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Is Colonialism Good For Growth? Evidence From A New Database of Islands

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Using a new database of islands throughout the Atlantic, Pacific and Indian Oceans we examine whether colonial origins affect modern economic outcomes. We argue that the nature of discovery and colonization of islands provides useful random variation in the colonial experience. We instrument for length of colonization using wind direction and wind speed. Wind patterns which mattered a great deal during the age of sail do not have a direct effect on GDP today, but do affect GDP via their historical effects on colonization. The number of years spent as a European colony is strongly positively related to the island's GDP per capita and negatively related to infant mortality. We test whether this link is directly related to democratic institutions, trade, and the identity of the colonizing nation. While there is substantial variation in the history of democratic institutions across the islands, such variation does not predict income growth. Islands with significant export products during the colonial period are wealthier today, but this does not diminish the importance of colonial tenure. The identity of the colonizer does seem to be important. Time spend as a French, British, or Dutch colony is associated with higher incomes while time spent as a Spanish or Portuguese colony has no impact on current income.

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I. Introduction

Understanding the variation in growth across countries remains one of economics' most important research questions. Many authors have explored the links between colonialism and modern day outcomes, though little consensus exists. Historians and political scientists have emphasized the long term negative consequences of colonial rule including the possible inability of former colonies to transition to a stable form of self government or the possible negative effects of resource extraction (see for example Rodney [1974]). In this paper we will argue that time spent as a colony is positively correlated with modern economic outcomes.

Recent economic work on the importance of institutions has shifted the focus of empirical growth toward colonialism. La Porta, Lopez de Silanes, Shleifer and Vishny [1997, 1998] show that legal origin of the colonizers is related to capital market size, with former colonies of English common law countries having more developed capital markets than those with French civil law. Acemoglu, Johnson and Robinson [2001, 2002] show that the form of colonization (extractive versus heavy settlement by Europeans) tended to determine the type of institutions created in the country and therefore strongly affected growth.

Obviously causality is problematic in considering the effect of institutions on growth. Glaeser, La Porta, Lopez de Silanes, Shleifer and Vishny [2004] argue that human capital causes growth and that rich countries then adopt good institutions. The literature has attempted to deal with this through the use of instrumental variables, but finding appropriate instruments is difficult. Mauro [1995] uses ethnolinguistic fractionalization (ELF) to instrument for corruption. Hall and Jones [1999] use the distance from the equator as an instrument, arguing that this determines the degree of European influence. In neither case is it clear that the instrument does not have a direct effect on output.

Acemoglu, Johnson, and Robinson [2001, 2002] argue that the death rates of settlers provide a useful instrument for modern institutions. This approach has not been without

critics. McArthur and Sachs [2000] argue that settler mortality is related to the overall disease environment and has a direct effect on output.

We bring two innovations to this debate. First, we have created a new database of 88 islands which contains a large number of additional data points beyond the usual cross section of countries examined by growth economists. (For example the Penn World Tables contains 2000 per capita GDP on 135 countries, 8 of which are in our database.) Islands provide an interesting experiment in that our sample has more homogenous initial conditions (island area, population density, level of technology and availability of natural resources) than the Penn World Tables group.

Second, we propose and implement a new source of exogenous variation in colonial history – wind patterns. Wind speed and direction were crucial during the age of sail, and have useful variation within each ocean and within a given latitude. Islands located in the prevailing winds made useful stopovers and were more easily revisited and colonized. However, since the beginning of the age of steam over 100 years ago, the importance of wind patterns has disappeared. We argue that any effect of wind speed on current GDP only works through wind's effect on European settlement.

We show that the length of colonial period is strongly positively related to modern outcomes. Since colonizers may settle the best places first and give them up last, we instrument for the year of European discovery and subsequent length of colonial period using data on wind patterns. The IV results are similar to OLS, suggesting that much of the variation in the colonization of islands may be fairly random anyway.

Like Acemoglu et al, our work suggests that differences in European settlement play an important role. However, our results differ in that the length of time, not the type of settlement is what matters. It may be that these effects are related, so we attempt to distinguish between them by examining some of the colonial era institutional features of the islands.

First, we examine the hypothesis that colonization raised income via the introduction of trade. For many of the islands the very notion of households generating a surplus and exporting this surplus in exchange for money and goods arrived with the colonizers. The historical record makes it clear that colonial governments were obsessed with introducing and expanding the production of export commodities like sugar, coffee, tobacco, and even coconuts. Islands whose primary colonial exports involved intensive agriculture (like tobacco, sugar or cotton) or complex extraction (like phosphates or nickel) fare better in modern times than islands whose main exports were dried coconut or fish. The trade results, however, do not significantly diminish the impact of the length of colonization.

One institutional feature that is often studied is democracy. We look at the first date that each island has an elected legislature (including colonial legislatures). By this measure, there is substantial variation in when the various islands obtained democratic institutions. Former Spanish island colonies were the slowest to have a democratically elected legislature and former British island colonies were the fastest. However, this measure of democratic institutions is not a significant predictor of modern output in our sample.

Next, we use colonial dependence on slave labor and the modern ethnic composition of the population as a measure of the type of colonial regime. Acemoglu et al. find that the difference between settlement and extractive colonial regimes is important for explaining modern outcomes. We find no significant difference between colonies with imported slaves and those without and we find no relationship between modern ethnic composition and output.

A final, less direct measure of institutional quality is the identity of the colonizer. La Porta, Lopez de Silanes, Shleifer and Vishny [1997, 1998] show that legal origin of the colonizers is related to capital market size, with former colonies of English common law countries having more developed capital markets than those with French civil law. We do not find a significant difference between the French and British colonial experience. We do, however, find that years as a Portuguese or Spanish colony are uncorrelated with

modern outcomes. This introduces an important caveat to our main findings. More years as a European colony are positively associated with modern GDP per capita for all colonizers but the Spanish and Portuguese.

The length of European colonization is a significant positive determinant of modern output. The use of wind as an instrument suggests that this effect is well identified. The fact that events centuries past exert a modern influence suggests the importance of institutions. Viewed in this way, our results may be most related to Hall and Jones [1999], who use geographical instruments to suggest that "social infrastructure," or broadly construed institutions, explain much of modern outcomes. They find that the quality of institutions is a result of European influence. We advance on their findings largely in the quality of identification and an attempt to distinguish between the quality and the quantity of European influence.

We find that the logical institutional channels are either insignificant in the face of our base result, or are separately important alongside our base result. Acemoglu et al suggest that modern institutional quality is a direct function of the quality of colonial institutions. While we do not contradict this result, our results suggest that the transmission of good institutions from Europe to the islands of the Atlantic, Pacific, and Indian Oceans goes beyond the obvious institutional features of the early colonies. The finding of a difference between the Iberian colonizers and other, however, does suggest that there are significant differences in the quality as well as the quantity of early experience with Europeans.

II. Patterns of Exploration and Colonization

II.A. Why Wind Mattered

The exploration and settlement of islands in the Pacific, Atlantic and Indian Oceans entails hundreds of fascinating stories and historical accidents. At the broadest level, the pattern of island discovery by Europeans makes a great deal of economic sense. Most of the Caribbean islands were known to Europeans prior to most of the Pacific Islands. This

was a matter of distance from Europe and the incredible vastness of the Pacific. For example, Columbus sighted the British Virgin Islands in 1493. And he had already sighted portions of the Bahamas, Hispaniola and Cuba a year before that. Of the 39 Atlantic islands in our database, 24 were first sighted by Columbus during one of his three voyages. By 1685 the Dutch were using St. Thomas (Virgin Islands) as a slave trading post and the island contained large sugar plantations by the mid 1700s.

Meanwhile certain islands in the Pacific (in French Polynesia and the Cook Islands in particular) were not sighted by Europeans until the late 1700s. Patterns of settlement were determined in part by obvious economic factors like distance to the mainland and quality of the land, factors which still affect modern economic outcomes. However, a fair amount of colonization was due to unique historical accidents and due to historical trade routes and to wind patterns.

The Mutiny on the Bounty itself led to the discovery of several islands and the colonization of at least two. While fleeing Tahiti, the mutineers discovered Rarotonga in the Cook Islands. Captain Bligh discovered Kadavu in Fiji as he sailed his open boat 3,600 miles from the Friendly Islands to Java (without losing a single one of his 18 crewmembers). The mutineers settled on Pitcairn (with their Tahitian wives) precisely because no one lived there and it was not near any land mass of note. The mutineers' descendants became so numerous that the British government then moved some of them to Norfolk Island thereby creating a second new colony.

One island in our data set, Penrhyn in the Cook Islands was accidentally colonized in 1788 when Captain Sever smashed his ship (the Penryhn) into the shoreline on his way to deliver convicts to Botany Bay. Vanuatu acquired a small settlement in 1825 when one sailor discovered that it contained sandalwood, which was at that time very valuable. Palmerston was colonized by the British mostly because it was empty when Captain Cook discovered it. The first group of settlers took to murdering each other. However the second settlement was more successful; William Marsters moved there in 1862 with his three Polynesian wives and his descendants are still there.

