important result because it signals that the Spanish Colonizing process was not homogeneous, and varied across regions.

[41]Tables 3.18 and 3.19 (shown in the appendix) replicate Table 3.6's regression but they add a second specification in which the geographical correlates of Spanish Cities (and its population densities) are also considered in order to compare the differences with those of the pueblos. Both pueblos and cities within Mesoamerica have a small association with latitude, but altitude only matters for pueblos, not for cities. It confirms the notion that Spanish preferred valleys and indigenous populations preferred hills. More evidence of favor of the pre-hispanic to modern nexus of pueblos.

[42]Evidence of such assertion can be seen in the fact that even within the northern Mexico alone (the

Table 3.7: Income Impact of Colonial Settlements in Mesoamerica and Aridamerica

	(1) Mesoamerica	(2) Mesoamerica	(3) Aridamerica	(4) Aridamerica
# Pueblos	184.1***	116.1***	186.8	114.4
	(34.7)	(41.1)	(118.98)	(137.1)
Pueblo Density(Pop/Km2)	12.15**	-0.434	-586.1	-1388.2 *
	(5.13)	(5.857)	(651.8)	(759.98)
# Pueblos X Pueblo Density		6.416**		215.1**
		(2.657)		(96.4)
City R Dummy	4837.4***	4972.8***	-1864.6	-1853.3
	(1159.6)	(1207.5)	(1295.08)	(1283.3)
City Density (Pop/Km2)	6.698	7.441	212.6***	214.5***
	(15.745)	(15.895)	(65.7)	(65.05)
Geographic Controls	Yes	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes	Yes
Indigenous % Control	Yes	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes	Yes
Language Controls	Yes	Yes	Yes	Yes
N	1650	1650	293	293
$Adj.R^2$	0.539	0.541	0.635	0.636

Note: Heteroskedasdicity robust standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported.

Table 3.8: Income Impact of Colonial Settlements by Altitude

	(1) Below Median	(2) Below Median	(3) Above Median	(4) Above Median
# Pueblos	33.67	62.32	293.2***	222.2***
	(35.95)	(54.78)	(47.01)	(55.0)
Pueblo Density (Pop/Km2)	17.39*	25.24**	9.008*	-2.364
	(9.36)	(12.11)	(5.1)	(6.127)
# Pueblos X Pueblo Density		-4.485		5.727**
		(4.041)		(2.829)
City R Dummy	2219.6*	2129.1*	5775.4***	5747.2***
	(1418.2)	(1390.1)	(1640.6)	(1713.1)
City Density (Pop/Km2)	-84.68***	-83.85***	13.87	15.63
	(27.85)	(27.82)	(14.52)	(14.64)
Geographic Controls	Yes	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes	Yes
Indigenous % Control	Yes	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes	Yes
Language Controls	Yes	Yes	Yes	Yes
N	998	998	945	945
$Adj.R^2$	0.654	0.654	0.541	0.544

Note: Heteroskedasdicity robust standard errors are reported in parentheses. Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels. The unit of observation is the county, as it was in 2010. All regressions include a constant not reported.

The assessment that the number of pueblos is a relevant measure of institutional capacity can be corroborated through Table 3.8. The impact of pueblos is dependent on them being located in high altitude areas; places where the institutional legacy is expected to be larger.[43]. Contrastingly, the impact of pueblo density is relevant—as expected across all specifications:[44] the agglomeration effects are independent of the specifics of where settlements got established. Cities can also serve as a contrast because their impact is positive independent of the altitude.

The implications of Tables 3.7 and 3.8 lend further credence to my empirical strategy: the number of pueblos within a county do identify institutional channels that are not entirely related to other different causal mechanisms.

3.8 Discussion

Mexico's history cannot be understood without referring to the resiliency of its indigenous institutions. The pre-hispanic geopolitical context was complex, fraught with conflict and hierarchical relations among communities. After the conquest of the Aztecs, the Spanish had to adapt to the indigenous geopolitical context that had preceded them. They built a state that was based on a division of political authority between Spanish and indigenous areas. The latter remained largely autonomous for all the colonial period. Mexico's independence brought an end to that system, yet local communities adapted. Ancient pre-hispanic polities became pueblos, and pueblos became counties.

