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REVERSAL OF FORTUNE: GEOGRAPHY AND INSTITUTIONS IN THE MAKING OF THE MODERN WORLD INCOME DISTRIBUTION*

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Among countries colonized by European powers during the past 500 years, those that were relatively rich in 1500 are now relatively poor. We document this reversal using data on urbanization patterns and population density, which, we argue, proxy for economic prosperity. This reversal weighs against a view that links economic development to geographic factors. Instead, we argue that the reversal reflects changes in the institutions resulting from European colonialism. The European intervention appears to have created an "institutional reversal" among these societies, meaning that Europeans were more likely to introduce institutions encouraging investment in regions that were previously poor. This institutional reversal accounts for the reversal in relative incomes. We provide further support for this view by documenting that the reversal in relative incomes took place during the late eighteenth and early nineteenth centuries, and resulted from societies with good institutions taking advantage of the opportunity to industrialize.

I. INTRODUCTION

This paper documents a reversal in relative incomes among the former European colonies. For example, the Mughals in India and the Aztecs and Incas in the Americas were among the richest civilizations in 1500, while the civilizations in North America, New Zealand, and Australia were less developed. Today the United States, Canada, New Zealand, and Australia are an order of magnitude richer than the countries now occupying the territories of the Mughal, Aztec, and Inca Empires.

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Our main measure of economic prosperity in 1500 is urbanization. Bairoch [1988, Ch. 1] and de Vries [1976, p. 164] argue that only areas with high agricultural productivity and a developed transportation network can support large urban populations. In addition, we present evidence that both in the time series and the cross section there is a close association between urbanization and income per capita.[1] As an additional proxy for prosperity we use population density, for which there are relatively more extensive data. Although the theoretical relationship between population density and prosperity is more complex, it seems clear that during preindustrial periods only relatively prosperous areas could support dense populations.

With either measure, there is a negative association between economic prosperity in 1500 and today. Figure I shows a negative relationship between the percent of the population living in towns with more than 5000 inhabitants in 1500 and income per capita today. Figure II shows the same negative relationship between log population density (number of inhabitants per square kilometer) in 1500 and income per capita today. The relationships shown in Figures I and II are robust—they are unchanged when we control for continent dummies, the identity of the colonial power, religion, distance from the equator, temperature, humidity, resources, and whether the country is landlocked, and when we exclude the "neo-Europes" (the United States, Canada, New Zealand, and Australia) from the sample.

This pattern is interesting, in part, because it provides an opportunity to distinguish between a number of competing theories of the determinants of long-run development. One of the most popular theories, which we refer to as the "geography hypothesis," explains most of the differences in economic prosperity by geographic, climatic, or ecological differences across countries. The list of scholars who have emphasized the importance of geographic factors includes, inter alia, Machiavelli [1519], Mon-

1. By economic prosperity or income per capita in 1500, we do not refer to the economic or social conditions or the welfare of the masses, but to a measure of total production in the economy relative to the number of inhabitants. Although urbanization is likely to have been associated with relatively high output per capita, the majority of urban dwellers lived in poverty and died young because of poor sanitary conditions (see, for example, Bairoch [1988, Ch. 12]).

It is also important to note that the Reversal of Fortune refers to changes in relative incomes across different areas, and does not imply that the initial inhabitants of, for example, New Zealand or North America themselves became relatively rich. In fact, much of the native population of these areas did not survive European colonialism.

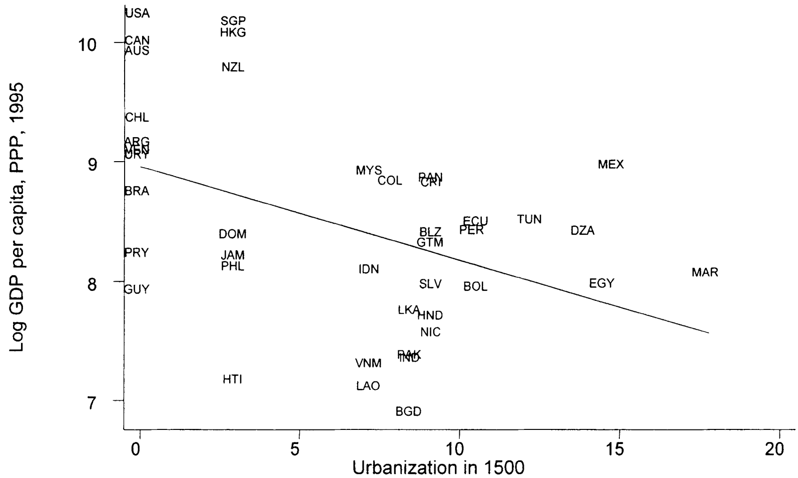

FIGURE I

Log GDP per Capita (PPP) in 1995 against Urbanization Rate in 1500

Note. GDP per capita is from the World Bank [1999]; urbanization in 1500 is people living in towns with more than 5000 inhabitants divided by total population, from Bairoch [1988] and Eggimann [1999]. Details are in Appendices 1 and 2.

tesquieu [1748], Toynbee [1934–1961], Marshall [1890], and Myrdal [1968], and more recently, Diamond [1997] and Sachs [2000, 2001]. The simplest version of the geography hypothesis emphasizes the time-invariant effects of geographic variables, such as climate and disease, on work effort and productivity, and therefore predicts that nations and areas that were relatively rich in 1500 should also be relatively prosperous today. The reversal in relative incomes weighs against this simple version of the geography hypothesis.

More sophisticated versions of this hypothesis focus on the time-varying effects of geography. Certain geographic characteristics that were not useful, or even harmful, for successful economic performance in 1500 may turn out to be beneficial later on. A possible example, which we call "the temperate drift hypothesis," argues that areas in the tropics had an early advantage, but later agricultural technologies, such as the heavy plow, crop rotation systems, domesticated animals, and high-yield crops, have favored countries in the temperate areas (see Bloch [1966], Lewis [1978], and White [1962]; also see Sachs [2001]). Although plausible, the temperate drift hypothesis cannot account for the

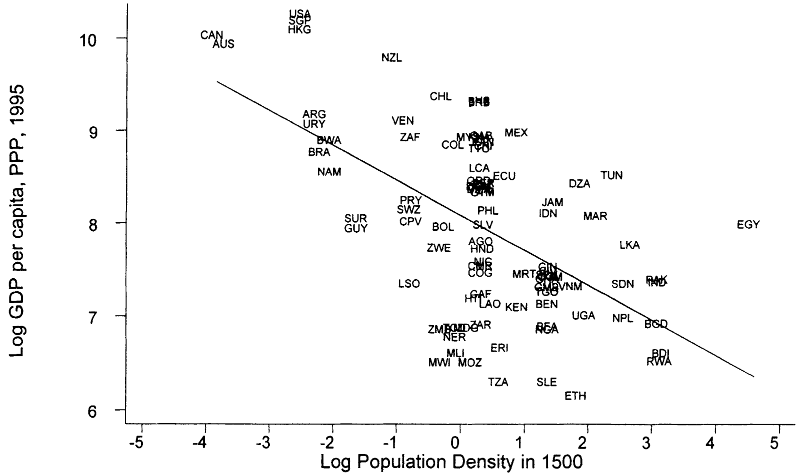

FIGURE II

Log GDP per Capita (PPP) against Log Population Density in 1500

Note. GDP per capita from the World Bank [1999]; log population density in 1500 from McEvedy and Jones [1978]. Details are in Appendix 2.

reversal. First, the reversal in relative incomes seems to be related to population density and prosperity before Europeans arrived, *not* to any inherent geographic characteristics of the area. Furthermore, according to the temperate drift hypothesis, the reversal should have occurred when European agricultural technology spread to the colonies. Yet, while the introduction of European agricultural techniques, at least in North America, took place earlier, the reversal occurred during the late eighteenth and early nineteenth centuries, and is closely related to industrialization. Another version of the sophisticated geography hypothesis could be that certain geographic characteristics, such as the presence of coal reserves or easy access to the sea, facilitated industrialization (e.g., Pomeranz [2000] and Wrigley [1988]). But we do not find any evidence that these geographic factors caused industrialization. Our reading of the evidence therefore provides little support to various sophisticated geography hypotheses either.

An alternative view, which we believe provides the best explanation for the patterns we document, is the "institutions hypothesis," relating differences in economic performance to the organization of society. Societies that provide incentives and opportunities for investment will be richer than those that fail to do so (e.g., North and Thomas [1973], North and Weingast [1989], and Olson [2000]). As we discuss in more detail below, we hypothesize that a cluster of institutions ensuring secure property rights for a broad cross section of society, which we refer to as *institutions of private property,* are essential for investment incentives and successful economic performance. In contrast, *extractive institutions,* which concentrate power in the hands of a small elite and create a high risk of expropriation for the majority of the population, are likely to discourage investment and economic development. Extractive institutions, despite their adverse effects on aggregate performance, may emerge as equilibrium institutions because they increase the rents captured by the groups that hold political power.