Though random accident played a large role, we will also argue that wind speed and direction are an important factor in the pattern of island colonization. Unlike powered boats, sailboats require steady wind to make headway. Islands located in areas where the wind is weak were less likely to be discovered, revisited, and colonized by Europeans. Wind direction is also important. The technology available at the time of the voyage of Columbus only allowed ships to sail about twenty degrees into the wind. This technology improved slowly over time, but sailing into the wind remained difficult until steamships became the norm in the twentieth century.

Consistent downwind routes between useful destinations were therefore well traveled while much of the globe went virtually untouched. Much of the east to west traffic across the Pacific after Magellan's 1521 crossing followed closely his pioneering voyage because his path was the logical and efficient way to cross. Crossing in the opposite direction turned out to be much more difficult due to prevailing wind patterns. At least four Spanish expeditions attempted and failed to establish a west to east route across the Pacific in the wake of Magellan's voyage. It was not until 1565 that a west to east path was found across the Pacific and this required sailing much farther north.

The net result of this history is that the pattern of colonization is related to the speed and direction of the prevailing winds. Islands like Fefan and Pohnpei in the Federated States of Micronesia have calm winds, were not located near the Spanish trade route and were basically left alone, even after their discovery in the 1680s. At the other extreme, despite also being quite isolated, Guam was directly on the Spaniard's Manila Galleon route due to a favorable combination of wind and currents. Magellan found Guam in 1521 and by the end of the century it was settled as a watering hole for Spanish ships on the Mexico-Philippines route.

Once an island was discovered, the path to European settlement was made more difficult due to mapping technology. Before the mid eighteenth century the measurement of longitude at sea was extremely imprecise. There are many cases of islands appearing

multiple times on early maps because longitude was estimated differently by separate voyages. Revisiting an island charted by a previous voyage was problematic. The known map of the world at the dawn of the eighteenth century was therefore incomplete and inaccurate. Such was the state of ignorance that many still held out hope of a large undiscovered land mass in the Pacific. This changed during the latter half of the eighteenth century with the solution of the longitude problem by Harrison. James Cook and others made voyages which filled in the remaining map of the Pacific.

Latitude sailing was the most common form of navigation. Suppose one was trying to sail from Europe to a particular island in the Pacific. One would head north after rounding Cape Horn until the vessel was at the same latitude as the destination. This was easy and effective because the ship's latitude could be easily and accurately determined by measuring the height of the sun off the horizon at noon. Similarly, the latitude of your destination on charts was well measured even if the longitude was not. Once at the proper latitude, all that was needed to get to the destination was to sail due west until you arrived. In order for this strategy to work, it is important that you arrive at the target latitude to the east of your destination, forcing ships to sail north more rapidly than would be sensible on a direct route. With this style of navigation, east-west corridors with steady winds were more frequently traveled.

We argue that wind speed and direction make ideal instruments for colonization and settlement. Wind was incredibly important during the age of sail, but its importance came to an abrupt halt early in the twentieth century. Thus within our sample wind direction and speed do not have a direct effect on an island's current level of GDP, but could have an important effect via the island's history of colonization. In a first stage regression, wind speed and direction are important determinants of the number of years of colonization. In a regression of years of colonization on minimum average monthly wind speed, we obtain a t-statistic of 3.14 and an F-test with a p-value of .002.

II.B. Patterns of Colonization

In the Atlantic islands, colonization generally consisted of several hundred or a few thousand Europeans arriving and in some cases being granted large parcels of land for farming. Natives (mostly Arawaks or Caribs) were often enslaved in order to work on these farms. Initially the Spanish focused on extracting gold from island rivers and showed reckless disregard for the natives enslaved to do the work. At its peak in 1510, Puerto Rico produced 100,000 pesos of gold, but gold production gave out completely by 1540 (Carrión [1973]). Sugar cane was introduced and soon became a chief export crop in the Caribbean islands. As early as 1550, Puerto Rico had 10 sugar mills producing 500,000 pounds of sugar a year. Coffee was introduced in Puerto Rico in 1736 and ginger and tobacco were also important crops (Carrión [1973]).

The English and French were more enterprising than the Spaniards in setting up the sugar-slave economy and by 1673 there were 57 plantations in English controlled Barbados. Jamaica was at one point in the 17th century (after the British captured it from the Spaniards) the world's largest producer of sugar (Black [1881]). By 1700, the French had established many sugar plantations on virtually all of their islands, including Martinique, Guadeloupe, Grenada, St. Croix, and Saint-Domingue (present day Haiti).

In the late sixteenth and early seventeenth centuries the island-colonies in the Caribbean tended to have several hundred Europeans and, following the introduction of sugar were often outnumbered by African slaves by a factor of 10 to 1. In 1530 Puerto Rico had about 400 Spaniards and 2200 African slaves (Wagenheim [1973]). By 1789 Saint-Domingue (present day Haiti) was home to 40,000 whites and 455,000 black slaves.

Colonies in the Pacific Islands tended to involve fewer numbers of Europeans and far less reliance on imported slaves. Missionaries were often the first colonial residents. For example, Guam was first sighted by Magellan in 1521. In 1668 the Spanish installed a group of Jesuit missionaries, a single garrison of soldiers and a colonial governor. The Spanish mission totaled 50 people relative to the 12,000 Chamorros on Guam. (Douglas [1994], Rogers [1995]).

European contact with and colonization of Tahiti was relatively late in coming. Wallis landed there and traded with the natives in 1767. Cook did the same two years later and then Bligh visited several times and stayed for several months. British missionaries eventually showed up around 1797. The mission consisted initially of 18 men and 5 women and these Europeans settled on the Matavai Bay peninsula. British ships continued to stop in Tahiti with increasing frequency to take on water and food. By the census in 1848 there were about 500 white people in Tahiti (Newbury [1980]).

French missionaries arrived in New Caledonia in 1843. By 1878, the French had established a penal colony there with 6,000 white prisoners and several hundred free whites including soldiers (Lyons [1986]). Spain's colonization of the Caroline and Marshall Islands was extremely sparse. In 1710 two Jesuit missionaries were landed at Palau but were never seen or heard from again. The Spanish placed a handful of Capuchin monks on Yap who opened a school and managed to convert a large number of natives.

In the late nineteenth century entrepreneurial traders and employees of trading companies were also responsible for a modest presence of Europeans and Americans on some Pacific Islands. O'Keefe was an Irish-American from Georgia who ran a series of trading outposts and stores on Yap and Palau (Hezel [1995]). James Paddon, a sandalwood merchant, was one of the first white settlers in New Caledonia. In 1851, he moved his trading and shipping business to the area that became the town of Noumea.

II.C. Magellan versus Cook

There was a distinct change in the attitude of the explorers toward the world between the beginning of the period of exploration and the final filling in of the maps of the world. One need only look at the differences in motivation between Ferdinand Magelland and James Cook.

When Magellan set sail on his famous circumnavigation in 1519 his goal was to find a Spanish route to the Spice Islands. The Treaty of Tordesillas in 1494 split the world between Spain and Portugal at 46°W longitude. It was also agreed that this line extended completely around the globe. However, due to the inability to measure longitude accurately, the exact location of this antemeridian was uncertain. The Spanish felt that a westward route would allow them to lay claims on the Spice Islands. The agreement between Spain and Portugal had the blessing of the Pope and along with their rights to these unfound lands came a responsibility to spread Christianity. Magellan's voyage was therefore explicitly commercial with religious overtones.

This stands in stark contrast to the voyages of James Cook between 1768 and 1779. Cooks missions had explicit scientific aims. The first voyage was commissioned by the Royal Society to observe the transit of Venus across the sun from Tahiti. The second voyage's goal was to find the Terra Australis, the mythical southern continent. The third voyage was in search of the Northwest passage. On all three voyages, Cook brought artist and scientists to record and study all that he found. Since the longitude problem had been solved, Cook was able to accurately fill in the map of the Pacific. His "discoveries" point out how weak European knowledge of the Pacific was at this late date. Many islands were first charted by Cook and his ships made the first European circumnavigation of New Zealand. He also claimed the east coast of Australia for Britain.

Unlike Magellan, who was driven to bring Christianity to the natives, Cook had a much more romantic view of the Pacific islanders.

> "We debauch their morals already too prone to vice and we introduce among them wants and perhaps diseases which they never before knew and which serves only to disturb that happy tranquility they and their forefathers have enjoyed … If anyone denies the truth of this assertion let him tell me what the natives of the whole extent of America have gained by the commerce they have had with Europeans."[2]

[2] Need reference

Clearly this suggests that islands found and colonized later had a much different experience than those found during the initial period.

III. The Impact of Colonization

III.A. Loss of Native Peoples to Disease and Slavery

One of the most striking and terrible facts about colonization by Europeans is the degree to which native populations on some islands were decimated either by brutal enslavement or by diseases carried by Europeans and their animals (See Diamond [1997]). This is most true in the Atlantic where certain islands lost their entire native population in a short amount of time. For example, the Spaniards began to colonize Puerto Rico in 1505 under the leadership of Ponce de Leon. The native Tainos were essentially enslaved as part of the "encomienda" system in which land grants to Spaniards included the right to extract tribute or labor from the natives assigned to that land. The original population of Tainos was estimated to have been 60,000. By 1515 this had fallen to 14,400 and by 1530 to 1,500 (Wagenheim [1998]). Prior to the arrival of Europeans, Jamaica was heavily settled and was home to tens of thousands of Arawaks. Not a single one of the natives were alive by the time the British took over from the Spanish in 1655 (Black [1881]).