In this chapter I have provided evidence that the number of historical pueblos per modern county is a pertinent proxy for the level of organizational capacity achieved by indigenous settlements (allowing them to stick together, avoiding political fragmentation). The amount of pueblos per county reflect the level of self-organization capacity these polities enjoyed (the more pueblos per county imply a larger potential to solve collective action problems).

Aridamerica specification), the impact of latitude is positive.

[43] As most pre-hispanic societies preferred settle in high altitude zones, unlike post-hispanic localities which were established mainly on valleys but didn't have any marked preferences).

[44] It is positive and significant for specifications [1–3], and is significant in interaction with the number of pueblos in specification [4].

I show that this proxy is positively correlated with larger income, more development (larger HDI, more night-light time density), less marginalization, but also more inequality. The effect of pueblos on income varies according to historical intuition: pueblos matter the most in the historical Mesoamerica area and in higher altitude zones. The former is important because it confirms that pueblo's self-organization capacity comes from pre-hispanic times (Aridamerica was largely nomad prior to the Spanish colonization).

I also contrast the results of the pueblo legacy (a proxy of institutional mechanism) with the importance of population density (as a measure of agglomeration effects). It confirms the hypothesis that a sub-national reversal of fortune occurred, where Mexico's development axis shifted: The North got more developed in comparison to its central and southern regions. Within Mexico's south and middle regions, more population density in the past does predict larger incomes today. In Mexico's northerner regions, pueblo density in the 18th century is a less relevant predictor of income today. More important is the conclusion derived from contrasting these two mechanisms according to altitude zones. Past density affects indistinctly, but the proxy of pueblo fragmentation/cohesion only affects in places where institutional stickiness is to be expected (in high altitude zones where the pre-hispanic legacy is larger).

There are several potential biases that my empirical analysis could be capturing. One important thing to note is that the legacy of pueblos in general is confounded by alternative transmission channels: a county formed by historical pueblos is correlated with a larger share of population that identifies as indigenous today too. This is problematic in as much as being indigenous today correlates with being poor. The mechanism by which this association works, however, is through modern channels of discrimination (Arceo-Gomez and Campos-Vazquez, 2014). I condition for these effects by controlling for the presence of indigenous population today. A second relevant bias is that establishing a pueblo could be correlated with geographical un-observables due to self-selection. I provide an analysis of the robustness against OVB of my results, based on Altonji et al. (2005) and Oster (2017), that suggests the unobservables would have to be implausibly large to nullify the

effect of pueblo fragmentation into income today. Moreover, I have presented evidence that suggests the settlement patterns of pre-hispanic societies favored localities that today are negatively correlated with income today. It implies that if any relevant omitted variable exists, its effects are dampening the coefficients I find: I could actually be underestimating the true impact of pueblos. The argument is confirmed by an IV estimation that shows larger coefficients than the OLS regression.

3.9 Appendix A: Discrepancy in Counties 1910-2010

The argument of the chapter hinges on the process of fragmentation that led to the creation of counties in Mexico: Indigenous polities breaking up and forming their own autonomous localities. It is possible to exploit the number of historical pueblos encompassed in current counties as a proxy of their historical level of political cohesiveness. Fragmentation started in the late 18th century and continued through Mexico's independence. It was not until Porfirio Diaz' dictatorship (1876–1911) that the Mexican state achieved a satisfactory level of control across its territory. Porfirio's government enacted many centralizing policies that hampered the autonomy of counties. The historical narrative suggests that the Mexican Revolution reversed the centralizing trend and gave back power to localities. Yet, is it possible that these policies—and the many others that came later—could have erased the indigenous legacy of counties? Table 3.9 registers the number of counties reported in Mexico's 1900 & 1910 censuses compared with those that existed in 2010, for each Mexican state. A raw analysis can be made out of this comparison. The differences in the number of counties are minimal across a span of 100 years. It suggests that notwithstanding the *de facto* changes that occurred between 1910 and 2010 —where counties merged and fragmented— counties converged more or less to the same levels that had existed in the 19th century. Oaxaca is the only state where the discrepancy is large: In 2010 it was composed of 570 counties, half of what it used to (1,139 in 1900). A potential explanation is that the level of indigenous fragmentation that occurred pre-1900 was very large, it is common to observe counties that had 100 persons or less. Such level of fragmentation facilitates federal control and allows

for exogenous reconfigurations by the government. It is evident that the process of county formation in Oaxaca may have followed a distinct trend compared to the rest of the country. Is it possible that Oaxaca is driving the main results I find? I drop counties in Oaxaca and redo the main regressions. Table 3.10 reports the results. Oaxaca is not driving our main results. The association between the number of pueblos in a county is still positive with income, HDI, Gini Index and negative with the Marginalization Index.