How does the institutions hypothesis explain the reversal in relative incomes among the former colonies? The basic idea is that the expansion of European overseas empires starting at the end of the fifteenth century caused major changes in the organization of many of these societies. In fact, historical and econometric evidence suggests that European colonialism caused an "institutional reversal": European colonialism led to the development of institutions of private property in previously poor areas, while introducing extractive institutions or maintaining existing extractive institutions in previously prosperous places.[2] The main reason for the institutional reversal is that relatively poor regions were sparsely populated, and this enabled or induced Europeans to settle in large numbers and develop institutions encouraging investment. In contrast, a large population and relative prosperity made extractive institutions more profitable for the colonizers; for example, the native population could be forced to work in mines and plantations, or taxed by taking over existing tax and tribute systems. The expansion of European overseas empires, combined with the institutional reversal, is consistent with the reversal in relative incomes since 1500.

Is the reversal related to institutions? We document that the reversal in relative incomes from 1500 to today can be explained,

2. By the term "institutional reversal," we do not imply that it was societies with good institutions that ended up with extractive institutions after European colonialism. First, there is no presumption that relatively prosperous societies in 1500 had anything resembling institutions of private property. In fact, their relative prosperity most likely reflected other factors, and even perhaps geographic factors. Second, the institutional reversal may have resulted more from the emergence of institutions of private property in previously poor areas than from a deterioration in the institutions of previously rich areas.

at least statistically, by differences in institutions across countries. The institutions hypothesis also suggests that institutional differences should matter more when new technologies that require investments from a broad cross section of the society become available. We therefore expect societies with good institutions to take advantage of the opportunity to industrialize, while societies with extractive institutions fail to do so. The data support this prediction.

We are unaware of any other work that has noticed or documented this change in the distribution of economic prosperity. Nevertheless, many historians emphasize that in 1500 the Mughal, Ottoman, and Chinese Empires were highly prosperous, but grew slowly during the next 500 years (see the discussion and references in Section III).

Our overall interpretation of comparative development in the former colonies is closely related to Coatsworth [1993] and Engerman and Sokoloff [1997, 2000], who emphasize the adverse effects of the plantation complex in the Caribbean and Central America working through political and economic inequality,[3] and to our previous paper, Acemoglu, Johnson, and Robinson [2001a]. In that paper we proposed the disease environment at the time Europeans arrived as an instrument for European settlements and the subsequent institutional development of the former colonies, and used this to estimate the causal effect of institutional differences on economic performance. Our thesis in the current paper is related, but emphasizes the influence of population density and prosperity on the policies pursued by the Europeans (see also Engerman and Sokoloff [1997]). In addition, here we document the reversal in relative incomes among the former colonies, show that it was related to industrialization, and provide evidence that the interaction between institutions and the opportunity to industrialize during the nineteenth century played a central role in the long-run development of the former colonies.[4]

3. In this context, see also Frank [1978], Rodney [1972], Wallerstein [1974–1980], and Williams [1944].

4. Our results are also relevant to the literature on the relationship between population and growth. The recent consensus is that population density encourages the discovery and exchange of ideas, and contributes to growth (e.g., Boserup [1965], Jones [1997], Kremer [1993], Kuznets [1968], Romer [1986], and Simon [1977]). Our evidence points to a major historical episode of 500 years where high population density was detrimental to economic development, and therefore sheds doubt on the general applicability of this recent consensus.

The rest of the paper is organized as follows. The next section discusses the construction of urbanization and population density data, and provides evidence that these are good proxies for economic prosperity. Section III documents the "Reversal of Fortune"—the negative relationship between economic prosperity in 1500 and income per capita today among the former colonies. Section IV discusses why the simple and sophisticated geography hypotheses cannot explain this pattern, and how the institutions hypothesis explains the reversal. Section V documents that the reversal in relative incomes reflects the institutional reversal caused by European colonialism, and that institutions started playing a more important role during the age of industry. Section VI concludes.

II. Urbanization and Population Density

II.A. Data on Urbanization

Bairoch [1988] provides the best single collection and assessment of urbanization estimates. Our base data for 1500 consist of Bairoch's [1988] urbanization estimates augmented by the work of Eggimann [1999]. Merging the Eggimann and Bairoch series requires us to convert Eggimann's estimates, which are based on a minimum population threshold of 20,000, into Bairoch-equivalent urbanization estimates, which use a minimum population threshold of 5000. We use a number of different methods to convert between the two sets of estimates, all with similar results. Appendix 1 provides details about data sources and construction. Briefly, for our base estimates, we run a regression of Bairoch estimates on Eggimann estimates for all countries where they overlap in 1900 (the year for which we have most Bairoch estimates for non-European countries). This regression yields a constant of 6.6 and a coefficient of 0.67, which we use to generate Bairoch-equivalent urbanization estimates from Eggimann's estimates.

Alternatively, we converted the Eggimann's numbers using a uniform conversion rate of 2 as suggested by Davis' and Zipf's Laws (see Appendix 1 and Bairoch [1988, Ch. 9]), and also tested the robustness of the estimates using conversion ratios at the regional level based on Bairoch's analysis. Finally, we constructed three alternative series without combining estimates from different sources. One of these is based on Bairoch, the second on Eggimann, and the third on Chandler [1987]. All four alternative series are reported in Appendix 3, and results using these measures are reported in Table IV.

While the data on sub-Saharan Africa are worse than for any other region, it is clear that urbanization in sub-Saharan Africa before 1500 was at a higher level than in North America or Australia. Bairoch, for example, argues that by 1500 urbanization was "well-established" in sub-Saharan Africa.[5] Because there are no detailed urbanization data for sub-Saharan Africa, we leave this region out of the regression analysis when we use urbanization data, although African countries are included in our regressions using population density.

Table I gives descriptive statistics for the key variables of interest, separately for the whole world, for the sample of ex-colonies for which we have urbanization data in 1500, and for the sample of ex-colonies for which we have population density data in 1500. Appendix 2 gives detailed definitions and sources for the variables used in this study.

II.B. Urbanization and Income

There are good reasons to presume that urbanization and income are positively related. Kuznets [1968, p. 1] opens his book on economic growth by stating: "we identify the economic growth of nations as a sustained increase in per-capita or per-worker product, most often accompanied by an increase in population and usually by sweeping structural changes. . . . in the distribution of population between the countryside and the cities, the process of urbanization."

Bairoch [1988] points out that during preindustrial periods a large fraction of the agricultural surplus was likely to be spent on transportation, so both a relatively high agricultural surplus and a developed transport system were necessary for large urban populations (see Bairoch [1988, Ch. 1]). He argues "the existence of true urban centers presupposes not only a surplus of agricul-

5. Sahelian trading cities such as Timbuktu, Gao, and Djenne (all in modern Mali) were very large in the middle ages with populations as high as 80,000. Kano (in modern Nigeria) had a population of 30,000 in the early nineteenth century, and Yorubaland (also in Nigeria) was highly urbanized with a dozen towns with populations of over 20,000 while its capital Ibadan possibly had 70,000 inhabitants. For these numbers and more detail, see Hopkins [1973, Ch. 2].

TABLE I
DESCRIPTIVE STATISTICS

	Whole world (1)	Base sample for urbanization (2)	Base sample for population density (3)	Below median urbanization in 1500 (4)	Above median urbanization in 1500 (5)	Below median population density in 1500 (6)	Above median population density in 1500 (7)
Log GDP per capita (PPP) in 1995	8.3	8.5	7.9	8.8	8.1	8.3	7.5
	(1.1)	(0.9)	(1.0)				
Urbanization in 1995	53.0	57.5	45.4	64.9	49.7	53.5	36.7
	(23.8)	(22.4)	(22.2)				
Urbanization in 1500	7.3	6.4	6.4	2.4	10.5	2.3	9.5
	(5.0)	(5.0)	(5.0)				
Log population density in 1500	1.0	0.2	0.5	−0.9	1.4	−0.6	1.6
	(1.6)	(1.9)	(1.5)				
Population density in 1500	9.2	6.3	4.8	1.2	11.7	0.8	9.1
	(24.3)	(16.4)	(11.7)				
Log population density in 1000	0.6	0.11	0.08	−1.20	1.22	−0.94	1.04
	(1.5)	(2.0)	(1.5)				
Average protection against expropriation, 1985–1995	7.1	6.9	6.5	7.5	6.3	6.8	6.2
	(1.8)	(1.5)	(1.4)				
Constraint on the executive in 1990	3.6	4.9	3.7	5.1	4.6	4.0	3.5
	(2.3)	(2.1)	(2.3)				
Constraint on the executive in first year of independence	3.6	3.3	3.4	3.8	2.8	3.6	3.3
	(2.4)	(2.5)	(2.3)				
European settlements in 1900	29.6	23.2	12.5	30.5	6.0	18.7	4.7
	(41.7)	(28.7)	(22.1)				
Number of observations	162	41	91	21	20	47	44

Standard deviations are in parentheses. Number of observations varies across rows due to missing data. The first three columns report mean values for the sample indicated at the head of the column. The last four columns report mean values for former colonies below and above the median, separately for the base urbanization and population density samples. For detailed sources and descriptions see Appendix 2.

tural produce, but also the possibility of using this surplus in trade" [p. 11].[6] See de Vries [1976, p. 164] for a similar argument.

