Indigenous Origins of Colonial Institutions*

Luz Marina Arias Desha Girod

February 20, 2011

Abstract

Differences in colonial institutions appear to explain divergent patterns of political and economic development across former colonies. However, the origins of colonial institutions are not well understood. This article hypothesizes that variation in colonial labor institutions can be explained by both pre-colonial indigenous governance and the resource promise of colonies. We derive the hypotheses using a game-theoretic framework that emphasizes constraints facing profit-maximizing colonists, indigenous leaders and workers. We test the hypotheses using an original dataset of natural resources and labor and tribute institutions from the pre-colonial and colonial periods for 454 sub-national territories in the Americas. The findings suggest that differences in political and economic development today may predate European colonialism.

*We thank Sondra Appelson, Meagan Barrera, Bradford Crist, Richa Goyal, Trevor Kosmo, Ben Rosenblum, Karl Schuettler, Virginia Smith, and Marie Tranvouez for their research assistance. We are also grateful to B. Douglas Bernheim, Alberto Díaz-Cayeros, Ricardo Fagoaga Hernández, Jennifer Gandhi, Avner Greif, David Laitin, Ev Meade, Luis Fernando Medina, Romans Pancs, Sebastián Saiegh, Gabriela Soto-Laveaga, William Sundstrom, Gabriela Torres-Mazuera, Eric Van Young, Joel Watson, and Chris Woodruff for their feedback. We also thank participants at the Social Science and History Workshop at Stanford University and the Center for U.S.-Mexican Studies' Seminar and Writers' Workshop at UCSD, the APSA and the EHA Meetings in 2010. The research also benefited from the financial support of the Center on Democracy, Development, and the Rule of Law (CDDRL) at Stanford University and the Center for U.S.-Mexican Studies at UCSD.

1 Introduction

While colonial institutions appear to explain contemporary development,[1] the origins of colonial institutions and the mechanisms through which institutions persist are not well understood. Traditional explanations of different types of colonial institutions focus on European culture and religion (Weber, 1958), and European legal and economic institutions (la Porta et al. 1997, 1998; Lange et al. 2006; Mahoney 2010). Recent research emphasizes indigenous prosperity (i.e. population density, urbanization), settler mortality, and natural endowments (Acemoglu et al. 2001, 2002b, Engerman and Sokoloff 1997, 2000, 2006). However, the role of indigenous institutions and peoples remains largely unaddressed and the mechanisms behind institutional persistence poorly specified.[2] Were colonial institutions new or did they represent the persistence of indigenous governance practices?

When colonists arrived to the Americas, they encountered much more than a tabula rasa or institutional vacuum. They found rich and diverse indigenous institutions. For example, when Cortés reached the valley of Mexico, he found the Aztec empire, a prosperous and organized society with an agricultural surplus that could sustain a political elite, a religious elite, and an administrative hierarchy. Cortés wrote: "There are many chiefs, all of whom reside in this city, and the country towns contain peasants who are vassals of these lords and each of whom holds his land independently; some have more than others... And there are many poor people who beg from the rich in the streets as the poor do in Spain and in other civilized places," (Cortés 1986). Similarly, the Aztecs lived in "large and intricate polities" (Macleod 2000, p. 5) with a political administration able to mobilize labor for public works, cultivation of the fields, and religious activities (Cline 2000, p. 194).

In contrast, colonists encountered dispersed settlements in the sub-national Mexican states of Sonora, Sinaloa, Durango, Chihuahua and Baja California. The Spanish called them *rancherías*. Indigenous peoples in these settlements subsisted mostly on hunting and gathering, and political organization was decentralized. Headmen or elders (*principales*) provided guidance "...with oratorical skill" (Deeds 2000, p. 51). Indigenous peoples in these territories did not institutionalize tribute or organize communal labor. Instead, they relied on "bilateral forms of kinship organization" (Deeds 2000, p. 52). The variation in indigenous institutions raises an important empirical puzzle: How did pre-colonial institutions influence colonial institution building?

We use the colonization of the Americas as a natural experiment to study institutional development. The arrival of the colonists is an exogenous shock that allows us to disentangle indigenous and European influences on colonial institutions since Europeans had no contact with the region prior to their first expeditions in 1492. In Africa, the Middle East, and Asia, it is much more difficult to disentangle indigenous from European influences on

[1] See Nunn and Wantchekon 2008, Bardhan 2005, Rodrik et al. 2004, Easterly and Levine 2003, Glaeser et al. 2004, Acemoglu et al. 2001, 2002b, and Hall and Jones 1999.

[2] Africa scholars acknowledge the impact of pre-colonial institutions on economic development (Gennaioli and Rainer 2007, Boone 2003, Englebert 2000; see also Acemoglu et al. 2002a), as do Ertan and Putterman (2007) considering all countries. However, they assume persistence rather than provide a mechanism to explain institutional development.

colonial institutions because Europeans traded with indigenous peoples for centuries prior to colonial rule. As a result, the Americas offer the cleanest study of the origins of colonial institutions.[3]

The theoretical framework presented here explains when and how colonists settled by focusing on the interaction between colonists, indigenous leaders, workers, and natural resources. We focus on colonial labor institutions and we predict and observe the reproduction of indigenous institutional attributes in some cases, and a change in the underlying mode of labor governance in others.

Whether colonists replicated indigenous institutions depended on the promise of natural resources and the *degree of hierarchy* in indigenous governance. We define the degree of hierarchic governance as the degree to which indigenous leaders relied on a political infrastructure to enforce tribute laws and mobilize labor. In polities with a high degree of hierarchy, rulers had an extensive administration. In polities with low degrees of hierarchic governance, leaders relied instead on kinship relations to obtain labor or goods. Indigenous governance institutions therefore help explain why and how colonists profited from natural resources across the Americas.

Our theoretical analysis predicts that colonists settled faster in territories with a high degree of hierarchy than in other territories. Colonists were also better off in these territories by imitating indigenous governance. In doing so, they could reap profits from the existing structure. Two institutional channels drive this in the model. First, the more hierarchy in indigenous governance, the higher the share of the wealth leaders are able to keep for themselves. Second, hierarchic societies are more easily captured than non-hierarchic societies. Indigenous leaders in territories with high hierarchic governance have more to lose if defeated and captured after a military confrontation.

Some territories with low degrees of hierarchy, however, had the potential for natural resource wealth. In these territories, colonists built new, hierarchical labor institutions to obtain a higher share of the wealth than they would obtain otherwise. The prospects of profit offset the cost of building institutions. However, when colonists found low hierarchy and no resource promise, colonists did not settle at first. Once they did settle, they imitated indigenous governance institutions, wherein labor exchange was based on familial ties and higher labor mobility. In these regions, laborers received higher compensation for their work.

To test the argument, we collected original data across 454 subnational territories in the Americas. These data improve on existing quantitative work on early colonial institutions in two main ways. First, while existing quantitative studies measure colonial institutions indirectly with variables like settler mortality, we measure institutional and resource types directly. Second, existing quantitative studies analyze differences in colonial institutions using present-day national boundaries, which include a very broad range of indigenous and colonial institutions. We analyze subnational territories (still based on modern day

[3]There had been a few short-term expeditions to Newfoundland. In contrast to Africa and Asia, however, there had been no previous trade relations between the continents.

boundaries) and therefore reduce the different number of colonial institutions present in each unit under study.[4]

Our analysis has implications for several literatures. Domar (1970) first developed the argument that economic forces (i.e. the land to labor ratio) alone are not sufficient to explain labor institutions. Domar emphasizes the role of a political infrastructure able to restrict the movement of peasants and limit land ownership to only a few. Like Domar, we emphasize the role of political institutions. We take it further by analyzing the mechanisms by which external actors imitate or change different types of political infrastructures.[5]

Also, our analysis is related to the literature on the transfer of institutions. Berkowitz et al. (2003) study the determinants of legal institutions by analyzing the process through which legal institutions were transplanted in the colonies and find that transfers were successful in colonies where the transplant adapted to local conditions or where the population was familiar with the law. Their findings are in line with our argument that the institutions colonists "built" share common elements with the indigenous institutions already in place.

Furthermore, the approach here contributes to the literature incorporating history to the game-theoretic study of institutions (Greif and Laitin, 2004). By studying institutions as an endogenous process, under specific historical conditions, we are able to provide an explanation for the endogenous persistence and change of institutions.

Finally, historical institutionalism holds that institutions persist until challenged by a critical juncture.[6] New institutions that emerge after a critical juncture depend on a constellation of interests, ideas and pre-existing institutions. Consistent with historical institutionalism, we find that the same critical juncture, colonial expansion, had widely different effects on colonial labor institutions throughout the Americas. We find that the underlying structure of economic potential encountered by Europeans influenced the development of colonial labor institutions in predictable ways.

We begin with a description of indigenous governance institutions and natural resources when colonists arrived to the Americas. Second, we offer a theoretical framework to explain variation in colonial labor institutions. Third, we test observable implications of the theory with original data on natural resources and indigenous and colonial institutions. The final section concludes with a discussion of the implications of our study.

2 Landscape of the Americas

When colonists arrived to the Americas, they observed diverse natural environments and heterogeneous indigenous societies. We emphasize two aspects of the landscape they encountered: indigenous governance institutions that might have influenced colonist decisions

[4]The only paper to our knowledge studying subnational variation in colonial institutions is Bruhn and Gallego 2009. Its focus is on economic development while ours is on the mechanisms behind institutional development.

[5]See also (Acemoglu and Wolitzky, 2009), for an economic theory of coercion in labor arrangements.

[6]See Thelen 2004, and Thelen 1999 for a review. Also Pierson and Skocpol 2002.

to settle and to organize labor, and natural resources and raw materials that promised profits to the potential settlers.

2.1 Indigenous Governance Hierarchy

We focus on the indigenous rules and beliefs governing labor and goods surplus extraction by indigenous authorities for political or other purposes.[7] Indigenous governance regarding labor and goods exchange can be classified across a continuum where one extreme represents exchange based on kinship relations and reciprocity, and the other extreme represents exchanges based on what we call *hierarchic governance*. We define the degree of hierarchic governance as the degree to which rulers relied on a political infrastructure to enforce tribute laws and mobilize labor. In polities with a high degree of hierarchy, rulers had extensive administration. In polities with low degrees of hierarchic governance, leaders relied instead on kinship relations to obtain labor or goods.

Indigenous regions with hierarchic governance were governed by an elite with control over resources and labor. Control is evident in two areas: mode of surplus extraction and the ease with which indigenous peoples could migrate or escape.[8] First, in regions with hierarchic governance the elite consisted of a political authority supported by a legal and religious infrastructure of norms, beliefs, and social and political organizations.[9] Social and political differentiation was sustained by economic specialization that allowed for overall productivity and thus food surpluses. This structure gave the ruler and the elite access to a share of the surplus through labor drafts for public works and the cultivation of the fields, and through the collection of tribute.

For example, in present-day Mexico, according to Gerhard, "often a state consisted of a group of *calputin* within a very small area, or even part of a single, complex settlement, with its own ruler, nobility, commoners, and slaves" (1993, p. 4-5). The Spanish referred to this Mesoamerican *altepetl*, or city-state, as *señorío*. The *altepetl* consisted of a head, the *tlatoani*, surrounded by counselors, the *pipitlin*. The *pipitlin* also served as high-level functionaries (Cline 2000, p. 193) and sometimes governed subunits of the *altepetl* (*calpulli*). Each *calpulli* had its own god and its own hierarchy (Lockhart 1992, p. 16). Elites in the *calpulli* mobilized labor for public works, cultivation of the fields, and religious activities (Cline 2000, p. 194). Some states wielded military, economic, and sometimes political hegemony over others, like in the case of the Triple Alliance of the Mexica, Tepanec, and Acolhuaque—known as the Aztec Empire—which controlled much of the area of central Mexico. This Triple Alliance controlled a far-flung empire in which these three *altepetl* were dominant and all others subordinated to them. "In the period prior to the Spanish

[7] For more on the role of institutions as rules and beliefs see Greif 2006, p. 190. These rules and beliefs shaped the cognitive, informational, coordinative, and normative context for indigenous peoples, and in doing so facilitated or hindered the colonists' ability to use indigenous labor and obtain goods. Tella et al. 2007 provide evidence of the influence of economic institutions on the formation of beliefs.

[8] For the following characterization we rely primarily on Lockhart and Schwartz (1983), Villamarín and Villamarín (1975), Sanders and Marino (1970), and Greif (2006).

[9] See Macleod 2000, p. 5-6, and Lockhart 1992, p. 16.

conquest all peoples in the Valley [of Mexico] had been subordinated by way of tribute and military service to the tlatoani of Tenochtitlan, Texcoco, or Tacuba" (Gibson 1964, p. 34). Their hierarchical administrative structure facilitated the transfer of goods and labor to the capital of the empire in the valley of Mexico, and other urban centers.[10] Within this complex there were "countless quite autonomous states with their own tlatoque, together with others ruled by military governors and tribute collectors imposed by a tlatoani of a dominant state" (Gerhard 1993, p. 5).

Also, in regions with hierarchies, political authority and class differentiation were institutionalized and visible. Not only was the clothing of the ruling class distinguishable from that of the commoners, also "lavish residences, stone-lined tombs, and sumptuary privileges" gave evidence of the status of the elite constituting the political and administrative authority (Zeitlin 1989, p. 32). This is important because the existence of a single, identifiable agent facilitates negotiation and makes enforcing agreements with outsiders more credible.

