Good, Bad, and Ugly Colonial Activities: Do They Matter for Economic Development?*

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Abstract

Levels of economic development vary widely within countries in the Americas. We argue that part of this variation has its roots in the colonial era. Colonizers engaged in different economic activities in different regions of a country, depending on local conditions. Some activities, such as mining and sugar cultivation, were "bad" in the sense that they depended heavily on the exploitation of labor and led to a low development path, while "good" activities that did not rely on the exploitation of labor led to a high development path. We show that regions with bad colonial activities have lower output per capita today than regions with good and regions with no colonial activities. Moreover, we examine levels of economic development before and after colonization and find evidence that colonization reversed the economic fortunes of regions within a country. Our results also suggest that differences in political representation (but not differences in income inequality or human capital) could be the intermediating factor between colonial activities and current development.

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1 Introduction

Levels of economic development vary widely across countries. For example, in a sample of seventeen countries in the Americas, the richest country (the US) has fifteen times the GDP per capita of the poorest country (Honduras). Several recent papers have argued that these large differences in economic development have their roots in history, particularly in the colonial era.[1] This paper provides new empirical evidence for a relationship between colonial activities and current day economic development using *within* country data. In particular, we empirically test, at the sub-national level, two related arguments present in the literature: (i) the claim that different types of economic activities that colonizers engaged in led to different growth paths (Engerman and Sokoloff, 1997, 2002), and (ii) the claim that colonization led to a reversal of fortunes (Acemoglu, Johnson, and Robinson, 2002).

Following Engerman and Sokoloff (1997 and 2002), from now on ES, our analysis starts by classifying colonial activities in to three categories, that we call "good", "bad", and "ugly" activities. ES argue that depending on factor endowments, such as climate, geography, and pre-colonial population density, colonizers engaged in different types of economic activities in different regions that consequently led to different growth paths. ES' first category, our bad activities, includes activities that displayed economies of scale and relied heavily on the exploitation of labor, such as mining and sugar production. We denote these activities to be "bad" since ES "associate them with low levels of economic development. ES' second category includes colonial activities that did not display economies of scale, such as the cultivation of subsistence crops, cattle raising, and manufacturing, that were performed in areas with low pre-colonial population density. We call these "good" colonial activities since ES argue that activities without economies of scale led to positive long-run outcomes if they were practiced in small-scale production by independent proprietors, which was the case in areas that did not have a large native population. In areas with a large native population, activities without economies of scale were typically performed in large-scale operations with forced labor. We call these colonial activities that relied primarily on the native population as an exploitable resource "ugly" colonial activities.

The reason why ES associate colonial activities that relied heavily on the exploitation of labor with low long-run outcomes is that areas with these activities developed an institutional environment that benefitted predominantly a relatively small elite of slave and land owners. ES support this argument with a number of summary statistics

[1]See Acemoglu, Johnson, Robinson (2005) and Nunn (2009) for reviews of this literature.

suggesting that countries that used to rely heavily on exploitation of labor during the colonial period extended the franchise later and had lower literacy rates than other countries in the early 1900s, and also had financial systems that primarily served the elite. We add to this evidence by showing empirically that colonial activities are correlated with current day measures of economic development (log GDP per capita and poverty rates) within countries. Based on history books, we collect data on economic activities performed during the colonial period in 345 different regions in seventeen countries in the Americas. We also collect data on pre-colonial population density at the sub-national level. Each region is then assigned four dummy variables summarizing whether it had predominantly good, bad, ugly or no colonial activities.

We collect this data at the sub-national level since the distinction between colonial activities is much sharper across regions within a country than it is across countries. Easterly and Levine (2003) examine at the country level whether the presence of certain crops and minerals is correlated with economic development. Whenever a country produced a certain crop or mineral in 1998-1999, they code a dummy to be equal to one for that crop or mineral. This method does not allow for distinguishing between good, bad, and ugly activities since most countries produce a range of crops and minerals. For example, some crops, such as maize are produced in almost all countries (68 out of 72 for maize). Within the countries in our sample, however, it is typically the case that the types of crops and minerals produced vary from region to region, allowing us to classify regions into different colonial activities. Our sub-national analysis is also made possible by the fact that levels of economic development vary almost as widely across states or regions within country as they do across countries (Table 1)[2].

Our empirical evidence supports ES's argument. We find that areas with bad colonial activities have 27.6 percent lower GDP per capita today than areas with no activities and 27.7 percent lower GDP per capita today than areas with good activities. Similarly, areas with ugly colonial activities have 15.9 percent lower GDP per capita today than areas with no activities and 16 percent *lower* GDP per capita today than areas with good activities. Our results also show that areas with bad colonial activities have a 16.4 percent higher poverty rate than areas with no colonial activities and a 13 percent

[2]Several other papers examine the effect of historical factors on within-country variation in development, including Banerjee and Iyer (2005), Banerjee, Iyer and Somanathan (2005), and Iyer (2005) for India; Acemoglu et al. (2008), Rosas and Mendoza (2004) and Bonet and Meisel (2006) for Colombia; Naritomi, Soares, and Assunção (2007) for Brazil; Merrouche (2007) for Algeria; Huillery (2007) for French Africa; Acemoglu et al. (2005) and Tabellini (2007) for Europe; Mitchener and McLean (1999, 2003) and Nunn (2008a) for the US; and Dell (2010) for Perú. Nunn (2009) provides a review of this literature.

higher poverty rate than areas with good colonial activities. Ugly colonial activities are not significantly correlated with poverty rates. Thus, overall, we find strong support for the claim that colonial activities with economies of scale led to low long-run levels of development. The evidence on the long-run consequences of ugly colonial activities is weaker since they have a smaller negative correlation with GDP per capita than bad colonial activities and they are not correlated with current day poverty rates.

We then ask whether it is indeed the case that colonial activities changed the economic fortunes of certain areas. An alternative explanation for our findings is that areas that were to have bad and ugly colonial activities already had lower levels of economic development before colonization. We test this alternative explanation in two ways. First, we use a pre-colonial health index as a proxy for pre-colonial levels of economic development to show that areas with bad and ugly colonial activities did not have statistically different levels of development before colonization. In fact, areas with bad and ugly colonial activities had higher measures of development before colonization than areas with good or no colonial activities, although these differences are not statistically significant.

Second, we follow Acemoglu, Johnson, and Robinson (2002), from now on AJR, in using pre-colonial population density as a measure of pre-colonial levels of economic development, where areas with higher pre-colonial population density were more developed. At the country level, AJR find a negative correlation between pre-colonial population density and current GDP per capita for countries that were colonized by European powers, suggesting a "reversal of fortunes". However, in countries that were not colonized, AJR find a positive correlation between pre-colonial population density and current GDP per capita. AJR argue that the reversal of fortunes was due to the fact that Europeans settled in large numbers only in areas that had low pre-colonial population density (in part due to differences in the disease environment that were associated with pre-colonial population density). Where Europeans settled in large numbers, they tended to create "neo-European" or inclusive institutions with strong emphasis on private property and checks against government power. In areas where Europeans did not settle in large numbers, they instead established "extractive states" that were geared towards transferring as much as possible of the resources of the colony to the colonizer. These extractive states did not provide protection for private property and had few checks and balances against government expropriation. AJR claim that colonial institutions persisted over time, even after independence and still influence current levels of economic development.

Our within country data mimics AJR's findings of a reversal of fortunes. Our results show that, in areas that had colonial activities, a one standard deviation increase in the log of pre-colonial population density is associated with about 13 percent lower current GDP per capita. On the other hand, in areas that had no colonial activities, a one standard deviation increase in the log of pre-colonial population density is associated with about 13 percent higher current GDP per capita. This supports our argument that colonial activities reversed the fortunes of different areas within countries.

Next, we examine the link between colonial activities and current day economic outcomes. Both AJR and ES argue that "institutions" link colonial activities to current day economic outcomes, although their definition of institutions differs. AJR focus on the importance of secure property rights for economic growth, whereas ES focus on the importance of economic and political inequality. An alternative theory, put forward by Glaeser et al. (2004) is that European settlers brought with them many other things, such as high human capital, that could also explain the effect of colonial activities on current levels of development. Given data availability, we test three different possible mechanisms that could link colonial activities to current development: economic inequality, education, and political representation.[3] Our results indicate that current income inequality and human capital are not correlated with colonial activities and thus cannot explain the link between colonial activities and current levels of development. In contrast, the results for political representation are mostly consistent with our reduced form regressions in terms of the signs, sizes, and significance of the effects, suggesting that political institutions may be the intermediating factor between colonial activities and current economic development.

The paper is organized as follows. Section 2 discusses the theoretical background and Section 3 provides historical examples for the theory. Section 4 describes our data. Section 5 examines what determined colonial activities. Section 6 analyzes the relationship between colonial activities and development. Section 7 asks whether colonization did indeed reverse the fortunes of different regions. Finally, Section 8 investigates the mediating factors between colonial activities and development today and Section 9 concludes.

2 Theoretical Background

In recent years, many studies have investigated the ultimate determinants of economic development. AJR (2001, 2002, 2005) and ES (1997, 2002), claim that levels of economic development in New World countries go back to patterns of colonization. In particular,

[3] We do not have data on property rights institutions at the region level for most of the countries included in this paper.

they argue that colonizers set up different types of the "institutions" in different parts of the New World, depending on the local environment. These institutions have persisted over time and affect long-run levels of economic development.[4]

AJR (2001) argue that the colonizers pursued two different types of colonization strategies in the New World, depending on the local disease environment. The first strategy was applied in areas with low settler mortality and was geared towards allowing a large number of Europeans to settle. This strategy involved the creation of "neo-European" or inclusive institutions with strong emphasis on private property and checks against government power (exemplified by Canada and the United States). The second colonization strategy was applied in areas with high settler mortality and consisted in establishing "extractive states" that were geared towards transferring as much as possible of the resources of the colony to the colonizer. These extractive states did not provide protection for private property and had few checks and balances against government expropriation (exemplified by Spanish and Portuguese colonization of Latin America). AJR claim that colonial institutions persisted over time, even after independence and still influence current levels of economic development. They empirically show that countries with high settler mortality have lower measures of protection against expropriation risk today and also have lower levels of GDP per capita today.

In a related paper, AJR (2002) document that, among the countries colonized by Europeans, the ones that were the richest in around 1500 are now the poorest. The authors use pre-colonial urbanization rates and pre-colonial population density as measures of pre-colonial prosperity and show that both measures are negatively correlated with GDP per capita today. AJR argue that this "reversal of fortunes" is due to the two different colonization strategies described in the previous paragraph. In areas that were relatively poor and sparsely populated in pre-colonial times, Europeans could settle in large numbers and develop inclusive institutions. In areas with high pre-colonial population density, on the other hand, it was more profitable for colonizers to establish extractive institutions since they could either force the native population to work in mines and plantations or they could extract economic benefits by taking over existing tax and tribute systems. An additional finding of the paper confirms the hypothesis that

[4] The argument that economic development depends on institutions goes back at least to North and Thomas (1973) and North (1981). There are several reasons why institutions may persist over time. In fact, ruling elites replacing colonial powers after independence tended to maintain the same institutional setting. As documented in Acemoglu and Robinson (2006), in some countries, the elites controlling political power were the same even well after the independence. There are a number of mechanisms leading to inertia, as discussed in AJR (2005) and modeled in Acemoglu, Ticchi, and Vindigni (2007) for the case of the emergence and persistence of inefficient states.

the reversal of fortunes is due to colonization: for countries that were not colonized, there is a positive instead of a negative correlation between pre-colonial population density and current levels of GDP per capita (AJR, 2002, p. 1253 and Columns 9 and 10 of Table VI).

ES (1997 and 2002) also develop a theory that links patterns of colonization to current day outcomes, focusing on New World economies. The authors argue that three local "factor endowments" determined the type of activities that the colonizers pursued in the New World: climate, soil, and the size of the native population (labor supply). Based on these factor endowments, ES classify New World countries into three different types of colonial economies. The first category includes colonies that had soil and climate suitable for producing sugar and other highly valued crops that were most efficiently produced on large slave plantations (due to economies of scale in production). These "sugar colonies" include Brazil and islands in the West Indies. Given the efficiency of large plantations and the extensive use of slaves, economic and political power became highly concentrated in the sugar colonies. ES argue that this concentration of power led to institutions that commonly protected the privileges of the elite and restricted opportunities for the broad mass of the population.

The second category of colonial economies corresponds to a number of Spanish colonies, such as Mexico and Peru, that were characterized by a large native population. Economic activity in these colonies was dominated by large-scale estates that were to some degree based on pre-conquest social organizations in which the elites extracted tribute from the general population. The Spanish Crown continued this tribute system in its colonies through so-called *encomiendas* that granted a small number of individuals land and claims on labor and tribute from natives. This led to the creation of large-scale estates with forced labor even where the main production activities did not display economies of scale (as was the case in grain agriculture). As in the sugar colonies, these economies featured highly concentrated political and economic power that translated into exclusive institutions preserving the power of the elite.

The third category of New World colonies is composed of the colonies on the North American mainland (Canada and the northern United States). These colonies were neither endowed with an abundant native population nor with a climate and soil that was suitable for producing highly valued crops, such as sugar. This lack of factor endowments, combined with the existence of abundant land and low capital requirements, implied that most adult men operated as independent proprietors, creating a relatively egalitarian society in economic and political terms.

ES argue that the unequal societies in sugar colonies and colonies dominated by *encomiendas* created an institutional environment that restricted economic growth in the long run, making them less prosperous today than the United States and Canada. They support this argument with a number of summary statistics suggesting that countries that used to be sugar colonies or dominated by *encomiendas* extended the franchise later than the United States and Canada and also had lower literacy rates than in the United States and Canada in the early 1900s. Moreover, ES argue that the banking systems that developed in Latin America served primarily a wealthy elite whereas the banking systems in the United States and Canada were more inclusive. ES do, however, not provide econometric evidence for their hypotheses.