Table 3.9: Counties per State in 1910 and in 2010

state	1900	2010	Diff
Aguascalientes	8	11	3
Baja Norte	10	5	-5
Baja Sur	7	5	-2
Campeche	15	11	-4
Coahuila	34	38	4
Colima	7	10	3
Chiapas	130	122	-8
Chihuaha	56	67	11
Distrito Federal	13	16	3
Durango	42	39	-3
Guanajuato	43	46	3
Guerrero	69	81	12
Hidalgo	70	84	14
Jalisco	104	125	21
Estado de México	120	125	5
Morelos	25	33	8
Michoacán	80	113	33
Nuevo León	49	51	2
Oaxaca	**1139**	**570**	**-569**
Puebla	179	217	38
Querétaro	19	18	-1
Quintana Roo	8	11	3
San Luis Potosí	54	58	4
Sinaloa	10	18	8
Sonora	70	72	2
Tabasco	17	17	0
Tamaulipas	37	43	6
Nayarit	17	20	3
Tlaxcala	36	60	24
Veracruz	181	212	31
Yucatán	88	106	18
Zacatecas	51	58	7
Total	2788	2462	-326
Total without Oaxaca	1649	1892	243
Average	87.1	76.9	-10.2
Avg without Oaxaca	42	46	4
Median	42.5	48.5	3.5
Median without Oaxaca	42	46	4
SD	194.5	103.7	101
SD without Oaxaca	47.1	54.8	11.1

Table 3.10: Main Regressions Dropping Oaxaca

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	income	loglight	idh2010	ind2010	income	loglight	idh2010	ind2010	gini100
# Pueblos	86.82*	0.0683***	0.00215***	-0.00437	86.82*	0.0683***	0.00215***	-0.00437	0.159***
	(41.78)	(0.0147)	(0.000603)	(0.00574)	(41.78)	(0.0147)	(0.000603)	(0.00574)	(0.0479)
Pueblo Density (Pop/km2)	-3.809	-0.0320***	0.000352**	-0.00129	-3.809	-0.0320***	0.000352**	-0.00129	-0.0170
	(6.627)	(0.00602)	(0.000117)	(0.000795)	(6.627)	(0.00602)	(0.000117)	(0.000795)	(0.00913)
# Pueblos X Pueblo Density	6.623*	0.000360	0.0000663*	-0.000480	6.623*	0.000360	0.0000663*	-0.000480	0.00195
	(2.622)	(0.000985)	(0.0000336)	(0.000285)	(2.622)	(0.000985)	(0.0000336)	(0.000285)	(0.00233)
City R Dummy	3490.7**	0.441	0.0517***	-0.362***	3490.7**	0.441	0.0517***	-0.362***	2.668***
	(1141.1)	(0.231)	(0.0133)	(0.102)	(1141.1)	(0.231)	(0.0133)	(0.102)	(0.777)
City Density (Pop/Km2)	7.980	-0.00248	0.00000783	-0.000470	7.980	-0.00248	0.00000783	-0.000470	-0.00272
	(16.22)	(0.00218)	(0.000208)	(0.00117)	(16.22)	(0.00218)	(0.000208)	(0.00117)	(0.00892)
Other Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1622	1622	1622	1622	1622	1622	1622	1622	1620
adj. R^2	0.580	0.646	0.606	0.724	0.580	0.646	0.606	0.724	0.193

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3.10 Appendix B: Other Figures and Tables

Here I report all the figures and tables that, while useful, are not necessary to understand the chapter. Figure 3.6 maps the main independent variable I use: the number of pueblos encompassed in a given county. Figure 3.7 reports a histogram of it. Figure 3.8 shows the main dependent variable I use: 2010 income per capita in 2005 dollars. Figure 3.9 displays the main federal subdivision in pre-18th century Mexico. I use them as a proxy of what is Mesoamerica and Aridamerica. Table 3.11 shows the summary statistics of all the variables used in the chapter. Table 3.12 reports the main identification mechanism followed in the chapter: how changes in the number of pueblos per county correlate with their income.