In contrast, territories with no hierarchic governance tended to lack visible leaders. As noted by Lockhart, "even at the village level, tribute paying and community rotary labor were not known, nor was there a strong chief empowered to demand levies" (Lockhart and Schwartz 1983, p. 52). If there was a leader at all, this chief or headman was concerned mostly with ceremony and war, and his authority depended on merit (e.g. success in war, healing powers), suasion skills, or age. To obtain labor or goods from the community, the leader needed the consent of the community, relying for enforcement on kinship relations and peer-pressure (Deeds 2000, p. 52).[11] Whenever labor was organized at all (i.e. for war or ceremony), it was organized on the bases of age and sex. These societies relied on hunting and gathering and therefore had smaller food surpluses. For example, the Chichimecs occupying the arid plains and mountains of the north of present-day Mexico were hunters and gatherers, and "considered barbarians by the Mexica [Aztecs]" and other peoples living in the more complex societies. The Chontal and the Huave in the present-day state of Oaxaca and other tribes in present-day Guerrero offer other examples of non-hierarchical societies. Colonists viewed them as "people on a relatively primitive cultural level with simpler social and political institutions" (Gerhard 1993, p. 5).

In addition to the potential for surplus extraction, the degree of hierarchic governance has implications for whether indigenous peoples could migrate or escape. While those living in specialized societies were sedentary, others were hunters and gatherers and "had literally no cultivation of domestic varieties, no permanent settlements" (Lockhart 1992, p. 56). Thus, less hierarchic societies were more accustomed to surviving on the move and adapting to new environments. They could find refuge in the hinterlands because they were relatively more self-sufficient. Migrating was less costly for them. Indigenous peoples

[10] Furthermore, the peoples of central Mexico had pre-hispanic experiences of conquest (Cline 2000, p. 198). *Altepetl* were in constant competition with each other, which resulted in their frequent restructuration and in the formation of expansive units as a consequence of alliances (Bartolomé 1992, p. 255), like in the case of the Aztec Empire.

[11] See Greif 1994 for a description of community-based enforcement.

in hierarchic regions found it more difficult to migrate because they possessed a specialized set of skills (intensive agriculture, trade, or ritual-making, for example). Furthermore, most of the hierarchical territories were in the highlands, from where it was harder to escape. Peoples on the lowlands and coastal areas could escape the colonists by retreating inland. This mobility has implications regarding the ability of indigenous societies to avoid capture in a military defeat. Because of the higher ability to flee in less hierarchic societies, the probability to be captured once defeated is higher the higher the degree of hierarchic governance.[12]

2.2 Resources

Colonists found different natural endowments and raw materials across the Americas. 'Resources' are those natural endowments and raw materials that were valuable because technological and institutional conditions made their appropriation and utilization possible and profitable.[13] For example, sugar grew better in tropical climates, but its large scale production became possible only in the fifteenth century with the technological innovation of the two-roller mill.[14] Furthermore, the possibility to commercialize the crop and export it to Europe was a necessary condition for its high profitability. The consumption of sugar was not widespread in the fifteenth century, but by the sixteenth century, cooking manuals include references to sugar that suggest sugar had become part of the European diet, at least for the aristocracy.[15]

We categorize resources according to whether they were valuable resources to potential settlers based on two factors.[16] First, we account for the marketability and price of the resource in world markets. Second, we account for the scalability of the production process, the capital investment required. Resources can therefore be categorized based on whether they had high or low marketability, and whether they required high or low levels of capital investment. Resources with high marketability and low levels of capital investment included minerals and timber (Glade 1969, p. 74-77). Resources with high marketability and high levels of capital investment included cotton and sugar. Resources with low marketability and low levels of capital investment included livestock. The category of low-marketability, high-capital investment resources was null.[17]

[12]For more on social and geographic factors relating to escape see Service (1955). See Lockhart 1992, p. 52-56 for mobility of warfare.

[13]For a thorough discussion of resources as a dynamic concept functionally related to a complex of variables see Glade 1969, p. 14-21.

[14]The traditional mill consisted of one large circular-stone and required cutting the sugar cane. The new form did not require the cane to be cut since it could pass through the two rollers cogged together. Schwartz (1985) has more detail on the role of the mill innovation in the appearance of the plantation as a way of organizing production.

[15]See Schwartz 1985, p. 5.

[16]We are not the first to emphasize marketability and the technology of production. See for instance Engerman and Sokoloff 2002, p. 44 .

[17]Cochineal could not be produced in large scale because of the time and care intensive labor that the cacti home to the cochineal insect require. For a specific analysis of the production and export of cochineal and its implications for the development of colonial institutions see Díaz-Cayeros and Jha, 2011.

Because the potential for large-scale, profitable agriculture was contingent on technology and markets, colonists sometimes viewed certain lands that lacked indigenous agriculture or society as potentially profitable. For example, some warm and tropical areas in the islands of the Caribbean, parts of Brazil and parts of southeast Mexico were optimal for sugar and cotton. Yet, none of these territories had pre-existing societies with high levels of hierarchic governance, nor did they have agriculture as the main form of sustenance. Similarly, while colonists found silver and gold mines in Central Mexico and the highlands of Peru, territories with high degrees of hierarchy, colonists also found mines in areas lacking hierarchy, such as present-day Zacatecas in the northeast of Mexico, for example.[18]

3 Analytic Framework

We propose a mechanism that explains differences in colonial labor institutions. We argue that early colonial outcomes in the Americas result from variation in indigenous governance, together with the natural endowments valuable to the colonists.

We formalize the strategic interaction between colonists, indigenous leaders, and labor. The historical evidence supports focusing on the entrepreneurs exploring the regions as opposed to the Crowns they represented. After the early experiences in the Caribbean, "the idea of direct crown supervision of overseas expansion (...) faded rapidly in the face of the realities of the Indies" (Lockhart and Schwartz 1983, p. 78). Conquest and colonization was largely carried out by private enterprise and organized on a mercantile basis backed by wealthy Europeans holding charters from their respective crowns. These entrepreneurs, however, relied mostly on their own financial resources. The crowns provided some financial resources at first, but the contributions were small relative to the overall cost of the enterprise. For instance, early explorations in Spanish America were undertaken by the *huestes Indianas*, parties consisting of military men, seamen, religious men for the spiritual care of the soldiers and to intervene in the conversion of the indigenous, and fiscal authorities. The leader of the exploration party would "sport the title captain," and was invariably a man of standing in the base area (Lockhart and Schwartz 1983, p. 79).[19]

Players, interaction, and payoffs

Consider a complete information game with three players: colonists (player 1), indigenous leaders (player 2), and workers (player 3). Colonists first explore a region and observe its indigenous governance institutions, α, and its resource wealth r.[20] As argued in section

[18] Minerals were not as highly valued or commercialized by the indigenous peoples, nor was their technology for the extraction of minerals from the ore as developed as that of the Europeans. Even though gold and silver were part of the attire of the highest indigenous authorities—which pointed out to the Europeans the existence of metals—these metals were not used as a means of exchange in the Americas, as was the case in Europe.

[19] See Zavala (1988) for more on the Spanish expeditions and legal instructions for the conquest.

[20] There is evidence that upon arrival colonists inquired about the types of resources and the forms of governance. See, for instance, Villamarín and Villamarín 1999, p 579. Furthermore, colonists obtained early

indigenous governance specifies the degree to which labor and tribute exchanges are enforced through a political administration, and thus the share of the surplus that goes to the rulers. We operationalize indigenous institutions as specifying the division of the output between indigenous leaders and workers *before* the arrival of colonists. Let $\alpha \in (0, 1)$ be the share of the output kept by indigenous leaders. Correspondingly, $1 - \alpha$ is the share kept by workers. A higher α implies more hierarchic indigenous governance, and thus a higher proportion of the output kept by the indigenous leaders. As such, the parameter α allows us to highlight the role of indigenous leaders as intermediaries between the colonists and workers.

After a colonist has explored the territory, he chooses whether to seek permanent settlement. If deciding not to settle, the colonist explores a new region and observes its governance institutions and resource wealth, and, again, chooses whether to seek permanent settlement. If choosing to settle, the colonist decides whether to imitate or to change the degree of hierarchy of indigenous forms of governance. Imitation entails bargaining with the leaders on a division of the total production surplus. In the case of imitation, the colonist interacts only with the leaders. If instead the colonist changes institutions, he faces the workers directly and suppresses the leaders. After observing the change in institutions, the workers choose whether to comply with the colonial regime.

Concretely, the timing is as follows:

1. Colonists explore and decide whether to settle. If not settling, they keep exploring.

2. Once they decide to seek permanent settlement, the colonists decide whether to invest in changing the degree of hierarchy of indigenous forms of governance. They can either imitate indigenous institutions or build new institutions.

3. If imitating indigenous institutions, colonists bargain with the indigenous leaders a division of the production surplus.

4. If building new institutions, colonists choose x such that $\alpha' = \alpha + x$, where $\alpha + x$ is between zero and one. There is a cost $c(x)$, increasing in x, to changing indigenous governance.

Let $p(r)Y(K, L)$ be the value of the total output from a region with resource wealth r, and capital investment K and labor L; $p(r)$ represents the price and marketability of the natural endowment in world markets. We include L in the production function to emphasize that labor is necessary to exploit the resources of a region. If labor does not comply with colonial rule after a change in institutions, total output is zero. To simplify notation in what follows we use pY for the total value of output.

In the following sections we specify in more detail the interaction at each stage of the game, the payoffs and the outside options of the players.

on an idea of the functioning of each society. They could not understand the detail of all the norms, beliefs and organizations. However, indigenous leaders and differentiation were often visible. See also Lockhart and Schwartz 1983, p. 79.

3.1 Bargaining

The colonists and the indigenous leaders, players 1 and 2, have the opportunity to reach an agreement whereby they will split the surplus from the production process. The set of possible agreements is:

$$\mathbf{Y} = \{(y_1, y_2) | y_1, y_2 \geqslant 0, y_1 + y_2 \leqslant \alpha p Y\}$$

As long as they do not reach an agreement, there is the possibility of a military confrontation between the colonists and the indigenous leaders. The outcome of the confrontation depends on who is defeated, and on whether the winner is able to capture the defeated. Thus, the 'loser' can escape and avoid being captured, or concede to the winner. There is broad scholarly agreement that the war technology of the colonists was superior to that of the indigenous peoples.[21] Therefore, we assume that if a confrontation ensues, the colonists win with probability one. Nonetheless, some indigenous peoples were more likely than others to be captured.

Let π^c be the probability that the colonists capture the indigenous leader and, correspondingly, $1-\pi^c$ the probability that the indigenous leader flees and resists to be captured. This probability is a function of the hierarchy in indigenous institutions. As argued in section 2, hierarchic societies are more likely to be captured once defeated. Therefore, π^c is increasing in α. If captured, the indigenous leader is killed and thus receives a zero payoff. Otherwise, the leader is able to keep all of the production surplus to herself: $\alpha p Y$. In turn, the colonist receives a zero payoff if the indigenous leader flees, and if capturing the leader obtains $(\alpha - \phi)pY$, where ϕ is the fraction of the production output that colonists are not able to extract without the indigenous leaders.

We apply a static axiomatic approach to obtain the outcome of the bargaining process, and in particular we use the Nash bargaining model.[22] Even though Nash's is a static approach that does not explicitly specify the extensive form representation of the bargaining procedure, Binmore et al. (1986) show that for an appropriate choice of the disagreement point, the Nash solution approximates the perfect equilibrium outcome of the alternating offers model in Rubinstein (1982) when the length of a single bargaining period is sufficiently small. In our case, the Nash bargaining problem is defined by:

$$S = \{(u_1, u_2) | y \in \mathbf{Y} \text{ subject to } (u_1, u_2) = (u_1(y), u_2(y))\},$$

$$s^0 = (u_1(b), u_2(b)).$$

where b is the disagreement outcome obtained in the case of a military confrontation between the players, as described above; $u_1(y)$ and $u_2(y)$ are the von Neumann-Morgenstern

[21] See Powell 1972, p. 205; Lockhart and Schwartz 1983, p. 80-83; Mahoney 2010, p. 57. Some indigenous leaders attempted to defeat the colonists to keep their position of authority intact, but no indigenous group succeeded. In some cases, indigenous leaders even sought agreements with the Colonists preemptively. After receiving notice of the defeat of the Aztecs in Tenochtitlán, the reigning Zapotec ruler in Tehuantepec, in the Isthmus region in Oaxaca, sent rich gifts and promises of loyalty to Spanish emissaries exploring the highlands of southern, present-day Mexico: see Zeitlin 1989, p. 34.

[22] This is also known as the Nash cooperative solution, first characterized by Nash (1950).

utility representations of the preferences of colonists and indigenous leaders over outcomes. We assume that players are risk neutral and so drop u from now on and focus on expected utilities.[23]

The agreement specified by the Nash solution to the problem described above is the solution for[24]

$$y^N = \arg\max_{y \in \mathbf{Y}} [y_1 - \pi^c(\alpha - \phi)pY][y_2 - (1 - \pi^c)\alpha pY].$$

There are mutually beneficial agreements since a portion of the production output surplus is lost if agreement breaks down: ϕpY is lost. The Nash solution specifies the following agreements:

$$y_1 = \pi^c \alpha pY - 1/2(\pi^c \phi pY), \tag{1}$$

$$y_2 = (1 - \pi^c)\alpha pY + 1/2(\pi^c \phi pY). \tag{2}$$

The players divide the value created from bargaining, ϕpY, in half and keep a share of the remaining production surplus according to the probability of capture. Societies with hierarchies are more likely to be captured and thus the leader must transfer a larger portion of the production surplus to the colonists to reach an agreement. The value created is divided in half because we assumed a symmetric solution. If we allow for asymmetries in the bargaining power of the players not resulting from differences in utility functions or the disagreement point, we could obtain different partitions of the surplus lost. A more general characterization of the partition would be $\beta \pi^c \phi pY$ where β is the bargaining power of the indigenous leaders. Alternatively, we could assume that the indigenous leaders are more risk averse than the colonists (not unreasonable) which would increase the share obtained by the colonists.