The Pacific islanders also faced shocking mortality due to smallpox and other diseases brought by the Europeans.[3] However, only a few of the islands saw a complete wiping out of the original inhabitants and several islands fared reasonably well. Perhaps the worst depopulation occurred in Guam and the Marianas. The number of pure blooded Chamorros on Guam fell from 12,000 in 1668 to 1,576 in 1742[4]. By this point the Chamorros were well intermarried with Filipino and Spanish immigrant families.

The Tahitians saw a drop in their population as a result of the introduction of European disease, but this was followed by a partial recovery. One estimate puts the population for Tahiti at 24,000 around the time of Cook's visit but only 9,000-10,000 by 1800. The

[3] Venereal disease brought by the Spaniards often lead to sterilization.
[4] Douglas [1995] notes that the population decline probably started much earlier, i.e. in 1564 when Legazpi's expedition visited the Marianas and likely introduced European diseases.

native population stabilized and remained around 9,500 at the time of the 1848 census. There was a discrete drop in the 1850s (an epidemic?) but population not only recovered to the 1848 level but grew modestly for the next 60 years (Newbury [1980]).

Any discussion of the effects of colonialism on economic output has to acknowledge the devastation of native populations and cultures. Our results show that islands with a longer colonial history (and more settlement by Europeans) have higher income per capita and lower infant mortality than other similar islands. Is it sensible to measure the positive effects on growth from European contact if in fact the original inhabitants are partially or entirely wiped out because of that contact? Is the possibility of no European contact a realistic counterfactual? One possible interpretation of our results is that native contact with the foreign disease environment and subsequent devastation was inevitable. Thus the question of colonialism promoting economic growth could be somewhat distinct from the decimation of the population since the latter tragedy would have happened anyway. But that assumes a certain epidemiological model which may or may not be accurate. Another less generous interpretation is that we are measuring one positive aspect of colonialism in the face of the enormous tragedy that resulted.

III.B. Promotion of Trade and Exports

If colonial tenure is related to modern economic outcomes, the obvious question is why? Our results and our reading of the historical record suggest a very sensible yet under-discussed explanation: the promotion of trade. Colonial island regimes were obsessed with "making the colony profitable" or at least self sustaining. Home governments wanted to collect more tax revenue than they were pouring into the island as subsidies. Colonial governors wanted to generate lots of cash flow from exports so that they could direct some of this cash into their pockets.

By 1510, Spain was closely monitoring production in Puerto Rico and the Crown appointed an accountant, a commissioner and a treasurer to measure production and exports and collect the appropriate duties on the King's behalf. When opportunities for extracting gold and salt ran out in 1530, Puerto Rico's Governor, Franciso Manuel de

Lando seized on the idea of growing sugar for export. He convinced the Crown to provide loans to build sugar mills and to finance the voyage of families from Spain and refugees from Brazil to provide labor. Prospective plantation owners were lured from Spain with the promise of the indefinite use of large (several hundred acre) tracts of land for growing sugar (Wagenheim, p 56-57).

The Spanish colonists in Jamaica experimented with a wide variety of export crops including tobacco, indigo, and cocoa before they hit upon sugar as the real cash crop. Once the British seized Jamaica, Governor Sir Thomas Modyford (1664) immediately set about both increasing the amount of land under sugar cultivation and encouraging large scale plantation agriculture (Black [1881], pp. 89-90).

European colonists in the Pacific Islands also focused on trade and exports. New Caledonia settlers in the 1860s initially tried growing coffee, sugar, tobacco and rice. But cattle proved the ideal product and there were more than 100,000 cattle there by 1890! However the real export legacy of colonists in New Caledonia came in 1864 when Garnier discovered nickel there (Lyons [1986], p. 49). New Caledonia is currently the world's fourth largest nickel producer and has about 25 percent of proven reserves. (CIA World Factbook, minerals.usgs.gov.) Even very lightly settled islands of the Pacific were affected by international trade introduced by the Europeans. Copra (dried coconut) became a chief export of Yap by the 1880s and natives would haul baskets of coconuts to local trading stations. (Hezel [1995], p 19.).

III.C. Building of Schools, Roads and Public Health Infrastructure by Colonizers

Besides the promotion of trade, colonizers also had a large hand in building schools, roads and infrastructure for drinking water. In the early colonial period, island schools were introduced and run by missionaries and were neither comprehensive (generally being grammar schools only) nor universal. San Juan, Puerto Rico had one school built by the Franciscans in 1640 and a second shortly thereafter by the local Bishop. (Wagenheim [1998], p. 74). San Juan's first high school was established in 1832 by a

group of clergymen. By 1897 Puerto Rico had 551 schools and 28,000 pupils. (Wagenheim, p. 234-235.) Many early public schools in Jamaica were set up by bequests from plantation owners who wanted to benefit the island residents. The first such school opened in 1694 using a bequest from Raines Waite (Black [1881], p. 187). The first school on Guam was opened in 1873 by the missionary Father San Vitores (Rogers [1995], p. 50). Several schools on Tahiti were opened by missionaries in the late 1800s and the colonial government opened a school for teachers in 1901 (Newbury [1980], p. 150).

Universal education did not arrive in any of the island colonies until the twentieth century, but in many cases colonizers had a hand in setting up universal educational systems. After Puerto Rico became a US commonwealth, the American administration rapidly expanded the number of rural schools. By 1920 there were 11 high schools and the University of Puerto Rico had been founded (Carrión [1983], p. 174).

IV. Data Description

The data on island colonization, GDP, and infant mortality are assembled from a large number of sources. Where available, we obtained current (2000 or 2003) GDP per capita numbers from the United Nations. GDP numbers at the island level were available for 35 island nations. Roughly 15 islands are possessions of other countries, for example Guam is a US possession. In those cases we obtained island level GDP and infant mortality numbers for the island from the statistical agency of the relevant country (e.g. the US Census.) In the case of distinct large islands that are currently parts of the same country, we disaggregated country level data into the component islands. For example Yap and Pohnpei are both members of the Federated States of Micronesia, but the two islands have different histories, wind patterns and economic output (and are located more than 1,000 miles apart). In some of these cases we were able to obtain separate GDP breakdowns from a series of reports on Pacific island groups produced by the Asian Development Bank.

The colonial and settlement histories for each island come from a myriad of sources. For the Pacific islands we relied heavily in the Pacific Island Yearbook. For Atlantic and Indian Ocean islands, we used Encyclopedia Britannica and supplemented this source with information from official websites maintained by the governments of each island. We collected the entire history of each island, including the first European sightings, the first settlements, the extent of such settlements, and the political history of the island's colonization if any.

Wind speed data are from satellite data taken from CERSTAT.[5] The satellites measure wind speeds over water for the entire globe, reported on a one degree longitude latitude grid. The data we utilize are reported monthly and consist of the average wind vector in the north-south direction and the average wind vector in the east-west direction. For our instruments, we average these two data points over the entire year.

Table I contains summary statistics for the data. Forty seven percent of the 88 islands are located in the Pacific, forty percent are in the Atlantic and the remainder are in the Indian Ocean. The median population on our islands is about 11,500 people. This ranges from as few as 102 people on Palmerston Island (in the Cook Islands) to more than 10 million people in Madagascar. Our results are robust to dropping islands with fewer than 10,000 people. The median land area for the islands is 160 square miles with a mean of 12,000 square miles.

Ninety five percent of the islands were politically a European colony at some point in their history with an average number of years as a colony of 200 years. In general the Atlantic islands were the first to be colonized by Europeans and islands including Bonaire, Curacao, and Barbados have 400 years of colonial history.

[5] The CERSAT (Centre ERS d'Archivage et de Traitement - French ERS Processing and Archiving Facility) is part of IFREMER (French Research Institute for Exploitation of the Sea. It was created in 1991 as a node of the ESA (European Space Agency) ground segment for the ERS-1 and ERS-2 Earth observation satellites. http://www.ifremer.fr/cersat/

The mean 2000 GDP per capita on the islands in the sample is $5,997 with a high of $33,400 for Bermuda. Grand Cayman is a close second with $26,919. Infant mortality averages 24 per thousand live births. The extreme outlier in infant mortality is Zanzibar (part of Tanzania) at 102 deaths per 1,000 live births and this is driven largely by the AIDS crisis there.

One possible criticism of our approach is that islands tend to be small and have different natural resources than continental nations and are therefore not "real countries" of interest to macroeconomists. And many successful islands focus on a tourism economy that again makes them different from "real" countries. We have several responses to this. First, the islands in the sample have rich variation in their latitudes and levels and types of natural resources. Appendix Table IV shows that agriculture is a large fraction of the economy for islands like Madagascar and some of the Federated States of Micronesia like Pohnpei. Bermuda and the Virgin Islands tend to focus on services, though this can mean banking and insurance in addition to tourism.