In this paper, we develop AJR's and ES's arguments further by examining the different colonization strategies in the New World and their consequences for long-run economic development in more detail.[5] We start with the observation that the economic activities that the colonizes performed in the New World varied not only across countries, but also within countries. For example, the southeastern United States were dominated by large-scale cotton and rice plantations during colonial times, while small-scale grain farmers and manufacturing workshops were predominant in the northeast. Similarly, most states in the northeast of Brazil grew sugar during colonial times, while the states in the southeast engaged in grain production and cattle raising. We also note that levels of economic development vary almost as widely within country in the Americas as they do across countries. Table 1 shows a summary of GDP per capita (PPP) in different regions in seventeen countries in the Americas. For some countries, the standard deviation of GDP per capita within country is of the same order of magnitude as the standard deviation of log GDP per capita across countries, which is equal to 0.71.[6]

We exploit this within country variation to study the relationship between different colonial activities and economic development in the Americas more explicitly than ES by correlating colonial activities at the region level with current day measures of economic development. Using within country data to examine the relationship between colonial activities and levels of economic development has several advantages over using country level data. First, it allows us to capture colonial activities more accurately since we are not limited to using a single colonial activity as a proxy for the activities performed in each country. Second, we obtain a much larger sample (345 regions, instead of seventeen

[5]AJR's and ES's arguments are obviously related. It goes beyond the objective of this paper to examine the differences among them. The comment by Acemoglu (2002) to ES (2002) includes a discussion on similarities and differences among them.

[6]According to country-level data on PPP GDP per capita from the International Monetary Fund's World Economic Outlook Database, April 2010.

countries), increasing statistical power. Moreover, the within country approach lets us examine in more detail which local conditions determined colonial activities. We can then control for these conditions when correlating colonial activities with current day outcomes.[7]

Our theoretical argument follows ES's categorization of colonial economies quite closely. We classify the activities that colonizers preformed in different regions of the New World into four categories.[8] The first category includes activities that displayed economies of scale and relied heavily on the exploitation of labor, such as mining and sugar production. We denote these activities to be "bad" activities since ES associate them with low levels of economic development in the long-run. Our second category includes colonial activities that did not display economies of scale, such as the cultivation of subsistence crops, cattle raising, and manufacturing, that were performed in areas with low pre-colonial population density. We call these "good" colonial activities since ES argue that activities without economies of scale led to positive long-run outcomes if they were practiced in small-scale production by independent proprietors, which was the case in areas that did not have a large native population. In areas with a large native population, activities without economies of scale were typically performed in large-scale operations with forced labor. We call these colonial activities that relied primarily on the native population as an exploitable resource "ugly" colonial activities. Fourth, some areas within a number of countries were not settled by the colonizers and therefore had no colonial activities.

Based on the discussion of colonial activities in this section, we test the following hypotheses in this paper:

- Differences in currents levels of development within countries can be explained by differences in colonial activities.

- More specifically, areas that had bad colonial activities (activities with economies of scale, relying heavily on the exploitation of labor) or ugly colonial activities

[7]One concern with going from the cross-country level of analysis to the within-country level is that labor and capital mobility are much greater within country. However, our aim is to explain existing differences in economic development across regions that have not been arbitraged away by factor mobility. A caveat here is that while in a frictionless economy, labor and capital should move across regions to equalize incomes, this may not be the case in an economy with institutional frictions. For example, if property rights protection is weak in some areas of a country, capital owners might move their capital to areas were property rights protection is stronger, exacerbating economic differences. Overall, these issues imply that the magnitude of our estimates may not generalize to the country level. We address this question in more detail in Footnote 39, which compares to the magnitude of our estimates to that of AJR (2002) and finds them to be similar.

[8]This classification is based on ES (2002) and is described in more detail in Section 4.2.

(activities without economies of scale practiced in areas with high pre-colonial population density, relying on forced labor) have lower levels of development today than areas that had good colonial activities or areas that had no colonial activities.

Both AJR and ES argue that ”institutions” link colonial activities to current day economic outcomes, although their definition of institutions differs. AJR focus on the importance of secure property rights for economic growth, whereas ES focus on the importance of economic and political inequality. An alternative theory, put forward by Glaeser et al. (2004) is that European settlers brought with them many other things, such as high human capital, that could also explain the effect of colonial activities on current levels of development. We explore different possible channels that could link colonial activities to current day levels of economic development in Section 8.

3 Historical Background

This section illustrates the hypotheses put forward in Section 2 with specific examples. We first provide an example that illustrates the difference between regions with bad colonial activities and regions with good colonial activities. Section 2 argues that bad colonial activities, such as the cultivation of highly valued crops that were most efficiently produced on large slave plantations, led to extractive institutions and to lower levels of development today. An example for this mechanism can be found along the north-eastern coast of Brazil, a region that grew sugar during colonial times. Nowadays the core of this region roughly corresponds to the states of Alagoas and Pernambuco. These states had very unequal colonial societies, with a small number of plantation owners and a large number of slaves. This inequality went along with the development of political institutions that benefited primarily the elite. For example, Burns (1993) states that the typical owner of a Brazilian sugar planation was a “patriarchal chief who ruled family, servants, slaves, and even neighbors - unless they were large estate owners like himself - with absolute authority. The great size of the estate, its isolation from royal officials, and the relative weakness of local bureaucrats all strengthened his power. [...] The patriarch oversaw the land, listened to petitions, dispensed justice, and in general held court.” (p. 63)

In contrast to this elite dominated society stood the regions in the interior and south of Brazil, such as the states of Mato Grosso and Rio Grande do Sul, where cattle ranching was the predominant colonial activity. These states also had relatively low pre-colonial population densities, and thus fall under our classification of regions with good activities. Burns describes colonial society in these cattle regions as follows. “In direct contrast to the coastal owners, the cattlemen could and often did provide some variance from the more rigid hierarchical system characteristic of the sugar industry. Some scholars choose to emphasize certain democratic features at work or latent in the cattle ranching. It would seem that often the ranch owners were closer to their workers [...] and on occasion even worked right along with them [...]. Slavery was not a widespread institution in the cattlelands. As a means of payment to his *vaqueiros* (cowboys), the rancher customarily shared the newborn calves with them. [...] In that way, it was possible for the ambitious *vaqueiro* to start his own herd." (p. 74-75, Burns, 1993). Burns also suggests that social and economic mobility was more feasible in the cattle industry than in other economic activities in the colony.

The long-run economic outcomes illustrate that colonial sugar cultivation in Alagoas and Pernambuco, a bad activity, is associated with a lower level of development than cattle ranching in Mato Grosso or Rio Grande do Sul, a good activity. In 2000, PPP GDP per capita in Alagoas was US$ 2,809 and US$ 3,531 in Pernambuco. In Mato Grosso and Rio Grande do Sul, on the other hand, PPP GDP per capita was two to three times higher, US$ 6,890 and US$ 9,059, respectively.

We now discuss the difference between regions with good colonial activities and regions with ugly colonial activities, using the example of textile production. In the colonial United States, where pre-colonial population densities were comparatively low, textile production was organized in many small scale mills under property ownership (McGaw, 1994, p. 396), corresponding to that what we call a good colonial activity. In contrast, textile production in many Spanish colonies, where pre-colonial population densities were relatively high, was organized in *obrajes de paño*[9]. *Obrajes* were large workshops that "integrated every part of the cloth production process" (Gómez-Galvarriato, 2006, p. 377). These workshops have been likened to modern day "sweat shops," and the labor force was based on coerced labor (slavery, *mita*,[10] etc.). *Obrajes* did not exist in Spain itself and were specifically developed for the colonies "with the techniques and experience of Spanish masters and artisans" (Gómez-Galvarriato, 2006, p. 377). Textile production in Spain was mainly organized in small shops, similarly to the United States. This suggests that textile production *per se* did not display economies of scale during colonial times. It is likely that *obraje* style production of textiles only

[9]Accordingly to Gómez-Galvarriate, *obrajes* were widely present in Latin America since the mid XVI century, including places such as Puebla and Michoacán in México, Cuzco, Cajamarca, and Huanuco in Perú, Quito in Ecuador, La Paz in Bolivia, and Córdoba in Argentina.

[10]The *mita* system was forced labor system that was widespread in colonial Spanish America. Using district-level data for Peru, Dell (2010) provides evidence, that the *mita* system had a negative impact on current consumption and educational attainment.

arose in the Spanish colonies due to the availability of a large coercible native population, resulting in an ugly colonial activity. Gómez-Galvarriato (2006) claims that the *obraje* system had negative consequences for long-run development. She argues that the strong dependence on coerced labor destroyed incentives for the accumulation of human capital among workers and increased income inequality. Both of these factors in turn contributed to the low levels of industrial development in many areas in Latin America over the XIX century.

4 Data

We constructed a data set that covers 345 regions from seventeen countries in the Americas. This section discusses general features of the data and data sources. A more detailed description of the data is in the appendix. Appendix A includes the definitions of all variables. The sources for each variable are listed in Appendix B. Summary statistics for all variables are in Table 2.[11]

4.1 Measures of Economic Development

The main outcome variable of our analysis is the current level of economic development of each modern day department, province, region, or state in the data set[12], measured by GDP per capita. We also use poverty rates as an alternative measure of economic development. The data on GDP per capita and poverty rates comes from country specific sources. We obtained data on state level GDP from local statistical agencies for most countries and supplemented it with data on population from each country's demographic census to calculate GDP per capita. For El Salvador, Guatemala, Honduras, and Paraguay, data on state level GDP per capita comes from the national Human Development Report for each country. For Venezuela, GDP per capita, to our knowledge, is not available at the region level. For this reason, we use regional income per capita from a household survey.

Data on poverty rates comes from household surveys. We define poverty rates according to the national definition of poverty lines. This may produce poverty rates that are not comparable across countries. To deal with this potential problem, we use the log poverty rate in our regressions and we include country fixed effects, so that the estimated effects can be interpreted as log deviations from country means. Similarly, we use the log of GDP per capita in the regressions to allow for a uniform interpretation of

[11] Our full dataset is available on-line at http://www.economia.puc.cl/fgallego

[12] In this paper, we use department, province, state, and region interchangeably.

the effects.

Our outcome data is generally for the year 2000 (or for a year close to that if data for 2000 was not available). For some countries, such as the US, it is a well known fact that levels of economic development across regions have converged quite significantly over the past few decades[13]. It would be interesting to replicate the results with earlier data to see how they change over time, but data at the state level is not available for earlier periods for many of the countries in our sample.

In addition to measures of current economic development, we also use a proxy for pre-colonial levels of development. This proxy is a pre-colonial health index that comes from the Backbone of History Project (Steckel and Rose, 2002). Steckel and Rose estimate a health index that ranges from 0 to 100 based on archeological data. For this paper, we match the location of the archeological sites to regions within countries. This allows us to obtain information for 53 regions in our sample.

4.2 Colonial Activities and Pre-Colonial Population Density

We construct three dummy variables to capture colonial activities, based on the main economic activity that colonizers performed in a region and on pre-colonial population density. We identify the main economic activity that the first European settlers performed in each region using country or region-specific history books[14]. Given that we would like to focus on the exogenous components of colonization we identify the activities that were first developed in a region and not subsequent activities, that according to the theoretical and historical arguments in the previous sections may be endogenous to the initial activities. Moreover, we only consider activities that were performed in permanent settlements that were more than just a fort or mission, even if they were small. The idea here is that an activity could not have had lasting effects if there were no settlers in a region to pass on the "institutions". For example, there were some regions in North America where settlers from one region traded fur and other goods with natives from a different region, without settling in this different region during the colonial period. We consider these regions that were not settled by the colonizers to have had no colonial activities. Following this definition, 18 percent of regions in our sample had no colonial activities.

Our measure of pre-colonial population density is based on several sources. We use pre-colonial population density instead of native population density during the coloniza-

[13] Iyer (2005) also shows that the effect of colonialism in India was stronger at the time of independence than in the 1990s.

[14] Appendix B lists the books used for each country.

tion period because the second variable is probably highly endogenous to the activities developed by the colonizers, as suggested in several papers, e.g. Denevan (1992). The information on this variable comes mainly from the chapters and references in Denevan (1992). Denevan provides estimates of the total native population for each country. For some countries, he also provides estimates of the native population for regions within a country. Whenever this is not the case, we complement this information with several other sources to arrive at estimates of population density at the region level. Appendix C describes in more detail how the variable was constructed. In some cases, we have to impute the same value of pre-colonial population density for more than one region due to missing information. We account for this in the empirical analysis, by clustering at the pre-colonial population density level. Our estimated native population density ranges from 0.01 people per square kilometer in the Southern regions of Argentina and Chile to 392 in Mexico City.

Taking our information on colonial activities and pre-colonial population density, we classify regions into having good, bad, and ugly activities following ES (2002). The category "bad" activities covers activities that displayed economies of scale and relied heavily on the exploitation of labor. ES (2002) provide a list of these crops and minerals in Footnote 11, which states that sugar, coffee, rice, and cotton all had extensive economies of scale. Similarly, mining also had economies of scale. This list of activities is based on evidence in Fogel (1989), Engerman (1983, pp. 635–59) and Deerr (1949–50). We denote these activities that displayed economies of scale to be bad activities, since Engerman and Sokoloff associate them with bad long-run outcomes, for the reasons outlined in Section 2. Following ES, pre-colonial population density does not enter into our classification of bad activities[15].

The category "good" activities includes colonial activities that did not display economies of scale, such as the cultivation of subsistence crops, cattle raising, and manufacturing, and that were performed in areas with low pre-colonial population density[16]. We call these activities good colonial activities since ES argue that activities without economies of scale led to positive long-run outcomes if they were practiced in small-scale production by independent proprietors, which ES claim was the case in areas that did not have a large native population. In areas with a large native population, activities without economies of scale were typically performed in large-scale operations with forced labor,

[15]The reason for this is that activities with economies of scale typically had revenues that were so high that they could cover the cost of importing forced labor to a region, making the activity independent of the pre-exiting local labor supply. Section 5 includes a longer discussion of these issues.

[16]Gallego (2010) also uses this classification of activities in his empirical strategy.

leading to negative long-run outcomes according to ES. We call these colonial activities that relied primarily on the native population as an exploitable resource "ugly" colonial activities.