The result shows that by imitating the existing indigenous institutions the colonists obtain a surplus. Furthermore, the surplus is higher, the higher the degree of hierarchy of the indigenous society. Two 'institutional' channels make the surplus higher. First, leaders of more hierarchic societies are able to extract a higher share of the surplus. Second, the share of the colonist is higher because more hierarchic societies are more easily captured. Indigenous leaders, thus, have more to lose if the agreement breaks down. Also note that the presence of highly profitable resources (higher pY) and a higher hierarchy (higher α) increase the share for both colonists and leaders, increasing the likelihood of an agreement.

3.2 Building institutions

The colonists can choose to create labor institutions that differ form indigenous institutions rather than bargain with the leaders and imitate indigenous forms of governance. When investing in new labor institutions, the colonist chooses a share $(1 - \alpha')$ of the production surplus to give to the workers. Colonists can change the degree of hierarchy by either reducing the mobility (ability to escape) of the workers through increases in coercion and

[23] We discuss below how making the players risk averse changes the results.

[24] The solution satisfies the four axioms formulated by Nash: scale invariance, efficiency, symmetry, and independence of irrelevant alternatives.

hierarchy (increase in α'), or by providing positive incentives to workers (decrease in α'). We focus on the case in which colonists always prefer a higher α' to simplify the exposition and because we seldom observe colonial institutions going in the opposite direction.[25] Therefore, we model institution building as the implementation of policies that reduce the outside option of the workers. For an investment in hierarchy of size x, the worker's participation constraint becomes $(1-\alpha')pY \geq v(\alpha) - x$, where $v(\alpha)$ is the outside option of the worker for a pre-existing degree of hierarchy α. As we argue in section 2, $v(\alpha)$ is decreasing in α.

For workers to comply with colonial rule, the colonist needs to give the workers at least a subsistence level wage. Let $\bar{v}$ be the subsistence wage. To maximize his payoff the colonist chooses x such that

$$\bar{\alpha} = 1 - \frac{\bar{v}}{pY}. \tag{3}$$

That is, $x = v(\alpha) - \bar{v}$. Equation 3 implies that colonists build institutions that extract more of the surplus from the workers the higher the resource wealth and the lower the level of subsistence of the workers.[26] African workers are an example of workers with a low subsistence level: they were displaced to unknown environments far away from their homeland. This result implies that using African slavery in regions with potential for sugar allowed for a large extraction of surplus.

Building more hierarchic institutions is costly. The cost depends on the difference between the new level of hierarchy and the previous level of hierarchy. The less hierarchic the society, the more costly it is for the colonist to impose a control infrastructure relying on hierarchy and coercion. Let $c(x)$ be the cost of hierarchies; $c(x)$ is increasing in x. The payoff to colonists from building more hierarchic labor institutions is $\bar{\alpha}pY - c(x)$, where $\bar{\alpha}$ is defined in (3).

The following proposition gives the condition under which we observe a change in governance in a subgame perfect equilibrium. The condition derives from comparing the payoff to the colonist upon reaching an agreement with indigenous leaders for a given α, to their payoff if instead more hierarchic institutions are put in place.

Proposition 1. *If the following inequality holds, in equilibrium the colonists invest in more hierarchic institutions $\alpha' = \bar{\alpha}$ and the workers comply with the colonial regime as long as $(1-\alpha')pY \geq \bar{v}$.*

$$\frac{\bar{v} + c(x)}{pY} \leq 1 - \pi^c \alpha + \frac{\phi}{2}. \tag{4}$$

[25] We could modify the model to allow for equilibria in which colonial institutions are less hierarchic than indigenous institutions by, for example, making the production process be influenced by the degree of hierarchy: if some production processes require more qualified workers, and qualified workers have higher reservation wages, increasing hierarchy may disincentivize effort.

[26] In addition to Indigenous labor, the colonists also employed Africans and Europeans in some regions to supply the necessary labor. Note that bringing outside labor can be interpreted as workers with a low subsistence wage specially in regions with difficult escape options. For instance, workers displaced to regions very different from their native regions, and regions lacking access to land. Displacing workers was indeed a from of building labor governance institutions. Workers in our analysis need not only refer to Indigenous labor but also to African or European labor.

Otherwise, in equilibrium the colonists reach an agreement with the indigenous leaders and imitate indigenous institutions.

This result implies that there is a cutoff value for the initial level of hierarchy,

$$\alpha^* = \frac{1}{\pi}(1 + \frac{\phi}{2} - \frac{\bar{v} + c(x)}{pY}),$$

below which we will see institutional change as long as the parameters are such that the following inequality holds: $\bar{v} + c(x) \leq pY[1 - (1/2)\phi]$.

Whenever the cost of building institutions plus the subsistence wage of workers are high as a proportion of the value of total output, we expect colonists to imitate indigenous levels of hierarchy. This will be the case whenever there are no highly profitable resources in the region, or workers have high subsistence wages. An increase in the profitability of resource wealth increases the range of values for which equation 4 holds and institutional change happens. Also, an increase in the proportion of the output lost in case of a break down in bargaining increases the cutoff value α^*, leading to institutional change for a larger range of initial levels of hierarchy; concretely, for any $\alpha < \alpha^*$. Finally, a decrease in the probability of capturing an indigenous society increases the range of values for which institutional change will be observed (recall that this probability is higher the higher the degree of hierarchy). In all, this implies that we should expect colonists to build more hierarchic labor institutions in societies with lower degrees of hierarchy and with profitable resources.

3.3 Settlement

When deciding whether to seek permanent settlement, colonists will make their decision based upon indigenous governance and resource wealth. Colonists will settle first in regions with high payoffs. Regions with hierarchic governance promise a share of the production surplus to colonists and facilitate the bargaining with indigenous leaders. Regions with resource wealth promise a higher value of the output produced. From the above analysis, thus, we expect that regions with more hierarchic governance and with high resource wealth will be settled first. Furthermore, recall that $Y = Y(K, L)$. Production requires not only labor but also capital. Different resources require different capital investments. Those production processes necessitating higher initial investments (high K) entail higher initial setup costs and so offer a relatively lower payoff upfront than do those with lower initial investment costs. Exploiting resources that require investment will thus be less attractive initially as long as lower investment resources are believed to be available.

The decision of whether to settle depends also on the regions yet to explore: the availability of unexplored regions and the belief about their potential. As settlement in other regions reduced the availability of unexplored areas, or changed the belief about the existence of hierarchic governance and/or resources in the unexplored areas, we expect to see an increase in settlement in regions with less expected payoffs. Thus, we expect regions with less governance hierarchy and with resources that require higher investment to be settled later.

3.4 Testable Hypotheses

The above analysis implies specific testable hypothesis regarding the colonist rate of settlement and the degree to which colonial labor arrangements rely on hierarchies:

Hypothesis 1a: After an expedition, colonists should settle faster in territories with higher indigenous governance hierarchy (high α). Hypothesis 1b: After an expedition, colonists should settle faster in territories with highly profitable resources that require little capital investment (high p and low K) than in territories that lack such resources.

Hypothesis 2a: When indigenous governance hierarchy is high, colonial labor institutions are likely to imitate indigenous institutions. That is, the cutoff value α^* falls as the probability of capture, π^c, increases. Hypothesis 2b: As resources become less profitable, colonial labor institutions are more likely to imitate indigenous institutions. That is, a decrease in pY reduces the range of values for which the inequality in proposition 1 holds. Hypothesis 2c: As resources become more profitable, new hierarchical colonial labor institutions are more likely to emerge. That is, an increase in pY increases the range of values for which the inequality in proposition 1 holds.

4 Data

To determine whether resources and indigenous institutions influence the speed and type of colonial settlements, we created an original dataset including all 454 subnational territories in the Americas. Our unit of analysis is the "territory" in the Americas. Territories constitute the largest political demarcation within present-day countries (i.e. 33 states in Mexico, 10 provinces and 3 territories in Canada, 9 departments in Bolivia, and so on).[27] The Americas offer the cleanest test of our argument because colonists had no contact with the territory prior to their expeditions. We therefore avoid the endogeneity problem we would face if studying other regions, where previous contact with colonists might have influenced the development of the colonial project.

We collected data on natural resources and indigenous institutions at the time that expeditions reached each of the subnational territories, as well as on colonial institutions once the colonists settled. Appendix A provides descriptive statistics. These data improve on existing quantitative work on early colonial institutions in two main ways. First, existing quantitative studies measure colonial institutions indirectly with variables like settler mortality. Some countries, however, received different colonial institutions despite having similar settler mortality rates. For example, while settler mortality was equally high in Mexico and Argentina, early settlers did not introduce free labor to Mexico, but introduced it to forty-three percent of Argentina. In contrast, we measure institutional and resource types directly. Second, existing studies analyze variation in colonial institutions using present-day national boundaries. However, indigenous peoples and settlers built different types of institutions within modern-day countries. Settlers in present-day Argentina and the United States, for example, established *repartimientos* and *encomiendas* in addi-

[27] The reported sample is smaller than 454 because of missing data on some of the variables.

tion to free labor. By analyzing subnational territories instead of nation states, we reduce the different number of colonial institutions present in each unit under study.[28]

4.1 Indigenous Governance Hierarchy

The first independent variable of interest is pre-colonial indigenous governance hierarchy. Hierarchy is based on the type of labor governance and tribute collection indigenous people organized in each territory. We code indigenous labor organization on an ordered 3-point scale fifty years before the colonial expedition reached the territory. The first expedition is coded on the earliest year on record marking the arrival of colonists to the territory. The fifty-year lag in coding indigenous institutions ensures that colonists did not influence indigenous institutions. Territories with no specialized political or religious institutions that could mobilize labor are coded as "0". In these territories, if labor was organized at all, it was organized on the bases of age and sex. An example of this type of indigenous governance are the Guaraní in Paraguay where kinship played an important role.[29] When indigenous leaders could mobilize communal labor, the territory was coded as "1". Leaders in such territories typically mobilized labor for religious or military purposes. The Arawaks in the Caribbean islands show this pattern of labor organization. There was some asymmetry in political power, even if nominal and on the basis of personality. Finally, territories where political or religious authorities systematically organized labor drafts for public works, cultivation of fields, and so on, were coded as "2".[30]

As with indigenous labor organization, indigenous tribute collection is coded on an ordered three-point scale fifty years before the colonial expedition arrived. Territories with no systematic collection were coded as "0".[31] Territories with systematic local collection were coded as "1" (for example, the Chibcha of present-day Colombia), and territories with systematic collection and transferring tribute to an authority external to the indigenous society were coded as "2".[32] The territories part of the Inca and Aztec empires, in the Andean region of South America and central Mexico, respectively, are examples of the latter type of tax governance. Indigenous labor and tribute are positively correlated at 0.68.

[28] We relied on ethnographic and secondary sources in the historical literature to code institutions and resources. We are in the process of creating a detailed Appendix for the sources and data collection. Some of our major sources are: Steward, ed 1946, Bethell, ed 1984, Sokolow 2003, Burkholder and Johnson 2007, Birmingham 2000, Tandeter 1993, Bethell 1987, Schwartz 1978, Newson 1995, Lovell 2005, Bakewell 1971, Boucher 1992, Newson 1987, Malinowski and Sheets, eds 1998, Osgood 1904-07, Rabushka 2008; http://countrystudies.us, http://www.britannica.com/.

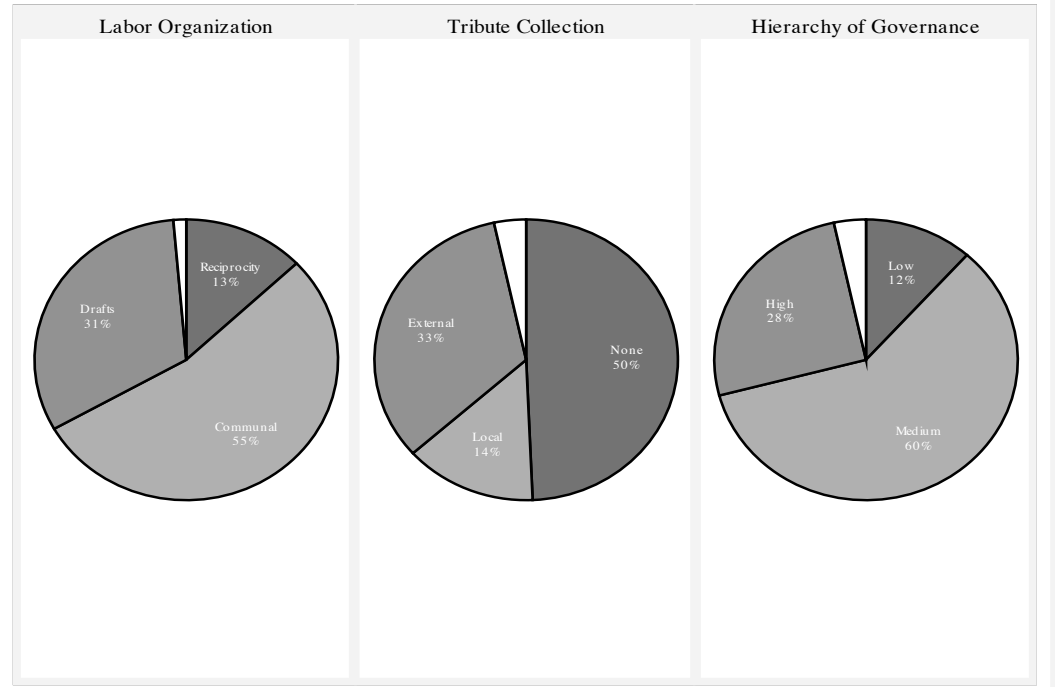
[29] See for instance Lockhart and Schwartz 1983, p. 260

[30] When more than one level of labor organization is present in a territory, we code the territory as having the higher level of labor organization (this was the case in eleven percent, 51 out of 454, territories). Results hold when coding the territory as having the lowest value.