More importantly, even if all the islands in the South Pacific or the Atlantic had beautiful beaches, we still would need to ask why certain islands have a subsistence level of income while others have a standard of living that rivals Sweden and the US. Grand Cayman is a tourist paradise while Hispaniola (Haiti plus the Dominican Republic) is not, despite the fact that both islands have tropical breezes and the beauty of the Caribbean Sea.[6]

V. Empirical Results

Figure 1 shows a scatter plot of log GDP per capita versus number of years as a colony (expressed in centuries). The circles are for islands in the Atlantic, the triangles are for islands in the Pacific and the squares are for islands in the Indian Ocean. The regression line shows a clear positive relationship between length of colonial period and modern

[6] We are not claiming that the length of the colonial period explains the Grand Cayman Hispaniola income gap but rather that even within Caribbean islands, there is massive and interesting variation in economic performance.

GDP. While there is a large amount of variation around the regression line (we certainly don't think colonial history explains everything), the t-statistic for the slope is 4.7. The coefficient is .30 meaning that every additional 100 years of colonial history is associated with a 30 percent increase in GDP. Remarkably the upward slope appears to hold within each of the oceans too. The relationship is not driven simply by the fact that Atlantic islands were discovered by Europeans earliest and are the richest.

Table 2 shows six different cross sectional regressions with our basic result. For columns (1) through (3) log (gdp/capita) is the dependent variable. Column (1) shows the basic correlation illustrated in Figure (1). Higher per capita GDP is associated with a longer period under colonial rule. Each additional hundred years is associated with GDP per capita that is 32 percent higher.

Column (2) adds geographic controls. We include dummies for each ocean and we control for island land area and absolute value of latitude (distance from the Equator). As in Gallup, Sachs and Mellinger [1999] and Sachs [2003], the absolute value of latitude is strongly related to current levels of income. Every 10 degree increase in latitude (i.e. moving roughly 700 miles away from the equator) is associated with a 58 percent increase in GDP. Those authors find that latitude works through the efficiency of agriculture and disease prevalence. AJR[2001] provide evidence that latitude's effects work through variation in the nature of European settlements and institutions that were established. Island area is also significant with larger islands doing more poorly than smaller islands. Interestingly, the ocean dummies are not significantly different from zero. Including the geographic controls does not alter the results for colonial tenure.

One important possibility is that colonialism in fact has no positive effect, but that Europeans simply chose to settle the best islands, or found the best ones first and hence the more successful islands have a longer colonial history. For example, being near a continent could be correlated both with heavy settlement and with current GDP. We are able to reject this explanation for our results by using wind direction and speed as instruments for settlement or length of colonial period. As discussed in a previous

section, wind patterns make an appealing instrument because they were incredibly important during 1500-1890 (and determined discovery and settlement), but may have little direct effect on GDP today.

In column (3) we instrument for the number of years as a colony using data on wind speed and direction. Specifically, we use the average north-south wind speed vector and the average east-west wind speed vector as instruments.[7] Column (1) in Appendix I shows the first stage. Both wind vectors are significant predictors of the length of colonial history with a first stage F statistic of 5.5. Longer colonial tenures are associated with a larger western and southern wind component, even controlling for ocean, latitude and island area.

Column (3) of Table I shows the second stage of the two stage least squares regression. We find that each additional hundred years of colonization is associated with 36 percent larger GDP per capita. This is not statistically different from the OLS result in column (2).

As an additional outcome measure we replace GDP per capital with infant mortality in Columns (4) – (6). These results mirror the results for GDP per capita. The number of centuries that an island was a colony is a negative and significant predictor of infant mortality in all the specifications. One notable difference compared to the GDP columns is the importance of the ocean dummies. The Indian Ocean has significantly higher infant mortality than the Pacific.

V.A. Mechanisms

The island data show a robust relationship between the length of colonization and modern day income. The next question is of course, why should past colonialism in these islands

[7] The use of the two wind vectors was chosen because it was the most parsimonious way to describe both wind speed and direction. It also happens to be the form in which the original satellite data is distributed. Appendix II explores the use of other variations on wind speed and direction as instruments. The results are quite similar.

be good for income levels?[8] Any explanation must allow for events happening centuries ago to matter today. This fact alone points to the importance of institutions, given their longevity. For example the establishment of property rights, courts and a stable government are all likely to be helpful for long run economic performance. Another related possibility is that the Europeans (particularly the missionaries who established many of the earliest settlements) established schools which raised human capital. The colonized islands may have been more able to trade with other islands and other countries following colonization.

This line of thought is hardly new. Acemoglu, Johnson and Robinson argue that certain forms of European settlement set up stable, pro-growth institutions. In particular, they distinguish between the types of colony, with settlement colonies producing positive modern outcomes and extractive colonies producing negative ones. La Porta, Lopez de Silanes, Shleifer and Vishny [1997, 1998] also emphasize an aspect of the quality of colonization, finding that the identity of the colonizer matters through differences in the legal systems. Our initial results emphasize the importance of the quantity of European influence, without reference to the specifics of the colonial regime. This section will ask whether controlling for mechanisms through which colonization may matter diminishes the importance of the length of the colonial experience.

Table III examines whether measures of the colonial experience other than length of time can reduce the importance. In other words, can any measures of the quality of the colonial experience diminish the importance of the length of colonial experience? Columns (1) and (2) look at the impact of trade, slavery and democracy. We include in our basic regression a dummy for whether the island engaged in trade in complex products during the colonial period. The dummy variable is positive for islands which only traded in gathered products such as fish or dried coconut during the colonial period. Islands trading in organized agriculture (such as sugar), mining, or livestock are coded with a zero. We include a dummy for whether agriculture used imported slaves. We also

[8] We can't come close to answering this question, but we mention here some of the most plausible reasons discussed in the literature.

check the possibility that the length of colonization is associated with greater democratization. We test this by including the year of the first elected legislature as a regressor. Column (3) uses dummies for 19th and 18th century legislatures to check for nonlinearity in this effect.

Islands with major trade goods in colonial times have higher modern output. The difference is large with traders having modern output on average about 40% higher. This result, however, does not diminish the importance of the length of colonization, suggesting that something other than the trade channel is at work. Our more direct measures of the quality of the colonial experience are insignificant. The use of imported slaves is not significantly correlated with income and the point estimate is quite close to zero. Similarly, an early legislature does not appear to be correlated with income.

Another potential (and insidious) possibility is that the colonizers of the earlier settled islands wiped out the native population and replaced it with Europeans with higher human capital or more ability to trade. We partially reject this explanation based on the fact that most of the Pacific Islands in our sample still have much of their native population intact. For example, on Guam, one of the most economically successful Pacific islands, 43 percent of the people can trace their roots back to the original Chamorros who inhabited the island and 22 percent of the people are Filipino. In Tahiti, 67 percent of the people are Polynesian and another 17 percent are part Polynesian. Only 10 percent are white.

More formally, we test to see whether the modern ethnic composition of the islands explains differences in output. This ties in nicely with Acemoglu et al, whose work suggests that higher rates of long run settlement are associated with better institutions.
Column (4) of Table III tests the effect of modern ethnic composition on output along with the length of colonial experience. We find that the modern ethnic composition is insignificantly correlated with output.

Columns (5) and (6) of Table III ask whether the nation doing the colonizing is related to modern day GDP per capita. There is no evidence that the British islands are outperforming the French ones. In column (5) the coefficient on number of centuries French is .15 versus .19 for number of centuries British. (In our coding we allow a single island to have a colonial history under several different countries.) The Spanish colonial experience is significantly worse than the French or British. (The US colonies are doing extraordinarily well, but this is not surprising given that residents of Puerto Rico, Guam and American Samoa are current recipients of government transfers and private remittances from the US.)

In column (4) we switch the key right hand side variables to dummies for the island ever being British, French or Spanish. Here again the French dummy is no different than the British dummy.

V.B. A Broader Sample of Countries

Our results suggest that the length of colonial experience is positively correlated with per capital GDP in a sample of islands. The IV results further suggest that these results are not being driven by the selective colonization of islands that have good modern outcomes. Given the similarity of the IV and OLS results, it may be instructive to check the basic results against a larger more traditional sample of countries. Table IV shows the results from regressing per capita GDP against the number of years a country was a colony for a sample of non-island developing countries. This sample is consistent with the countries included in Acemoglu, Johnson, and Robinson.

The basic results match quite nicely with our island results. Each additional century of colonial tenure is associated with a 40 percent increase in GDP. This is not statistically significantly different from the 32 percent coefficient found in the island sample. Including latitude as a control does not significantly change this coefficient. One

advantage of using this sample is that standard measures of modern institutional quality can be included. Column (3) of Table IV includes expropriation risk as an additional regressor. Expropriation risk is significant and negative, as expected. This reduces the point estimate on colonial tenure, but it remains large and significant. In column (4) we include the Acemoglu, Johnson and Robinson measure of log settler mortality with similar results.