We supplement this argument by empirically investigating the link between urbanization and income in Table II. Columns (1)–(6) present cross-sectional regressions. Column (1) is for 1900, the earliest date for which we have data on urbanization and income per capita for a large number of countries. The regression coefficient, 0.038, is highly significant, with a standard error of 0.006. It implies that a country with 10 percentage points higher urbanization has, on average, 46 percent (38 log points) greater income per capita (throughout the paper, all urbanization rates are expressed in percentage points, e.g., 10 rather than 0.1—see Table I). Column (2) reports a similar result using data for 1950. Column (3) uses current data and shows that even today there is a strong relationship between income per capita and urbanization for a large sample of countries. The coefficient is similar, 0.036, and precisely estimated, with a standard error of 0.002. This relationship is shown diagrammatically in Figure III.

Below, we draw a distinction between countries colonized by Europeans and those never colonized (i.e., Europe and non-European countries not colonized by Western Europe). Columns (4) and (5) report the same regression separately for these two samples. The estimates are very similar: 0.037 for the former colonies sample, and 0.033 for the rest of the countries. Finally, in column (6) we add continent dummies to the same regression. This leads to only a slightly smaller coefficient of 0.030, with a standard error of 0.002.

Finally, we use estimates from Bairoch [1978, 1988] to construct a small unbalanced panel data set of urbanization and income per capita from 1750 to 1913. Column (7) reports a re-

6. The view that urbanization and income (productivity) are closely related is shared by many other scholars. See Ades and Glaeser [1999], De Long and Shleifer [1993], Tilly and Blockmans [1994], and Tilly [1990]. De Long and Shleifer, for example, write "The larger preindustrial cities were nodes of information, industry, and exchange in areas where the growth of agricultural productivity and economic specialization had advanced far enough to support them. They could not exist without a productive countryside and a flourishing trade network. The population of Europe's preindustrial cities is a rough indicator of economic prosperity" [p. 675].

A large history literature also documents how urbanization accelerated in Europe during periods of economic expansion (e.g., Duby [1974], Pirenne [1956], and Postan and Rich [1966]). For example, the period between the beginning of the eleventh and mid-fourteenth centuries is an era of rapid increase in agricultural productivity and industrial output. The same period also witnessed a proliferation of cities. Bairoch [1988], for example, estimates that the number of cities with more than 20,000 inhabitants increased from around 43 in 1000 to 107 in 1500 [Table 10.2, p. 159].

TABLE II
URBANIZATION AND PER CAPITA INCOME

	Cross-sectional regression in 1913, all countries (1)	Cross-sectional regression in 1950, all countries (2)	Cross-sectional regression in 1995, all countries (3)	Cross-sectional regression in 1995, only for ex-colonies (4)	Cross-sectional regression in 1995, never colonized countries only (5)	Cross-sectional regression in 1995, all countries, with continent dummies (6)	Panel data set through 1913 (7)
	Dependent variable is log GDP per capita						
Urbanization	0.038	0.026	0.036	0.037	0.033	0.030	0.026
	(0.006)	(0.002)	(0.002)	(0.003)	(0.007)	(0.002)	(0.004)
R^2	0.69	0.57	0.63	0.69	0.34	0.68	0.93
Number of observations	22	128	162	93	51	162	55

Standard errors are in parentheses. Log GDP per capita through 1913 is from Bairoch [1978]. Urbanization is percent of population living in towns with at least 5000 people, from Bairoch [1988] through 1900 with supplementary sources as described in Appendix 1. Log GDP per capita in 1950 is from Maddison [1995]; this regression uses urbanization in 1960 from the World Bank's *World Development Indicators* [1999]. Log GDP per capita (PPP) and Urbanization data for 1995 are from the World Bank's *World Development Indicators* [1999]. Population density is total population divided by arable land area, both from McEvedy and Jones [1978]. For detailed sources and descriptions see Appendix 2.

The countries and approximate years for which we have data (used in the unbalanced panel regression in column (7)) are Australia (1830, 1860, and 1913), Austria (1830, 1860, 1913), Belgium (1830, 1860, 1913), Britain (1750, 1830, 1860, 1913), Bulgaria (1860, 1913), Canada (1830, 1860, 1913), China (1830, 1860), Denmark (1830, 1860, 1913), Finland (1830, 1860, 1913), France (1750, 1830, 1860, 1913), Germany (1830, 1860, 1913), Greece (1860, 1913), India (1830, 1913), Italy (1830, 1860, 1913), Jamaica (1830, 1913), Japan (1750, 1830, 1913), Netherlands (1830, 1860, 1913), Norway (1830, 1860, 1913), Portugal (1830, 1860, 1913), Romania (1830, 1860, 1913), Russia (1750, 1830, 1860, 1913), Spain (1830, 1860, 1913), Sweden (1830, 1860, 1913), Switzerland (1830, 1860, 1913), United States (1750, 1830, 1860, 1913), and Yugoslavia (1830, 1860, 1913).

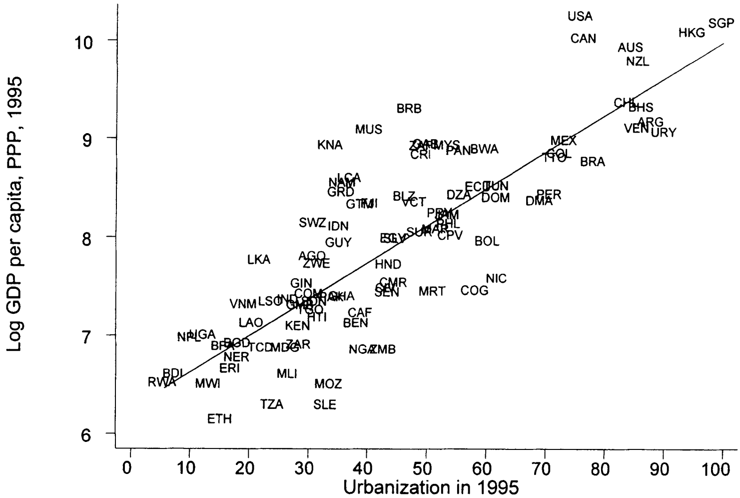

FIGURE III

Log GDP per Capita (PPP) in 1995 against the Urbanization Rate in 1995

Note. GDP per capita and urbanization are from the World Bank [1999]. Urbanization is percent of population living in urban areas. The definition of urban areas differs between countries, but the usual minimum size is 2000–5000 inhabitants. For details of definitions and sources for urban population in 1995, see the United Nations [1998].

gression of income per capita on urbanization using this panel data set and controlling for country and period dummies. The estimate is again similar: 0.026 (s.e. = 0.004). Overall, we conclude that urbanization is a good proxy for income.

II.C. Population Density and Income

The most comprehensive data on population since 1 A.D. come from McEvedy and Jones [1978]. They provide estimates based on censuses and published secondary sources. While some individual country numbers have since been revised and others remain contentious (particularly for pre-Columbian Meso-America), their estimates are consistent with more recent research (see, for example, the recent assessment by the Bureau of the Census, www.census.gov/ipc/www/worldhis.html). We use McEvedy and Jones [1978] for our baseline estimates, and test the effect of using alternative assumptions (e.g., lower or higher population estimates for Mexico and its neighbors before the arrival of Cortes).

We calculate population density by dividing total population by arable land (also estimated by McEvedy and Jones). This excludes primarily desert, inland water, and tundra. As much as possible, we use the land area of a country at the date we are considering.

The theoretical relationship between population density and income is more nuanced than that between urbanization and income. With a similar reasoning, it seems natural to think that only relatively rich areas could afford dense populations (see Bairoch [1988, Ch. 1]). This is also in line with Malthus' classic work. Malthus [1798] argued that high productivity increases population by raising birthrates and lowering death rates. However, the main thrust of Malthus' work was how a higher than equilibrium level of population increases death rates and reduces birthrates to correct itself.[7] A high population could therefore be reflecting an "excess" of population, causing low income per capita. So caution is required in interpreting population density as a proxy for income per capita.

The empirical evidence regarding the relationship between population density and income is also less clear-cut than the relationship between urbanization and income. In Acemoglu, Johnson, and Robinson [2001b] we documented that population density and income per capita increased concurrently in many instances. Nevertheless, there is no similar cross-sectional relationship in recent data, most likely because of the demographic transition—it is no longer true that high population density is associated with high income per capita because the relationship between income and the number of children has changed (e.g., Notestein [1945] or Livi-Bacci [2001]).