[31] There could be some tribute collection for war or other purposes, but the tribute had to be requested each time. Again, the Guaraní fit this category.

[32] In two percent of the territories (8 out of 454), we found more than one level of tribute collection and, as with labor organization, we code these territories as having the higher level of tribute collection. Results hold when coding the territory as having the lowest value.

Figure 1: **Distribution of Indigenous Institutions**



Using the data on indigenous labor and tribute, the degree of indigenous governance hierarchy can be separated into three levels: low, medium, and high. Territories where labor and tribute both equal "0" are coded as having low-level hierarchy. These territories consist of societies with no specialization of labor, where some individuals functioned as leaders but only for specific roles and under specific circumstances, such as war. In these territories, kinship was stressed in economic and political exchange. Territories were coded as having medium-level hierarchy when labor and tribute were not both "0" or "2". These territories had some political leadership with the ability to obtain labor and resources from the local community on a regular basis, but lacked routinized labor drafts. Territories were coded as having high-level hierarchy when both labor and tribute were coded as "2". In these territories, a central authority operated with intermediary authorities that administered the relationship between communities and the elite.

Figure 1 demonstrates the distribution of indigenous labor organization, tribute collection, and governance hierarchy. While 13% of territories had the lowest-level labor organization, 50% had the lowest-level tribute collection. The two categories overlap in 12% of territories, and the territories in the overlap are considered to have low-levels of indigenous governance hierarchy. These territories constituted 10% of the landmass of the Americas by area.

Thirty-one percent of territories had labor drafts and 33% had external tribute collection. Twenty-eight percent of territories had both and are therefore coded as having high-level hierarchy. These constituted 20% of the landmass of the Americas by area.

The vast majority of territories, the remaining 60%, had medium-level hierarchy. These territories represented 63% of the landmass by area. Most of the observations in this category (77%) have communal labor and no systematic tribute collection (labor = 1 and tribute = 0) or communal labor and local tribute collection (labor =1 and tribute = 1). Finally, 10% of territories, mostly small island countries, are missing data on at least one of the two variables, and these represent 13% of the landmass.

4.2 Resources

The second independent variable of interest is resources. Highly profitable resources are coded as requiring minimal capital investment (minerals and timber), or large amounts of capital (cotton and sugar). Resources that generated lower profit, but required low investment (livestock) are also analyzed. We code whether any of these resources were available in each territory on the expedition year, regardless of whether the indigenous groups were exploiting the resource. If the specific resource was present, the territory was coded as "1" for the binary variable representing the resource. If the resource was lacking, the territory was coded as "0" for the specific resource. Forty-five percent of the territories had minerals, 41% had timber, 33% had livestock, 26% had cotton, and 18% had sugar. Resources and indigenous governance hierarchy are not strongly correlated, with none of the pairs exceeding 0.4.

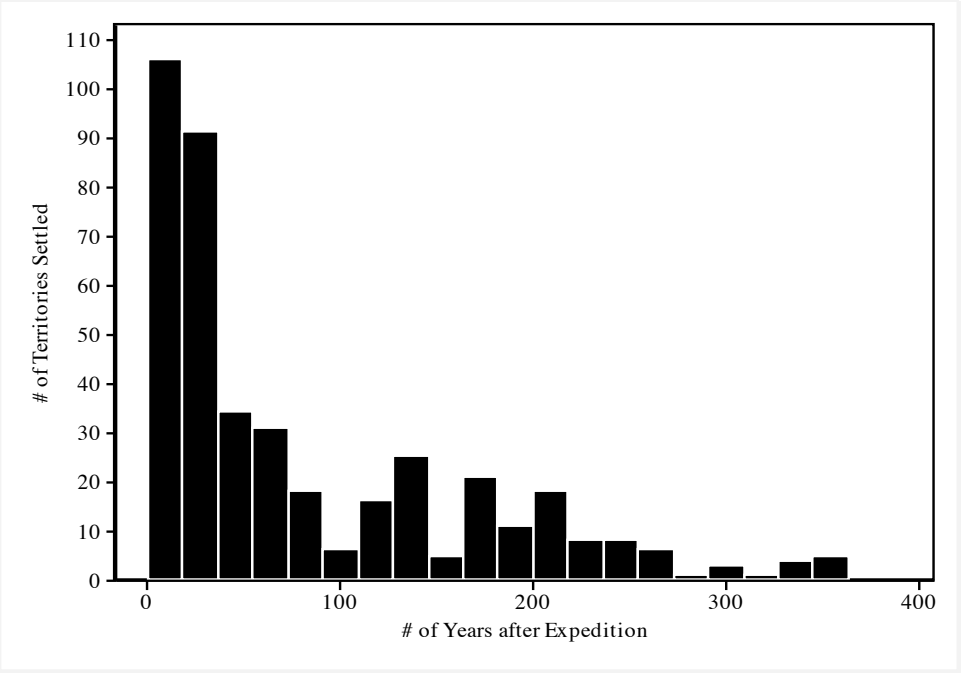
4.3 Settlement and Colonial Labor Institutions

We investigate the influence of indigenous governance and resources on settlement and on the development of five common colonial labor institutions: *Free Labor*, repartimiento *Repart*, encomienda *Encom*, indigenous slavery *IndigSlavery*, and African slavery *AfrSlavery*. The precise year of settlement was coded on the year that a governor or mayor arrived (whichever was first) to govern the territory. The five institutions were coded as present, "1", or absent ,"0", fifty years after a governor or mayor began governing the territory.

Of the five types of colonial labor arrangements, free labor is the least hierarchical. It is based on direct, sometimes contractual, agreements between laborer and employer. Free labor did not involve coercion, quotas or intervention of crown officials. The institutions of repartimiento and encomienda were more hierarchical. Repartimiento was a system of quotas wherein the colonists had to petition crown officials—the viceroy or the audiencia in Spanish America—for workers.[33] For a fixed wage, workers would tend to colonist property on a rotational basis. The legal work period was one or two weeks and wages were lower

[33]In central Mexico before the conquest, this form of labor arrangement was known as *cuatequitl* and in Ecuador, Peru, and Bolivia, it was known as *mita*.

Figure 2: **Number of Territories Settled Across the Americas**



than those paid for free labor.[34] The encomienda was a legal institution that assigned a number of indigenous people to a colonist, who then seized tribute and labor from them, supposedly in exchange for protection and instruction in the Catholic faith. Unlike workers in repartimientos, workers in encomiendas were nonsalaried, but owned the lands where they worked. Finally, there was slavery of indigenous and African peoples.[35] The five institutions can be roughly mapped onto a continuum where free labor represents the least hierarchical, then repartimiento, encomienda, and finally indigenous slavery and African slavery.

Free labor was present in 41% of the territories, repartimientos were present in 37%, encomiendas, were present in 27%, indigenous slaves were present in 21%, and African slaves were present in 30%. Fifty-one percent territories (218 out of 425) had more than one type of colonial labor institution (Appendix A).

5 Empirical Analysis

5.1 The Rate of Settlement

According to the theory presented here, indigenous governance hierarchies and highly profitable resources that are require minimum capital to extract should accelerate the rate of colonial settlement (hypotheses 1a and 1b, respectively). The dependent variable is the probability of settlement after the first colonial expedition in a territory. Expeditions in the Americas occurred over 333 years, and settlement took almost four centuries, 398 years. Spain launched the first expedition in 1492 and reached the Dominican Republic, Haiti, Cuba and the Bahamas. The United Kingdom launched the last expedition in 1825 into the Yukon province of Canada. The median year of expedition was 1530. On average, colonists settled 81 years following an expedition. The first settlement was in 1500 in the Dominican Republic, and the last was in 1898 in Yukon. The shortest amount of time between expedition and settlement was one year (in Cusco, Peru, for example), and the longest was 360 years (in Tierra Del Fuego, Argentina). By 1550, 28% of the territories were settled. Fifty-five percent of the territories were settled by 1600, 75% by 1700, and 89% by 1800. All territories were settled by 1898. Figure 2 demonstrates the distribution of the data.

Raw score data appear to support both hypotheses 1a and 1b. Figure 3 uses the Kaplan Meier (1958) nonparametric failure function to display the probability that colonists settled after an expedition in territories with differing levels of governance hierarchy. Settlement occurs fastest (slope is steepest) in territories with high level hierarchy. Settlement occurs less fast in territories with medium level hierarchy, and is slowest in territories with the lowest level hierarchy. The log-rank test for the equality of the function for the three levels is statistically significant at the 99 percent level. On average, colonists took 22 years to settle in territories with high hierarchy, 89 years to settle in territories with medium-level hierarchy, and 167 years to settle in low-hierarchy regions.[36]

Furthermore, resources that involved highly profitable resources requiring minimal capital (minerals and timber) accelerated settlement. Figure 4 uses the Kaplan Meier nonparametric failure function to demonstrate the likelihood that colonists settled after an expedition in territories with and without minerals and in territories with and without timber. While colonists settled in territories with minerals in 51 years after an expedition on average, colonists settled in territories without minerals in 111 years on average, a difference of 60 years. The rate of settlement is 34 years faster in territories with timber than in territories without timber. Colonists took much longer to settle in territories with

[34] According to Haring, "by the mining ordinances of the viceroy Toledo, *mitayos* assigned to the mines in Peru were to be paid two and a half reals a day, free laborers three and a half reals."

[35] The raiding of indigenous peoples was prevalent only during the initial stages of expeditions, the first 15 to 20 years. The high mortality of the indigenous slaves, and the rapid depopulation of the first islands encountered curbed mass raidings. See Trigger and Swagerty 1996, p. 339.

[36] Figure 3 demonstrates that, in the first years of expedition, settlement occurred fast in certain territories that lacked high-level hierarchy. These fast settlements occurred in rich Caribbean countries with medium-level hierarchy where colonists saw the potential for mineral wealth.