While the results from this sample are not as well identified as from the islands sample, they are still instructive. The basic relationship appears to extend beyond our island sample. The results are robust to the inclusion of standard modern institutional measures and geographic controls.

VI. Concluding Remarks

We have argued for an "islands as experiments" approach in which individual islands can be used as separate data points to think about the long run effects of institutions, natural resources, latitude or colonial history on long run economic performance. The most interesting fact in our sample is a robust positive relationship between European settlement (or the length of colonization) and current levels of income. Similarly, settlement and colonization are strongly negatively related to infant mortality.

While some of this relationship may be driven by smart selection of islands by colonizers or distance to the mainland, we suspect that part of the relationship is causal. In particular, when we instrument for colonization and settlement using wind direction and speed, we obtain coefficients on years of colonization that are similar to our OLS result. This is consistent with the Acemoglu Johnson Robinson results on the nature of settlement and modern outcomes. The data also support the Sachs effect of latitude in a new sample of relatively homogenous and relatively independent data points.

However, we depart from these earlier works in that we emphasize the length of European settlement as well as the quality. Controls for institutional features such as

trade and slavery do not diminish the importance of the raw length of time the island was influenced by Europeans. Our results also suggest that the Spanish and the Portugese instilled significantly worse institutions than the other countries in our sample.

References

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation," *American Economic Review* 91(5): 1369-401.

Acemoglu, Daron, Simon Johnson, and James A. Robinson. 2002. "Reversal of Fortune: Geography and Development in the Making of the Modern World Income Distribution," *Quarterly Journal of Economics* 117(4), 1231-1294.

Aldrich, Robert, *France and the South Pacific Since 1940*, University of Hawaii Press, Honolulu, 1993.

Ashcraft, Norman, *Colonialism and Underdevelopment: Processes of Political Economic Change in British Honduras*, Teachers College Press, New York, 1973.

Aten, Bettina, Alan Heston and Robert Summers. 2002. *Penn World Tables Version 6.1*. Center for International Comparisons at the University of Pennsylvania (CICUP).

Barro, Robert J. 1991 "Economic Growth in a Cross-Section of Nations," *Quarterly Journal of Economics* 106(2): 407-43.

Beckles, Hilary, *A History of Barbados: From Amerindian Settlement to Nation-State*, Cambridge University Press, Cambridge, 1990.

Black, Clinton V., *The Story of Jamaica from Prehistory to the Present*, Collins Clear-Type Press, London, 1965.

Brett, E. A., *Colonialism and Underdevelopment in East Africa: The Politics of Economic Change 1919-1939*, NOK Publishers, Ltd., New York, 1973.

Campbell, Gwyn, *An Economic History of Imperial Madagascar, 1750-1895: The Rise and Fall of an Island Empire*, Cambridge University Press, New York, NY, 2005.

Campbell, I. C., A *History of the Pacific Islands*, University of California Press, Berkeley, 1989.

Carano, Paul and Pedro C. Sanchez, *A Complete History of Guam*, Charles E. Tuttle Company, Rutland, VT, 1964.

Carrión, Arturo Morales, *Puerto Rico: A Political and Cultural History*, W.W. Norton & Company, Inc., New York, NY, 1983.

Dietz, James L., *Economic History of Puerto Rico: Institutional Change and Capitalist Development*, Princeton University Press, Princeton, New Jersey, 1986.

Dominican Republic and Haiti: Country Studies, Richard A. Haggerty (ed.), Federal Research Division, Library of Congress, Washington D.C., 1991.

Douglas, Norman and Ngaire Douglas (eds.), *Pacific Islands Yearbook*, 17th ed, Fiji Times Ltd., Fiji, 1994.

Dupay, Alex, *Haiti in the World Economy: Class, Race, and Underdevelopment Since 1700*, Westview Press, Inc., Boulder, Co, 1989.

Fieldhouse, D.K., *The West and the Third World: Trade, Colonialism, Dependence and Development*, Blackwell Publishers, Oxford, UK, 1999.

Gallup, John Luke; Sachs, Jeffrey D; Mellinger, Andrew D, "Geography and Economic Development." *International Regional Science Review*, vol. 22, no. 2, August 1999, pp. 179-232.

Glaeser, Edward L., Rafael La Porta, Florencio Lopez-de-Silanes and, Andrei Shleifer, "Do Institutions Cause Growth?," National Bureau of Economic Research Working Paper 10568, June 2004.

Graham, Norman A. and Keith L. Edwards, *The Caribbean Basin to the Year 2000: Demographic, Economic, and Resource-Use Trends in Seventeen Countries*, Westview Press, Boulder, Colorado, 1984.

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

Hezel, Francis X., *Strangers in Their Own Land: A Century of Colonial Rule in the Caroline and Marshall Islands*, University of Hawai'i Press, Honolulu, 1995.

Hope, Kempe Ronald, *Economic Development in the Caribbean*, Praeger Publishers, New York, NY, 1986.

Hough, Richard, *Captain James Cook*, W.W. Norton & Company, Inc., New York, 1994

Howard, Rhoda, *Colonialism and Underdevelopment in Ghana*, Africana Publishing Company, New York, 1978.

Howe, K R, *Where the Waves Fall: A New South Sea Islands History from First Settlement to Colonial Rule*, University of Hawaii Press, Honolulu, 1984.

Huxley, Anthony (ed.), *Standard Encyclopedia of the World's Oceans and Islands*, G.P. Putnam's Sons, New York, NY, 1962.

Indian Ocean: Five Island Countries, Helen Chapin Metz (ed.), Federal Research Division, Library of Congress, Washington D.C., 1995.

Islands of the Commonwealth Caribbean: A Regional Study, Sandra W. Meditz and Dennis M. Hanratty (eds.), Federal Research Division, Library of Congress, Washington D.C., 1989.

Iyer, Lakshmi, "The Long-term Impact of Colonial Rule: Evidence from India" Massachusetts Institute of Technology PhD Dissertation 2003.

Jiménez de Wagenheim, *Puerto Rico: An Interpretive History from Pre-Columbian Times to 1900*, Markus Wiener Publishers, Princeton, NJ, 1998.

Knight, Franklin W., *The Caribbean: The Genesis of a Fragmented Nationalism*, Oxford University Press, New York, 1978.

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

La Porta, Rafael, Florencio Lopez-de-Silanes, Andrei Shleifer, and Robert Vishny. 1998. "Law and Finance," *Journal of Political Economy* 106(6), 1113-1155.

Lyons, Martyn, *The Totem and the Tricolour: A Short History of New Caledonia Since 1774*, New South Wales University Press, Kensington NSW Australia, 1986.

McArthur, John W. and Jeffrey D. Sachs, "Institutions and Geography: Comment on Acemoglu, Johnson and Robinson (2000)," NBER Working Paper No. 8114, 2000.

Malcolm, George A., *The Commonwealth of the Philippines*, D. Appleton-Century Company, Inc., New York, 1936.

Maude, H. E., *Of Islands and Men: Studies in Pacific History*, Oxford University Press, Melbourne, 1969.

Mauro, Paolo. "Corruption and Growth." *Quarterly Journal of Economics*, August 1995, 100:3, 681-712.

Newbury, Colin, *Tahiti Nui: Change and Survival in French Polynesia 1767-1945*, The University Press of Hawaii, Honolulu, 1980.

Pacific Islands, Naval Intelligence Division, Geographical Handbook Series: General Study, Volume I, 1945.

Pacific Islands, Naval Intelligence Division, Geographical Handbook Series: Eastern Pacific, Volume II, 1943.

Pacific Islands, Naval Intelligence Division, Geographical Handbook Series: Western Pacific (Tonga to Solomon Is.), Volume III, 1944.

Pacific Islands, Naval Intelligence Division, Geographical Handbook Series: Western Pacific (New Guinea and Islands Northward), Volume IV, 1945.

Parsons, James J., San *Andrés and Providencia: English-Speaking Islands in the Western Caribbean*, University of California Publications in Geography (Vol. 12), University of California Press, Berkeley, 1956.

Philippines: A Country Study, Frederica M. Bunge (ed.), Federal Research Division, Library of Congress, Washington D.C., 1984.

Pons, Frank Moya, *The Dominican Republic: A National History*, Hispaniola Books, New Rochelle, NY, 1995.

Rodney, Walter, *How Europe Underdeveloped Africa*, Howard University Press, Washington, D. C., 1974.

Roger, Robert F., *Destiny's Landfall: A History of Guam*, University of Hawai'i Press, Honolulu, 1995.

Sachs, Jeffrey D., "Institutions Don't Rule: Direct Effects of Geography on Per Capita Income," National Bureau of Economic Research, Inc, NBER Working Papers: 9490, 2003.

Table I
Summary Statistics

These are summary statistics for the variables in the islands database. See the text for details on variable sources and construction. Islands still without an elected legislature are coded as getting a legislature in 2002.