Despite these reservations, we present results using population density, as well as urbanization, as a proxy for income per capita. This is motivated by three considerations. First, population density data are more extensive, so the use of population density data is a useful check on our results using urbanization data. Second, as argued by Bairoch, population density is closely

7. A common interpretation of Malthus' argument is that these population dynamics will force all countries down to the subsistence level of income. In that case, population density would be a measure of total income, but not necessarily of income per capita, and in fact, there would be no systematic (long-run) differences in income per capita across countries. We view this interpretation as extreme, and existing historical evidence suggests that there were systematic differences in income per capita between different regions even before the modern period (see the references below).

related to urbanization, and in fact, our measures are highly correlated. Third, variation in population density will play an important role not only in documenting the reversal, but also in explaining it.

III. The Reversal of Fortune

III.A. Results with Urbanization

This section presents our main results. Figure I in the introduction depicts the relationship between urbanization 1500 and income per capita today. Table III reports regressions documenting the same relationship. Column (1) is our most parsimonious specification, regressing log income per capita in 1995 (PPP basis) on urbanization rates in 1500 for our sample of former colonies. The coefficient is -0.078 with a standard error of 0.026.[8] This coefficient implies that a 10 percentage point lower urbanization in 1500 is associated with approximately twice as high GDP per capita today (78 log points $\approx$ 108 percent). It is important to note that this is not simply mean reversion—i.e., richer than average countries reverting back to the mean. It is a *reversal.* To illustrate this, let us compare Uruguay and Guatemala. The native population in Uruguay had no urbanization, while, according to our baseline estimates Guatemala had an urbanization rate of 9.2 percent. The estimate in column (1) of Table II, 0.038, for the relationship between income and urbanization implies that Guatemala at the time was approximately 42 percent richer than Uruguay ($\exp(0.038 \times 9.2) - 1 \approx 0.42$). According to our estimate in column (1) of Table III, we expect Uruguay today to be 105 percent richer than Guatemala ($\exp(0.078 \times 9.2) - 1 \approx 1.05$), which is approximately the current difference in income per capita between these two countries.[9]

The second column of Table III excludes North African countries for which data quality may be lower. The result is un-

8. Because China was never a formal colony, we do not include it in our sample of ex-colonies. Adding China does not affect our results. For example, with China, the baseline estimate changes from -0.078 (s.e. = 0.026) to -0.079 (s.e. = 0.025). Furthermore, our sample excludes countries that were colonized by European powers briefly during the twentieth century, such as Iran, Saudi Arabia, and Syria. If we include these observations, the results are essentially unchanged. For example, the baseline estimate changes to -0.072 (s.e. = 0.024).

9. Interestingly, these calculations suggest that not only have relative rankings reversed since 1500, but income differences are now much larger than in 1500.

changed, with a coefficient of -0.101 and standard error of 0.032. Column (3) drops the Americas, which increases both the coefficient and the standard error, but the estimate remains highly significant. Column (4) reports the results just for the Americas, where the relationship is somewhat weaker but still significant at the 8 percent level. Column (5) adds continent dummies to check whether the relationship is being driven by differences across continents. Although continent dummies are jointly significant, the coefficient on urbanization in 1500 is unaffected—it is -0.083 with a standard error of 0.030.

One might also be concerned that the relationship is being driven mainly by the neo-Europes: United States, Canada, New Zealand, and Australia. These countries are settler colonies built on lands that were inhabited by relatively undeveloped civilizations. Although the contrast between the development experiences of these areas and the relatively advanced civilizations of India or Central America is of central importance to the reversal and to our story, one would like to know whether there is anything more than this contrast in the results of Table III. In column (6) we drop these observations. The relationship is now weaker, but still negative and statistically significant at the 7 percent level.

In column (7) we control for distance from the equator (the absolute value of latitude), which does not affect the pattern of the reversal—the coefficient on urbanization in 1500 is now -0.072 instead of -0.078 in our baseline specification. Distance from the equator is itself insignificant. Column (8), in turn, controls for a variety of geography variables that represent the effect of climate, such as measures of temperature, humidity, and soil type, with little effect on the relationship between urbanization in 1500 and income per capita today. The R^2 of the regression increases substantially, but this simply reflects the addition of sixteen new variables to this regression (the adjusted R^2 increases only slightly, to 0.27).

In column (9) we control for a variety of "resources" which may have been important for post-1500 development. These include dummies for being an island, for being landlocked, and for having coal reserves and a variety of other natural resources (see Appendix 2 for detailed definitions and sources). Access to the sea may have become more important with the rise of trade, and availability of coal or other natural resources may have different effects at different points in time. Once again, the addition of these variables has no effect on the pattern of the reversal.

TABLE III
URBANIZATION IN 1500 AND GDP PER CAPITA IN 1995 FOR FORMER EUROPEAN COLONIES

	Dependent variable is log GDP per capita (PPP) in 1995										
	Base sample (1)	Without North Africa (2)	Without the Americas (3)	Just the Americas (4)	With continent dummies (5)	Without neo-Europes (6)	Controlling for latitude (7)	Controlling for climate (8)	Controlling for resources (9)	Controlling for colonial origin (10)	Controlling for religion (11)
Urbanization in 1500	−0.078 (0.026)	−0.101 (0.032)	−0.115 (0.051)	−0.053 (0.029)	−0.083 (0.030)	−0.046 (0.026)	−0.072 (0.025)	−0.088 (0.030)	−0.058 (0.029)	−0.071 (0.028)	−0.060 (0.033)
Asia dummy					−1.33 (0.61)						
Africa dummy					−0.53 (0.77)						
America dummy					−0.96 (0.57)						
Latitude							1.42 (0.92)				
P-value for temperature								[0.51]			
P-value for humidity								[0.40]			
P-value for soil quality								[0.96]			
P-value for resources									[0.16]		

Landlocked									−0.54		
									(0.48)		
Island									0.27		
									(0.33)		
Coal									0.11		
									(0.28)		
Former French colony										−0.59	
										(0.39)	
Former Spanish colony										0.06	
										(0.29)	
P-value for religion											[0.47]
R^2	0.19	0.22	0.26	0.13	0.32	0.09	0.24	0.53	0.45	0.27	0.25
Number of observations	41	37	17	24	41	37	41	41	41	41	41

Standard errors are in parentheses. P-values from F-tests for joint significance are in square brackets. Dependent variable is log GDP per capita (PPP) in 1995. Base sample is all former colonies for which we have data. Urbanization in 1500 is percent of the population living in towns with 5000 or more inhabitants. The regression that includes continent dummies has Oceania as the base category. The neo-Europes are the United States, Canada, Australia, and New Zealand.

In the "climate" regression we include five measures of temperature, four measures of humidity, and seven measures of soil quality. In the "resources" regression we include reserves of gold, iron, zinc, silver, and oil. Coal is a dummy for the presence of coal, landlocked is a dummy for not having access to the sea, and island is a dummy for being an island. The regression that controls for colonial origin includes dummies for former French colony, Spanish colony, Portuguese colony, Belgian colony, Italian colony, German colony, and Dutch colony. British colonies are the base category. The religion variables are percent of the population who are Muslim, Catholic, and "other"; percent Protestant is the base category. For detailed sources and descriptions see Appendix 2.

Finally, in columns (10) and (11) we add the identity of the colonial power and religion, which also have little effect on our estimate, and are themselves insignificant.

The urbanization variable used in Table III relies on work by Bairoch and Eggimann. In Table IV we use data from Bairoch and Eggimann separately, as well as data from Chandler, who provided the starting point for Bairoch's data. We report a subset of the regressions from Table III using these three different series and an alternative series using the Davis-Zipf adjustment to convert Eggimann's estimates into Bairoch-equivalent numbers (explained in Appendix 1). The results are very similar to the baseline estimates reported in Table III: in all cases, there is a negative relationship between urbanization in 1500 and income per capita today, and in almost all cases, this relationship is statistically significant at the 5 percent level (the full set of results are reported in Acemoglu, Johnson, and Robinson [2001b]).

III.B. Results with Population Density

In Panel A of Table V we regress income per capita today on log population density in 1500, and also include data for sub-Saharan Africa. The results are similar to those in Table IV (also see Figure II). In all specifications we find that countries with higher population density in 1500 are substantially poorer today. The coefficient of -0.38 in column (1) implies that a 10 percent higher population density in 1500 is associated with a 4 percent lower income per capita today. For example, the area now corresponding to Bolivia was seven times more densely settled than the area corresponding to Argentina; so on the basis of this regression, we expect Argentina to be three times as rich as Bolivia, which is more or less the current gap in income between these countries.[10]

The remaining columns perform robustness checks, and show that including a variety of controls for geography and resources, the identity of the colonial power, religion variables, or dropping the Americas, the neo-Europes, or North Africa has very

10. The magnitudes implied by the estimates in this table are similar to those implied by the estimates in Table III. For example, the difference in the urbanization rate between an average high and low urbanization country in 1500 is 8.1 (see columns (4) and (5) in Table I), which using the coefficient of -0.078 from Table III translates into a $0.078 \times 8.1 \approx 0.63$ log points difference in current GDP. The difference in log population density between an average high-density and low-density country in 1500 is 2.2 (see columns (6) and (7) in Table I), which translates into a $0.38 \times 2.2 \approx 0.84$ log points difference in current GDP.