Table 3.14 and 3.13 show information concerning the controls used. First, Table 3.14 reports the correlation between the presence of a pueblo and the current amount of indigenous population. The identification strategy of the chapter depends on controlling for alternative mechanisms of transmission. It is known that Mexican indigenous population is poorer in comparison to the rest of Mexicans for non-historical reasons (e.g. because of current classicism and discrimination). To find the proper institutional effect of pueblos, I control for these alternative channels. Table 3.13 shows the diverse languages spoken in Mexico and the number of persons that can speak them. I use them as a control for localized effects: for example, to asses the differences (cultural and others) between the proper indigenous peoples.

Figure 3.10 details the interaction effects between the number of pueblos and pueblo density. Each variable has a positive correlation with income. Table 3.15 shows the first stage regression for the IV strategy. It passes the heuristic that suggests that the F-statistic must be larger than 10 for the instrument to be non-weak. The neighboring counties' coefficient follows the intuition explained in the chapter and is positive. Table 3.16 shows the results of applying the same instrument to alternative dependent variables besides income. The results confirm the relevance of the number of pueblos per county—as a proxy of institutional heritage. They have had a positive economic impact in Mexico's economic development.

Finally, Table 3.17– 3.19 dwell on the geographical patterns determining the impact of indigenous pueblos. Table 3.17 replicates Table 3.6 but using a negative binomial regression. I do so because the main dependent variable in this regression is the number of pueblos, which is count data and is skewed. An OLS regression may be biased. Yet, the results are consistent with the main ones. Tables 3.18 and 3.19 report the same relationship but also use non-pueblo data (cities) for comparison.

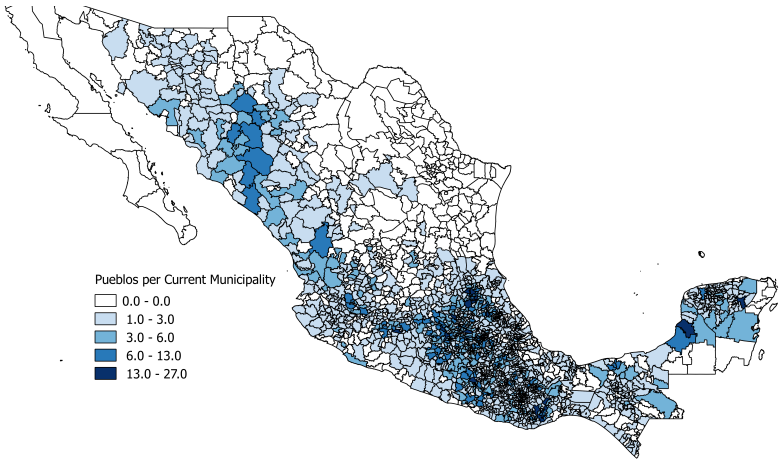


Figure 3.6: Number of Colonial Pueblos Encompassed in Current Counties

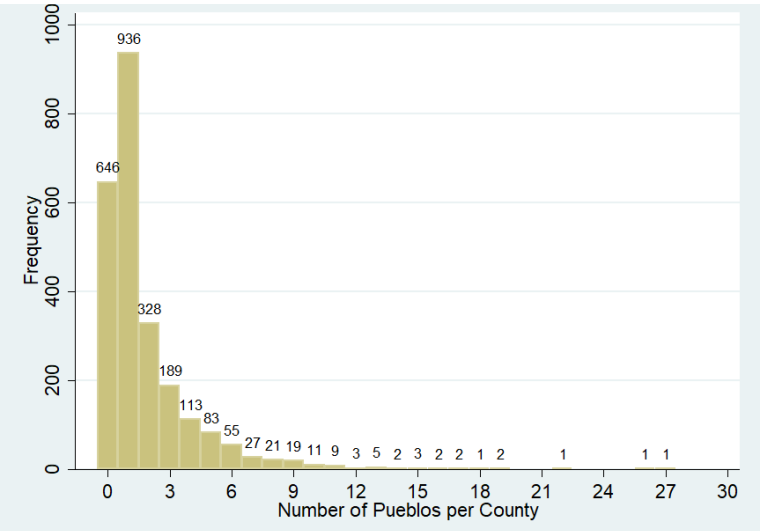


Figure 3.7: Distribution of Number of 18th Century Pueblos Encompassed in a Given County Today