Figure 3: **Colonists Settled Faster in Territories with More Hierarchy**

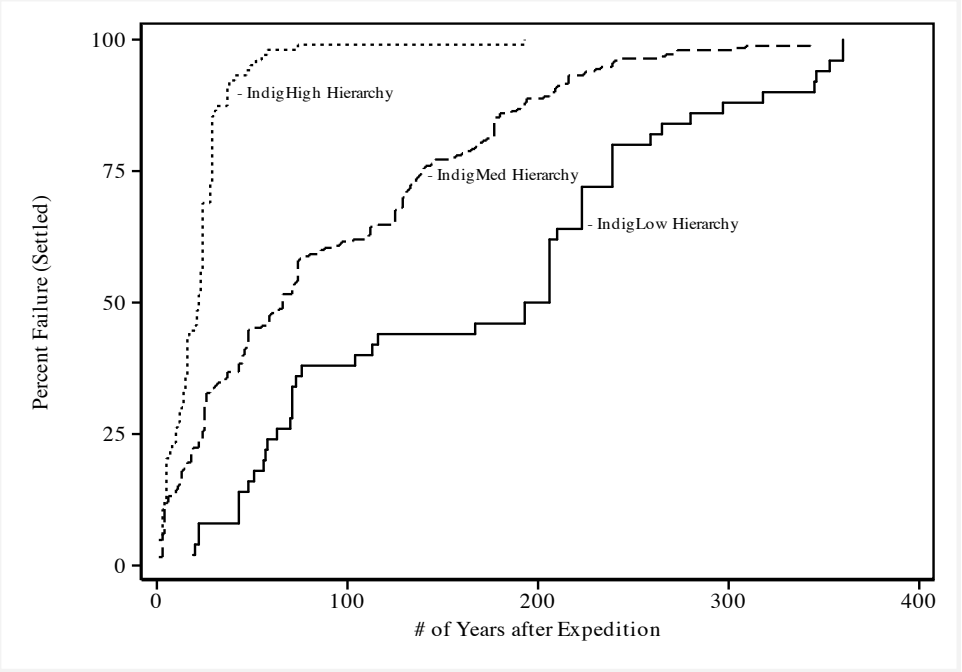


Figure 4: **Faster Settlement if High Profit - Low Investment Resources**

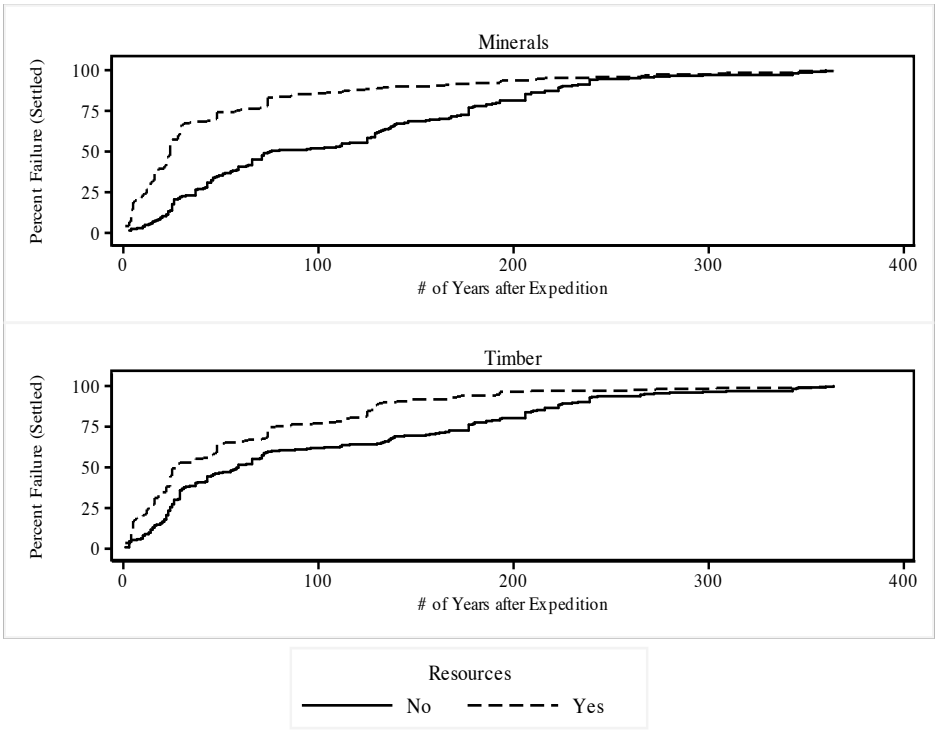
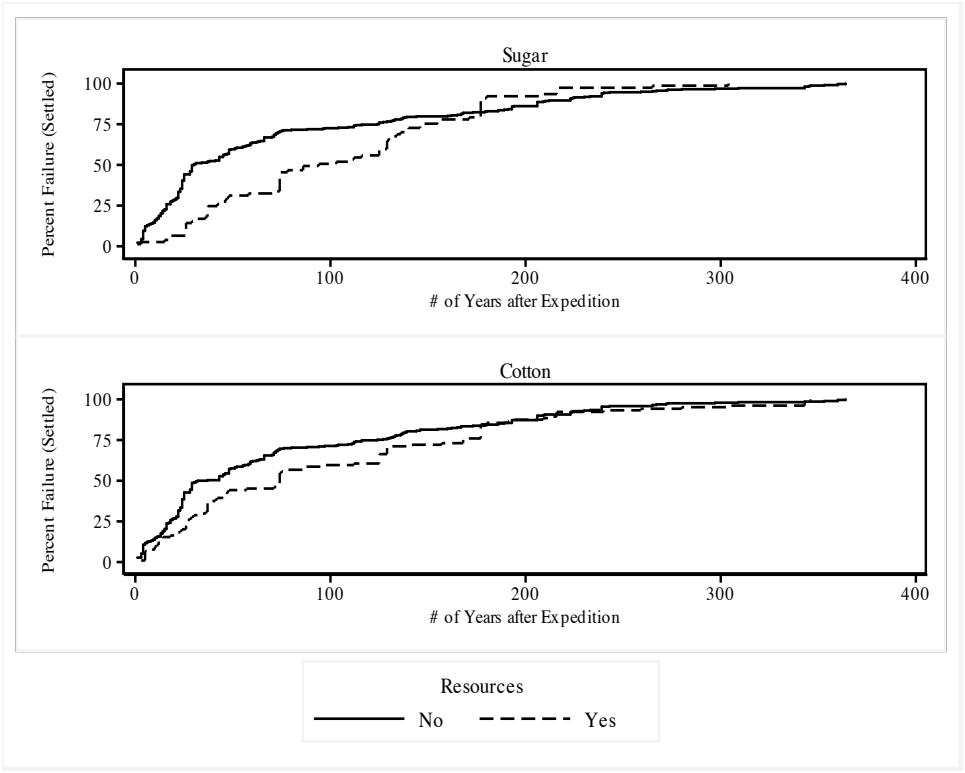


Figure 5: **Slower Settlement if High Profit - High Investment Resources**



other resources: 100 in territories with cotton and 104 in territories with sugar. Figure 5 demonstrates that the rate of settlement was higher for regions without sugar and without cotton for the first 150 years of settlement.

While the raw data appear to support the hypotheses that higher governance hierarchy and the scale of production influence settlement rates, several factors could confound these relationships. We control for five possible confounding variables. First, we control for the logarithm of the area of each territory (in square kilometers) to account for the discrepancy in square kilometers across observations.[37] Because regions closer to the expedition nation of origin might have received faster settlement, we control for the logarithm of distance from the nation of origin to the expedition destination.[38] Settler mortality might have influenced settlement rates since colonists might have found it harder to settle in territories where expeditions encountered more disease. Data on settler mortality are not available for sub-national territories, so we account for settler mortality in two ways. First, we control for settler mortality at the modern-nation-state level using data from Albouy (2006) and from Acemoglu et al. (2002b) (see Appendix B). Second, we control for the elevation of each territory, assuming that regions with higher elevation should have had lower settler

[37]We collected spatial data for the Americas at the subnational level from http://www.gadm.org. The areas were calculated using the Albers Conical Equal Area Projection.

[38]This data was also calculated using the spatial data from http://www.gadm.org.

mortality. We also control for the absolute geographic latitude of each territory.[39] Finally, because the Spanish and British were the most prominent settlers in the Americas and might have settled using systematically differing strategies, we code each territory for Spanish expedition and British expedition. We code Spanish expedition as a binary variable where each territory is coded as "1" if its first expedition was Spanish and zero otherwise. We similarly code British expeditions as a binary variable where each territory as "1" if its first expedition came from the United Kingdom and zero otherwise.

We analyze the influence of increasing indigenous governance hierarchy and differences in resource wealth on the rate of colonial settlement by modeling the probability of settlement (known as the hazard rate) after an expedition into the territories of the Americas (i). We use a Cox proportional hazards duration model because it is non-parametric, and we cannot assume that settlement increases, decreases or stays constant over time (equation 5):[40]

$$h(t|X) = h(t)exp\{\beta_1 \text{indig gov}_i + \beta \times \text{resources} + \gamma \times \text{controls} + \epsilon_i\} \quad (5)$$

The probability of settlement, represented by the hazard function $h(t|X)$, depends on indigenous governance hierarchy, the promise of resources, and the existence of sustenance. The model includes a vector of control variables and an error term (ϵ).

5.1.1 Results for Rate of Settlement

Table 1 demonstrates the influence of indigenous governance on the rate of colonial settlement across the Americas (model 1). The coefficients can be interpreted by calculating them as hazard ratios, or the probability of settlement for each independent variable holding the other variables constant. When an independent variable has a hazard ratio greater than 1, the independent variable has a positive effect on the dependent variable. When the hazard ratio is less than 1, the independent variable has a negative effect on the dependent variable. In model 1, the hazard ratio of indigenous governance is 2.64. As indigenous governance hierarchy increases, the rate of settlement more than doubles on average. The result is statistically significant at the 99 percent level.[41] Thus, the data confirm Hypothesis 1a that indigenous governance hierarchy accelerates colonial settlement.

The data also confirm Hypothesis 1b. Resources that were highly profitable and that required minimum capital accelerated settlement more than other types of resources. Minerals and timber consistently positively influenced the rate of settlement and the effect is

[39] Results hold when we control for temperature instead of latitude (see Appendix B). Elevation is calculated as the mean elevation for each territory, using the Global Digital Elevation Model (GTOPO30). We calculated latitude from the GADM spatial data and temperature using spatial data from http://www.worldclim.org.

[40] Results stay the same when using a parametric model, the Weibull distribution (Appendix B).

[41] The standard deviation of indigenous governance is 0.6, relatively close to one. As a result, we take the liberty to interpret the coefficients in indigenous governance as one unit increases. Results are similar when running the model with separate binary variable for each category of indigenous governance hierarchy (Appendix B). Results are also similar when running the model with indigenous labor organization or indigenous tribute collection instead of indigenous governance hierarchy (Appendix B).

Table 1: **Indigenous Governance and Resources Accelerate Colonial Settlement**

	Basic Model	Colonist FE	Timing FE	Both FE
	(1)	(2)	(3)	(4)
IndigGov	0.971***	0.995***	1.036***	1.048***
	(0.12)	(0.12)	(0.122)	(0.123)
Log(Area)	-.229***	-.231***	-.240***	-.240***
	(0.037)	(0.038)	(0.038)	(0.038)
Log(Elevation)	0.151***	0.143***	0.145***	0.14**
	(0.054)	(0.055)	(0.054)	(0.056)
Latitude	-.069***	-.068***	-.071***	-.072***
	(0.018)	(0.018)	(0.018)	(0.018)
log(Distance)	-.079	0.104	0.073	0.116
	(0.081)	(0.228)	(0.119)	(0.228)
Cotton	-.204	-.188	-.247	-.243
	(0.162)	(0.164)	(0.168)	(0.17)
Sugar	-.137	-.112	-.095	-.085
	(0.189)	(0.195)	(0.193)	(0.197)
Minerals	0.306**	0.317**	0.296**	0.308**
	(0.128)	(0.13)	(0.133)	(0.135)
Timber	0.613***	0.657***	0.649***	0.651***
	(0.127)	(0.132)	(0.131)	(0.135)
Livestock	-.140	-.120	-.126	-.131
	(0.125)	(0.128)	(0.127)	(0.129)
Spanish Expedition	-.019	-.316	0.047	0.065
	(0.187)	(1.876)	(0.193)	(2.134)
British Expedition	-.074	-.390	-.334	-.298
	(0.328)	(1.892)	(0.344)	(2.158)
Obs.	368	368	368	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

statistically significant. Minerals accelerate settlement by 36% and timber accelerates it by more than 85%.[42]

In conclusion, we find that indigenous institutions, minerals and timber accelerate the rate of settlement holding five potentially confounding variables constant. There are two important threats to validity, however. First, although the British or Spanish origin of the expedition has no effect on the rate of settlement, other colonizers might still have been better equipped to settle than others (France, Netherlands, and so on). Second, over time, colonists might have become better equipped to settle. For example, the United States might have had more technology and know-how to settle its hinterlands in the 1800s than the Spanish in the same hinterlands in the 1500s. Models 2-4 in Table 1 address these threats to validity. Model 2 includes fixed effects for the national origin of every country that launched a first expedition into a territory of the Americas between 1492 and 1898. Model 3 includes fixed effects for each 50-year period from 1450 to 1850. Model 4 includes both sets of fixed effects. The results hold in the three additional models and remain statistically significant at the 99 percent level.

5.2 Colonial Institutions

Hypothesis 2 states that colonial labor institutions should imitate indigenous institutions when hierarchy in indigenous institutions is high (Hypothesis 2a) or as the resource promise of a territory declines (Hypothesis 2b). It was also anticipated that colonists built new forms of hierarchical labor arrangements as they discovered highly profitable resources in territories with low hierarchy in indigenous institutions (Hypothesis 2c). Concretely, hypothesis 2a implies that as hierarchy in indigenous institutions increase, the probability of free labor institutions should decline and the probability of repartimientos, encomiendas, and indigenous slavery should increase. Hypothesis 2b implies that when colonists found the least profitable of the resources presented here (livestock) they were more likely implement free labor institutions. Hypothesis 2c implies that when colonists found the prospect of resources that were not exploited by indigenous peoples, but would become highly profitable after capital investment, such as cotton or sugar, African slavery was more likely.

Because any territory can contain more than one labor institution, we analyze colonists choice to imitate or build new labor institutions by modeling the probability of each colonial institution separately in each territory i using a logistic (logit) regression, equation 6:

$$logit(\pi_i) = \beta_0 + \beta_1 \text{indig gov}_i + \beta \times \text{resources} + \gamma \times \text{controls} + \epsilon_i \tag{6}$$

The probability depends on indigenous governance hierarchy, resources that are highly profitable and easy to extract (minerals and timber), resources that are highly profitable

[42] One might ask whether territories with highly profitable resources and high levels of indigenous governance may increase the rate of settlement most dramatically. These regions may have had the greatest wealth, urbanization, and population densities, when colonists arrived. A control for population is coming soon. We are still coding this.