Variable	Obs	Mean	Std. Dev.	Min	Max
Island's GDP per Capita 2000	88	5996.97	6659.93	256.00	33400.00
Log (GDP Capita)	88	8.09	1.16	5.55	10.42
Infant Mortality 2002	88	24.48	21.40	4.35	102.13
Number of Centuries as a Colony	88	2.00	1.54	0.00	5.11
Northerly Vector of Prevailing Wind	88	0.37	1.41	-1.55	4.20
Easterly Vector of Prevailing Wind	88	-3.93	2.21	-6.88	4.42
No Historical (1500-1820) Off Island Trade Except Fish or Coconuts (0-1)	88	0.31	0.46	0.00	1.00
Agriculture Used Imported Slaves	88	0.39	0.49	0.00	1.00
Year of First Elected Legislature	88	1941.19	66.57	1639.00	2002.00
Had Legislature by 1800	88	0.07	0.25	0.00	1.00
Had Legislature by 1900	88	0.14	0.35	0.00	1.00
Island Population	79	425,995	1,830,327	102	11,600,000
Percent Current Pop Native	83	48.30	44.85	0.00	100.00
Percent Current Pop White	83	7.57	15.54	0.00	95.88
Percent Current Pop Black	83	21.07	35.44	0.00	95.00
Percent Current Pop Mixed	83	16.55	28.79	0.00	95.90
Number of Centuries British	88	0.82	1.20	0.00	3.95
Number of Centuries French	88	0.33	0.71	0.00	3.69
Number of Centuries Spanish	88	0.44	1.00	0.00	4.05
Ever British	88	0.67	0.47	0.00	1.00
Ever French	88	0.32	0.47	0.00	1.00
Ever Spanish	88	0.30	0.46	0.00	1.00
Absolute Value of Latitude	88	14.90	8.11	0.20	51.92
Island Area ('000 Square Miles)	88	12.12	65.09	0.00	587.71
Island is in Pacific	88	0.47	0.50	0.00	1.00
Island is in Atlantic	88	0.44	0.50	0.00	1.00
Island is in Indian	88	0.09	0.29	0.00	1.00

Table II
Outcomes Regressed on Years of Colonization

We regress Log GDP per capita and infant mortality on the number of years the island spent as a colony of a European power. Columns (1), (2), (4), and (5) are OLS. Columns (2) and (6) are two stage least squares where we instrument for centuries of colonial rule using wind speed and direction. Specifically we use the average northerly vector and average easterly vector of the prevailing winds for the island. We average these vectors over 12 months.

	(1) Log GDP Capita	(2) Log GDP Capita	(3) Log GDP Capita (IV Using Wind Speed and Direction)	(4) Infant Mortality Per 1000	(5) Infant Mortality Per 1000	(6) Infant Mortality Per 1000 (IV Using Wind Speed and Direction)
Number Centuries As Colony	0.323	0.247	0.398	-3.452	-3.757	-17.285
	(0.069)**	(0.108)*	(0.190)*	(1.633)*	(1.464)*	(7.732)*
Abs(Latitude)		0.058	0.054		-1.153	-0.853
		(0.012)**	(0.012)**		(0.336)**	(0.262)**
Area in 1000s Sq Miles		-0.005	-0.005		0.087	0.063
		(0.002)**	(0.002)*		(0.025)**	(0.038)
Island is in Pacific Ocean		0.395	0.570		-23.626	-39.282
		(0.385)	(0.436)		(10.772)*	(14.164)**
Island is in Atlantic Ocean		0.443	0.348		-14.768	-6.246
		(0.359)	(0.336)		(11.312)	(11.752)
Constant	7.447	6.417	6.124	31.376	65.669	92.042
	(0.194)**	(0.397)**	(0.510)**	(5.439)**	(12.414)**	(20.146)**
Observations	88	88	88	88	88	88
R-squared	0.184	0.442	0.416	0.062	0.452	

Robust standard errors in parentheses. We cluster at the island group level since a few of the islands (e.g. the Cook Islands and the Federated States of Micronesia) are used as separate observations from a cluster of politically related yet geographically distinct islands.

+ significant at 10%; * significant at 5%; ** significant at 1%

Table III
Possible Mechanisms for GDP – Colonialism Relationship

	(2) Log GDP Capita	(3) Log GDP Capita	(4) Log GDP Capita	(5) Log GDP Capita	(6) Log GDP Capita
Number Centuries As Colony	0.252	0.247	0.215		
	(0.119)*	(0.121)*	(0.121)+		
No Significant Historical Form of Trade Other Than Fish and Coconuts	-0.072	-0.072	-0.086		
	(0.241)	(0.245)	(0.238)		
Agriculture Used Imported Slaves\	-0.030	0.003			
	(0.349)	(0.359)			
Year Of First Elected Federal Legislature	0.001		0.001		
	(0.001)		(0.002)		
Had Elected Legislature by 1800		0.163			
		(0.620)			
Had Elected Legislature by 1900		-0.335			
		(0.591)			
Percent White			0.016		
			(0.010)		
Percent Black			0.006		
			(0.007)		
Percent Mixed			0.007		
			(0.005)		
Number Centuries British				0.334	
				(0.118)**	
Number Centuries French				0.478	
				(0.150)**	
Number Centuries Spanish				-0.002	
				(0.098)	
Number Centuries Dutch				0.479	
				(0.090)**	
Number Centuries Portuguese				0.102	
				(0.128)	
Number Centuries German				0.999	
				(1.787)	
Number Centuries Japanese				-1.598	
				(1.211)	
Number Centuries US				1.849	
				(0.353)**	
Island Was Ever British					0.232
					(0.252)
Island Was Ever French					0.347
					(0.333)
Island Was Ever Spanish					-0.000
					(0.286)
Island Was Ever Dutch					0.618
					(0.289)*
Island Was Ever Portuguese					-0.563
					(0.407)
Island Was Ever German					0.141
					(0.655)
Island Was Ever Japanese					-0.298

					(0.660)
Island Was Ever US					0.669
					(0.380)+
Abs(Latitude)	0.059	0.059	0.050	0.056	0.051
	(0.013)**	(0.013)**	(0.016)**	(0.013)**	(0.014)**
Area in 100s Sq Miles	-0.005	-0.005	-0.006	-0.004	-0.005
	(0.002)**	(0.002)**	(0.002)**	(0.001)**	(0.002)**
Island is in Pacific Ocean	0.339	0.302	0.585	0.764	0.239
	(0.404)	(0.426)	(0.386)	(0.438)+	(0.541)
Island is in Atlantic Ocean	0.397	0.336	0.215	0.613	0.717
	(0.362)	(0.386)	(0.477)	(0.433)	(0.456)
Constant	4.685	6.547	4.509	5.922	6.580
	(2.665)+	(0.420)**	(2.803)	(0.499)**	(0.578)**
Observations	88	88	83	88	88
R-squared	0.445	0.448	0.492	0.562	0.455

Robust standard errors in parentheses. Standard errors are clustered at the island group level.
+ significant at 10%; * significant at 5%; ** significant at 1%

Table IV
GDP and Colonialism Within Non-island Developing Countries

We started with the Acemoglu-Robinson-Johnson [2001] database and added our own measure of length of colonial period. We dropped the three island countries that were in AJR and our islands database.

	(1) Log GDP Per Capita	(2) Log GDP Per Capita	(3) Log GDP Per Capita	(4) Log GDP Per Capita
Number of Centuries a Colony	0.401	0.358	0.287	0.232
	[0.097]**	[0.090]**	[0.072]**	[0.084]**
Absolute Value of Latitude		2.952	1.406	1.825
		[0.883]**	[0.746]+	[0.822]*
Mean Temperature		-0.023	-0.013	0.005
		[0.023]	[0.019]	[0.021]
Expropriation Risk			0.404	
			[0.067]**	
Log Settler Mortality (AJR)				-0.403
				[0.093]**
Constant	7.276	7.344	4.873	9.034
	[0.215]**	[0.686]**	[0.682]**	[0.728]**
Observations	64	64	64	60
R-squared	0.22	0.40	0.63	0.56

Appendix I
IV First Stage Regression and Reduced Form Regression

Columns (1) and (2) are OLS. Column (1) is the first stage regression using our preferred set of instruments. We regress the islands' number of centuries as a colony on the northerly and easterly vectors of the island's prevailing wind. Column (2) is a reduced form in which we show the direct effect of wind on modern day GDP.

	(1) Number Centuries As Colony	(2) Log GDP Capita
Northerly Vector of Wind	-0.268	-0.061
	(0.098)**	(0.068)
Easterly Vector of Wind	-0.145	-0.090
	(0.063)*	(0.051)+
Area in 1000s Sq Miles	-0.002	-0.006
	(0.001)	(0.001)**
Abs(Latitude)	0.024	0.065
	(0.014)+	(0.013)**
Island is in Pacific Ocean	-1.702	-0.100
	(0.488)**	(0.422)
Island is in Atlantic Ocean	0.019	0.352
	(0.460)	(0.408)
Constant	1.977	6.746
	(0.475)**	(0.429)**
Observations	88	88
R-squared	0.452	0.407
F Statistic for Instruments	5.50	
Prob > F =	.0062	

Robust standard errors in parentheses. Standard errors are clustered at the island group level.