Figure 1 summarizes our classification of activities into good, bad, and ugly. Areas with bad colonial activities were areas that had activities with economies of scale, independent of the pre-colonial population density. Areas with good and areas with ugly colonial activities both had activities that did not display economies of scale, but they differed in the availability of exploitable local labor (proxied by pre-colonial population density). In our main analysis, we divide areas that had activities without economies of scale into areas with good and ugly colonial activities based on the median of pre-colonial population density, with areas with above the median pre-colonial population density being classified as areas with ugly colonial activities. The choice of the median as the dividing number is *ad hoc*, and we provide results using alternative classifications based on the 75th percentile and the average in Appendix Table 1.

Based on this classification, we construct three dummy variables, indicating whether a region had good, bad, or ugly activities, with the omitted category being no colonial activities.[17] The summary statistics in Table 2 show that 27 percent of all areas had good colonial activities, 21 percent had bad colonial activities, and 34 percent had ugly colonial activities. Among the 21 percent of areas that had bad colonial activities, 12 percent engaged in mining and the remaining 9 percent engaged in plantation agriculture.

4.3 Intermediating Factors and Control Variables

We complement the previous information with four outcome variables that could be a link between colonial activities and current levels of economic development[18]. Three of these variables come from local statistical agencies and/or household surveys: a measure of income inequality (the Gini index), schools per child, and literacy rates. The fourth variable is the number of seats in the lower house per voter, from Bruhn, Gallego, and Onorato (2008). This variable is typically constructed using information from local electoral agencies. Unfortunately, these four variables are not available at the region level for some countries, as stated in Appendix A.

[17] One challenge in coding these dummy variable is that it is sometimes the case that the colonizers engaged in various activities within the same region. However, the history books are typically quite clear about which activity dominated the economy. For example, some mining regions also grew wheat for local consumption, but the region's employment, infrastructure, and the administration were typically centered around mining since this activity was export-oriented and more profitable than wheat production.

[18] We discuss the motivation for choosing these four variables in Section 8.

Finally, we also include control variables in the regressions to account for regional differences in climate and geography. The climate variables are average temperature and rainfall. The geography variables are altitude and a dummy variable indicating whether the region is landlocked.

5 What Determined Colonial Activities?

Our paper aims to provide evidence for the argument that the first type of economic activity that colonizers engaged in had lasting effects on economic development. An important question that relates to the validity of this argument and our evidence is what determined colonial activities in the first place? If the determinants of colonial activities are correlated with current levels of economic development for reasons other than the colonial activities itself, any empirical relationship between colonial activities and current levels of economic development may be spurious. In order to examine these issues in more detail, this section discusses which factors determined colonial activities from a historical perspective and provides empirical evidence on these determinants.

To provide a framework for our discussion, we express the colonizers' decision to settle in an area and to engage in certain activities as the outcome of the following cost-benefit comparison

$$\begin{aligned} NB_{ir} &= P_i F_i(climate_r, soil_r, elevation_r, labor_r, luck_r, ...) \\ &\quad - C_i(labor_r, transportation_r, disease_r, threats_r, luck_r ...) \end{aligned}$$

where NB_{ir} stands for the net benefits of the different possible colonial activities i, for example gold mining, growing sugar, or cattle ranching, in region r. The net benefits are composed of the revenues derived from each activity, given by the price of the product, P_i, times the quantity produced with production function $F_i(.)$, minus the costs from engaging in an activity, $C_i(.)$. The price, the production function and the cost function vary with the type of activity i. The observable (for the econometrician) inputs into production are climate, soil, elevation, and labor. Similarly, the observable costs of engaging in different colonial activities arise from labor, transportation, disease, threats. Both the production and cost functions also depend on luck and potentially on other observable and unobservable factors.

We argue that, in each region, the colonizers engaged in the activity that had the highest net benefits according to the net benefit function NB_{ir}. If the net benefits of all activities were negative in a region, the colonizers would not settle in this region and would not engage in any activities. Section 4.2 mentions that 18 percent of regions did not have any colonial activities at all. Although this model is quite simple and stylized, we feel that it captures the important elements behind the colonizer's decision of which economic activities to perform in different regions of the New World.[19]

We now discuss the different elements of the net benefit function NB_{ir} stipulated above. The first element is the price or value of each product. The colonial products that had the highest value were gold and silver since they were used to mint currency. After gold and silver, cash crops, such as sugar, appear to have been the most valuable colonial products since there was a large demand for them in Europe. Subsistence crops, such as wheat, on the other hand, where mostly produced for local consumption in the colonies. Table 3 shows the price of sugar in different colonies, compared to the price of wheat or flour. The price of sugar was 13 silver grams per kilogram on average, nine times as high as the price of wheat or flour (1.4 silver grams per kilogram on average).

Based on price alone, the most desirable colonial activity was to mine gold or silver, followed by the production of cash crops, such as sugar.[20] The production function of gold or silver, however depended on luck in the sense that these metals could only be mined where they had been discovered. For geological reasons, the probability of discovering gold, silver, or other minerals was greater in high mountains, such as the Andes in South America and the Sierra Madre in Mexico, which is why we include elevation as one of the elements in the production function.[21] The production function we specified above also depends on climate and soil. While these factors seem to have played

[19]Some may object to the fact that our argument is based on a simple comparison of economic benefits, without considering other factors, such as ideological or religious motives. While we recognize that these factors played a role in the colonization of the New World, we abstract from them here and focus solely on economic motives for colonization. ES (2002) argue that "immigrants from Europe were drawn to the New World primarily by the prospect of improving their material welfare" (p. 54).

[20]Two historical examples provide support for the argument that the colonizers' preferred activity was mining, followed by producing cash crops, and then other colonial activities. The first example, from Colombia, shows that the colonizers allocated labor first to gold mining and then moved it into plantation agriculture after mines were exhausted. The colonizers mined gold in the Pacific lowlands of the Chocó region in Colombia during the early colonial period, relying heavily on imported slave labor. McFarlane (2002) and Ocampo (1997) document that, after many of the gold reserves were depleted in Chocó, owners moved their slaves to sugar plantations in the neighboring Valle del Cauca and Cauca regions.

Second, an example from Burns (1993) illustrates that the Portuguese colonial administration had a greater interest in sugar production than in the production of livestock. Burns states that "by 1600 [...] sugar yielded more profit to Portugal than all its exotic trade with India." (p. 65) and "as cattle breeding [in Brazil] expanded quickly in the second half of the sixteenth century, the Portuguese government forbade it within ten leagues of the coast in order to protect the precious sugar lands" (p. 72).

[21]While some mines were discovered during the colonial period, ES (2002) and Tanderet (2006) document that some mines had existed and been used by natives prior to colonization. For example, Porco in present-day Bolivia was an Inca mine located close to Potosí, one of the largest silver mines in the New World that was discovered during the colonial period (Tandeter, 2006).

almost no role in the production of minerals, they were important for the production of certain crops, such as sugar (ES, 2002).

A crucial factor of production for all colonial activities was labor. The availability of labor and associated labor costs varied from region to region, depending on whether or not natives were present in a region who could be forced to work for the colonizers. If no natives were present in a region, the colonizers could import forced labor from other regions or countries at higher cost. Historical evidence suggests that the returns to mining and cash crops were large enough to cover the costs of importing labor from other areas. For example, most labor on sugar planations in the New World consisted in slaves that had been brought to the New World from Africa. Similarly, mining in Bolivia and Mexico depended critically on moving the native labor force from regions that did not have mines to the regions that did have mines, such as Potosí and Guanajuato (Tandeter, 2006).[22] The relatively low-return production of subsistence crops, on the other hand, tended to rely on local labor, either from natives who lived in the region or from the colonizers themselves.

An important element in the cost function of colonial activities were transportation costs. These costs were particularly relevant for export goods, such as sugar, that were shipped to Europe. Based on the historical evidence, it appears that producing export goods was only profitable close to the sea since transportation over land was very costly during the colonial period. However, there were also some random elements that influenced colonial transportation costs and thereby the location of colonial activities. For example, in Brazil, sugar in the colonial period was produced in the states along the north-eastern sea cost. Nowadays, the Brazilian state that produces the most sugar is Sao Paulo in the southeast of Brazil.[23] Sao Paulo did not produce any sugar during the colonial period despite having a sea cost with a port, Santos, that is today the biggest port in Latin America[24]. The reason is that the fertile plains of Sao Paulo are separated from Santos by a mountain range that had to be crossed by mule during the colonial period, making transportation of goods very expensive (nowadays there are roads and railways connecting the port to the rest of Sao Paulo).

Transportation costs and proximity to the sea were less important for the production of subsistence crops, such as wheat, since these were typically consumed locally. More-

[22]A canonical example along these lines is the decision by Viceroy Toledo in the late XVI century in which "he resolved that each year more than 13,000 indigenous workers and their families from a vast area of the Andes would travel to Potosí to work in its mines for twelve months " (Tandeter, 2006).

[23]According to data from the Brazilian statistical institute, Instituto Brasileiro de Geografia e Estatística (IBGE).

[24]According to statistics from the Economic Commission for Latin America (ECLAC).

over, cattle raising for the local market had relatively low transportation costs since cattle could walk itself to the market where it would be sold. This made it possible to raise cattle in some relatively remote colonial areas that were far from other settlements, such as Mato Grosso in central Brazil.

Although transportation costs were high for gold or silver, as far as we know, conditional on gold or silver having been discovered, the colonizers would always decide to engage in mining activities in a region since the revenues were so great that they outweighed even very high costs. Silver mining in Potosí is a very telling example. Despite being one of the highest (modern) cities in the world (with an elevation of about 4,000 meters) and being located more than 400 miles away from the nearest colonial sea port, it became one of the centers of silver production in the New World. Potosí had up to 120,000 inhabitants during colonial times (Cobb, 2006, and Tandeter, 2006). Silver from Potosí and supplies to Potosí were transported through the Andes on pack trains using mules, llamas, (and in some cases Indians carriers), with the help of native guides. Cobb (2006) documents that the Potosí-Arica pack train (covering a distance of about 120 miles) relied on 312 Indians and 5,000 llamas in 1603.

Finally, our stylized model includes two additional costs of settling in an area and engaging in colonial activities. The first of these costs is related to the risk of contracting a potentially fatal disease, such as malaria. AJR (2001) point out that the higher the expected settler mortality, the lower the probability of reaping the returns of colonial activities, discouraging colonizers from settling in an area[25]. The second cost arises from threats by hostile natives or other colonizers that might attack local settlers to drive them out of a region, again lowering the probability of reaping the returns of colonial activities. For example, the Mexican state of Quintana Roo, where nowadays the resort city of Cancun is located, was not settled during colonial times, in part because Spaniards who tried to settle there faced frequent raids from pirates and the English in Belize.

To summarize, our model identifies a number of factors that appear to have played a role in determining colonial activities. These factors include availability of local labor, climate, soil, elevation, transportation costs, as well as the disease environment and threats from natives or other colonizers. We now test empirically whether these factors are indeed correlated with colonial activities. We measure the determinants of colonial

[25]On the other hand, ES(2002) state that historical migration statistics for British America do not support this argument since the colonies that had the highest mortality rates, i.e. the southern mainland and the West Indies, attracted the great majority of European migrants (according to ES because survivors could earn very high incomes in these colonies).

activities as follows. First, we use pre-colonial population density as a proxy for the availability of local labor. Second, we capture the local climate with four variables: average temperature, average temperature squared, rainfall, and rainfall squared. Third, we use altitude and altitude squared to capture elevation. [26] Fourth, our proxy for transportation costs is a dummy indicating whether a region is landlocked or not. In addition, altitude may also influence transportation costs.

We do not have a direct measure of settler mortality or disease risk at the region level. However, Hong (2007) shows that malaria incidence at US army forts in the 19th century is strongly correlated with local temperature, rainfall, altitude, and an indicator for being landlocked. These variables are already included in our analysis and thus also act as proxies for disease risk. We were not able to obtain data on soil or on threats from natives or other colonizers. However, since our main concern in this section is to identify variables that could potentially bias the relationship between colonial activities and current day levels of economic development, we consider the lack of data on soil and threats during colonial times as secondary. While soil quality likely influences agricultural output today, GDP in agriculture as a percentage of total GDP is generally small.[27] Moreover, we consider threats from natives or other colonizers to have no independent influence on current levels of development since these threats disappeared over time and all areas in our sample were settled eventually.

Table 4 displays the results of regressing our colonial activities dummies on the potential determinants of colonial activities.[28] Column 1 shows the results for our bad activities dummy. We find, consistently with our previous discussion, that pre-colonial population density is not correlated with the development of bad activities: if needed, labor was imported from other regions or countries given the high expected profits. Several of the climate and geography variables predict the probability of having bad activities in a region. However, as Columns 2 and 3 suggest, the margins through which these variables operate are different for mining and plantations. We find that altitude is correlated in a non-linear way with the presence of mining. This mainly captures the fact that minerals are more likely to be found in high mountain ranges, as previously discussed.[29] Our proxy for transportation costs (the landlocked dummy) is

[26]Altitude may also capture climate characteristics. Dell (2010) argues that altitude is the main determinant of climate and crop choice in Perú.

[27]Based on region level data from Brazil, Chile, Colombia, Mexico, Peru, and the US, the median percentage of GDP in argiculture is only 6.5.

[28]Panel A of Table 4 shows regressions without country dummies and Panel B of Table 4 displays regressions including country dummies. The results in these two panels are not qualitatively different, but we include them for transparency.

[29]The non-linear effect of rainfall probably also captures this.

not statistically significant for mining, but it is negatively correlated with the probability of having plantations. This is also consistent with the our previous discussion on the profitability of these activities.

Next, we examine what determined good and ugly colonial activities in Columns 4 and 5. Pre-colonial population density is mechanically correlated with the dummy variables for good and ugly activities, since they are defined in part based on pre-colonial population density. Moreover, some of the geography and climate variables show a statistically significant correlation with good and ugly activities, but these correlations are not robust to controlling for country dummies. Finally, in Column 6 we include regressions for the determinants of not having any colonial activities. The results suggest that areas without colonial activities correspond to relatively isolated (landlocked) regions with low pre-colonial population density.