TABLE IV
ALTERNATIVE MEASURES OF URBANIZATION

	Dependent variable is log GDP per capita (PPP) in 1995				
	Base sample (1)	With continent dummies (2)	Without neo-Europes (3)	Controlling for latitude (4)	Controlling for resources (5)
Panel A: Using our base sample measure of urbanization					
Urbanization in 1500	−0.078	−0.083	−0.046	−0.072	−0.058
	(0.026)	(0.030)	(0.026)	(0.025)	(0.029)
R^2	0.19	0.32	0.09	0.24	0.45
Number of observations	41	41	37	41	41
Panel B: Using only Bairoch's estimates					
Urbanization in 1500	−0.126	−0.107	−0.089	−0.116	−0.092
	(0.032)	(0.034)	(0.033)	(0.036)	(0.037)
R^2	0.30	0.37	0.19	0.31	0.49
Number of observations	37	37	33	37	37
Panel C: Using only Eggimann's estimates					
Urbanization in 1500	−0.041	−0.043	−0.022	−0.036	−0.022
	(0.019)	(0.019)	(0.018)	(0.019)	(0.023)
R^2	0.10	0.28	0.04	0.16	0.39
Number of observations	41	41	37	41	41
Panel D: Using only Chandler's estimates					
Urbanization in 1500	−0.057	−0.072	−0.040	−0.054	−0.049
	(0.019)	(0.021)	(0.019)	(0.019)	(0.025)
R^2	0.27	0.43	0.17	0.34	0.66
Number of observations	26	26	23	26	26
Panel E: Using Davis-Zipf Adjustment for Eggimann's series					
Urbanization in 1500	−0.039	−0.048	−0.024	−0.040	−0.031
	(0.015)	(0.020)	(0.014)	(0.015)	(0.017)
R^2	0.14	0.30	0.08	0.23	0.44
Number of observations	41	41	37	41	41

Standard errors are in parentheses. Dependent variable is log GDP per capita (PPP) in 1995. Base sample is all former colonies for which we have data. Urbanization in 1500 is percent of the population living in towns with 5000 or more people. In Panels B, C, D, and E, we use, respectively, Bairoch's estimates, Eggimann's estimates, Chandler's estimates, and a conversion of Eggimann's estimates into Bairoch-equivalent numbers using the Davis-Zipf adjustment. Eggimann's estimates (Panel C) and Chandler's estimates (Panel D) are not converted to Bairoch-equivalent units. The continent dummies, neo-Europes, and resources measures are as described in the note to Table III. For detailed sources and descriptions see Appendix 2. The alternative urbanization series are shown in Appendix 3.

little effect on the results. In all cases, log population density in 1500 is significant at the 1 percent level (although now some of the controls, such as the humidity dummies, are also significant).

TABLE V
POPULATION DENSITY AND GDP PER CAPITA IN FORMER EUROPEAN COLONIES

	Dependent variable is log GDP per capita (PPP) in 1995										
	Base sample (1)	Without Africa (2)	Without the Americas (3)	Just the Americas (4)	With continent dummies (5)	Without neo-Europes (6)	Controlling for latitude (7)	Controlling for climate (8)	Controlling for resources (9)	Controlling for colonial origin (10)	Controlling for religion (11)
Panel A: Log population density in 1500 as independent variable											
Log population density in 1500	−0.38 (0.06)	−0.40 (0.05)	−0.32 (0.07)	−0.25 (0.09)	−0.26 (0.05)	−0.32 (0.06)	−0.33 (0.06)	−0.31 (0.06)	−0.30 (0.06)	−0.32 (0.06)	−0.37 (0.07)
Asia dummy					−0.91 (0.55)						
Africa dummy					−1.67 (0.52)						
America dummy					−0.69 (0.51)						
Latitude							2.09 (0.74)				
P-value for temperature								[0.18]			
P-value for humidity								[0.00]			
P-value for soil quality								[0.10]			
P-value for natural resources									[0.34]		
Landlocked									−0.58 (0.23)		
Island									0.62 (0.23)		

Coal									0.01		
									(0.19)		
Former French colony										−0.48	
										(0.20)	
Former Spanish colony										0.25	
										(0.22)	
P-value for religion											[0.73]
R^2	0.34	0.55	0.27	0.22	0.56	0.24	0.40	0.59	0.54	0.48	0.36
Number of observations	91	47	58	33	91	87	91	90	85	91	85
Panel B: Log population and log land in 1500 as separate independent variables											
Log population in 1500	−0.34	−0.30	−0.32	−0.13	−0.23	−0.27	−0.29	−0.27	−0.27	−0.28	−0.31
	(0.05)	(0.05)	(0.07)	(0.07)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)
Log arable land in 1500	0.26	0.27	0.21	0.16	0.18	0.15	0.20	0.20	0.08	0.21	0.24
	(0.06)	(0.06)	(0.09)	(0.06)	(0.05)	(0.06)	(0.06)	(0.06)	(0.07)	(0.06)	(0.07)
R^2	0.35	0.45	0.31	0.17	0.55	0.31	0.41	0.59	0.55	0.47	0.36
Number of observations	91	47	58	33	91	87	91	90	85	91	85
Panel C: Using population density in 1000 A.D. as an instrument for population density in 1500 A.D.											
Log population density in 1500	−0.31	−0.4	−0.15	−0.38	−0.18	−0.22	−0.27	−0.26	−0.22	−0.26	−0.25
	(0.06)	(0.06)	(0.08)	(0.11)	(0.07)	(0.08)	(0.06)	(0.07)	(0.07)	(0.06)	(0.08)
Number of observations	83	43	51	32	83	80	83	83	78	83	77

Standard errors are in parentheses. P-values from F-tests for joint significance are in square brackets. Dependent variable is log GDP per capita (PPP) in 1995. Base sample is all former colonies for which we have data. Population density in 1500 is total population divided by arable land area. See Table III for an explanation of the sample and covariates in each column. For detailed sources and descriptions see Appendix 2.

The estimates in the top panel of Table V use variation in population density, which reflects two components: differences in population and differences in arable land area. In Panel B we separate the effects of these two components and find that they come in with equal and opposite signs, showing that the specification with population density is appropriate. In Panel C we use population density in 1000 as an instrument for population density in 1500. This is useful since, as discussed in subsection II.C, differences in long-run population density are likely to be better proxies for income per capita. Instrumenting for population density in 1500 with population density in 1000 isolates the long-run component of population density differences across countries (i.e., the component of population density in 1500 that is correlated with population density in 1000). The Two-Stage Least Squares (2SLS) results in Panel C using this instrumental variables strategy are very similar to the OLS results in Panel A.

III.C. Further Results, Robustness Checks, and Discussion

Caution is required in interpreting the results presented in Tables III, IV, and V. Estimates of urbanization and population in 1500 are likely to be error-ridden. Nevertheless, the first effect of measurement error would be to create an attenuation bias toward 0. Therefore, one might think that the negative coefficients in Tables III, IV, and V are, if anything, underestimates. A more serious problem would be if errors in the urbanization and population density estimates were not random, but correlated with current income in some systematic way. We investigate this issue further in Table VI, using a variety of different estimates for urbanization and population density. Columns (1)–(5), for example, show that the results are robust to a variety of modifications to the urbanization data.

Much of the variation in urbanization and population density in 1500 was not at the level of these countries, but at the level of "civilizations." For example, in 1500 there were fewer separate civilizations in the Americas, and even arguably in Asia, than there are countries today. For this reason, in column (6) we repeat our key regressions using variation in urbanization and population density only among fourteen civilizations (based on Toynbee [1934–1961] and McNeill [1999]—see the note to Table VI). The results confirm our basic findings, and show a statistically significant negative relationship between prosperity in 1500 and today. Columns (7) and (8) report robustness checks using variants of the population density data constructed under different assumptions, again with very similar results.

Is there a similar reversal among the noncolonies? Column (9) reports a regression of log GDP per capita in 1995 on urbanization in 1500 for all noncolonies (including Europe), and column (10) reports the same regression for Europe (including Eastern Europe). In both cases, there is a *positive* relationship between urbanization in 1500 and income today.[11] This suggests that the reversal reflects an unusual event, and is likely to be related to the effect of European colonialism on these societies.