+ significant at 10%; * significant at 5%; ** significant at 1%

Appendix II
IV Results Using Alternative Sets of Wind Based Instruments

In addition to specifying the prevailing wind as two vectors per island, we also tried several other measures of wind speed and direction and used these to instrument for an islands' years of colonization. Below are the second stage results and F-statistics for three different types of wind related instruments. Column (1) takes eight compass headings and measures the knots of prevailing wind along each heading and each month. The instrument is the sum of knots*months that the prevailing wind blew on that heading. We use knot*months along headings 2,4,6,8 as the set of instruments. In column (2) we use simply the knot*months of wind of blowing towards the South West. Wind on this compass heading is the single strongest predictor of an island being discovered and colonized early. In column (3) we perform a similar exercise but limit ourselves to four compass headings and measure the wind as negative if it blew away from a compass heading instead of towards it. In other words, we have only 4 headings but the wind speed can be positive or negative. We use all four points as instruments.

	(1) Log GDP Capita (2SLS)	(2) Log GDP Capita (2SLS)	(3) Log GDP Capita (2SLS)
Number Centuries	0.483	0.380	0.377
As Colony	(0.200)*	(0.192)+	(0.197)+
Area in 1000s Sq	-0.005	-0.005	-0.005
Miles	(0.002)*	(0.002)*	(0.002)*
Abs(Latitude)	0.053	0.055	0.055
	(0.012)**	(0.012)**	(0.012)**
Island is in Pacific Ocean	0.669	0.549	0.545
	(0.448)	(0.429)	(0.433)
Island is in Atlantic Ocean	0.294	0.360	0.361
	(0.350)	(0.344)	(0.342)
Constant	5.957	6.159	6.165
	(0.522)**	(0.499)**	(0.514)**
Observations	88	88	88
R-squared	0.378	0.422	0.423
F Statistic for Instruments in First Stage	4.99	15.07	3.09
Prob > F =	0.0014	0.0002	0.0217

Robust standard errors in parentheses
+ significant at 10%; * significant at 5%; ** significant at 1%

Appendix III
List of Islands Within Our Dataset

Island Group	Island	Country	Year First Sighted By Europeans	Number Centuries As Colony	Log GDP Capita 1990	GDP Per Capita
Cook Islands	Aitutaki	Cook Islands	1789	0.13	7.64	2,088
Bahamas	Andros, North	Bahamas	1492	4.79	9.39	11,957
Anguilla	Anguilla	United Kingdom - Anguilla	1493	3.54	8.71	6,033
Equatorial Guinea	Annobón	Equatorial Guinea	1474	2.06	7.90	2,700
Antigua and Barbuda	Antigua	Antigua and Barbuda	1493	3.49	8.57	5,276
Ascension	Ascension	United Kingdom - Ascension Island	1501	0.82	7.82	2,500
Cook Islands	Atiu	Cook Islands	1777	0.13	7.27	1,432
Barbados	Barbados	Barbados	1510	3.84	8.81	6,689
Bermuda	Bermuda	Bermuda	1503	3.95	10.42	33,400
Equatorial Guinea	Bioko	Equatorial Guinea	1472	1.9	7.90	2,700
Netherlands Antilles	Bonaire	Netherlands	1499	4.78	9.25	10,388
Cuba	Cuba	Cuba	1492	3.89	7.55	1,904
Netherlands Antilles	Curacao	Netherlands	1499	4.92	9.25	10,388
Dominica	Dominica	Dominica	1493	2.46	7.75	2,322
East Falkland	East Falkland	Falkland Islands (United Kingdom)	1592	2.31	10.13	25,000
Easter	Easter	Chile - Easter Island	1772	0.04	9.20	9,900
Vanuatu	Efate	Vanuatu	1606	1.86	6.93	1,023
Federated States of Micronesia	Fefan	Federated States of Micronesia	1687	1.01	6.90	995
Fernando de Noronha	Fernando de Noronha	Brazil	1504	0	7.41	1,645
Tuvalu	Funafuti	Tuvalu	1819	0.62	6.92	1,012
Futuna	Futuna	France	1616	1.17	8.22	3,700
Grand Cayman	Grand Cayman	United Kingdom	1503	3.69	10.20	26,919
Comoros	Grande Comore	Comoros	1505	0.88	6.16	475
Guadeloupe	Grande Terre	France	1493	3.76	8.97	7,900
Grenada	Grenada	Grenada	1498	3.44	7.64	2,079
Guam	Guam	United States	1521	4.43	9.95	21,000
Dominican Republic	Hispaniola DOM	Dominican Republic	1492	3.13	7.16	1,289
Hispaniola	Hispaniola HTI	Haiti	1492	3.31	5.94	381
Huvadu	Huvadu	Maldives	1558	3.2	6.91	1,000
Jamaica	Jamaica	Jamaica	1494	1.68	7.50	1,803
Fiji	Kadavu	Fiji	1789	0.95	7.52	1,848

Island Group	Island	Country	Year First Sighted By Europeans	Number Centuries As Colony	Log GDP Capita 1990	GDP Per Capita
Federated States of Micronesia	Kosrae	Federated States of Micronesia	1688	1.01	7.63	2,051
Loyalty Islands	Lifou	France	1774	2.31	9.60	14,786
Philippines	Luzon	Philippines	1521	2.97	6.59	725
Madagascar	Madagascar	Madagascar	1500	0.62	5.55	256
Seychelles	Mahe	Seychelles	1502	2.2	8.54	5,116
Marshall Islands	Majuro	Marshall Islands	1526	1	7.28	1,453
Solomon Islands	Malaita	Solomon Islands	1568	0.86	6.49	657
Cook Islands	Mangaia	Cook Islands	1777	0.13	7.38	1,610
Gambier Is	Mangareva	France	1687	1.24	9.62	14,995
Cook Islands	Manihiki	Cook Islands	1822	0.13	7.67	2,147
Martinique	Martinique	France	1502	2.26	9.57	14,400
Cook Islands	Mauke	Cook Islands	1823	0.13	7.52	1,849
Mauritius	Mauritius	Mauritius	1507	3.59	7.80	2,449
Mayotte	Mayotte	France	1529	1.61	7.86	2,600
Cook Islands	Mitiaro	Cook Islands	1823	0.13	7.61	2,028
Federated States of Micronesia	Moen	Federated States of Micronesia	1528	4.58	6.90	995
Montserrat	Montserrat	United Kingdom	1493	3.72	8.74	6,257
Nauru	Nauru	Nauru	1798	0.78	8.59	5,401
Papua New Guinea - Bismarck Archipelago	New Britain	Papua New Guinea	1616	0.61	6.68	799
New Caledonia	New Caledonia	France	1774	2.31	9.60	14,786
Niue	Niue	Niue	1774	0.01	8.19	3,600
Turks and Caicos Islands	North Caicos	United Kingdom	1512	2.38	9.17	9,600
Palau	Oreor	Palau	1710	1.2	8.39	4,389
Cook Islands	Palmerston	Cook Islands	1774	0.13	7.52	1,849
Cook Islands	Penrhyn	Cook Islands	1788	0.13	6.60	734
Federated States of Micronesia	Pohnpei	Federated States of Micronesia	1689	1.01	7.61	2,021
Puerto Rico	Puerto Rico	United States	1493	5.11	9.12	9,152
Cook Islands	Pukapuka	Cook Islands	1595	0.13	6.29	537
Cook Islands	Rakahanga	Cook Islands	1606	0.13	7.03	1,133
Cook Islands	Rarotonga	Cook Islands	1789	0.13	8.47	4,772
Reunion	Reunion	France - Reunion	1513	3.41	8.73	6,200
Austral Is	Rurutu	France	1769	2.36	9.62	14,995
Netherlands	Saba	Netherlands	1493	3.72	9.25	10,388
Northern Mariana Islands	Saipan	United States	1521	4.4	9.43	12,500
San Andres	San Andres	Colombia		1.93	7.10	1,208
Galapagos Islands	San Cristobal	Ecuador	1535	0	7.44	1,700
Sao Tome and Principe	Sao Tome	Sao Tome and Principe	1495	0	6.20	493
US Virgin Islands	St Croix	United States	1493	1.01	9.38	11,868

Island Group	Island	Country	Year First Sighted By Europeans	Number Centuries As Colony	Log GDP Capita 1990	GDP Per Capita
Netherlands Antilles	St Eustatius	Netherlands	1493	3.75	9.25	10,388
St Helena	St Helena	United Kingdom	1502	3.51	7.82	2,500
US Virgin Islands	St John	United States	1493	1.01	9.80	18,012
St. Kitts and Nevis	St Kitts	St. Kitts and Nevis	1493	3.60	8.27	3,910
St Lucia	St Lucia	St Lucia	1500	4.81	8.01	3,022
Netherlands Antilles	St Martin	Netherlands	1493	3.56	9.13	9,200
US Virgin Islands	St Thomas	United States	1493	1.01	9.55	14,061
St Vincent	St Vincent	St Vincent	1498	2.99	7.50	1,812
Society Is	Tahiti	France	1767	2.08	9.62	14,995
Marquesas	Tahuata	France	1595	0.05	9.62	14,995
Kiribati - Line Islands	Tarawa	Kiribati	1788	0.66	5.98	396
Federated States of Micronesia	Tol	Federated States of Micronesia	1528	1.01	6.90	995
Tonga	Tongatapu	Tonga	1643	0	7.18	1,311
British Virgin Islands	Tortola	United Kingdom	1493	3.56	9.59	14,570
Trinidad and Tobago	Trinidad TTO	Trinidad and Tobago	1498	2.89	8.34	4,171
Tristan da Cunha & Gouh	Tristan da Cunha	United Kingdom	1506	1.88	7.82	2,500
American Samoa (Tutuila Swain)	Tutuila	United States	1787	1.75	8.99	8,000
Federated States of Micronesia	Yap	Federated States of Micronesia	1686	1.01	7.63	2,051
Zanzibar	Zanzibar	Tanzania - Zanzibar	1500	1.13	6.40	600