Overall, these regression results confirm our conceptual and historical discussion on the determinants of colonial activities in the New World. We control for these determinants in our empirical exercises below in order to make it less likely that our measured relationships between colonial activities and current levels of development are spurious rather than causal.

6 The Effects of Historical Factors on Development

Section 2 argues that areas with bad and ugly colonial activities should have lower levels of economic development today than areas with good or no colonial activities. We test this hypothesis by running the following reduced form regression

$$Y_{rc} = \mathbf{Z}_{rc}^{\prime}\alpha + \mathbf{X}_{rc}^{\prime}\beta + \eta_c + e_{rc}, \tag{1}$$

where c refers to country, r stands for region, Y is a measure of development, $\mathbf{Z}$ is a vector of historical variables, $\mathbf{X}$ is a vector of current day control variables, η is a country fixed effect, and e is the error term.

The set of historical variables, $\mathbf{Z}$, includes our good, bad, and ugly colonial activities dummies, with no activities being the omitted category, as well as pre-colonial population density. The vector $\mathbf{X}$ consist of climate and geography controls. We cluster standard errors at the pre-colonial population density level since, as discussed in Section 4, there are some cases where we impute the same value of pre-colonial population density for more than one region due to missing information.

According to the hypotheses stated in Section 2, the coefficient on bad and ugly colonial activities should be negative: we expect areas with bad and ugly colonial activities to have lower levels of development than areas with no activities. Moreover, testing for the equality of the coefficients on the good and bad activities dummies, as well as on the good and ugly activities dummies, should also show that the coefficients on bad and ugly activities are statistically significantly lower than the coefficient on good activities.

Table 5 displays the regression results for log GDP per capita (PPP) as the outcome variable. While the coefficients on the good, bad, and ugly colonial activities dummies represent the differences in GDP per capita today relative to areas with no colonial activities, the bottom panel of Table 5 shows the statistical differences between the coefficients on good, bad, and ugly colonial activities relative to each other. Column 1 includes only good, bad, and ugly colonial activities dummies, without any control variables. As predicted, areas with bad activities have statistically significantly lower GDP per capita today than areas with no colonial activities and areas with good colonial activities (by 39.2 percent and 33.2 percent, respectively). Similarly, areas with ugly colonial activities have 26.3 percent lower GDP per capita today than areas with no colonial activities, and 20.3 percent lower GDP per capita today than areas with good colonial activities.

We now add pre-colonial population density to the regression. As discussed above, it is important to include this variable since pre-colonial population density is a predictor of colonial activities. Column 2 displays a regression with pre-colonial population density as the only regressor, showing that it is negatively and significantly correlated with current GDP per capita. Column 3 includes all historical variables together and Columns 4 and 5 add the set of climate and geography controls to the regression step by step. Column 4 includes climate variables - average yearly temperature and total rainfall and both of these variables squared. Column 5 includes climate controls, plus altitude, altitude squared and a dummy for whether the region is landlocked or not.

The coefficients on the bad and ugly dummies shrink in magnitude once pre-colonial population density is included in the regression, but they are relatively robust to the inclusion of the climate and geography control variables. In fact, the only control variables that are statistically significant are rainfall and the landlocked dummy.[30] In our preferred specification, in Column 5, areas with bad colonial activities have 27.6 percent lower GDP per capita today than areas with no activities and 27.7 percent lower GDP per capita today than areas with good activities. Similarly, areas with ugly colonial activities have 15.9 percent lower GDP per capita today than areas with no activities and

[30]As mentioned above, the landlocked dummy works as a proxy for transportation costs that could generate a number of negative effects on trade and development (See Frankel and Romer, 1999, Irwin and Tervio, 2000, and Spolaore and Wacziarg, 2005).

16 percent lower GDP per capita today than areas with good activities. An additional finding that is not directly discussed in our theoretical arguments is that areas with good colonial activities are not significantly different from areas with no activities in terms of current GDP per capita. Moreover, bad colonial activities are associated with lower GDP per capita today than ugly colonial activities.[31]

The coefficient on log pre-colonial population density is statistically significant in all regressions. In Column 5, the coefficient on log pre-colonial population density is (-0.052), implying that going from the 25th percentile in log pre-colonial population density (-0.91) to the 75th percentile (2.10) is associated with 15.5 percent lower GDP per capita. A one standard deviation increase in pre-colonial population density is associated with a 11.7 percent decrease in current per-capita GDP. There are several possible explanations for finding a direct negative effect of pre-colonial population density on current levels of development that is independent from colonial activities. First, greater pre-colonial population density could be associated with stronger pre-colonial tax systems, that the colonizers could take over and exploit, independent of colonial activities. Second, in areas with low pre-colonial population density, Europeans tended to be more likely to settle in large numbers and to introduce institutions that encouraged investment (Acemoglu, 2002, and AJR, 2002).[32]

The last column of Table 5 displays a regression that splits our bad colonial activities dummy among plantation and mining dummies to check whether bundling them together in one category is supported by the data. Both dummies show a negative and statistically significant correlation with current GDP per capita. Even though the plantations dummy has a larger coefficient in absolute terms, the F-test at the bottom of Table 5 suggests that we cannot reject the null hypothesis that the coefficients on the mining

[31] In a robustness exercise that we do not report in paper, we add an interaction of our bad activities dummy with a dummy for being in a region with pre-colonial population density above the median and find that, as expected given our theoretical discussion, this interaction is not statistically different from 0.

[32] A negative coefficient on pre-colonial population density in this regression could also be due to convergence if the pre-colonial production function was $Y = L^{(1-\alpha)}N^{\alpha}$, where L stands for land and N stands for labor and if there were a convergence process of the form: $\log(Y_t/N_t) - \log(Y_0/N_0) = -\lambda \log(Y_0/N_0)$, where t stands for the current period, 0 for the past, and λ is a function of the speed of convergence. In this setup we get that: $\log(Y_t/N_t) = -\lambda(1-\alpha)\log(N_0/A_0)$. However, simulations using this process and a time span of 400 years show that, at the speed of convergence that Barro and Sala-i-Martin (1999) find for U.S. states from 1880 to1980, namely 1.74 percent per year, the coefficient on pre-colonial population density would have to be between 100 and 1000 times smaller in absolute value than what we find, depending on the assumption of the share of labor in production. Thus, a conventional convergence model cannot explain the magnitude of our coefficient. Moreover, notice that the absolute value of our estimate of the effect of pre-colonization population density on current development is probably biased downwards, given that our population density variable is measured with error.

and plantations dummies are not statistically different. Therefore, in the remainder of the paper we continue grouping them into a single category (bad activities).

In order to examine the robustness of the results, Panel A of Table 6 displays seventeen different runs of the regression in Column 5 of Table 5. Each row corresponds to this regression with a different country excluded from the sample. The bottom part of Panel A of Table 6 includes summary statistics for the seventeen coefficients. The estimated coefficients on the bad and ugly colonial activities dummies, as well as the coefficient on pre-colonization population density are fairly robust to excluding singly countries from the sample.[33] Panel B of Table 6 focusses on the robustness of the pre-colonial population variable. It excludes from the sample all the countries for which more than 50% of regions have data on this variable imputed from other countries.[34] The results are mostly consistent with the results for the complete sample: the only coefficient that drops in magnitude slightly is the coefficient on ugly colonial activities. It is now equal to 13.7 (vs. 15.9) and is only statistically significant at the 21.9 percent level (possibly due to the smaller sample size). Overall, the results in Table 6 imply that our main estimates are not driven by any country in particular and do not seem to be affected by data imputation in the pre-colonial population density variable.[35] [36]

Table 7 considers poverty rates as an alternative measure of economic development. The data set for poverty rates is slightly smaller than for GDP per capita since data on poverty rates is not available for eight Colombian regions, two Honduran regions, and one Argentinean region. Similarly to Table 5, Table 7 first shows the relationship between poverty rates and our colonial activities dummies. Here, only the coefficient on the bad colonial activities dummies is positive and statistically significant. In the next column, we display the correlation between the log of poverty rate and pre-colonial population density alone. Finally, we include all historical variables in the same regression

[33]The coefficients on the good activities dummy vary more but the dummy is never statistically significant.

[34]These countries are Guatemala, Honduras, Panama, Paraguay, Uruguay, and Venezuela.

[35]Appendix Table 1 includes estimates in which we divide our good and ugly activities dummies using three different cutoffs for defining high population density: the median (0.30, the results we report in the main text), the average (0.50), and the 75th percentile (2.10) of the distribution of population density. Results show that the coefficients on our variables of interest are fairly robust to these different definitions.

[36]We also experimented with adding other control variables to the regression to examine robustness of our results. For instance, we added the share of the current population that is indigenous. This does not change or results, although the variable is negatively correlated with GDP per capita. The interactions between good and bad colonial activities and the share of the population that is native are negative and statistically different from 0. However, the magnitude of our main effects does not change much, suggesting that the interaction effects are not economically relevant. Results available upon request.

and also add climate and geography control variables to the regression. All columns unambiguously show that current poverty rates are positively correlated with pre-colonial population density. The coefficients imply that going from the 25th percentile in log pre-colonial population density (-0.97) to the 75th percentile (2.10) is associated with a 14 percent higher poverty rate. Our preferred specification in Column 5 shows that areas with bad colonial activities have a 16.4 percent higher poverty rate than areas with no colonial activities and a 13 percent higher poverty rate than areas with good colonial activities. The results for ugly colonial activities are different from those in Tables 5 and 6. Unlike for GDP per capita, we do not find a statistically significant correlation between ugly colonial activities and current poverty rates.[37]

Overall, the evidence in this section supports the theoretical argument that bad colonial activities led to lower long-run levels of economic development than good colonial activities or no colonial activities. The corresponding evidence for ugly colonial activities is mixed, suggesting that ugly colonial activities may have been less detrimental for long-run economic development than bad colonial activities. However, ugly colonial activities are associated with significantly lower GDP per capita today.

7 Did Colonization Reverse Fortunes?

Our argument postulates that colonial activities changed the economic fortunes of certain areas. Thus, before colonization, areas where bad and ugly colonial activities were to take place should not have been worse off than other areas, *ceteris paribus*. If those areas were worse off even before colonization, then there must be something else other than colonization patters that explains these differences. We would thus like to verify that bad and ugly colonial activities were not negatively correlated with economic development before colonization. This check is, however, not easily done since there are no measures of pre-colonial GDP per capita or other conventional measures of development at the region level.

To get a proxy measure of economic development, we use a health index which is available for 53 regions in seven of the seventeen countries in the full sample, Brazil, Canada, Chile, Ecuador, Mexico, Peru and the US. The health index was calculated based on different skeletons found in each region. These skeletons often come from different centuries. To control for possible differences in the quality of the data arising from the age of the skeletons, we add the variable "year" to the health index regression. "Year" is the average of all the estimated years in which the found bodies lived.

[37]The correlation between GDP per capita and poverty rates is -0.46.

Using our pre-colonial measure of economic development, the health index, and our current day measure of economic development, GDP per capita, we construct a difference-in-difference exercise in the following way. First, we standardize the health index by subtracting its sample average from each observation and dividing it by its standard deviation. We standardize log current GDP per capita in the same way for each of the 53 regions for which we have data on the pre-colonial health index. Then, we run the following regression:[38]

$$S_{rct} = \mathbf{Z}'_{rc} * \alpha + \mathbf{Z}'_{rc} * Post_t * \alpha_{post} + \mathbf{X}'_{rc}\beta + Post_t * \gamma + \eta_c + e_{rct}, \tag{2}$$

where S is the standardized measure of development in region r in country c at time t. Time t takes two values: before or after colonization and, therefore, the variable $Post$ is a dummy that takes the value of one when $t = after\ colonization$. The variables $\mathbf{Z}$, $\mathbf{X}$, and η are defined as in Equation (1). Thus, α captures the effect of the vector of historical variables on development *before colonization* and α_p captures the change in this effect *after colonization.*

Table 8 shows the results of this difference-in-difference regression. Before colonization, areas with bad colonial activities and areas with ugly colonial activities did not have statistically different levels of economic development from areas with good colonial activities and areas with no colonial activities. In fact, the coefficients on the activities dummies suggest that areas with bad and areas with ugly colonial activities had higher levels of economic development than areas with good colonial activities and areas with no colonial activities before colonization, although these coefficients are not statistically significant. The interactions of the colonial activities with the post colonization dummy show that areas with bad colonial activities and areas with ugly colonial activities saw a decline in economic development after colonization (for ugly colonial activities, this differences is only statistically significant at the 19.3 percent level in this sample). Table 8 also shows that pre-colonial population density was associated with higher levels of economic development before colonization, but that this correlation was reversed after colonization (this difference is statistically significant at the 16.4 percent level). Although the results in Table 8 are not precisely estimated, possibly because the sample is quite small, they suggest that colonization reversed the economic fortunes of different areas in the New World.

Another way of testing the hypothesis that colonization reversed economic fortunes is to follow AJR (2002) in using pre-colonial population density as a proxy for pre-colonial

[38]This idea of using standardized outcomes is based on the estimation of mean standardized treatment effects in the policy evaluation literature (e.g. Kling et al. 2004).

levels of economic development, where areas with higher pre-colonial population density were more developed. If colonization reversed fortunes, then we should not see a negative correlation between pre-colonial population density in areas that did not have any colonial activities. Table 9 shows the correlation between pre-colonial population density and current GDP per capita separately for areas that had colonial activities and areas that did not have colonial activities. The results illustrate that while population density has a *negative* and significant relationship with current GDP per capita in areas with colonial activities, the same correlation is *positive* and statistically significant for areas without colonial activities. For areas with colonial activities a one standard deviation increase in the log of pre-colonial population density is associated with about 13 percent *lower* current GDP per capita. For areas without colonial activities a one standard deviation increase in the log of pre-colonial population density is associated with about 13 percent *higher* GDP per capita. These results mimic the cross-country results in AJR (2002). AJR find a "reversal of fortunes" only for countries that were colonized by European powers, but not for countries that were not colonized (AJR, 2002, p. 1253 and Table VI).[39] Our within-country finding of no reversal of fortunes in areas without colonial activities supports the argument that colonization changed the fortunes of colonized areas.