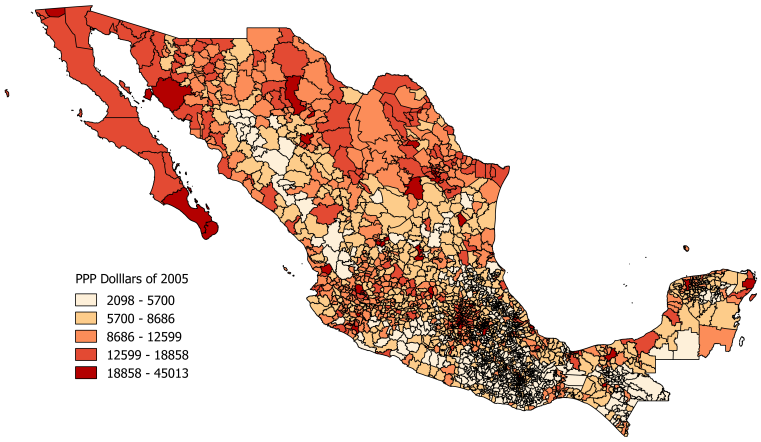


Figure 3.8: 2010 Income in 2005 PPP Dollars by County

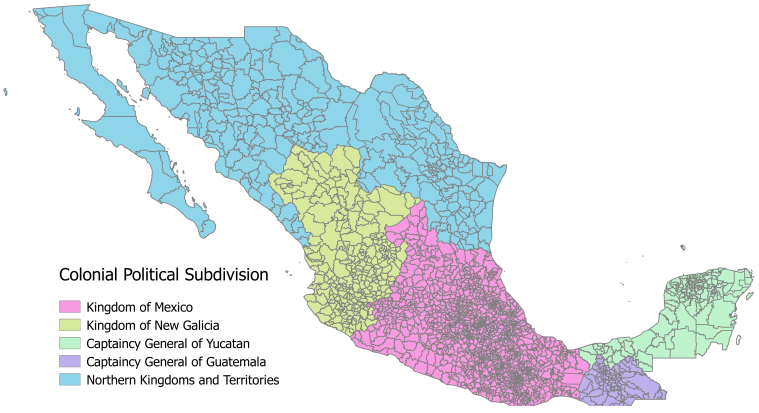


Figure 3.9: Colonial Jurisdicitions pre Intendencias in Mexico

Table 3.11: Summary Statistics

	# Obs	Median	Mean	SD	Min	Max
Pueblo Dummy	2,460	1	.74	.44	0	1
# Pueblos	2,460	1	1.81	2.43	0	27
Pueblo Density (Pop/km2)	1,996	1.42	7.56	18.21	0	310.83
City AvZ Dummy	2,460	0	.01	.09	0	1
City AvZ Density	2,460	0	2.69	103.79	0	5,121.95
City Rojas Dummy	2,460	0	.01	.09	0	1
City Rojas Density	2,460	0	2.49	103.56	0	5,121.95
Latitude (Degrees)	2,460	19.33	20.03	3.34	14.64	32.49
Altitude (Km)	2,460	1.47	1.3	.82	0	3.01
Ruggedness (SD Alt per Loc)	2,460	111.76	149.63	137.7	0	811.98
# Indigenous	2,456	0.01	.18	.29	0	.95
Rural Dummy	2,456	0	.38	.49	0	1
County Density 2010	2,456	50.88	273.14	1,151.19	.14	17,396.07
Income 2010 (PPP Dollars)	2,456	7,175	7,965.58	4,332.04	2097.81	45,012.62
HDI 2010	2,456	0.64	.64	.08	.36	.92
Marginalization Index	2,456	-0.14	0	1	-1.89	4.44
Gini Index	2,454	40.83	41.2	3.9	28.57	59.08
Log Night Light Density	2455	2.78	2.7	1.89	-3.49	8.29