Table 2: **Indigenous Governance and Resources Affect Colonial Labor**

	Free Labor	Repart	Encom	IndigSlav	AfrSlav
	(1)	(2)	(3)	(4)	(5)
IndigGov	-.893***	0.649**	0.589**	0.802**	0.259
	(0.271)	(0.307)	(0.237)	(0.314)	(0.247)
Log(Area)	0.217**	-.216*	-.238***	0.298**	0.092
	(0.097)	(0.127)	(0.084)	(0.121)	(0.089)
Log(Elevation)	-.336**	0.098	-.135	0.039	-.269**
	(0.135)	(0.175)	(0.117)	(0.165)	(0.124)
Latitude	0.154***	-11.667***	-.167***	-.869	-.009
	(0.054)	(2.367)	(0.057)	(1.262)	(0.043)
log(Distance)	-1.337	11.058***	-.030	5.894***	-.071
	(1.374)	(2.486)	(0.279)	(1.576)	(0.185)
Cotton	-.537	0.214	0.304	-1.223**	0.645*
	(0.406)	(0.48)	(0.333)	(0.484)	(0.338)
Sugar	-.667	-.670	0.677*	2.442***	1.835***
	(0.478)	(0.715)	(0.403)	(0.553)	(0.399)
Minerals	-1.066***	0.913**	-.340	1.352***	0.035
	(0.324)	(0.407)	(0.307)	(0.378)	(0.32)
Timber	-1.586***	0.284	-.645**	-.752**	0.261
	(0.345)	(0.396)	(0.303)	(0.349)	(0.297)
Livestock	0.72**	-.932**	-.619**	1.149***	-.832**
	(0.327)	(0.384)	(0.285)	(0.345)	(0.326)
Spanish Expedition	-.788*	2.629**	0.427	-2.673***	-.901**
	(0.461)	(1.169)	(0.471)	(0.521)	(0.429)
British Expedition	2.220*		-.533	-1.553*	-.767
	(1.166)		(1.152)	(0.853)	(0.767)
Obs.	378	364	378	378	380

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

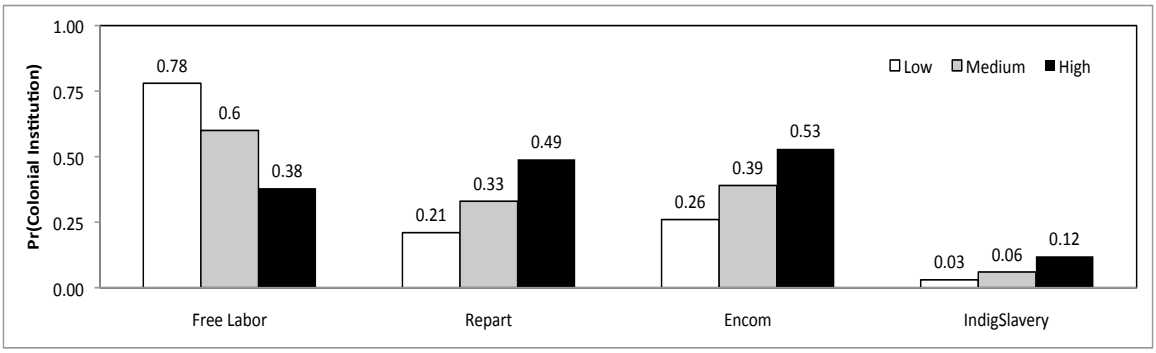
and relatively difficult to extract (cotton and sugar), and resources that are less highly profitable but relatively easy to extract (livestock). The model includes the same vector of control variables as the duration model and an error term (ϵ).[43]

5.2.1 Results for Colonial Institutions

Consistent with Hypothesis 2a, higher levels of indigenous governance hierarchy reduces the probability of free labor (Table 2). The result is statistically significant at the 99 percent level. Also, higher level of indigenous governance increases the likelihood of repartimiento (model 2), encomienda (model 3), and indigenous slavery (model 4). Consistent with Hypothesis 2b, of all resources under study, only livestock increase the likelihood of free labor. Finally, the data confirm Hypothesis 2c. Both cotton and sugar increase the likelihood of African slavery. Indigenous governance hierarchy, however, has no effect on

[43]Results hold when we control for temperature instead of latitude (see Appendix B). The results also hold controlling for settler mortality (Appendix C and C).

Figure 6: **Effects of Indigenous Governance on Colonial Labor**



African slavery, suggesting that African slavery was not the continuation of indigenous hierarchies.

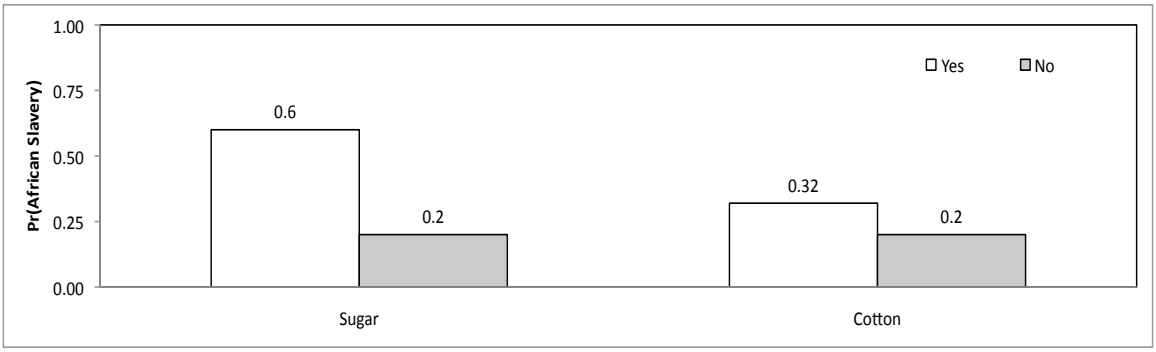
To interpret the logit coefficients, it is useful to see the marginal effects of indigenous governance on each dependent variable (Figure 6). Based on model 1, the probability of free labor in territories with low levels of hierarchy is 78%.[44] The probability declines to 60% in territories with medium levels of hierarchy, and declines further to 38% in territories with high levels of hierarchy. The pattern reverses when considering the probability of repartimiento, encomienda and slavery of indigenous peoples. Increases in indigenous governance hierarchy increases the probability of these more hierarchical colonial labor institutions. Finally, Figure 7 demonstrates that in territories with sugar or cotton, the probability of African slavery was 60% and 32% respectively. In territories with livestock, the probability of free labor was 75%.

The logit model presented here faces similar threats to validity to the duration model presented above. Some colonists may be inclined to build some institutions over others due to their cultures or crown policies. For example, Spanish settlers may have seized opportunities for repartimiento because the Spanish crown outlawed slavery. In addition, colonists might have been more likely to choose a certain type of labor arrangement over time because of prior successes of one exploitative model. To ensure these results are not an artifact of timing, or of the culture or national policies behind different expeditions, we demonstrate that the results hold after running the models in Table 2 including fixed effects for all nations of origins involved in expeditions and time-period (Appendix C).

Combined, these findings support the hypotheses that indigenous governance institutions and resources influenced early colonial institution building. When indigenous governance institutions were more hierarchical or when resources are highly profitable and relatively easy to extract, colonists settled faster. As the hierarchy in indigenous institutions increased, so did the hierarchy of subsequent colonial labor arrangements. However, when

[44]These estimates where generated using Clarify (King et al 2001) holding the other variables in the model at their medians.

Figure 7: **Effects of Resources on African Slavery**



indigenous institutions were less hierarchical, but colonists anticipated the profitability of existing resources, colonists built new hierarchical labor institutions (African slavery). The hypotheses are supported in the raw data, and after accounting for potentially confounding variables. We find that indigenous governance hierarchy and resources influence the rate of settlement and type of colonial labor institution holding five potentially-confounding variables constant, including fixed effects for the national origin of the expeditions, and including fixed effects for the time period in which the expedition occurred.

6 Conclusion

What explains differences in colonial labor arrangements? Our findings suggest that both indigenous governance hierarchies as well as resources help explain why colonists designed one type of labor institution instead of another. When indigenous governance hierarchy was high or low, colonists imitated indigenous institutions. However, when colonists discovered highly profitable resources that required novel hierarchical institutions, they built new institutions. The findings therefore explain why some colonies were based on free labor while others were based on encomiendas or slavery.

The results here are consistent with existing studies of institutional transfer and of endogenous institutions. In the endogenous institutions literature, certain institutions are more or less sensitive to exogenous shocks. In our analysis, the degree of hierarchy influenced the constraints facing colonists and indigenous peoples, and led to institutional change in some cases and persistence in others. In the language of Greif and Laitin (2004), institutions with hierarchies are self-enforcing for a larger set of 'quasi-parameters' than are institutions with low degree of hierarchy.

Because our analysis suggests that the contemporary study of institutions must incorporate the role of prior institutional elements as well as resources, it is important to consider how our results agree with Engerman and Sokoloff (1997, 2000, 2006) and Acemoglu et al. (2001, 2002b). Both seek to explain differences in today's economic development by reference to history. Engerman and Sokoloff emphasize natural resource endowments while

Acemoglu et al. emphasize settler mortality and prosperity. We demonstrate when and how resource endowments and the indigenous institutions that likely supported prosperity before colonists arrived, matter for future institutional development. Moreover, we suggest that the history of institutions that is relevant for understanding differences in today's economic development predates European colonialism.

An open question that is beyond the scope of this paper is what are the conditions and processes occurring since early history that led to indigenous governance hierarchies in some regions of the Americas but not in others. Our findings point to physical geography and the relative abundance of resources valued by specific societies at specific periods in history as key factors leading to institutional divergence.

References

Acemoglu, Daron and Alexander Wolitzky, "The Economics of Labor Coercion," *Massachusetts Institute of Technology, Department of Economics Working Paper Series*, 2009.

_ **and Simon Johnson**, "Unbundling Institutions," *Journal of Political Economy*, 2004, *113*, 949–95.

_ **, María Angélica Bautista, Pablo Querubin, and James A. Robinson**, "Economic and Political Inequality in Development: The Case of Cundinamarca, Colombia,," in "Institutions and Economic Performance," Harvard University Press, 2009.

_ **, Simon Johnson, and James A. Robinson**, "The Colonial Origins of Comparative Development: an Empirical Investigation," *American Economic Review*, 2001, *91*, 1369–1401.

_ **,** _ **, and** _ , "An African success story: Botswana," *CEPR Discussion Paper 3219*, 2002.

_ **,** _ **, and** _ , "Reversal of Fortune: Geography and Institutions in the Making of the Modern World Income Distribution," *Quarterly Journal of Economics*, 2002, *117*, 1231–1294.

Adams, Richard E.W. and Murdo J. MacLeod, eds, *The Cambridge History of the Native Peoples of the Americas*, Cambridge University Press, 2000.

Albouy, David, "The Colonial Origins of Comparative Development: An Investigation of the Settler Mortality Data," *Center for International and Development Economics Research, Working Paper Series 1055*, 2006.

Bakewell, Peter John, *Silver mining and society in colonial Mexico: Zacatecas, 1546-1700*, Cambridge University Press,, 1971.

Bardhan, Pranab, *Scarcity, conflicts, and cooperation: essays in the political and institutional economics of development*, Massachusetts: MIT Press, 2005.

Bartolomé, Miguel A., "La identidad residencial en Mesoamérica: fronteras étnicas y fronteras coloniales," *América Indígena*, 1992, *52* (1-2), 251–73.

Berkowitz, David, Katarina Pistor, and Jean-Francois Richard, "Economic development, legality, and the transplant effect," *European Economic Review*, 2003, *47* (1), 165–95.

Bethell, Leslie, *Colonial Brazil*, Cambridge University Press, 1987.

_ **, ed.**, *The Cambridge History of Latin America*, Cambridge University Press, 1984.

Binmore, Ken, Ariel Rubinstein, and Asher Wolinsky, "The Nash Bargaining solution in economic modelling," *Rand Journal of Economics*, 1986, *17* (2).

Birmingham, David, *Trade and empire in the Atlantic, 1400-1600*, Routledge, 2000.

Bockstette, Valerie and Chanda L. Putterman, "States and Markets: The Advantage of an Early Start," *Journal of Economic Growth*, 2002, *7*, 347–69.

Boone, Catherine, *Political topographies of the African State: Territorial authority and institutional choice*, Cambridge University Press, 2003.

Boucher, Philip P., *Cannibal Encounters: Europeans and Island Caribs, 1492-1763*, The Johns Hopkins University Press, 1992.

Bowles, Samuel, Steven N. Durlauf, and Karla Hoff, eds, *Poverty Traps*, Princeton University Press, Russel Sage Foundation, 1986.

Bruhn, Miriam and Francisco A. Gallego, "Good, Bad and Ugly Colonial Activities: Do They Matter for Economic Development?," *Working paper*, 2009.

Burkholder, Mark A. and Lyman L. Johnson, *Colonial Latin America*, Oxford University Press, 2007.

Cline, Howard F., *Handbook of MIddle American Indians*, University of Texas Press, Austin, 1972.

Cline, Sarah L., "Native Peoples of Colonial Central Mexico," in Richard E.W. Adams and Murdo J. MacLeod, eds., *The Cambridge History of the Native Peoples of the Americas*, Vol. II, Cambridge University Press, 2000.

Cortés, Hernán, *Letters From Mexico*, New Haven, Conn: Yale University Press, 1986.

Deeds, Susan M., "Legacies of Resistance, Adaptation, and Tenacity: History of the Native Peoples of Northwest Mexico," in "The Cambridge History of the Native Peoples of the Americas," Vol. II, Cambridge University Press, 2000.

Denevan, William M., ed., *The Native Population of the Americas in 1492*, The University of Wisconsin Press, 1992.

Diamond, Jared, *Guns, Germs, and Steel: The Fate of Human Societies*, W. W. Norton, 1997.

Domar, Evsey D., "The Causes of Slavery or Serfdom: A Hypothesis," *The Journal of Economic History*, Mar. 1970, *30* (1), 18–32.

Easterly, William and Ross Levine, "Tropics, germs, and crops: How endowments influence economic development," *Journal of Monetary Economics*, 2003, *50* (3-39).

Elliot, J. H., "Colonial Spanish America," in Leslie Bethell, ed., *Spain and America before 1700*, Cambridge University Press, 1987.