8 History and Development: Looking Inside the "Black Box"

This section examines several potential mechanisms that may account for the effect on history on current levels of development.[40] We consider the following three potential mechanisms: income inequality, human capital, and political representation. Our theoretical discussion suggests that extractive colonial activities went along with the formation of an economic and political elite. As a result, society came to be dominated by relatively few individuals, making it difficult for others to prosper and acquire human and physical capital. Based on this argument, colonial activities could be correlated with income inequality, such that areas with bad or ugly colonial activities and high

[39] AJR's cross-country results and our within country results provide an opportunity to assess whether the magnitude of the effect of colonial activities on current levels of development differs when measured within countries vs. across countries. As mentioned in Footnote 7, the within country results may be different due to larger factor mobility. We used AJRs dataset to compute that for countries in the Americas, a one standard deviation increase in pre-colonial population density decreases GDP per capita by about 0.22 standard deviations when controlling for similar variables as we do. The comparable elasticity in our within country data is 0.18 (after removing country fixed effects from the standard deviations). The fact that the two numbers are quite close suggests that within country findings may also apply across countries.

[40] Our approach here is similar to the one used by Nunn (2008b), Section VI, where he studies the mechanisms through which the past slave trade could be affecting current development.

population density are more unequal today, which in turn could imply that these areas have lower levels of development today. Similarly, education levels could also be lower in areas with unfavorable colonial activities, which could lead to lower levels of development. We discuss the third possible channel, political representation in more detail below.

Ideally, we would also like to examine institutions, such as property rights, as a channel. The previous literature has often referred to institutions as constraints on the government and security of property rights and has argued that these particular institutions drive economic growth at the country level. At the sub-national level, constraints on the government may be less important, since these constraints typically relate to the central government only, and policies and regulations may be more important. Clearly, regions within a country are subject to many common policies and regulations set by the central government. However, in many countries, regions also set their own local policies. Moreover, the way in which *de jure* national policies and regulations are applied and enforced locally often varies, implying that *de facto* institutions could be different. For example, Almeida and Carneiro (2007) document that enforcement of labor regulation varies widely across cities within Brazil and that areas with stricter enforcement have higher unemployment. Laeven and Woodruff (2007) exploit the fact that state laws and also legal enforcement differ from state to state in Mexico to show that average firm size is larger in states with more effective legal systems. In order to verify whether differences in institutions, or regulations, are a possible channel, we would need a measure of institutions at the sub-national level. To our knowledge, such a measure does not yet exist for the set of countries in our analysis. Some of the countries, such as Brazil and Mexico, have some measures or proxies for institutions at the state level. However, these measures differ from country to country and the coverage within country is often limited.

For the other three channels mentioned above, we have data at the sub-national level. Panel A of Table 10 displays the results of regressing proxies for each of the three channels on our colonial variables. The regressions include all control variables. Column 1 of Table 10 reproduces the results for GDP per capita from Column 5 of Table 5, as a benchmark. Panel B of Table 10 shows the size of the standardized effects of the colonials variables on each dependent variable (i.e. by how many standard deviations the dependent variable increases with a one standard deviation increase in the colonial variable). Panel B also displays the same standardized effects of colonial activities on GDP per capita, corresponding to the regression results in Column 5 of Table 5. In order to evaluate whether each potential mechanism could account for the effect of history on development we consider the following three criteria:

1. The estimated coefficients on the colonial variables in each column are statistically significant and their sign is consistent with our theoretical predictions[41].

2. The size of the effect of each colonial variable is economically significant, i.e. the colonial variables have non-trivial effects on the channel variables that could be consistent with the size of our reduced-form estimates of the effects of colonial variables on development.

3. The regressions show a differential effect of good and bad and good and ugly colonial activities on the channel variables.

The first possible channel is that extractive colonial activities led to higher inequality which led to lower GDP per capita, implying that the correlation of inequality and colonial activities should have the opposite sign from the correlation of economic development and colonial activities. Column 2 in Table 10 shows a regression of the log Gini index on colonial activities. Areas with bad and ugly colonial activities do not have statistically different levels of inequality today from areas with good or areas with no colonial activities. Pre-colonial population density is also not significantly correlated with inequality today. Overall, current income inequality does not seem to be a relevant mechanism for explaining the effects of colonial activities on current levels of development. [42]

The second possible link between colonial activities and current economic outcomes we study is human capital. We use two proxies for education in each region: the log

[41]Formally, this criterion works as follows. In each case, we estimate the following equation

$$M_{rc} = \mathbf{Z}_{rc}^{'}\alpha_I + \mathbf{X}_{rc}^{'}\beta_I + \theta_c + \varepsilon_{rc},$$

where M is a measure of a potential mechanism. This regression includes the vector of historical variables, $\mathbf{Z}$, and control variables, $\mathbf{X}$, as well as a country fixed effect, θ. We then assess whether the variable M could explain the effects of colonial activities on development by verifying wether

$$sign\left(\widehat{\alpha}_I\right) = sign\left(\widehat{\alpha}\right) * sign\left(\frac{\partial Y}{\partial I}\right),$$

where $\frac{\partial Y}{\partial I}$ is the theoretical partial effect of variable I on economic development (Y). For instance, ES argue that more inequality leads to lower levels of development, implying that $\frac{\partial Y}{\partial I} < 0$. Therefore, the correlation of inequality and colonial activities should have the opposite sign from the correlation of economic development and colonial activities, such that $sign\left(\widehat{\alpha}_I\right) = -sign\left(\widehat{\alpha}\right)$.

[42]Nunn (2008a) and Acemoglu et al. (2008) find evidence against the argument that economic inequality is the reason why colonial activities and historical variable influence current levels of development, using data from the US and Colombia, respectively.

of schools per child and the log literacy rate. The first variable measures the current availability of schools, and the second is a proxy for the current stock of human capital of the population. Columns 3 and 4 in Table 10 present the results. None of the colonial variables show any statistically significant correlation with our human capital variables. Therefore, current schooling and education do not seem to explain the correlation between colonial activities and current levels of development.

Next, we study the potential role of political representation in Column 5 of Table 10. Our dependent variable is the log of the ratio of seats in the lower house to the total population in each region.[43] Our rationale for using this variable relates to Bruhn, Gallego, and Onorato's (2010) ongoing research on legislative malapportionment. Legislative malapportionment results when the number of seats per voter is unequally distributed across regions within a country, leading to an over-representation of some regions and an under-representation of other regions. Bruhn, Gallego, and Onorato (2010) develop a theoretical argument and provide corresponding evidence that political elites used legislative malapportionment to secure their political power after transition to democracy. That is, the paper finds that areas that used to vote for parties associated with military dictators before transition to democracy are over-represented today. These areas continue to elect the same parties as before transition to democracy. The paper also finds that areas that are over-represented in the lower house receive higher transfers from the central government and have a lower degree of political competition, both of which can influence economic outcomes.

We believe that the link to colonial activities and colonial elites could be as follows. Areas with bad and ugly colonial activities tended to be wealthier during the colonial period than other areas (since they produced the highest value products). They also had the strongest elites capturing this wealth and unequal societies, probably with a small middle class. When military dictatorships developed in Latin America, the military and associated parties were often supported by the middle class (see for example Burns, 1993), possibly in an effort to break the political power of colonial elites. This then might have led to political over-representation of areas with good and no colonial activities (through the mechanism described in Bruhn, Gallego, and Onorato, 2010) after transition to democracy relative to areas with bad and ugly colonial activities. This over-representation could have resulted in increased economic benefits for areas with good and no colonial activities (such as higher transfers from the central government)

[43]We use lower house representatives because the composition of this chamber is typically less distorted by geo-political factors than the upper house (see Bruhn, Gallego, and Onorato, 2010 for a more detailed discussion).

that could explain why areas with bad and ugly colonial activities are less economically developed today.

The results in Column 5 of Table 10 show a pattern that is quite similar to our regression results with current GDP per capita as the dependent variable: bad and ugly colonial activities, as well as pre-colonial population density, are negatively correlated with political representation, and the standardized effects are big. Areas with good colonial activities are not statistically different from areas with no activities. Comparing areas with good and bad colonial activities suggests that areas with bad activities are less politically represented today and this difference is statistically significant (p-value of 0.01). Similarly, areas with ugly colonial activities are less politically represented than areas with good colonial activities (with a p-value of 0.02). Overall, the results for political representation are consistent with this channel being a link between colonial activities and current levels of development.

All in all, the regressions in Table 10 indicate that only the correlations between colonial activities and political representation are fully consistent with the correlations between colonial activities and current levels of development. The other two mechanisms we examine, income inequality and human capital do not seem to explain the effects on colonial activities on current levels of economic development.

9 Conclusion

This paper shows that within-country differences in levels of economic development in the Americas are correlated with the type of activity performed in each region during colonial times. In particular, it provides evidence that areas that were suitable for the activities that displayed economies of scale and relied heavily on the exploitation of labor, such as mining and plantation agriculture, have lower levels of economic development today. The estimated effects are economically relevant. Our estimates imply areas that had bad colonial activities (mining and plantation agriculture), have 27.6 percent lower GDP per capita today than areas that had no colonial activities within the same country. Areas with bad colonial activities also have 27.7 percent lower GDP per capita than areas that had good colonial activities (activities without economies of scale, such as growing staple crops and textile production that were performed in areas with low pre-colonial population density). Our results also show that ugly colonial activities (activities without economies of scale that were performed in areas with high pre-colonial population density and therefore typically relied on the exploitation of local labor) have 15.9 percent lower GDP per capita today than areas with no activities and 16 percent lower GDP per capita today than areas with good activities.

These results lend support to ES's (1997 and 2002) argument that the type of colonial activity preformed in a region mattered greatly for long-run development paths. More broadly, our results extend the theoretical and empirical findings of the recent literature that investigates the effects of colonial characteristics on development *at the country level*. The fact that we find within-country correlations between colonial activities and current levels of development suggests that it is not only the identity (nationality) of the colonizers that matters for subsequent development, as argued by some papers. The identity of the colonizer varies across countries, but we control for country effects. Moreover, our paper provides within country evidence for a "reversal of fortunes" due to colonization that AJR (2002) find at the country level. In areas that had no colonial activities, pre-colonial population density (a proxy for pre-colonial levels of development) is positively correlated with current GDP per capita. In areas with colonial activities, on the other hand, this correlation is negative.

We examine three potential channels that could be the link between colonial activities and current level of development: inequality, human capital, and political representation. The previous literature has argued that two of these variables, income inequality and human capital, are correlated with colonial characteristics at the country level. Our within-country regression, however, do not show a correlation between these two variables and colonial activities. On the other hand, a variable that has been less emphasized in the literature, political representation, is highly correlated with colonial activities. Areas with high pre-colonial population density and areas with bad activities are underrepresented in the lower house today. This could lead to lower levels of development since underrepresented areas have been shown to receive fewer transfers and to be subject to less political competition. We are not able to investigate whether differences in regulations or other sub-national institutions are also correlated with colonial activities due to a lack of consistent sub-national data. More research is needed to study the effect of colonial activities on these types of institutions.

10 Appendix A: Variable Definitions

- PPP GDP per capita: Gross state product for each state divided by the contemporaneous population of that state and converted to PPP values using the 2000 value from the World Development Indicators. Due to data limitations, the data for Venezuela corresponds to household income.

- Poverty rate: Percentage of the population living below the poverty line, according to each country's definition of the poverty line.

- Health index: The health index measures the quality-adjusted-life-years (QALY) based on the health status attributed to skeletal remains, which display chronic health conditions and infections. The health index is adjusted for the age distribution of the population and is a simple average of seven health indicators: stature, hypoplasias, anemia, dental health (teeth and abscesses), infections, degenerative joint disease, and trauma.
- Pre-colonial population density: The ratio of the estimated pre-colonial population to the area of modern states.
- Colonial activities: Predominant economic activity performed during the colony in the region that matches the current day state.
- Average temperature: Average yearly temperature (°C)
- Total rainfall: Total yearly rainfall (mm)
- Altitude: Elevation of capital city of the state (kms)
- Landlocked dummy: This dummy is equal to one if the state does not have a sea coast.
- Gini index: Gini measure of income inequality for households (not available for Honduras, Panama, Paraguay, and Uruguay).
- Schools per child: total numbers of schools divided by the school-age population of a region (not available for Panama and Uruguay).
- Literacy rates: percentage of the population that is literate (not available for El Salvador, Honduras, Panama, and Paraguay).
- Ratio of seats to total voting population: The ratio of lower house representatives of a region to the total number of people eligible to vote (not available for Panama, Peru, and Uruguay).