Table 3.12: Income According to # of Pueblos, Summary Statistics

# Pueblos	Obs	Mean	Median	St.Dev	Min	Max
1	936	7102.869	6370.78	3658.793	2097.806	30265.07
2	328	7328.588	6706.122	4104.515	2147.106	32609.23
1 - 2	1264	7161.442	6419.752	3779.134	2097.806	2097.806
3 -5	385	8030	7089.701	4809.589	2119.042	45012.62
6-12	145	8901.09	7873.395	4908.984	2919.22	24622.06
13-27	20	9543.835	8241.654	5646.63	3305.379	21712.6

Table 3.13: Correlation Between Modern County's Indigenous Population % and their Pueblo Heritage

	Pueblo Dummy	# Pueblos	Pueblo Density	% Indigenous
Pueblo Dummy	1			
# Pueblos	0.48	1		
Pueblo Density (Pop/Km2)	0.29	0.16	1	
% Indigenous	0.25	0.07	0.15	1

Table 3.14: Speakers of Indigenous Languages by County (1990 Census)

Language	# Counties Where it is Spoken	Mean	SD	Min	Max	Total Speakers In Mexico
Aguacateco	2	0	.03	0	1	2
Amuzgo	2	0	.03	0	1	2
Cahita	5	.06	2.08	0	95	144
Cakchiquel	6	.06	2.55	0	125	135
Chatino	30	11.82	205.76	0	5,828	28,398
Chiapaneco	1	0	.12	0	6	6
Chichimecajonaz	8	.47	21.17	0	1,036	1,130
Chinanteco	72	39.77	522.45	0	12,451	95,565
Chinantecodeojitlan	7	1.3	58.62	0	2869	3,122
Chocho	33	4.20	114.11	0	5,244	10,111
Chol	31	51.26	1000.76	0	32,906	12,3216
Chontal	23	9.1	215.93	0	7,894	2,1871
Chontal de Oaxaca	13	.69	21.78	0	981	1,668
Cora	27	4.75	190.3	0	9,249	11,412
Cucapa	2	.03	1.26	0	62	63
Cuicateco	22	4.69	85.36	0	1,956	11,286
Huasteco	141	48.73	908.78	0	35,902	117,099
Huave	15	4.77	166.5	0	7,855	11,451
Huichol	63	7.73	170.44	0	6,464	18,575
Ixcateco	4	.03	.98	0	47	62
Jacalteco	3	.37	10.99	0	371	877
Kanjobal	7	4.9	148.79	0	6,003	11,763
Kekchi	3	0	.04	0	1	3
Kikapu	1	.08	3.94	0	193	193
Mame	23	4.32	73.02	0	2,402	10,383
Matlatzinca	2	.42	20.36	0	998	999
Maya	260	293.16	2,528.25	0	8,7296	704,466
Mayo	43	15.39	324.21	0	10,163	36,976
Mazahua	107	47.04	1,075.18	0	44,633	113,037
Mazateco	92	64.01	847.39	0	20,845	153,825
Mixe	99	35.76	480.42	0	17,434	85,935
Mixteco	490	148.67	841.58	0	17,569	357,252
Mixteco Baja	5	.63	30.19	0	1,480	1502
Mixteco Costa	1	.01	.37	0	18	18
Mixteco Alta	1	.02	.9	0	44	44
Motocintleco	1	.07	3.43	0	168	168
Nahuatl	1020	494.01	2,556.22	0	51,015	1,187,113
Ocuilteco	3	.26	12.69	0	622	625
Otomi	345	11.17	1,067.52	0	31,031	264,744
Others	3	0	.06	0	2	5
Pame	10	1.26	35.18	0	1,393	3,036
Pame del sur	1	1.08	53.1	0	2,603	2,603
Pima	11	.27	7.55	0	252	656
Pima Alto	3	.02	.65	0	31	40
Pima Bajo	1	0	.04	0	2	2
Popoluca	22	11.82	325.56	0	13,765	28,398
Popoluca Texistepec	1	.07	3.47	0	170	170
Purepecha	181	37.56	501.94	0	11,619	90,259
Quiche	1	0	.1	0	5	5
Solteco	1	0	.02	0	1	1
Seri	1	.08	4.02	0	197	197
Tarahumara	137	21.81	389.75	0	15,914	52,402
Tepehua	5	1.67	57.96	0	2,081	4,022
Tepehuan	41	7.51	247.86	0	11,699	18,039
Tlapaneco	44	26.03	588.75	0	19,837	62,557
Tojolabal	10	14.4	551.1	0	26,533	34,598
Totonaca	193	81.07	957.71	0	36,131	19,4805
Triqui	18	5.26	163.84	0	6,901	12,640
Tzeltal	65	106.84	1911.71	0	64,917	256,725
Tzotzil	77	92.72	1241.35	0	40,692	222,802
Yaqui	87	3.97	151.47	0	7,271	9,547
Yuma	1	0	.02	0	1	1
Zapoteco	578	144.4	1,082.54	0	42,886	346,995
Zapoteco Ixtlan	4	.28	8.31	0	315	675
Zapoteco Istmo	2	0	.03	0	1	2
Zapoteco Sureo	25	6.84	166.11	0	7,448	16,441
Zoque	43	15.87	200.27	0	5,090	38,132