Appendix IV
GDP By Sector

This is for a subsample of islands in the database. Source is CIA Worldfactbook 2002, which in turn uses both UN Data and national government statistics from the relevant countries.

island	ocean	GDP	Agriculture	Industry	Services
Bermuda	Atlantic	36 B	1%	10%	89%
Grand Cayman	Atlantic	1.27 B.	1%	3%	95%
Jamaica	Atlantic	10.21 B.	6%	24%	70%
Anguilla	Atlantic	104 Mill	4%	18%	78%
New Britain	Pacific	11.4 B.	32%	36%	32%
Majuro	Pacific	115 Mill	14%	16%	70%
Madagascar	Indian	13.02 B.	27%	13%	60%
Mauritius	Indian	13.85 B.	6%	33%	61%
US Virgin Islands	Atlantic	2.4 B.	1%	19%	80%
Sao Tome	Atlantic	200 Mill	25%	10%	65%
Tongatapu	Pacific	236 Mill	26%	12%	62%
Pohnpei	Pacific	277 Mill	50%	4%	46%
Montserrat	Atlantic	29 Mill	5%	14%	81%
New Caledonia	Pacific	3.158 B.	5%	30%	65%
Guam	Pacific	3.2 B.	7%	15%	78%
Cuba	Atlantic	31.59 B.	8%	35%	58%
British Virgin Islands	Atlantic	320 Mill	2%	6%	92%
St Vincent	Atlantic	339 Mill	10%	26%	64%
Dominica	Atlantic	380 Mill	18%	24%	58%
Barbados	Atlantic	4.496 B.	6%	16%	78%
Grenada	Atlantic	440 Mill	8%	24%	68%
Kadavu	Pacific	5.007 B.	17%	22%	61%
Efate	Pacific	563 Mill	26%	12%	62%
Martinique	Atlantic	6.117 B.	6%	11%	83%
Puerto Rico	Atlantic	65.28 B.	1%	42%	57%
Antigua	Atlantic	750 Mill	4%	19%	77%
Tarawa	Pacific	79 Mill	30%	7%	63%
Malaita	Pacific	800 Mill	42%	11%	47%
St Lucia	Atlantic	866 Mill	7%	20%	73%
Reunion	Indian	9.387 B.	8%	19%	73%

Figure 1
GDP Per Capita Versus Years of Colonialism

Circles represent islands in the Atlantic, triangles are islands in the Pacific and squares are islands in the Indian Ocean.

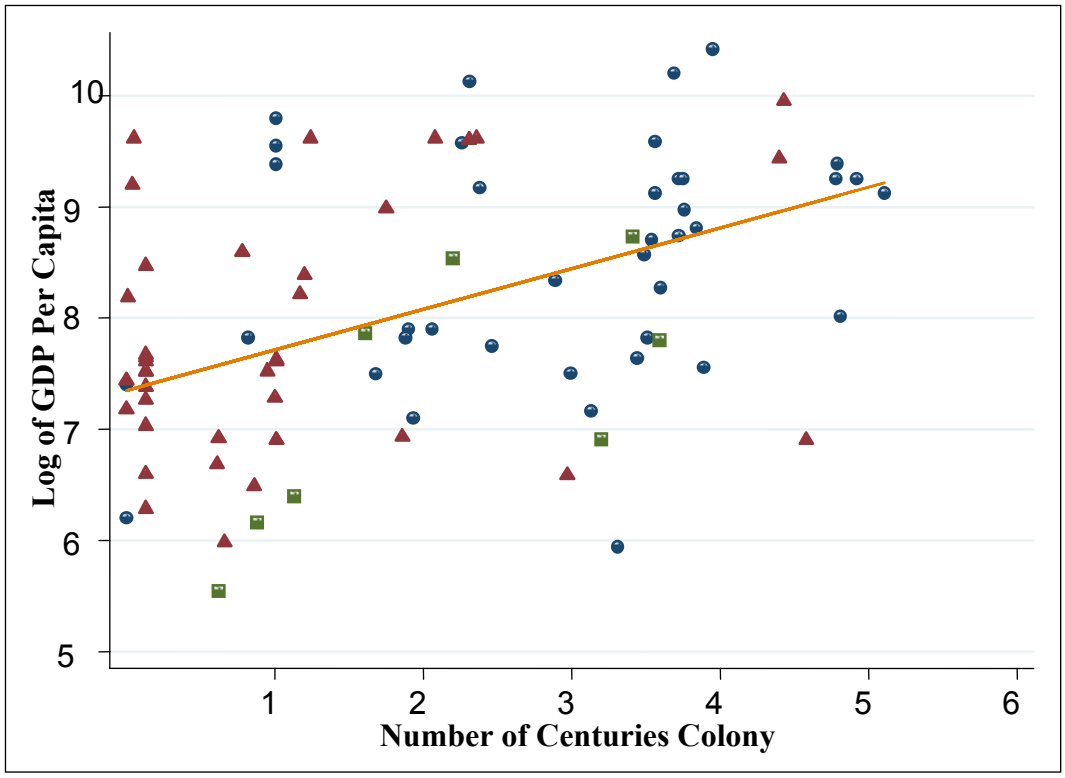

Figure 2
Years of Colonialism Versus Easterly Vector of Wind

Circles represent islands in the Atlantic, triangles are islands in the Pacific and squares are islands in the Indian Ocean.

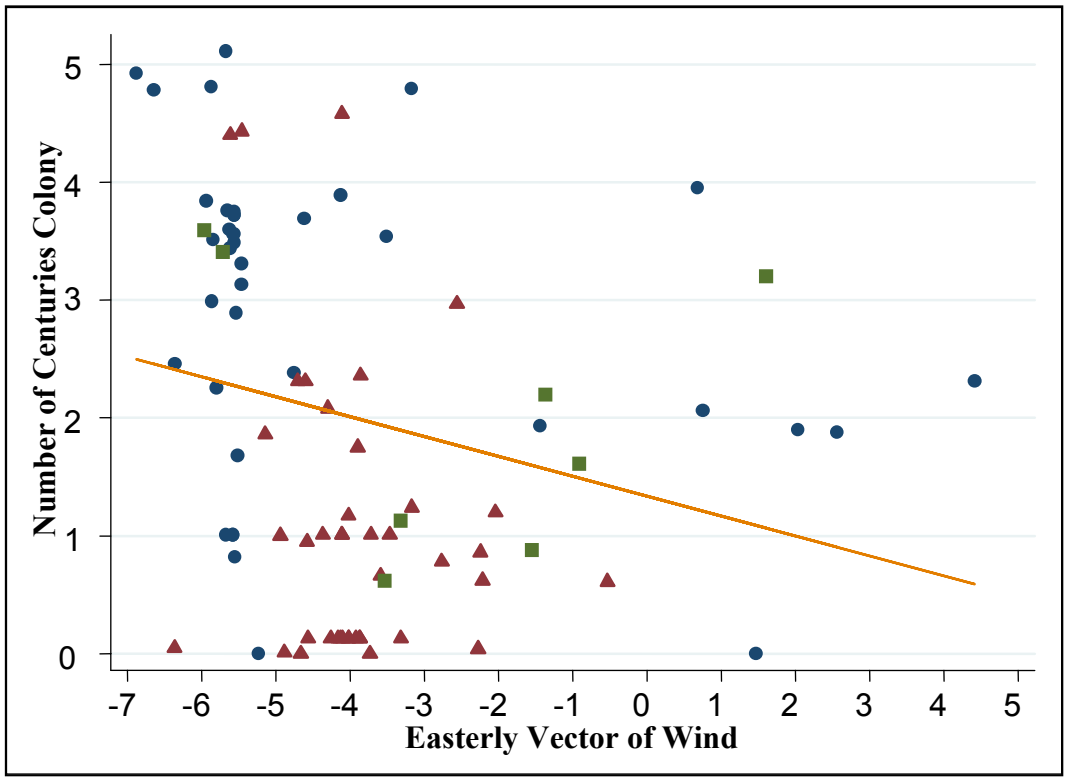

Figure 3
Years of Colonialism Versus Northerly Vector of Wind

Circles represent islands in the Atlantic, triangles are islands in the Pacific and squares are islands in the Indian Ocean.