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Figure 1: Classification of Colonial Activities into Good, Bad, and Ugly

		Pre-colonial population density	
		Low	High
Colonial activities	Without economies of scale	Good - No exploitation of labor	Ugly - Exploitation of local labor
	With economies of scale	Bad - Exploitation of imported labor	Bad - Exploitation of local and imported labor

Table 1: Regional PPP GDP per Capita Across the Americas

Country	Obs	Mean	Log S.D.	Min	Max	Ratio ymax/ymin
Argentina*	24	11706	0.553	4578	40450	8.84
Bolivia	9	2715	0.395	1245	4223	3.39
Brazil	27	5754	0.576	1793	17596	9.81
Canada	13	44267	0.358	26942	94901	3.52
Chile	13	8728	0.423	4154	19820	4.77
Colombia	30	5869	0.489	2368	22315	9.43
Ecuador	22	5058	0.834	1458	26574	18.23
El Salvador	12	3336	0.300	2191	5954	2.72
Guatemala	8	3563	0.439	2100	8400	4.00
Honduras	18	2108	0.140	1716	2920	1.70
Mexico	32	8818	0.461	3664	23069	6.30
Panama	9	4336	0.676	1805	12696	7.04
Paraguay	18	4513	0.293	2843	7687	2.70
Peru	24	3984	0.570	1287	13295	10.33
US	48	32393	0.179	22206	53243	2.40
Uruguay	19	6723	0.231	3902	10528	2.70
Venezuela**	19	5555	0.231	3497	9088	2.60

*Data for 1993, **Income data

Table 2: Summary Statistics

Outcome variables	Obs	Mean	Std. Dev.	Min	Max
Log PPP GDP per capita	345	8.83	0.97	7.13	11.67
Log poverty rate	331	2.93	0.92	0.21	4.40
Health Index	53	4.22	0.38	2.95	4.52
Log Gini	268	-0.74	0.16	-1.15	-0.46
Log schools per child	317	-5.31	0.64	-7.29	-3.69
Log literacy rate	270	-0.14	0.13	-0.76	0
Log seats in lower house per voter	318	-11.42	1.19	-13.59	-8.14
Historical variables					
Good activities dummy	345	0.27	0.44	0	1
Bad activities dummy	345	0.21	0.41	0	1
- Mining dummy	345	0.12	0.33	0	1
- Plantations dummy	345	0.09	0.29	0	1
Ugly activities dummy	345	0.34	0.48	0	1
No activities dummy	345	0.18	0.38	0	1
Log pre-colonial population density	345	0.30	2.27	-6.91	5.97
Control variables					
Avg. temperature	345	19.33	6.66	-9.80	29.00
Total rainfall	345	1.26	0.94	0	8.13
Altitude	345	0.64	0.91	0	4.33
Landlocked dummy	345	0.56	0.50	0	1.0

Table 3: Prices during Colonial Times

		Price (Silver Grams per Kilogram)	
Country	Year	Wheat or Flour	Sugar
Bolivia	1677	1.68	22.29
Chile	1634	0.26	2.94
Colombia	1635	1.56	8.49
Massachusetts	1753	2.5	8.16
Peru	1635	1.12	23.37
Average		1.42	13.05

Source: Global Price and Income History Group, UC Davis

Table 4: What Determines Colonial Activities?

	Dependent variable:					
	Bad activities	Mining	Plantations	Good activities	Ugly activities	No activities
Panel A:	(1)	(2)	(3)	(4)	(5)	(6)
W/o country dummies						
Log pre-colonial pop dens	0.009	0.005	0.004	-0.068***	0.112***	-0.053***
	(0.012)	(0.008)	(0.010)	(0.015)	(0.021)	(0.011)
Avg. temperature	0.023**	0.008	0.014**	0.016	0.024***	-0.062***
	(0.009)	(0.005)	(0.007)	(0.010)	(0.009)	(0.012)
Avg. temp. squared	-0.001	-0.000	-0.000	-0.000	-0.001	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total rainfall	0.007	-0.063	0.070*	0.046	0.005	-0.058
	(0.053)	(0.040)	(0.036)	(0.048)	(0.052)	(0.041)
Total rainfall squared	0.011	0.022***	-0.011**	-0.008	-0.008	0.006
	(0.007)	(0.006)	(0.005)	(0.007)	(0.008)	(0.006)
Altitude	-0.017	-0.017	-0.001	-0.208***	0.142*	0.083*
	(0.079)	(0.060)	(0.058)	(0.070)	(0.085)	(0.048)
Altitude squared	0.049**	0.047**	0.002	0.039**	-0.045**	-0.043***
	(0.023)	(0.019)	(0.013)	(0.017)	(0.022)	(0.013)
Landlocked dummy	-0.127***	-0.028	-0.099**	0.125**	-0.093*	0.095**
	(0.048)	(0.032)	(0.040)	(0.057)	(0.052)	(0.041)
R-squared	0.103	0.142	0.033	0.207	0.342	0.259
Panel B:						
With country dummies						
Log pre-colonial pop dens	0.013	-0.018	0.030**	-0.027	0.096***	-0.082***
	(0.017)	(0.013)	(0.013)	(0.022)	(0.020)	(0.019)
Avg. temperature	0.028**	0.009	0.018*	0.015	-0.001	-0.041***
	(0.013)	(0.007)	(0.010)	(0.016)	(0.007)	(0.016)
Avg. temp. squared	-0.000	-0.000	-0.000	-0.000	-0.000	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total rainfall	-0.052	-0.119***	0.067*	0.124**	-0.031	-0.041
	(0.058)	(0.045)	(0.039)	(0.051)	(0.055)	(0.044)
Total rainfall squared	0.018**	0.028***	-0.010*	-0.015**	-0.006	0.004
	(0.007)	(0.006)	(0.005)	(0.007)	(0.008)	(0.006)
Altitude	-0.011	-0.078	0.067	-0.105	0.074	0.041
	(0.085)	(0.062)	(0.065)	(0.085)	(0.082)	(0.059)
Altitude squared	0.054**	0.065***	-0.011	0.007	-0.032	-0.029*
	(0.024)	(0.019)	(0.016)	(0.023)	(0.023)	(0.016)
Landlocked dummy	-0.115**	-0.023	-0.092**	0.069	-0.080	0.126**
	(0.057)	(0.045)	(0.043)	(0.067)	(0.054)	(0.051)
R-squared	0.156	0.206	0.135	0.273	0.402	0.267
Observations	345	345	345	345	345	345

Robust standard errors (clustered at pre-colonial population density level) in brackets. Significance levels: * 10%, ** 5%, *** 1%

Table 5: Colonial Activities and Current GDP per Capita

	Dependent variable: Log PPP GDP per capita					
	(1)	(2)	(3)	(4)	(5)	(6)
Good activities dummy	-0.061		-0.019	0.018	0.001	0.004
	(0.101)		(0.091)	(0.081)	(0.076)	(0.075)
Bad activities dummy	-0.392***		-0.286***	-0.293***	-0.276***	
	(0.099)		(0.087)	(0.085)	(0.082)	
Ugly activities dummy	-0.263***		-0.123	-0.138*	-0.159**	-0.166**
	(0.099)		(0.090)	(0.084)	(0.079)	(0.077)
Log pre-colonial pop density		-0.078***	-0.059**	-0.056**	-0.052**	-0.053**
		(0.024)	(0.024)	(0.022)	(0.020)	(0.020)
Plantations dummy						-0.318***
						(0.095)
Mining dummy						-0.231**
						(0.098)
Avg. temperature				0.002	-0.002	-0.002
				(0.016)	(0.015)	(0.015)
Avg. temp. squared				-0.000	-0.001	-0.001
				(0.000)	(0.000)	(0.000)
Total rainfall				-0.211**	-0.198**	-0.207**
				(0.084)	(0.082)	(0.081)
Total rainfall squared				0.026	0.022	0.024
				(0.020)	(0.020)	(0.020)
Altitude (per km)					-0.050	-0.055
					(0.107)	(0.106)
Altitude squared					-0.031	-0.028
					(0.035)	(0.034)
Landlocked dummy					-0.106*	-0.104*
					(0.063)	(0.063)
Observations	345	345	345	345	345	345
R-squared	0.794	0.793	0.799	0.805	0.815	0.830
Coefficient Bad - Good	-0.332		-0.267	-0.311	-0.277	
F test: Good = Bad p-value	(0.002)		(0.008)	(0.002)	(0.005)	
Coefficient Ugly - Good	-0.203		-0.104	-0.156	-0.160	-0.170
F test: Good = Ugly p-value	(0.061)		(0.336)	(0.115)	(0.084)	(0.068)
Coefficient Bad - Ugly	-0.129		-0.163	-0.154	-0.117	
F test: Bad = Ugly p-value	(0.071)		(0.025)	(0.032)	(0.082)	
Coefficient Plantations - Mining						-0.087
F test: Plantations = Mining p-value						(0.439)

Robust standard errors (clustered at pre-colonial population density level) in brackets. Regressions include country fixed effects. Significance levels: * 10%, ** 5%, *** 1%

Table 6: Colonial Activities and Current GDP per Capita - Robustness

	Coefficient on					
Panel A:	Good activities	Bad activities	Ugly activities	Log pre-col pop dens	Observations	R-squared
Excluded country						
Argentina	0.047	-0.275***	-0.160**	-0.036	321	0.822
	(0.081)	(0.084)	(0.080)	(0.022)		
Bolivia	0.004	-0.278***	-0.167**	-0.052**	336	0.812
	(0.078)	(0.083)	(0.080)	(0.020)		
Brazil	0.024	-0.278***	-0.158**	-0.053**	318	0.832
	(0.076)	(0.082)	(0.077)	(0.021)		
Canada	0.014	-0.287***	-0.162**	-0.055***	332	0.782
	(0.081)	(0.082)	(0.079)	(0.021)		
Chile	0.004	-0.264***	-0.142*	-0.055**	332	0.818
	(0.075)	(0.083)	(0.079)	(0.022)		
Colombia	-0.017	-0.289***	-0.120	-0.048**	315	0.851
	(0.066)	(0.085)	(0.081)	(0.020)		
Ecuador	-0.054	-0.208***	-0.130*	-0.039**	323	0.845
	(0.066)	(0.077)	(0.076)	(0.020)		
El Salvador	0.001	-0.276***	-0.158**	-0.052***	333	0.813
	(0.076)	(0.082)	(0.079)	(0.020)		
Guatemala	0.000	-0.277***	-0.160**	-0.052**	337	0.816
	(0.076)	(0.082)	(0.079)	(0.020)		
Honduras	0.003	-0.289***	-0.146*	-0.052**	327	0.801
	(0.076)	(0.084)	(0.079)	(0.021)		
Mexico	0.007	-0.267***	-0.152*	-0.063***	313	0.829
	(0.076)	(0.084)	(0.083)	(0.020)		
Panama	-0.014	-0.288***	-0.171**	-0.045**	336	0.821
	(0.076)	(0.082)	(0.082)	(0.020)		
Paraguay	0.023	-0.256***	-0.142	-0.053***	327	0.816
	(0.082)	(0.086)	(0.086)	(0.021)		
Peru	-0.009	-0.252***	-0.156*	-0.050**	321	0.820
	(0.077)	(0.085)	(0.081)	(0.022)		
US	-0.031	-0.376***	-0.240***	-0.050**	297	0.697
	(0.101)	(0.104)	(0.093)	(0.022)		
Uruguay	0.001	-0.263***	-0.140	-0.062**	326	0.817
	(0.084)	(0.086)	(0.086)	(0.025)		
Venezuela	0.006	-0.304***	-0.186**	-0.047**	326	0.817
	(0.081)	(0.088)	(0.086)	(0.021)		
None	0.001	-0.276***	-0.159**	-0.052**	345	0.815
	(0.076)	(0.082)	(0.079)	(0.020)		
Average	0.001	-0.278	-0.158	-0.051	326	0.812
Median	0.003	-0.277	-0.158	-0.052	327	0.817
Max	0.047	-0.208	-0.120	-0.036	345	0.851
Min	-0.054	-0.376	-0.240	-0.063	297	0.697
Panel B:						
Excluding countries with	0.024	-0.289***	-0.137	-0.055**	254	0.810
low data quality	(0.100)	(0.103)	(0.111)	(0.027)		

The dependent variables is log GDP per capita. Panel B excludes all the countries for which more than 50% of regions have data on this variable imputed from other countries (Guatemala, Honduras, Panama, Paraguay, Uruguay, and Venezuela).

Table 7: Colonial Activities and Current Poverty Rate

	Dependent variable: Log poverty rate				
	(1)	(2)	(3)	(4)	(5)
Good activities dummy	0.091		0.054	0.001	0.035
	(0.108)		(0.096)	(0.080)	(0.070)
Bad activities dummy	0.297***		0.202**	0.194**	0.164*
	(0.110)		(0.098)	(0.090)	(0.094)
Ugly activities dummy	0.095		-0.029	-0.026	0.001
	(0.118)		(0.110)	(0.100)	(0.106)
Log pre-colonial pop density		0.054**	0.053*	0.052**	0.046**
		(0.027)	(0.027)	(0.025)	(0.023)
Avg. temperature				-0.000	0.015
				(0.038)	(0.031)
Avg. temp. squared				0.000	0.001
				(0.001)	(0.001)
Total rainfall				0.267***	0.252***
				(0.081)	(0.078)
Total rainfall squared				-0.028*	-0.023
				(0.015)	(0.014)
Altitude (per km)					0.028
					(0.118)
Altitude squared					0.059*
					(0.033)
Landlocked dummy					0.175**
					(0.076)
Observations	331	331	331	331	331
R-squared	0.751	0.749	0.755	0.774	0.802
Coefficient Bad - Good	0.206		0.148	0.193	0.130
F test: Good = Bad p-value	(0.028)		(0.117)	(0.031)	(0.096)
Coefficient Ugly - Good	0.003		-0.084	-0.027	-0.033
F test: Good = Ugly p-value	(0.975)		(0.447)	(0.786)	(0.703)
Coefficient Bad - Ugly	0.203		0.232	0.220	0.163
F test: Bad = Ugly p-value	(0.017)		(0.007)	(0.010)	(0.033)

Robust standard errors (clustered at pre-colonial population density level) in brackets. Regressions include country fixed effects. Significance levels: * 10%, ** 5%, *** 1%

Table 8: Colonial Activities and Pre-Colonial Development

	Dependent variable: Normalized measure of economic development
Good activities dummy	0.193
	(0.333)
Good activities dummy*Post	-0.790
	(0.608)
Bad activities dummy	0.472
	(0.323)
Bad activities dummy*Post	-1.406**
	(0.614)
Ugly activities dummy	0.307
	(0.358)
Ugly activities dummy*Post	-0.832
	(0.629)
Log pre-colonial population density	0.135*
	(0.069)
Log pre-colonial population density *Post	-0.191
	(0.135)
Observations	106
R-squared	0.599
Coefficient Bad - Good	0.280
F test: Good = Bad p-value	(0.482)
Coefficient Ugly - Good	0.114
F test: Good = Ugly p-value	(0.798)
Coefficient Bad - Ugly	0.166
F test: Bad = Ugly p-value	(0.331)

Robust standard errors (clustered at pre-colonial population density level) in brackets. The regression includes country fixed effects, as well as climate and geography controls. The outcome variable is composed of a normalized health index for the pre-colonial period, and normalized GDP per capita for the post-colonial period. The post dummy refers to post-colonization. The regression also controls for the year for which the health index is observed to control for differences in the quality of the index. Significance levels: * 10%, ** 5%, *** 1%