Engerman, Stanley L. and Kenneth L. Sokoloff, "Factor Endowments, Institutions, and Differential Paths of Growth Among New World Economies: A View from Economic Historians of the United States," in Stephen H. Haber, ed., *How Latin America Fell Behind*, Stanford, Calif.: Stanford University Press, 1997.

_ **and** _ , "History Lessons: Institutions, Factor Endowments, and the Paths of Development in the New World," *The Journal of Economic Perspectives*, 2000, *14* (3), 217–232.

_ **and** _ , "Factor Endowments, Inequality, and Paths of Development among New World Economies," *Economia*, 2002, *Fall*.

_ **and** _ , "The Persistence of Poverty in the Americas: The Role of Institutions," in Samuel Bowles, Steven N. Durlauf, and Karla Hoff, eds., *Poverty Traps*, Princeton University Press, 2006.

Englebert, Pierre, "Pre-Colonial Institutions, Post-Colonial States, and Economic Development in Tropical Africa," *Political Research Quarterly*, 2000, *53* (7-36).

Ertan, Ahran S. and Louis Putterman, "Determinants and Economic Consequences of Colonization," 2007. Mimeo, Brown University.

Galeson, D., "The Settlement and Growth of the Colonies," in Stanley L. Engerman and Gallman, eds., *The Cambridge History of the United States*, Cambridge University Press, 1996.

Gennaioli, Nicola and Ilia Rainer, "The modern impact of pre-colonial centralization in Africa," *Journal of Economic Growth*, 2007, *12*, 185–234.

Gerhard, Peter, *A Guide to the Historical Geography of New Spain*, Cambridge University Press, 1972.

_ , *A Guide to the Historical Geography of New Spain: Revised Edition*, University of Oklahoma Press, 1993.

Gibson, Charles, *The Aztecs Under Spanish Rule*, Stanford University Press, 1964.

_ **and Pekham, eds**, *Attitudes of Colonial Powers toward the American Indian*, University of Utah Press, 1969.

Glade, William P., *The Latin American Economies: a study of their institutional evolution*, American Book, 1969.

Glaeser, Edward L., Rafael La Porta, Florencio Lopez-De-Silanes, and Andrei Shleifer, "Do Institutions Cause Growth?," *Journal of Economic Growth*, 2004, *9* (271-303).

Greif, Avner, "Cultural beliefs and the organization of society: A historical and theoretical reflection on collectivist and individualist societies," *Journal of Political Economy*, 1994, *102*, 912–50.

_ , *Institutions and the Path to the Modern Economy: Lessons from Medieval Trade*, Cambridge University Press, 2006.

_ , "The Impact of Administrative Power on Political and Economic Development: Toward a Political Economy of Implementation," in Elhanan Helpman, ed., *Institutions and Economic Performance*, Harvard University Press, 2008.

_ **and David D. Laitin**, "A Theory of Endogenous Institutional Change," *The American Political Science Review*, November 2004, *98* (4), 633–652.

Hall, Robert E. and Charles I. Jones, "Why Do Some Countries Produce So Much More Output Per Worker than Others?," *Quarterly Journal of Economics*, 1999, *114* (83-116).

Haring, C. H., *The Spanish Empire: in America*, Harbinger Books, 1963.

Iyer, Lakshmi, "Direct Versus Indirect Colonial Rule in India: Long-Term Consequences," *Harvard Business School Working Paper*, 2008, (05-041).

Kaplan, E. L. and Paul Meier, "Nonparametric Estimation from Incomplete Observations," *Journal of the American Statistics Association*, 1958, *53* (282).

Krishna, Vijay and Roberto Serrano, "Multilateral Bargaining," *The Review of Economic Studies*, 1996, pp. 61–80.

la Porta, Rafael, Florencio Lopez-De-Silanes, Andrei Shleifer, and Robert Vishny, "Legal Determinants of External Finance," *Journal of Finance*, 1997, *52* (3), 1131–1150.

_ **,** _ **,** _ **, and** _ , "Law and Finance," *Journal of Political Economy*, 1998, *106* (6), 1113–55.

Lange, Matthew, James Mahoney, and Matthias vom Hau, "Colonialism and Development: A Comparative Analysis of Spanish and British Colonies," *American Journal of Sociology*, 2006, *111* (5).

León-Portilla, Miguel, *Visión de los Vencidos*, Historia 16, Madrid, 1985.

Lockhart, James, *The Nahuas after the Conquest*, Stanford University Press, 1992.

_ **and Stuart B. Schwartz**, *Early Latin America: a history of colonial Spanish America and Brazil*, Cambridge University Press, 1983.

Lovell, William George, *Conquest and survival in colonial Guatemala: a historical geography of the Cuchumatán Highlands, 1500-1821*, McGill-Queen's Press, 2005.

Macleod, Murdo J., "Aspects of the Internal Economy," in Leslie Bethell, ed., *Colonial Spanish America*, Cambridge University Press, 1987.

_ , "Mesoamerica Since the Spanish Invasion: an Overview," in Richard E.W. Adams and Murdo J. MacLeod, eds., *The Cambridge History of the Native Peoples of the Americas*, Vol. II, Cambridge University Press, 2000.

Mahoney, James, *Colonialism and Postcolonial Development: Spanish America in Comparative Perspective*, Cambridge University Press, 2010.

Malinowski, Sharon and Anna Sheets, eds, *The Gale Encyclopedia of Native American Tribes*, Thomson Gale, 1998.

Morales-Padron, F., *Atlas Histórico Cultural de América*, Consejería Cultural y Deportes, Gobierno de Canarias, 1988.

Nash, John F., "The bargaining problem," *Econometrica*, 1950, *18* (155-62).

_ , "Two-Person Cooperative Games," *Econometrica*, 1953, *21* (128-40).

Newson, Linda A., "Indian Population Patterns in Colonial Spanish America," *Latin American Research Review*, 1985, *2* (3), 41–74.

_ , *Indian Survival in Colonial Nicaragua*, University of Oklahoma Press, 1987.

_ , *Life and Death in Early Colonial Ecuador*, University of Oklahoma Press, 1995.

Nunn, Nathan, "The Importance of History for Economic Development," *Annual Review of Economics*, 2009, *1*, 65–95.

_ **and Leonard Wantchekon**, "The Trans-Atlantic Slave Trade and the Evolution of Mistrust in Africa: An Empirical Analysis," *Afrobarometer Working Papers*, 2008, (100).

Osgood, Herbert, *The American Colonies in the 17th Century.*, Columbia University, 1904-07.

Pierson, Paul and Theda Skocpol, "Historical Institutionalism in Contemporary Political Science," *Political Science: State of the Discipline*, 2002.

Przeworsky, Adam, "The Last Instance: Are Institutions the Primary Cause of Economic Development?," *European Journal of Sociology*, 2004, *45* (2), 165–188.

Rabushka, Alvin, *Taxation in Colonial America*, Princeton University Press, 2008.

Rodrik, D., A. Subramanian, and F. Trebbi, "Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development," *Journal of Economic Growth*, 2004, *9* (2).

Rubinstein, A., "Perfect Equilibrium in a Bargaining Model," *Econometrica*, 1982, *50.*

Sachs, Jeffrey D., "Notes on a New Sociology of Economic Development," in Lawrence E. Harrison and Samuel P. Huntington, eds., *Culture Matters: How Values Shape Human Progress*, New York, NY: Basic Books, 2000.

_ , "Tropical Underdevelopment," *NBER Working Paper*, 2001, *8119.*

Sanders, William T. and Joseph Marino, *New world prehistory; archaeology of the American Indian*, Englewood Cliffs, N.J., Prentice-Hall, 1970.

Schwartz, Stuart B., "Indian Labor and New World Plantations: European Demands and Indian Responses in Northeastern Brazil," *The American Historical Review*, 1978, *83* (1).

_ , *Sugar Plantations in the Formation of Brazilian Society: Bahia, 1550-1835*, Cambridge University Press, 1985.

Service, Elman R., "Indian-European Relations in Colonial Latin America," *American Anthropologist, New Series*, 1955, *57* (3), 411–425.

Sokolow, Jayme A., *The great encounter: native peoples and European settlers in the Americas, 1492-1800*, M.E. Sharpe, 2003.

Steward, Julian H., ed., *Handbook of South American Indians*, Vol. 3-5, Bureau of American Ethnology, Smithsonian Institution, 1946.

Tandeter, Enrique, *Coercion and Market: Silver Mining in Colonial Potosi 1692-1826*, University of New Mexico Press, 1993.

Tella, Rafael Di, Sebastian Galiani, and Ernesto Schargrodsky, "The Formation of Beliefs: Evidence from the Allocation of Land Titles to Squatters," *Quarterly Journal of Economics*, 2007, *122* (1), 209–41.

Thelen, Kathleen, "Historical Institutionalism in Comparative Politics," *Annual Review of Political Science*, 1999, *2.*

_ , *How Institutions Evolve: The Political Economy of Skills in Germany, Britain, the United States, and Japan*, Cambridge University Press, 2004.

Trigger, Bruce G. and William R. Swagerty, "Entertaining Strangers: North America in the Sixteenth Century," in Bruce G. Trigger and Wilcomb E. Washburn, eds., *The Cambridge History of the Native Peoples of the Americas*, Vol. I: North America, Cambridge University Press, 1996.

Villamarín, Juan A. and Judith E. Villamarín, *Indian Labor in Mainland Colonial Spanish America*, University of Delaware, 1975.

_ **and** _ , "Chiefdoms: The prevalence and persistence of "Señoríos Naturales" 1400 to European conquest," in Frank Saloman and Stuart B. Schwartz, eds., *The Cambridge History of the Native Peoples of the Americas*, Vol. 3, Cambridge University Press, 1999.

Weber, Max, *The Protestant Ethic and the Spirit of Capitalism*, Scribner, New York, 1958.

Young, Eric Van, ed., *Mexico's Regions: Comparative History and Development*, Center for U.S.-Mexican Studies, UC San Diego, 1992.

Zavala, Silvio Arturo, *Las instituciones jurídicas en la conquista de América*, México: Editorial Porrúa, 1988.

Zeitlin, Judith F., "Ranchers and Indians on the Southern Isthmus of Tehuantepec: Economic Change and Indigenous Survival in Colonial Mexico," *The Hispanic American Historical Review*, 1989, *69* (1), 23–60.

A Descriptive Statistics

Appendix Table A1: **Descriptive Statistics**

Variable	**N**	**Mean**	**SD**	**Min**	**Max**
IndigLabor	434	1.19	0.65	0	2
IndigTribute	425	0.83	0.91	0	2
IndigGov	425	1.15	0.60	0	2
Minerals	411	0.48	0.50	0	1
Timber	410	0.43	50	0	1
Cotton	411	0.27	0.45	0	1
Sugar	411	0.19	0.39	0	1
Livestock	411	0.35	0.48	0	1
log(Area)	436	9.87	1.87	4.54	14.56
log(Elevation)	436	5.92	1.32	2.30	8.27
Latitude	437	1.40	4.60	0.22	51.74
log(Distance)	415	9.10	0.60	2.30	9.77
Spanish Expedition	419	0.85	0.32	0	1
British Expedition	419	0.04	0.19	0	1
Free Labor	425	0.42	0.49	0	1
Repartimiento	425	0.38	0.49	0	1
Encomienda	425	0.28	0.45	0	1
IndigSlavery	425	0.30	0.46	0	1
AfrSlavery	425	0.22	0.41	0	1

Appendix Table A2: **Cross-tabulation of frequencies by colonial institution**

	Free labor	**Repart**	**Encom**	**IndigSlavery**	**AfrSlavery**
Free Labor	178	11	23	17	44
Repart		163	25	42	35
Encom			117	35	40
IndigSlavery				93	46
AfrSlavery					130

Note: The diagonal indicates the total frequencies for each colonial institution.