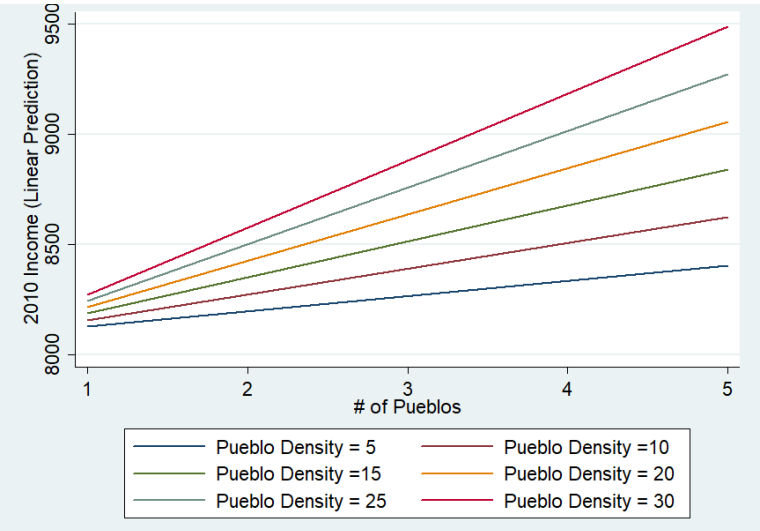


Figure 3.10: Interaction Effects # Pueblos and Pueblo Density

Table 3.15: First Stage Regression: # Pueblos and # of Neighboring Counties

	(1) # Pueblos	(2) # Pueblos	(3) # Pueblos
# Neighboring Counties	0.334***	0.360***	0.350***
	(0.0220)	(0.0257)	(0.0256)
Pueblo Density (Pop/Km2)		0.0232***	0.0236***
		(0.00324)	(0.00323)
City R Dummy			1.828**
			(0.607)
City R Density (Pop/Km2)			0.00739
			(0.00687)
Geographic Controls	Yes	Yes	Yes
Indigenous % Control	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes
Language Controls	Yes	Yes	Yes
N	2403	1943	1943
$Adj.R^2$	0.223	0.268	0.27
F	10.33	10.88	10.94

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.16: IV Estimation on HDI, Marginalization Index, and Gini Index

	(1) Marg I	(2) Marg I	(3) HDI	(4) HDI	(5) Gini	(6) Gini
# Pueblos	-0.0416*	-0.0275	0.00800***	0.00699***	0.907***	0.827***
	(0.0167)	(0.0171)	(0.00161)	(0.00163)	(0.115)	(0.124)
Pueblo Density (Pop/km2)		-0.00250**		0.000315***		-0.0156**
		(0.000829)		(0.0000789)		(0.00603)
City R Dummy		-0.376*		0.0446**		1.325
		(0.147)		(0.0140)		(1.067)
City R Density (Pop/Km2)		-0.0000620		0.0000293		-0.00484
		(0.00161)		(0.000153)		(0.0117)
Geographic Controls	Yes	Yes	Yes	Yes	Yes	Yes
Indigenous % Control	Yes	Yes	Yes	Yes	Yes	Yes
Rural Control	Yes	Yes	Yes	Yes	Yes	Yes
Modern Density Control	Yes	Yes	Yes	Yes	Yes	Yes
Language Controls	Yes	Yes	Yes	Yes	Yes	Yes
N	2403	1943	2403	1943	2401	1941
R^2	0.700	0.717	0.560	0.582	0.079	0.101