Table 9: Reversal of Fortunes

	Dependent variable: Log PPP GDP per capita	
	(1)	(2)
Log pre-colonial pop density	-0.065**	0.061**
	(0.028)	(0.028)
Observations	284	61
R-squared	0.752	0.898
Regions in sample	With colonial activities	Without colonial activities

Robust standard errors (clustered at pre-colonial population density level) in brackets. Regressions include country fixed effects, as well as climate and geography controls. Significance levels: * 10%, ** 5%, *** 1%

Table 10: Possible Channels Linking Colonial Activities to Current Levels of Development

	Dependent variable:				
	Log GDP per capita	Log Gini Index	Log schools per child	Log literacy rate	Log Seats in lower house per voter
	(1)	(2)	(3)	(4)	(5)
Panel A: Regression Results					
Good activities dummy	0.001	0.001	0.073	-0.006	-0.014
	(0.076)	(0.014)	(0.071)	(0.010)	(0.085)
Bad activities dummy	-0.276***	0.017	-0.011	-0.023	-0.273**
	(0.082)	(0.018)	(0.085)	(0.015)	(0.113)
Ugly activities dummy	-0.159**	-0.005	-0.075	-0.016	-0.321**
	(0.079)	(0.020)	(0.096)	(0.016)	(0.132)
Log pre-colonial pop density	-0.052**	0.000	-0.014	-0.001	-0.070**
	(0.020)	(0.007)	(0.018)	(0.003)	(0.028)
Observations	345	268	317	270	318
R-squared	0.815	0.713	0.688	0.609	0.849
Coefficient Bad - Good	-0.277	0.016	-0.084	-0.017	-0.259
F test: Good = Bad p-value	(0.005)	(0.354)	(0.161)	(0.355)	(0.013)
Coefficient Ugly - Good	-0.160	-0.006	-0.148	-0.010	-0.307
F test: Good = Ugly p-value	(0.084)	(0.761)	(0.037)	(0.571)	(0.017)
Coefficient Bad - Ugly	-0.117	0.022	0.064	-0.007	0.048
F test: Bad = Ugly p-value	(0.082)	(0.221)	(0.336)	(0.734)	(0.503)
Panel B: Standardized Effects					
Good activities dummy	0.000	0.002	0.051	-0.022	-0.005
Bad activities dummy	-0.117	0.044	-0.007	-0.072	-0.094
Ugly activities dummy	-0.078	-0.017	-0.056	-0.058	-0.129
Log pre-colonial pop density	-0.120	0.002	-0.050	-0.012	-0.134

Robust standard errors (clustered at pre-colonial population density level) in brackets. Regressions in Panel A include country fixed effects, as well as climate and geography controls. The number of observations varies, depending on data availability. Standardized effects in Panel B show the standard deviation change in the dependent variable for a one standard deviation change in the colonial activities variable. Significance levels: * 10%, ** 5%, *** 1%

Appendix Table 1: Colonial Activities and Current GDP per Capita
Different definitions of Good and Ugly Activities

	Dependent variable: Log PPP GDP per capita		
Cutoff of pre-colonial pop density	Median	Average	75th percentile
	(1)	(2)	(3)
Good activities dummy	0.001	0.003	-0.035
	(0.076)	(0.078)	(0.067)
Bad activities dummy	-0.276***	-0.271***	-0.237***
	(0.082)	(0.083)	(0.077)
Ugly activities dummy	-0.159**	-0.147*	-0.127
	(0.079)	(0.078)	(0.094)
Log pre-colonial pop density	-0.052**	-0.053***	-0.059***
	(0.020)	(0.020)	(0.020)
Observations	345	345	345
R-squared	0.815	0.815	0.813
Coefficient Bad - Good	-0.277	-0.274	-0.202
F test: Good = Bad p-value	(0.005)	(0.007)	(0.006)
Coefficient Ugly - Good	-0.160	-0.150	-0.092
F test: Good = Ugly p-value	(0.084)	(0.117)	(0.301)
Coefficient Bad - Ugly	-0.117	-0.124	-0.110
F test: Bad = Ugly p-value	(0.082)	(0.060)	(0.209)

Robust standard errors (clustered at pre-colonial population density level) in brackets. Regressions include country fixed effects, as well as climate and geography controls. Significance levels: * 10%, ** 5%, *** 1%

Bruhn and Gallego (2010)
Appendix B: Data Sources

Variable	Argentina	Bolivia	Brazil	Canada	Chile	Colombia
GDP	INDEC - Dirección de Cuentas Nacionales - PBG por provincia y sector de actividad económica	Instituto Nacional de Estadísticas de Bolivia - PIB departamental	IBGE - Contas Regionais	Statistics Canada	Central Bank of Chile	DANE - Cuentas Departamentales
Population	INDEC - Censo Nacional de Población, Hogares y Viviendas 2001	Instituto Nacional de Estadísticas de Bolivia - Censo 2001	IBGE - Censo Demográfico 2000	Statistics Canada	MIDEPLAN projections based on 2002 Census	DNP projections - 2000
Poverty rate	INDEC - EPH - May 2001	Instituto Nacional de Estadísticas de Bolivia - MECOVI 1999	http://tabnet.datasus.gov.br/cgi/idb2004/b05uf.htm	Canadian Council on Social Development	MIDEPLAN - 2000 CASEN Survey	SISD
Health index			Backbone of History Project (Steckel and Rose, 2002)			
Colonial acitvities	Brown, J. (2003), Rock (1987)	Peñaloza (1981), Arze Aguirre (1996), Klein (2003), Serrano (2004)	Bethell (1987), Burns (1993)	Brown, C. (2003)	Collier and Sater (2004)	McFarlane (1993), Ocampo (1997)
Pre-colonial population density	Own calculations from Pyle (1992)	Own calculations from Denevan (1992)	Own calculations from Denevan (1992)	Own calculations from Denevan (1992) and "Canada Natives People 1630" of the National Atlas of Canada	Own calculations from Denevan (1992)	Own calculations from Denevan (2002), Ocampo (1997), and Villamarín (1999)
Temperature	Servicio Metereológico Nacional	Servicio Nacional de Meteorología e Hidrología	IBGE - Annuário estatístico do Brazil.	National Climate Data and Information Archive	Dirección Metereológica de Chile	IDEAM
Rainfall	Servicio Metereológico Nacional	Servicio Nacional de Meteorología e Hidrología	IBGE - Annuário estatístico do Brazil.	National Climate Data and Information Archive	Dirección Metereológica de Chile	IDEAM
Altitude			Global Gazetteer Version 2.1 (www.fallingrain.org)			
GINI index	Own calculations from 1998 EPH	Calvo, Alfredo. 2000. Analisis de la Situacion Socioeconomica del Pais. Organización Panamericana de la Salud	IBGE - Censo Demográfico 2000	Kellerman (2005)	Own calculations from 2000 CASEN	SISD
Number of Schools	INDEC - Estadísticas de Educación y Ciencias	Instituto Nacional de Estadísticas de Bolivia - Estadisticas Departamentales de Bolivia 2005	Sinopse estatística da educação básica: censo escolar 2001. Brasília, DF: INEP, 2002.	Statistics Canada	MINEDUC - Directorio de Establecimientos Educacionales 2000	Ministerio de Educación Nacional - Oficina Asesora de de
Literacy rate	INDEC - Censo Nacional de Población, Hogares y Viviendas 2001	Instituto Nacional de Estadísticas de Bolivia - Estadisticas Departamentales de Bolivia 2005	IBGE - Censo Demográfico 2000	2001 Census	MIDEPLAN - 2000 CASEN Survey	SISD
Political representation	Cámara Nacional Electoral	Corte Nacional Electoral	Tribunal Superior Eleitoral	Elections Canada	Tribunal Calificador de Elecciones	Consejo Nacional Electoral

Variable	Ecuador	El Salvador	Guatemala	Honduras	Mexico	Panama
GDP	Banco Central del Ecuador - Cuentas Provinciales	Informe del Desarrollo Humano El Salvador (2005)	Informe del Desarrollo Humano Guatemala (2002)	Informe del Desarrollo Humano Guatemala (2002)	INEGI - Producto Interno Bruto por Entidad Federativa	Dirección de Estadísticas y Censos, PIB Provincial
Population	Instituto Nacional de Estadísticas y Censos, 2001 Census	Dirección General de Estadísticas y Censos, projections 2005	Informe del Desarrollo Humano Guatemala (2002)	Informe del Desarrollo Humano Guatemala (2002)	INEGI - Censo General de Población y Vivienda 2000	Dirección de Estadísticas y Censos, 2000 Census
Poverty rate	Informe sobre Desarrollo Humano, Ecuador 2001. PNUD	Compendio Estadistico	Informe Nacional de Desarrollo Humano Guatemala (2005)	Informe sobre Desarrollo Humano 2002. PNUD	SEDESOL	"La pobreza en Panama. Encuesta de Niveles de Vida 2003". Ministerio de Economia y Finanzas, Republica de Panama. 2005
Health index			Backbone of History Project (Steckel and Rose, 2002)			
Colonial acitvities	Reyes, Oscar Efren (1965); Padre Juan de Velasco (1960)	Rodriguez Becerra, Salvador (1977); Torrer-Rivas, Edelberto (1993)	Webre, Stephen (1989); Jiménez, Alfredo (1997)	Torrer-Rivas, Edelberto (1993); Jiménez, Alfredo (1997)	Cumberland (1968), Gerhard (1979), Hamnett (1999), Knight (2002), Zabre (1969)	Ots y Capdequí (1810)
Pre-colonial population density	Own calculations from Denevan (1992)	Own calculations from Denevan (1992)	Own calculations from Denevan (1992)	Own calculations from Denevan (2002)	Own calculations from Denevan (2002) and Sanders (2002)	Own calculations from Denevan (2002)
Temperature	Instituto Nacional de Meteorología e Hidrología	Servicio Nacional de Estudios Territoriales - Perfiles Climatológicos	Instituto Nacional De Sismologia, Vulcanología, Meteorología E Hidrologia	Servicio Metereológico Nacional	INEGI	Dirección de Meteorología
Rainfall	Instituto Nacional de Meteorología e Hidrología	Servicio Nacional de Estudios Territoriales - Perfiles Climatológicos	Instituto Nacional De Sismologia, Vulcanología, Meteorología E Hidrologia	Servicio Metereológico Nacional	INEGI	Dirección de Meteorología
Altitude			Global Gazetteer Version 2.1 (www.fallingrain.org)			
GINI index	Informe sobre Desarrollo Humano, Ecuador 2001. PNUD	Informe sobre Desarrollo Humano, El Salvador 2005. PNUD.	Informe Nacional de Desarrollo Humano Guatemala (2003)	-	Own calculations from 2000 ENE	-
Schools per kids	Ministerio de Educación, Censo Nacional de Instituciones Educativas	Ministerio de Educación - Censo Matricular 1999-2000	Ministerio de Educación - Boletín Estadístico 2001	Informe de Progreso Educativo, Honduras. 2005. PREAL	INEGI - Anuario de Estadisticas por Entidad Federativa 2003	-
Literacy rate	Informe sobre Desarrollo Humano, Ecuador 2001. PNUD	.PREAL. Informe de Progreso Educativo, El Salvador. 2002	Informe del Desarrollo Humano Guatemala (2002)	Informe del Desarrollo Humano Guatemala (2002)	INEGI - Censo General de Población y Vivienda 2000	Informe Nacional de Desarrollo Humano, 2002. PNUD
Political representation	Consejo Nacional Electoral	-	Tribunal Supremo Electoral	Tribunal Supremo Electoral	Mexico Electoral 1970-2003 Banamex CD	Tribunal Electoral

Variable	Paraguay	Peru	US	Uruguay	Venezuela
GDP	Atlas de Desarrollo Humano Paraguay 2005	INEI - Dirección Nacional de Cuentas Nacionales - PBI por departamento.	BEA - Gross Domestic Product by State	Anuario Diario El País 2001	Own calculations from 1998 EHM (household income)
Population	Dirección General de Estadísticas, Encuestas y Censos	INEI	U.S. Census Bureau	Instituto Nacional de Estadística de Uruguay	INE
Poverty rate	Robles, Marcos. Pobreza y Gasto Publico en Educacion en Paraguay. Economia y Sociedad, numero 3.	INEI	State and Metropolitan Area Data Book 1997-1998	Desarrollo Humano en Uruguay 2001. PNUD	INE
Health index	Backbone of History Project (Steckel and Rose, 2002)				
Colonial acitvities	Lugones (1985), Rivarola (1986), Armani (1988)	Fisher (1970), Dobyns and Doughty (1976)	Andrews (1914), Eccles (1972), McCusker and Menard (1985)	Bauza, Francisco (1895); Rubio, Julián María (1942)	Lombardi (1982)
Pre-colonial population density	Own calculations from Denevan (2002)	Own calculations from Denevan (2002) and Cook (1981)	Own calculations from Ubelaker (2002)	Own calculations from Denevan (2002)	Own calculations from Denevan (2002)
Temperature	Grassi et al. (2004)	INEI	http://www.met.utah.edu/jhorel/html/wx/climo.html	Wikipedia.org	INE
Rainfall	Grassi et al. (2005)	INEI	http://www.met.utah.edu/jhorel/ht	Wikipedia.org	INE
Altitude	Global Gazetteer Version 2.1 (www.fallingrain.org)				
GINI index	-	Own calculations from 2000	U.S. Census Bureau, Table S4	-	Own calculations from 1998
Schools per kids	La Educacion en Cifras 2000. Ministerio de Educacion y Cultura, DPEI	INEI	U.S. Department of Education, National Center for Education Statistics	-	INE
Literacy rate	-	INEI	-	Desarrollo Humano en Uruguay 1999. PNUD	INE - 2001 Census
Political representation	Tribunal Supremo de Justicia Electoral	-	House Election Statistics	Corte Electoral	Consejo Nacional Electoral

Bruhn and Gallego (2010)
Appendix C: Pre-Colonial Population Density

June 25, 2010

This appendix describes in detail how we construct the pre-colonial population density variable. We use data from several sources to estimate pre-colonial population density at the state level. The main sources of information are region-specific chapters in Denevan (1992) and references cited in that book. This section presents the main sources for each country and explains the assumptions we used to impute population estimates for the different regions of each country. In each case we adjust the estimated size of the native population in each country to match the numbers presented in Denevan (1992, Table 00.1).