B Robustness Checks: Rate of Settlement

Appendix Table B1: **Results Hold Controlling for Temperature**

	Basic Model	Colonist FE	Timing FE	Both FE
	(1)	(2)	(3)	(4)
IndigGov	1.049***	1.104***	1.160***	1.188***
	(0.121)	(0.121)	(0.124)	(0.124)
Log(Area)	-.113***	-.084**	-.113***	-.080**
	(0.037)	(0.039)	(0.037)	(0.039)
Log(Elevation)	0.213***	0.248***	0.208***	0.25***
	(0.055)	(0.059)	(0.056)	(0.059)
Temperature	0.002***	0.004***	0.003***	0.005***
	(0.0007)	(0.0009)	(0.0008)	(0.0009)
log(Distance)	-.114	0.207	0.127	0.225
	(0.086)	(0.194)	(0.118)	(0.192)
Cotton	-.293*	-.331**	-.386**	-.412**
	(0.166)	(0.168)	(0.175)	(0.174)
Sugar	-.294	-.207	-.241	-.190
	(0.179)	(0.184)	(0.182)	(0.185)
Minerals	0.353***	0.34**	0.366***	0.35**
	(0.129)	(0.132)	(0.134)	(0.136)
Timber	0.556***	0.642***	0.57***	0.629***
	(0.125)	(0.127)	(0.128)	(0.129)
Livestock	-.029	0.032	-.001	0.041
	(0.123)	(0.124)	(0.125)	(0.126)
Spanish Expedition	-.072	-1.795	-.017	-.598
	(0.192)	(1.700)	(0.195)	(1.953)
British Expedition	0.164	-1.382	-.018	-.335
	(0.346)	(1.710)	(0.361)	(1.984)
Obs.	368	368	368	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table B2: **Results Hold Controlling for Settler Mortality**

	Settler Mortality (AJR)	Settler Mortality (Albouy)
	(1)	(2)
IndigGov	1.064***	0.919***
	(0.127)	(0.128)
Log(Area)	-.155***	-.154***
	(0.044)	(0.045)
Log(Elevation)	0.124**	0.12*
	(0.058)	(0.062)
Latitude	-.094***	-1.901***
	(0.024)	(0.598)
log(Distance)	-.134	-.112
	(0.082)	(0.084)
Cotton	-.356**	-.296
	(0.18)	(0.186)
Sugar	-.004	-.276
	(0.215)	(0.243)
Minerals	0.323**	0.22
	(0.137)	(0.145)
Timber	0.536***	0.531***
	(0.131)	(0.138)
Livestock	-.217*	-.173
	(0.13)	(0.135)
Spanish Expedition	-.030	0.066
	(0.204)	(0.212)
British Expedition	0.218	0.409
	(0.342)	(0.359)
log(SettlMort) (AJR)	0.419***	
	(0.108)	
log(SettlMort) (Albouy)		0.022
		(0.099)
Obs.	352	336

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table B3: **Results Hold Using Weibull Model**—

	Basic Model	Colonist FE	Timing FE	Both FE
	(1)	(2)	(3)	(4)
IndigGov	0.945***	0.972***	1.007***	1.022***
	(0.117)	(0.117)	(0.119)	(0.12)
Log(Area)	-.245***	-.246***	-.254***	-.252***
	(0.036)	(0.036)	(0.037)	(0.037)
Log(Elevation)	0.168***	0.159***	0.164***	0.159***
	(0.053)	(0.055)	(0.054)	(0.055)
Latitude	-.073***	-.070***	-.075***	-.074***
	(0.018)	(0.018)	(0.018)	(0.018)
log(Distance)	-.103	0.125	0.056	0.144
	(0.082)	(0.207)	(0.118)	(0.204)
Cotton	-.162	-.148	-.220	-.214
	(0.16)	(0.163)	(0.167)	(0.168)
Sugar	-.211	-.187	-.172	-.157
	(0.184)	(0.19)	(0.189)	(0.192)
Minerals	0.349***	0.352***	0.329**	0.334**
	(0.126)	(0.129)	(0.131)	(0.133)
Timber	0.631***	0.675***	0.658***	0.666***
	(0.126)	(0.131)	(0.13)	(0.135)
Livestock	-.152	-.125	-.138	-.134
	(0.122)	(0.125)	(0.124)	(0.126)
Spanish Expedition	0.137	-.529	0.19	-.418
	(0.183)	(1.758)	(0.189)	(2.015)
British Expedition	0.064	-.618	-.243	-.830
	(0.323)	(1.772)	(0.34)	(2.039)
Obs.	368	368	368	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table B4: **Greater Hierarchy Increases the Rate of Settlement**

	Low Hierarchy	Medium Hierarchy	High Hierarchy
	(1)	(2)	(3)
High IndigGov	-.885***		
	(0.185)		
Medium IndigGov		-.162	
		(0.125)	
Low IndigGov			1.228***
			(0.168)
Log(Area)	-.261***	-.247***	-.205***
	(0.038)	(0.039)	(0.038)
Log(Elevation)	0.231***	0.289***	0.189***
	(0.053)	(0.052)	(0.054)
Latitude	-.072***	-.073***	-.069***
	(0.018)	(0.017)	(0.017)
log(Distance)	-.058	-.041	-.069
	(0.081)	(0.079)	(0.079)
Cotton	-.237	-.300*	-.260
	(0.164)	(0.165)	(0.162)
Sugar	-.198	0.129	0.163
	(0.192)	(0.197)	(0.19)
Minerals	0.371***	0.514***	0.405***
	(0.127)	(0.129)	(0.129)
Timber	0.694***	0.699***	0.598***
	(0.128)	(0.126)	(0.126)
Livestock	0.007	-.077	-.238*
	(0.126)	(0.127)	(0.128)
Spanish Expedition	0.078	-.032	-.127
	(0.191)	(0.193)	(0.19)
British Expedition	-.120	-.474	-.404
	(0.329)	(0.333)	(0.328)
Obs.	368	368	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table B5: **Hierarchy in Indigenous Labor and the Rate of Settlement**

	IndigLabor	IndigTribute
	(1)	(2)
indig-labor	0.801***	
	(0.104)	
indig-tax-tribute		0.54***
		(0.077)
Log(Area)	-.224***	-.236***
	(0.038)	(0.037)
Log(Elevation)	0.182***	0.177***
	(0.053)	(0.054)
Latitude	-.068***	-.060***
	(0.018)	(0.017)
log(Distance)	-.081	-.043
	(0.081)	(0.077)
Cotton	-.168	-.234
	(0.164)	(0.161)
Sugar	-.110	0.002
	(0.189)	(0.184)
Minerals	0.343***	0.385***
	(0.128)	(0.13)
Timber	0.59***	0.726***
	(0.126)	(0.125)
Livestock	-.051	-.098
	(0.123)	(0.126)
Spanish Expedition	-.010	-.164
	(0.187)	(0.188)
British Expedition	-.070	-.458
	(0.33)	(0.329)
Obs.	373	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

C Robustness Checks: Colonial Institutions

Appendix Table C1: **Results Hold Controlling for Temperature**

	Free Labor	Repart	Encom	IndigSlav	AfrSlav
	(1)	(2)	(3)	(4)	(5)
IndigGov	-1.006***	0.843***	0.638***	0.808***	0.268
	(0.273)	(0.282)	(0.235)	(0.31)	(0.249)
Log(Area)	0.025	-.354***	-.076	0.349***	0.049
	(0.093)	(0.109)	(0.08)	(0.114)	(0.087)
Log(Elevation)	-.493***	0.608***	0.086	0.134	-.319**
	(0.134)	(0.177)	(0.123)	(0.164)	(0.125)
Temperature	-.007***	0.008**	0.007***	0.002	-.003**
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
log(Distance)	-2.112	6.099***	-.119	5.583***	-.033
	(1.438)	(1.876)	(0.322)	(1.469)	(0.186)
Cotton	-.227	-.073	0.208	-1.212**	0.823**
	(0.394)	(0.397)	(0.329)	(0.485)	(0.348)
Sugar	-.447	-.345	0.195	2.265***	1.911***
	(0.471)	(0.624)	(0.378)	(0.535)	(0.39)
Minerals	-1.165***	1.137***	-.324	1.364***	-.013
	(0.328)	(0.36)	(0.308)	(0.375)	(0.322)
Timber	-1.376***	0.659*	-.740**	-.727**	0.403
	(0.345)	(0.354)	(0.301)	(0.35)	(0.307)
Livestock	0.585*	-1.053***	-.447	1.235***	-.789**
	(0.321)	(0.346)	(0.282)	(0.342)	(0.317)
Spanish Expedition	-.363	1.875*	0.145	-2.665***	-.537
	(0.494)	(1.124)	(0.499)	(0.532)	(0.455)
British Expedition	1.448		0.416	-1.449*	-1.165
	(1.229)		(1.253)	(0.85)	(0.794)
Obs.	378	364	378	378	380

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table C2: **Results Hold Controlling for Settler Mortality (AJR)**

	Free Labor	Repart	Encom	IndigSlav	AfrSlav
	(1)	(2)	(3)	(4)	(5)
IndigGov	-.886***	0.645**	0.6**	0.822***	0.213
	(0.277)	(0.31)	(0.241)	(0.315)	(0.255)
Log(Area)	0.171	-.116	-.340***	0.364***	-.005
	(0.111)	(0.136)	(0.094)	(0.122)	(0.1)
Log(Elevation)	-.257*	0.174	-.101	0.017	-.285**
	(0.137)	(0.178)	(0.12)	(0.164)	(0.13)
Latitude	0.213***	-10.984***	-.058	-.216	-.044
	(0.077)	(2.372)	(0.069)	(0.391)	(0.073)
log(Distance)	-1.590	12.012***	0.055	6.310***	-.003
	(1.443)	(2.589)	(0.297)	(1.576)	(0.187)
Cotton	-.625	0.253	0.406	-1.307***	0.783**
	(0.425)	(0.504)	(0.349)	(0.478)	(0.359)
Sugar	-.508	-.390	0.524	2.396***	1.877***
	(0.495)	(0.714)	(0.416)	(0.552)	(0.425)
Minerals	-1.362***	0.97**	-.342	1.432***	0.128
	(0.349)	(0.418)	(0.312)	(0.388)	(0.329)
Timber	-1.306***	0.243	-.757**	-.943**	0.311
	(0.36)	(0.398)	(0.316)	(0.368)	(0.316)
Livestock	0.825**	-1.162***	-.545*	1.162***	-.811**
	(0.336)	(0.402)	(0.287)	(0.346)	(0.331)
Spanish Expedition	-.354	2.367**	0.387	-3.239***	-.793*
	(0.499)	(1.188)	(0.508)	(0.599)	(0.461)
British Expedition	1.868		-1.020	-1.371	-1.199
	(1.193)		(1.168)	(0.888)	(0.78)
log(SettlMort) (AJR)	-.743***	1.129**	-.432*	0.791**	-.535**
	(0.274)	(0.527)	(0.257)	(0.339)	(0.259)
Obs.	367	353	367	367	368

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table C3: **Results Hold Controlling for Settler Mortality (Albouy)**

	Free Labor	Repart	Encom	IndigSlav	AfrSlav
	(1)	(2)	(3)	(4)	(5)
IndigGov	-.939***	0.736**	0.594**	0.92***	0.231
	(0.287)	(0.315)	(0.257)	(0.325)	(0.254)
Log(Area)	0.103	-.219	-.138	0.282**	0.062
	(0.12)	(0.133)	(0.1)	(0.124)	(0.102)
Log(Elevation)	-.186	0.075	-.088	-.025	-.249*
	(0.15)	(0.177)	(0.133)	(0.17)	(0.133)
Latitude	3.137*	-10.710***	-4.859***	0.561	0.486
	(1.624)	(2.381)	(1.541)	(1.620)	(1.319)
log(Distance)	-3.570**	11.214***	0.279	5.960***	-.015
	(1.690)	(2.498)	(0.583)	(1.661)	(0.186)
Cotton	-.405	0.2	0.061	-1.124**	0.652*
	(0.445)	(0.508)	(0.375)	(0.475)	(0.36)
Sugar	-.297	-.437	-.512	2.567***	1.642***
	(0.525)	(0.72)	(0.499)	(0.564)	(0.468)
Minerals	-1.360***	1.205***	-.899**	1.623***	0.045
	(0.394)	(0.44)	(0.363)	(0.406)	(0.337)
Timber	-.917**	0.072	-1.236***	-.965***	0.278
	(0.384)	(0.414)	(0.357)	(0.374)	(0.328)
Livestock	0.837**	-1.188***	-.381	0.975***	-.706**
	(0.364)	(0.408)	(0.311)	(0.351)	(0.328)
Spanish Expedition	0.137	2.077*	-.318	-3.228***	-.986**
	(0.531)	(1.202)	(0.524)	(0.6)	(0.462)
British Expedition	1.700		-.507	-1.677*	-1.075
	(1.261)		(1.213)	(0.894)	(0.795)
log(SettlMort) (Albouy)	-.788***	0.628**	-.060	0.622**	-.086
	(0.22)	(0.248)	(0.199)	(0.268)	(0.211)
Obs.	351	337	351	351	352

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Appendix Table C4: **Results Hold with Fixed Effects By Colonist Origin and Timing of Expedition**

	Free Labor	Repart	Encom	IndigSlav	AfrSlav
	(1)	(2)	(3)	(4)	(5)
IndigGov	-.874***	0.634**	0.692***	0.712**	0.333
	(0.273)	(0.308)	(0.249)	(0.32)	(0.256)
Log(Area)	0.224**	-.249*	-.174**	0.245**	0.128
	(0.099)	(0.132)	(0.088)	(0.119)	(0.092)
Log(Elevation)	-.304**	0.086	-.048	0.048	-.240*
	(0.136)	(0.175)	(0.122)	(0.172)	(0.129)
Latitude	0.155***	-11.337***	-.183***	-.490	-.010
	(0.054)	(2.362)	(0.063)	(0.334)	(0.044)
log(Distance)	-1.336	10.966***	-5.064***	6.399***	-2.812**
	(1.403)	(2.447)	(1.571)	(1.626)	(1.280)
Cotton	-.429	0.238	0.227	-1.563***	0.586*
	(0.404)	(0.484)	(0.34)	(0.52)	(0.349)
Sugar	-.574	-.530	-.197	2.437***	1.420***
	(0.479)	(0.715)	(0.478)	(0.593)	(0.445)
Minerals	-1.202***	0.999**	-.522	1.479***	0.111
	(0.342)	(0.415)	(0.329)	(0.402)	(0.335)
Timber	-1.429***	0.286	-.845**	-1.093***	0.103
	(0.356)	(0.393)	(0.328)	(0.379)	(0.317)
Livestock	0.807**	-1.001***	-.536*	1.001***	-.850**
	(0.329)	(0.388)	(0.297)	(0.348)	(0.339)
Spanish Expedition	-5.421	-62.029	48.481	-33.282	31.645
	(551.125)	(2920.311)	(2655.967)	(522.857)	(785.416)
British Expedition	-2.386		46.466	-32.161	31.462
	(551.126)		(2655.966)	(522.854)	(785.414)
Obs.	374	340	374	374	379

Coefficients reported with standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.