Panel B of Table VI reports results weighted by population in 1500, with very similar results. In Panel C we include urbanization and population density simultaneously in these regressions. In all cases, population density is negative and highly significant, while urbanization is insignificant. This is consistent with the notion, discussed below, that differences in population density played a key role in the reversal in relative incomes among the colonies (although it may also reflect measurement error in the urbanization estimates).

As a final strategy to deal with the measurement error in urbanization, we use log population density as an instrument for urbanization rates in 1500. When both of these are valid proxies for economic prosperity in 1500 and the measurement error is classical, this procedure corrects for the measurement error problem. Not surprisingly, these instrumental-variables estimates reported in the bottom panel of Table VI are considerably larger than the OLS estimates in Table III. For example, the baseline estimate is now -0.18 instead of -0.08 in Table III. The general pattern of reversal in relative incomes is unchanged, however.

Is the reversal shown in Figures I and II and Tables III, IV, and V consistent with other evidence? The literature on the history of civilizations documents that 500 years ago many parts of Asia were highly prosperous (perhaps as prosperous as Western Europe), and civilizations in Meso-America and North Africa were relatively developed (see, e.g., Abu-Lughod [1989], Braudel [1992], Chaudhuri [1990], Hodgson [1993], McNeill [1999], Pomeranz [2000], Reid [1988, 1993], and Townsend [2000]). In con-

11. In Acemoglu, Johnson, and Robinson [2001b] we also provided evidence that urbanization and population density in 1000 are positively correlated with urbanization and population density in 1500, suggesting that before 1500 there was considerable persistence in prosperity both where the Europeans later colonized and where they never colonized.

TABLE VI
ROBUSTNESS CHECKS FOR URBANIZATION AND LOG POPULATION DENSITY

	Dependent variable is log GDP per capita (PPP) in 1995									
	Base sample (1)	Assuming lower urbanization in the Americas (2)	Assuming lower urbanization in North Africa (3)	Assuming lower urbanization in Indian subcontinent (4)	Using least favorable combination of assumptions (5)	Using augmented Toynbee definition of civilization (6)	Using land area in 1995 for population density (7)	Alternative assumptions for log population density (8)	All countries never colonized by Europe (9)	Europe (including Eastern Europe) (10)
	Former colonies								Never colonized	
	Panel A: Unweighted regressions									
Urbanization in 1500	−0.078 (0.026)	−0.089 (0.027)	−0.102 (0.029)	−0.073 (0.027)	−0.105 (0.032)	−0.117 (0.052)			0.068 (0.023)	0.077 (0.023)
Log population density in 1500							−0.41 (0.06)	−0.32 (0.07)		
R^2	0.20	0.22	0.24	0.16	0.21	0.30	0.35	0.21	0.18	0.27
Number of observations	41	41	41	41	41	14	91	91	43	32
	Panel B: Regressions weighted using log population in 1500									
Urbanization in 1500	−0.072 (0.025)	−0.084 (0.026)	−0.097 (0.029)	−0.064 (0.026)	−0.099 (0.032)	−0.118 (0.053)			−0.064 (0.023)	−0.073 (0.022)
Log population density in 1500							−0.39 (0.06)	−0.29 (0.07)		
R^2	0.18	0.22	0.23	0.14	0.20	0.29	0.32	0.19	0.17	0.24
Number of observations	41	41	41	41	41	14	91	91	43	32

Panel C: Including both urbanization and log population density as independent variables										
Urbanization in 1500	0.038	0.039	0.017	0.037	0.020	0.072	0.017	0.003	0.028	0.032
	(0.028)	(0.031)	(0.033)	(0.027)	(0.035)	(0.047)	(0.023)	(0.022)	(0.020)	(0.021)
Log population density in 1500	−0.41	−0.41	−0.36	−0.40	−0.37	−0.48	−0.43	−0.41	0.34	0.37
	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)	(0.09)	(0.07)	(0.07)	(0.07)	(0.08)
R^2	0.56	0.56	0.54	0.56	0.54	0.79	0.61	0.60	0.48	0.57
Number of observations	41	41	41	41	41	14	41	41	43	32
Panel D: Instrumenting for urbanization in 1500 using log population density in 1500										
Urbanization in 1500	−0.178	−0.181	−0.215	−0.194	−0.242	−0.237	−0.217	−0.239	0.259	0.226
	(0.04)	(0.040)	(0.048)	(0.048)	(0.057)	(0.080)	(0.053)	(0.063)	(0.090)	(0.074)
Number of observations	41	41	41	41	41	14	41	41	43	32

Standard errors are in parentheses. Dependent variable is log GDP per capita (PPP) in 1995. Base sample is all former colonies for which we have data. In our base sample, urbanization in 1500 is percent of the population living in towns with 5000 or more people. Column (2) assumes 9 percent urbanization in the Andes and Central America. Column (3) assumes 10 percent urbanization in North Africa. Column (4) assumes 6 percent urbanization in the Indian subcontinent. Column (5) combines the assumptions of columns (2), (3), (4), and (5) to create the least favorable combination of assumptions for our hypothesis. Column (6) is only civilizations in former European colonies. The augmented Toynbee civilizations, used in column (6), include Andean, Mexic, Yucatec, Arabic (North Africa), Hindu, Polynesian, Eskimo (Canada) North American Indian, South American Indian (Brazil/Argentina/Chile), Australian Aborigine, Malay (Malaysia and Indonesia), Philippines, Vietnam/Cambodia, and Burma. In column (7) population density in 1500 is total population divided by arable land area in 1995. Column (8) halves the population density estimates for Africa. For detailed sources and descriptions see Appendix 2.

trast, there was little agriculture in most of North America and Australia, at most consistent with a population density of 0.1 people per square kilometer. McEvedy and Jones [1978, p. 322] describe the state of Australia at this time as "an unchanging palaeolithic backwater." In fact, because of the relative backwardness of these areas, European powers did not view them as valuable colonies. Voltaire is often quoted as referring to Canada as a "few acres of snow," and the European powers at the time paid little attention to Canada relative to the colonies in the West Indies. In a few parts of North America, along the East Coast and in the Southwest, there was settled agriculture, supporting a population density of approximately 0.4 people per square kilometer, but this was certainly much less than that in the Aztec and Inca Empires, which had fully developed agriculture with a population density of between 1 and 3 people (or even higher) per square kilometer, and also much less than the corresponding numbers in Asia and Africa [McEvedy and Jones 1978, p. 273]. The recent work by Maddison [2001] also confirms our interpretation. He estimates that India, Indonesia, Brazil, and Mexico were richer than the United States in 1500 and 1700 (see, for example, his Table 2-22a).

III.D. The Timing and Nature of the Reversal

The evidence presented so far documents the reversal in relative incomes among the former colonies from 1500 to today. When did this reversal take place? This question is relevant in thinking about the causes of the reversal. For example, if the reversal is related to the extraction of resources from, and the "plunder" of, the former colonies, or to the direct effect of the diseases Europeans brought to the New World, it should have taken place shortly after colonization.

Figure IV shows that the reversal is mostly a late eighteenth- and early nineteenth-century phenomenon, and is closely related to industrialization. Figure IVa compares the evolution of urbanization among two groups of New World ex-colonies, those with low urbanization in 1500 versus those with high urbanization in 1500.[12] We focus on New World colonies since the societies came

12. The initially high urbanization countries for which we have data and are included in the figure are Bolivia, Mexico, Peru, and all of Central America, while the initially low urbanization countries are Argentina, Brazil, Canada, Chile, and the United States.

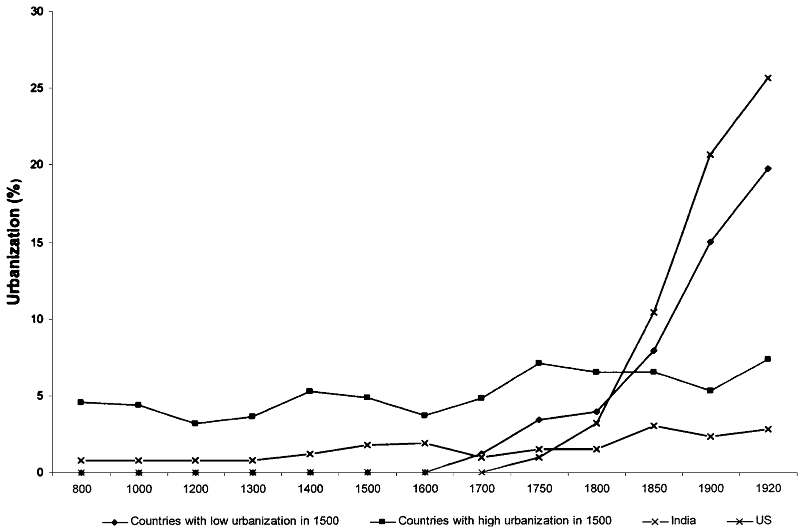

FIGURE IVa
Urbanization Rate in India, the United States, and New World Countries with Low and High Urbanization, 800–1920

Note. Urbanization is population living in urban areas divided by total population. Urban areas have a minimum threshold of 20,000 inhabitants, from Chandler [1987], and Mitchell [1993, 1995]. Low urbanization in 1500 countries are Argentina, Brazil, Canada, Chile, and the United States. High urbanization in 1500 countries are Bolivia, Ecuador, Mexico, Peru, and all of Central America. For details see Appendix 1.

under European dominance very early on. The averages plotted in the figure are weighted by population in 1500. In addition, in the same figure we plot India and the United States separately (as well as including it in the initially low urbanization group). The figure shows that the initially low urbanization group as a whole and the United States by itself overtake India and the initially high urbanization countries sometime between 1750 and 1850.