0.1 Argentina

The only source of information we use corresponds to Pyle (1992), a chapter in Denevan (1992). This paper includes several estimates of the native population for different regions of Argentina. We take the average of the number of natives in each region as our estimate of the denominator. In addition, using maps from the same paper, we allocate different tribes or groups to the different modern states. As some of the Argentinean regions identified in Pyle (1992) correspond to clusters of more than one modern Argentinean states, we estimated population density for the regions presented in Pyle (1992) and we impute the same population density for all the states in the same region. In particular, the regions that include more than one state are: (i) Buenos Aires and Capital Federal, (ii) Chubut, La Pampa, Neuquén, Río Negro, Santa Cruz, and Tierra del Fuego.

0.2 Bolivia

The information for Bolivia comes from Denevan (1992) for the East of the country. We also use estimates for the South Sierra derived from Cook (1981), implying a population density of 17.3 people per square kilometer for the South Sierra. In addition, Denevan (1992, p. 228) presents his preferred estimated population figures for different regions of Northeastern Bolivia: Floodplain (14.6 people per square kilometer), Lowland Savanna, mainly Mojos (2.0), Santa Cruz area (1.8), Upland Forest (1.2), Lowland Forest (0.2), and Superhumid Upland Forest (0.1). Using estimates for the area of each state belonging to each region, we estimate population density in each state.

0.3 Brazil

The main source of information is Denevan (1992, p. 226 and 231). Denevan presents estimated population density at time of contact for different habitats in Greater Amazonia, which includes most of the Brazilian states except for portions of the coastal states in the South (Paraná, Rio Grande do Sul, Santa Catarina, and Sao Paulo). The habitats (estimated population density at contact time) considered by Denevan are: Central coast (9.5 people per square kilometer), Floodplain (14.6), Lowland–Amazon Basin (0.2), Mangrove coasts (4.75)[1], Upland and Central savannas (0.5). Using these estimates we classify each Brazilian state in each habitat and we estimate population density for the states. In the cases that a state has more than one habitat we use a weighted average considering the different habitats. In order to identify the habitats of the different regions we use information from the Natural Vegetation Map from the Perry-Castañeda Library Map Collection of the University of Texas.

For the Southern states we also use information from Denevan (1992, Table 00.1) on the total population for Southern Coastal Brazil combined (which implies a population density of 4 people per square kilometer) with

[1] For Mangrove coasts, Denevan states "probably considerably less than 9.5 per square kilometer". We use 50% of 9.5.

the previous information on the density for the different habitats of the Greater Amazonia. Finally, we impute the population density of the state of Goias to the Federal District (Brasilia).

0.4 Canada

The information for British Columbia comes from Denevan (1992)–equivalent to 85,800. For the other regions of Canada we rely on Denevan (1992) for the total population estimates and on and the Map "Canada Natives People 1630" of the National Atlas of Canada (5th edition) for the distribution of native people across regions. This map provides information on the location and population of native settlements around 1630. So we use data in the map to compute an initial estimate by region and next adjust the map estimates so as to match Denevan's estimates for the macro-regions of Eastern (54,200) and Central Canada (50,950).

0.5 Chile

In the case of Chile there are no detailed estimates of population by state. Instead, there is some information on the location of several native groups, except for the Mapuche people. In this case, Cooper (1946) quoted in Denevan (1992) estimates a pre-contact population of the Mapuche people of between 500,000 and 1,500,000, and we use the mean point of 1,000,000. We also know that these people were located between the fifth and the tenth region. So we estimate a pre-contact population density of 4.7. For the other regions in the country, we know the location of other people and we take the estimates of population density for these tribes in neighboring countries. In particular, we know about half of the modern first region was populated by tribes linked to the Inca empire. So we use half of the estimate we have for the Tacna region in Perú, which is equal to 1.3. For the second region, we know it was just sparely unpopulated so we use an estimate of 0.1 (similar to the estimate used by Denevan, 1992 for other sparely populated regions in Latin America). The third region was populated in part by the Diaguita people, which also lived in the Catamarca region in Argentina. So we use half of the estimate for 0.13 for the region and 0.1 for the remainder area of the region. The fourth region was populated by the Diaguita people, so we use in this case the same estimate as for Catamarca, equal to 0.17. Finally, the peoples living to the South of the tenth region were basically the same as those living in the Argentinean Patagonia, so we assume the same population density, equal to 0.01 people per square kilometer.

0.6 Colombia

We take the information on total pre-contact population for Colombia from Denevan (1992, Table 00.1). He estimates a total population of 3 million people. Using information from Ocampo (1997) and Villamarín and Villamarín (1999), we estimate population densities for 8 regions: Eastern Cordillera (13 people per square kilometer), Cauca Valley (9.2), the Caribbean Coast (2.8), Upper Magdalena (4.9), Lower Magdalena (4.3), Pasto (7.7), and Llanos (1.3). In the case of the Amazonas region, we use estimates for the Brazilian amazonas from Denevan (1992), which are equal to 0.2 people per square kilometer. Next, we classify each modern state in one of these regions accordingly to the Colombian maps of the Perry-Castañeda Library Map Collection of the University of Texas. Finally, the San Andrés, Providencia and Santa Catalina islands we use population density for the Caribbean islands from Denevan (1992).

0.7 Ecuador

Estimates for Ecuador are very sparse, and we apply estimates for neighboring countries and complement them with some information available in Vieria Powers (1995) for the coastal regions. We classify each state into the following regions: Central Andes (for which we use an estimated population density of 12.1 people per square kilometer, which is the average for similar regions in Colombia and Perú), Coast (for which use estimates from Viera Powers that range from 1 to 2 people per square kilometer), Upland Forest (1.2, from Denevan), and East (0.7 from similar regions in Colombia and Perú). Using estimates for the area of each state belonging to each region, we estimate population density in each state.

0.8 El Salvador

Denevan (1992, p. 38) argues that population in Central America was mainly located in the plain regions close to the Pacific coast "...where there were rich volcanic soils from Guatemala to Costa Rica, and also in Panamá".

Thus, for all Central American countries we keep this stylized fact in mind in order to assign populations to different regions. In addition, Denevan gives an estimate of the total population living in El Salvador before contact with colonizers of about 500,000. Thus, we classify all states in two regions: Coast and Mountains. In the case of population density for mountains we use 0.01 people per square kilometer and for the Coastal regions we use a population density of 39.3 people per square kilometer, so that we generate a total population of 500,000. As for other countries, using estimates for the area of each state belonging to each region, we estimate population density in each state.

0.9 Guatemala

As for El Salvador, we take advantage of the estimate of the total population from Denevan (1992, p. 291). In this case Denevan gives an estimate of 2,000,000. To distribute this population in the states we proceed as follows. First, we consider the state of Petén and parts of the Norte and Noroccidente states. For these states we use a population density of 5.63 people per square kilometer, which corresponds to the simple average of the population density of the Mexican state of Campeche and the estimated population density for Belize. Second, we assign a population density of 23.60 to all areas on the Coast (which correspond to parts of the states of Central, Suroriente, and Suroccidente), where the value 23.60 is our estimate for the state of Ahuachapán in Salvador. This leaves us with a total estimated population of about 500,000 people. The remaining population corresponds to the highlands, which were populated by Mayan tribes (such as the Cakchiquel and the Quiché). Thus, we assign 29.05 people per square kilometer to these areas, so as to arrive at the total population estimated in Denevan.

0.10 Honduras

As for El Salvador and Guatemala, we take advantage of the estimate of the total population from Denevan (1992, p. 291), which is 750,000 for both Honduras and Belize. We assume a similar population density in both areas and therefore, we get a total estimated population of 622,843 people for Honduras. To distribute this population across the states we proceed as follows. First, we consider the coastal states of Choluteca and Valle and parts of the state of El Paraíso. For these areas, we apply a population density of 17.70, which corresponds to the simple average of the coastal states of La Unión and Morazán in El Salvador. This leaves us with a total estimated population of about 220,000 people. The remaining population corresponds to the eastern regiones of the country, which were populated by several peoples, such as the Lencas. Thus, we apply an estimate of 8.19 people per square kilometer to these areas, to get the total population estimated in Denevan.

0.11 Mexico

Estimates for Central Mexico come from Sanders (1992), in particular for Mexico, DF, Hidalgo, Puebla, Tlaxcala, Tamaulipas, and Morelos. In addition, Denevan (1992) presents population estimates for the following regions: (i) Baja California Norte and Sur; (ii) Campeche, Quintana Roo, and Yucatán; (iii) Chiapas; (iv) Chihuahua, Durango, Sinaloa, and Sonora; (v) Coahuila de Zaragoza and Nuevo León; (vi) Colima, (vii) and Tabasco. In the cases in which a region includes more than one state, we impute the same population density for each region. As in all the other cases, we adjust the population estimates so to match the total estimate for Mexico from Denevan (1992, Table 00.1).

0.12 Panamá

As for all other Central American countries, we take advantage of the information that coastal areas were more densely populated. In this case, we use a population density of 0.01 people per square kilometer in the mountain areas. For the coastal regions we apply a population density of 30.88 people per square kilometer, so that we generate the total population of 1,000,000 estimated by Denevan (1992, p. 291). Using estimates for the area of each state belonging to each region, we estimate population density in each state.

0.13 Paraguay

Estimates of the total population for Paraguay, Uruguay, and the South of Brazil in Denevan (1992, p. 291) imply a population density of 0.9 people per square kilometer. We use this estimate and estimates for neighboring regions in Argentina, Bolivia, and Brazil, as benchmarks to estimate population density in different regions. In particular, for Alto Paraguay we use the average population density of Santa Cruz (Bolivia) and Matto Grosso do Sul (Brazil). For Alto Paraná and Caaguazú, we use the estimated population density for the interior areas of neighboring Paraná (Brazil). For Amambay, we just the estimate from Matto Grosso so Sul (Brazil). For Asunción, Central, and Cordillera, we use weighted averages of the Argentinian regions of Corrientes and Formosa. For Boquerón we use population density from the Chaco region in Argentina. For Caazapá and Guairá we use the simple average of the estimates for Alto Paraná and Misiones (Argentina). For Canindeyú we also use estimates for Alto Paraná, but in this case we take the simple average with population density for Matto Grosso do Sul. For Concepción, we take the simple average of Matto Grosso do Sul and Chaco. For Itapúa we use the simple average of Rio Grande do Sul (Brazil) and Misiones (Argentina). For Misiones we use the average of the Argentinean states of Corrientes and Misiones. For Ñeembucú, we use a weighted average of estimates for Formosa and Chaco in Argentina. For Paraguarí, we use the average of estimates for Misiones (Paraguay) and Central. For Presidente Hayes we apply the estimates from Formosa (Argentina). And, finally, for San Pedro we take the average of Presidente Hayes and Canindeyú. All these estimates imply a population density of 0.9, similar to those implied in Denevan´s calculations.

0.14 Perú

The information for Perú comes from Cook (1981) for most of the regions in the country and from Denevan (1992) for the East of the country. In particular, Cook (1981, p. 96) presents his preferred estimated population figures for six different Peruvian regions: North coast, Central coast, South coast, North sierra, Central sierra, and South sierra. From Denevan (1992, pp. 228), we estimate the population density for six regions located in the East of the country: Amazonas (50% of the area), Loreto, Madre de Dios, Puno (50% of the area), and Ucayali.

0.15 United States

The raw information on the native population of the United States comes from Ubelaker (1992). This paper presents information on the native population of all the tribes in the United States and the location of these tribes (see Map 8.1, p. 244). Using this information we assign each tribe to the modern US states and in this way we estimate pre-contact population densities. In some cases it was impossible to estimate population densities for specific states because some tribes lived in more than one state so we present population density estimates for groups of modern states. This is the case for: 1. Arizona and New Mexico; 2. Delaware and New Jersey; 3. Rhode Island and Massachusetts; 4. Maryland and Washington D.C.; and 5. Virginia and West Virginia.

0.16 Uruguay

First, we consider a number of regions for which there was no evidence of being settled by natives. The states of Artigas, Flores, Florida, Lavallejana, Montevideo, Rivera, Canelones, Maldonado, and San José fall into this category. We assign a population density of 0.01 people per square kilometer to all these states. Next, we consider regions in which there was some evidence of settlements by some peoples, such as the Gueonas, Chaná, Bohan, and Charrua. These states are Cerro Largo, Colonia, Paysandú, Rocha, Salto, Tacuarembo, and Treinta y Tres, and we assign them a population density of 0.05 people per square kilometer. Finally, the remaining three states of Durazno, Soriano, Río Negro were more heavily settled by peoples such as the Yaros, Chaná, and Charruas, and we assign them a weighted average of population density estimated for Entre Ríos (Argentina), where the weights are increasing in the area closer to this region.

0.17 Venezuela

Denevan (1992) presents estimates for the total pre-contact population of Venezuela and gives pre-contact population densities for the Orinoco llanos (1.3 people per square kilometer), Amazon Basin (0.2), and Guiana Highlands (less than 0.5 people per square kilometer, we use 0.4). In order to get estimates for the other regions of Venezuela, first we use estimates available from other countries with similar habitats and native groups in the region (in particular, from North and East Colombia and the Caribbean) in the following way: 1. the Caribbean Coast: we use estimates for the same habitat in the Colombian Caribbean Coast; 2. the Selva: we use estimates for the same habitat in Colombia, and 3. the Caribbean (the Dependencias Federales region): we use estimates from Denevan for the Caribbean islands. Finally, we estimate population density for the Coastal Ranges and the Eastern Andes by choosing a pre-contact population density that matches the total population of about 1,000,000 people for Venezuela, as presented in Denevan (1992, Table 00.1).