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.17: Negative Binomial Regression on the Effects of Geography in the Number of Pueblos

	(1) # Pueblos	(2) # Pueblos
Latitude	-0.0484***	-0.0140
	(0.00812)	(0.0173)
Altitude	0.254***	0.278***
	(0.0354)	(0.0351)
Ruggedness	0.00154***	0.00198***
	(0.000188)	(0.000182)
Mexico		4.174***
		(0.586)
New Galicia		3.783***
		(0.579)
Yucatán		4.856***
		(0.586)
New Vizcaya		3.964***
		(0.592)
New Navarra		4.217***
		(0.586)
Guatemala		3.320***
		(0.598)
lnalpha		
	-0.427***	-0.615***
	(0.0672)	(0.0670)
N	2460	2460
$PseudoR^2$		

Heteroskedasdicity robust standard errors are reported in parentheses

Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels

Table 3.18: Mesoamerica: Geographical Determinants of Pueblos, Cities, and its Populations

	(1) # Pueblos	(2) Pueblo Density	(3) Cities Rojas	(4) Cities Rojas Density	(5) Cities AvZ	(6) Density Cties AvZ
Latitude(Degrees)	0.0320	-1.013***	0.00234**	0.0789	0.00236**	0.0784
	(0.0242)	(0.1781)	(0.0011)	(0.0943)	(0.0010)	(.0956)
Altitude(Km)	0.351***	5.724***	0.00101	3.599	0.00412**	3.633
	(0.0635)	(0.5387)	(0.0026)	(3.423)	(.0021)	(3.424)
Ruggedness	0.00281***	-0.0308***	-0.00000111	-0.0209	-0.00000555	-0.0211
	(0.0004)	(0.0034)	(0.0001)	(0.0208)	(0.00009)	(0.0208)
N	2161	1699	2161	2161	2161	2161
$Adj.R^2$	0.042	0.097	0.002	0.0001	0.003	0.0001

Heteroskedasdicity robust standard errors are reported in parentheses

Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels

Note: Mesoamerica is calculated by the overlapping of current counties to the colonial borders that encompassed the territories of Kingdom of Galicia, Kingdom of Mexico, Captaincy of Yucatan, and the region of Chiapas, which at that time belonged to the Captaincy of Guatemala

Table 3.19: Aridamerica: Geographical Determinants of Pueblos, Cities, and its Populations

	(1) # Pueblos	(2) Pueblo Density	(3) Cities Rojas	(4) Cities Densities Rojas
Latitude (Degrees)	-0.0261	0.00373	-0.00288	-0.0263
	(0.0346)	(0.00548)	(0.0034)	(0.0264)
Altitude (Km)	0.396	0.0847*	-0.00437	0.0417
	(0.2722)	(0.0490)	(0.0043)	(0.0436)
Ruggedness	0.00377***	0.000367**	-0.0000154	-0.000452
	(0.0010)	(0.000167)	(0.0000205)	(0.0004548)
N	299	297	299	299
$Adj.R^2$	0.111	0.064	0.004	0.003

Heteroskedasdicity robust standard errors are reported in parentheses

Coefficient is statistically different from zero at the ***1 %, **5 % and *10% levels

Note: Aridoamerica is calculated by overlapping the current Mexican counties that did not belong to Mesoamerica, as expressed in last table (mainly the territories of Nueva Vizcaya, Nueva Navarra and Nuevo Santander)

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Biography

Fernando Arteaga González is a PhD Candidate in Economics at George Mason University. He graduated from *Centro de Ensenñanza Técnica y Superior* High School, Ensenada, Baja California, Mexico, in 2005. He received his Bachelor of Science in Economics from *Universidad Nacional Autónoma de México* in 2013.