Figure IVb depicts per capita industrial production for the United States, Canada, New Zealand, Australia, Brazil, Mexico, and India using data from Bairoch [1982]. This figure shows the takeoff in industrial production in the United States, Australia, Canada, and New Zealand relative to Brazil, Mexico, and India. Although the scale makes it difficult to see in the figure, per capita industrial production in 1750 was in fact higher in India, 7, than in the United States, 4 (with U. K. industrial production per capita in 1900 normalized to 100). Bairoch [1982] also reports that in 1750 China had industrial production per capita twice the

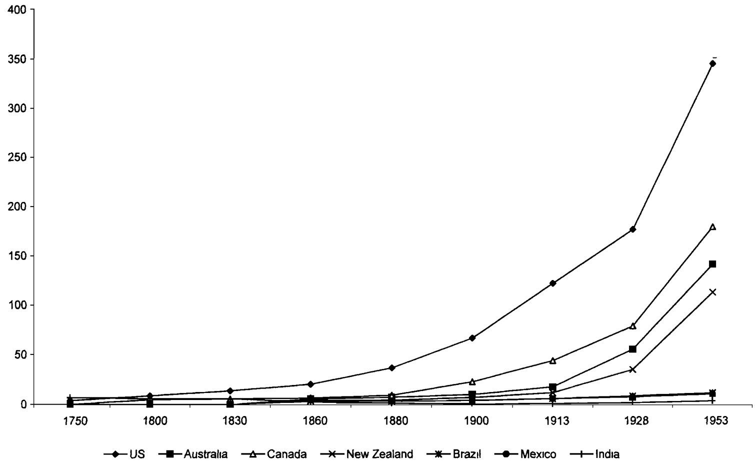

FIGURE IVb
Industrial Production per Capita, 1750–1953
Note. Index of industrial production with U. K. per capita industrialization in 1900 is equal to 100, from Bairoch [1982].

level of the United States. Yet, as Figure IVb shows, over the next 200 years there was a much larger increase in industrial production in the United States than in India (and also than in China).

This general interpretation, that the reversal in relative incomes took place during the late eighteenth and early nineteenth centuries and was linked to industrialization, is also consistent with the fragmentary evidence we have on other measures of income per capita and industrialization. Coatsworth [1993], Eltis [1995], Engerman [1981], and Engerman and Sokoloff [1997] provide evidence that much of Spanish America and the Caribbean were more prosperous (had higher per capita income) than British North America until the eighteenth century. The future United States rose in per capita income during the 1700s relative to the Caribbean and South America, but only really pulled ahead during the late eighteenth and early nineteenth centuries. Maddison's [2001] numbers also show that India, Indonesia, Brazil, and Mexico were richer than the United States in 1700, but had fallen behind by 1820.

U. S. growth during this period also appears to be an industry-based phenomenon. McCusker and Menard [1985] and Galenson [1996] both emphasize that productivity and income growth in North America before the eighteenth century was limited. During the critical period of growth in the United States, between

1840 and 1900, there was modest growth in agricultural output per capita, and very rapid growth in industrial output per capita; the numbers reported by Gallman [2000] imply that between 1840 and 1900 agricultural product per capita increased by about 30 percent, a very small increase relative to the growth in manufacturing output per capita, which increased more than fourfold.

IV. Hypotheses and Explanations

IV.A. The Geography Hypothesis

The geography hypothesis claims that differences in economic performance reflect differences in geographic, climatic, and ecological characteristics across countries. There are many different versions of this hypothesis. Perhaps the most common is the view that climate has a direct effect on income through its influence on work effort. This idea dates back to Machiavelli [1519] and Montesquieu [1748]. Both Toynbee [1934, Vol. 1] and Marshall [1890, p. 195] similarly emphasized the importance of climate, both on work effort and productivity. One of the pioneers of development economics, Myrdal [1968], also placed considerable emphasis on the effect of geography on agricultural productivity. He argued: "serious study of the problems of underdevelopment . . . should take into account the climate and its impacts on soil, vegetation, animals, humans and physical assets—in short, on living conditions in economic development" [Vol. 3, p. 2121].

More recently, Diamond [1997] and Sachs [2000, 2001] have espoused different versions of the geography view. Diamond, for example, argues that the timing of the Neolithic revolution has had a long-lasting effect on economic and social development. Sachs, on the other hand, emphasizes the importance of geography through its effect on the disease environment, transport costs, and technology. He writes: "Certain parts of the world are geographically favored. Geographical advantages might include access to key natural resources, access to the coastline and sea—navigable rivers, proximity to other successful economies, advantageous conditions for agriculture, advantageous conditions for human health" [2000, p. 30]. Also see Myrdal [1968, Vol. 1, pp. 691–695].

This simple version of the geography hypothesis predicts persistence in economic outcomes, since the geographic factors that are the first-order determinants of prosperity are time-invariant. The evidence presented so far therefore weighs against the simple geography hypothesis: whatever factors are important in making former colonies rich today are very different from those contributing to prosperity in 1500.

IV.B. The Sophisticated Geography Hypotheses

The reversal in relative incomes does not necessarily reject a more sophisticated geography hypothesis, however. Certain geographic characteristics that were not useful, or that were even harmful, for successful economic performance in 1500 may turn out to be beneficial later on. In this subsection we briefly discuss a number of sophisticated geography hypotheses emphasizing the importance of such time-varying effects of geography.[13]

The first is the "temperate drift hypothesis," emphasizing the temperate (or away from the equator) shift in the center of economic gravity over time. According to this view, geography becomes important when it interacts with the presence of certain technologies. For example, one can argue that tropical areas provided the best environment for early civilizations—after all, humans evolved in the tropics, and the required calorie intake is lower in warmer areas. But with the arrival of "appropriate" technologies, temperate areas became more productive. The technologies that were crucial for progress in temperate areas include the heavy plow, systems of crop rotation, domesticated animals such as cattle and sheep, and some of the high productivity European crops, including wheat and barley. Despite the key role of these technologies for temperate areas, they have had much less of an effect on tropical zones [Lewis 1978]. Sachs [2001, p. 12] also implies this view in his recent paper when he adapts Diamond's argument about the geography of technological diffusion: "Since technologies in the critical areas of agriculture, health, and related areas could diffuse *within* ecological zones, but not across ecological zones, economic development spread through the tem-

13. Put differently, in the simple geography hypothesis, geography has a *main effect* on economic performance, which can be expressed as $Y_{it} = \alpha_0 + \alpha_1 \cdot G_i + \nu_t + \epsilon_{it}$, where Y_{it} is a measure of economic performance in country i at time t, G_i is a measure of geographic characteristics, ν_t is a time effect, and ϵ_{it} measures other country-time-specific factors. In contrast, in the sophisticated geography view, the relationship between income and geography would be $Y_{it} = \alpha_0 + \alpha_1 \cdot G_{it} + \alpha_2 \cdot T_t \cdot G_{it} + \nu_t + \epsilon_{it}$, where T_t is a time-varying characteristic of the world as a whole or of the state of technology. According to this view, the major role that geography plays in history is not through α_1, but through α_2.

perate zones but not through the tropical regions" (italics in the original; also see Myrdal [1968], Ch. 14).

The evidence is not favorable to the view that the reversal reflects the emergence of agricultural technologies favorable to temperate areas, however. First, the regressions in Tables III, IV, and V show little evidence that the reversal was related to geographic characteristics. Second, the temperate drift hypothesis suggests that the reversal should be associated with the spread of European agricultural technologies. Yet in practice, while European agricultural technology spread to the colonies between the sixteenth and eighteenth centuries (e.g., McCusker and Menard [1985], Ch. 3 for North America), the reversal in relative incomes is largely a late eighteenth- and early nineteenth-century, and industry-based phenomenon.

In light of the result that the reversal is related to industrialization, another sophisticated geography hypothesis would be that certain geographic characteristics facilitate or enable industrialization. First, one can imagine that there is more room for specialization in industry, but such specialization requires trade. If countries differ according to their transport costs, it might be those with low transport costs that take off during the age of industry. This argument is not entirely convincing, however, again because there is little evidence that the reversal was related to geographic characteristics (see Tables III, IV, and V). Moreover, many of the previously prosperous colonies that failed to industrialize include islands such as the Caribbean, or countries with natural ports such as those in Central America, India, or Indonesia. Moreover, transport costs appear to have been relatively low in some of the areas that failed to industrialize (e.g., Pomeranz [2000], Appendix A).

Second, countries may lack certain resource endowments, most notably coal, which may have been necessary for industrialization (e.g., Pomeranz [2000] and Wrigley [1988]). But coal is one of the world's most common resources, with proven reserves in 100 countries and production in over 50 countries [World Coal Institute 2000], and our results in Table III and V offer little evidence that either coal or the absence of any other resource was responsible for the reversal. So there appears to be little support for these types of sophisticated geography hypotheses either.[14]

14. Two other related hypotheses are worth mentioning. First, it could be argued that people work less hard in warmer climates and that this matters more

IV.C. The Institutions Hypothesis

According to the institutions hypothesis, societies with a social organization that provides encouragement for investment will prosper. Locke [1980], Smith [1778], and Hayek [1960], among many others, emphasized the importance of property rights for the success of nations. More recently, economists and historians have emphasized the importance of institutions that guarantee property rights. For example, Douglass North starts his 1990 book by stating [p. 3]: "That institutions affect the performance of economies is hardly controversial," and identifies effective protection of property rights as important for the organization of society (see also North and Thomas [1973] and Olson [2000]).

In this context we take a good organization of society to correspond to a cluster of (political, economic, and social) institutions ensuring that a broad cross section of society has effective property rights. We refer to this cluster as *institutions of private property,* and contrast them with *extractive institutions,* where the majority of the population faces a high risk of expropriation and holdup by the government, the ruling elite, or other agents. Two requirements are implicit in this definition of institutions of private property. First, institutions should provide secure property rights, so that those with productive opportunities expect to receive returns from their investments, and are encouraged to undertake such investments. The second requirement is embedded in the emphasis on "a broad cross section of the society." A society in which a very small fraction of the population, for example, a class of landowners, holds all the wealth and political power may not be the ideal environment for investment, even if

for industry than for agriculture, thus explaining the reversal. However, there is no evidence either for the hypothesis that work effort matters more for industry or for the assertion that human energy output depends systematically on temperature (see, e.g., Collins and Roberts [1988]). Moreover, the available evidence on hours worked indicates that people work harder in poorer/warmer countries (e.g., ILO [1995, pp. 36–37]), though of course these high working hours could reflect other factors.

Second, it can be argued that different paths of development reflect the direct influence of Europeans. Places where there are more Europeans have become richer, either because Europeans brought certain values conducive to development (e.g., Landes [1998], and Hall and Jones [1999]), or because having more Europeans confers certain benefits (e.g., through trade with Europe or because Europeans are more productive). In Acemoglu, Johnson, and Robinson [2001b] we presented evidence showing that the reversal and current income levels are not related to the current racial composition of the population or to proxies of whether the colonies were culturally or politically dominated by Europeans.

the property rights of this elite are secure. In such a society, many of the agents with the entrepreneurial human capital and investment opportunities may be those without effective property rights protection. In particular, the concentration of political and social power in the hands of a small elite implies that the majority of the population risks being held up by the powerful elite after they undertake investments. This is also consistent with North and Weingast's [1989, pp. 805–806] emphasis that what matters is: "... whether the state produces rules and regulations that benefit a small elite and so provide little prospect for long-run growth, or whether it produces rules that foster long-term growth." Whether political power is broad-based or concentrated in the hands of a small elite is crucial in evaluating the role of institutions in the experiences of the Caribbean or India during colonial times, where the property rights of the elite were well enforced, but the majority of the population had no civil rights or property rights.

It is important to emphasize that "equilibrium institutions" may be extractive, even though such institutions do not encourage economic development. This is because institutions are shaped, at least in part, by politically powerful groups that may obtain fewer rents with institutions of private property (e.g., North [1990]), or fear losing their political power if there is institutional development (e.g., Acemoglu and Robinson [2000, 2001]), or simply may be reluctant to initiate institutional change because they would not be the direct beneficiaries of the resulting economic gains. In the context of the development experience of the former colonies, this implies that equilibrium institutions are likely to have been designed to maximize the rents to European colonists, not to maximize long-run growth.

The organization of society and institutions also persist (see, for example, the evidence presented in Acemoglu, Johnson, and Robinson [2001a]). Therefore, the institutions hypothesis also suggests that societies that are prosperous today should tend to be prosperous in the future. However, if a major shock disrupts the organization of a society, this will affect its economic performance. We argue that European colonialism not only disrupted existing social organizations, but led to the establishment of, or continuation of already existing, extractive institutions in previously prosperous areas and to the development of institutions of private property in previously poor areas. Therefore, European colonialism led to an *institutional reversal,* in the sense that regions that were *relatively prosperous* before the arrival of Europeans were more likely to end up with extractive institutions under European rule than previously poor areas. The institutions hypothesis, combined with the institutional reversal, predicts a reversal in relative incomes among these countries.

The historical evidence supports the notion that colonization introduced relatively better institutions in previously sparsely settled and less prosperous areas: while in a number of colonies such as the United States, Canada, Australia, New Zealand, Hong Kong, and Singapore, Europeans established institutions of private property, in many others they set up or took over already existing extractive institutions in order to directly extract resources, to develop plantation and mining networks, or to collect taxes.[15] Notice that what is important for our story is not the "plunder" or the direct extraction of resources by the European powers, but the long-run consequences of the institutions that they set up to support extraction. The distinguishing feature of these institutions was a high concentration of political power in the hands of a few who extracted resources from the rest of the population. For example, the main objective of the Spanish and Portuguese colonization was to obtain silver, gold, and other valuables from America, and throughout they monopolized military power to enable the extraction of these resources. The mining network set up for this reason was based on forced labor and the oppression of the native population. Similarly, the British West Indies in the seventeenth and eighteenth centuries were controlled by a small group of planters (e.g., Dunn [1972, Chs. 2–6]). Political power was important to the planters in the West Indies, and to other elites in the colonies specializing in plantation agriculture, because it enabled them to force large masses of natives or African slaves to work for low wages.[16]

What determines whether Europeans pursued an extractive

15. Examples of extraction by Europeans include the transfer of gold and silver from Latin America in the seventeenth and eighteenth centuries and of natural resources from Africa in the nineteenth and twentieth centuries, the Atlantic slave trade, plantation agriculture in the Caribbean, Brazil, and French Indochina, the rule of the British East India Company in India, and the rule of the Dutch East India Company in Indonesia. See Frank [1978], Rodney [1972], Wallerstein [1974–1980], and Williams [1944].

16. In a different vein, Europeans running the Atlantic slave trade, despite their small numbers, also appear to have had a fundamental effect on the evolution of institutions in Africa. The consensus view among historians is that the slave trade fundamentally altered the organization of society in Africa, leading to state centralization and warfare as African polities competed to control the supply of slaves to the Europeans. See, for example, Manning [1990, p. 147], and also

strategy or introduced institutions of private property? And why was extraction more likely in relatively prosperous areas? Two factors appear important.

1. *The economic profitability of alternative policies.* When extractive institutions were more profitable, Europeans were more likely to opt for them. High population density, by providing a supply of labor that could be forced to work in agriculture or mining, made extractive institutions more profitable for the Europeans.[17] For example, the presence of abundant Amerindian labor in Meso-America was conducive to the establishment of forced labor systems, while the relatively high population density in Africa created a profit opportunity for slave traders in supplying labor to American plantations.[18] Other types of extractive institutions were also more profitable in densely settled and prosperous areas where there was more to be extracted by European colonists. Furthermore, in these densely settled areas there was often an existing system of tax administration or tribute; the large population made it profitable for the Europeans to take control of these systems and to continue to levy high taxes (see, e.g.,

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Wilks [1975] for Ghana, Law [1977] for Nigeria, Harms [1981]) for the Congo/Zaire, and Miller [1988] on Angola.

17. The Caribbean islands were relatively densely settled in 1500. Much of the population in these islands died soon after the arrival of the Europeans because of the diseases that the Europeans brought (e.g., Crosby [1986] and McNeill [1976]). It is possible that the initial high populations in these islands induced the Europeans to take the "extractive institutions" path, and subsequently, these institutions were developed further with the import of slaves from Africa. An alternative possibility is that the relevant period of institutional development was after the major population decline, but the Caribbean still ended up with extractive institutions because the soil and the climate were suitable for sugar production, which encouraged Europeans to import slaves from Africa and set up labor-oppressive systems (e.g., Dunn [1972] and Engerman and Sokoloff [1997, 2000]).

18. The Spanish conquest around the La Plata River (current day Argentina) during the early sixteenth century provides a nice example of how population density affected European colonization (see Lockhart and Schwartz [1983, pp. 259–260] or Denoon [1983, pp. 23–24]). Early in 1536, a large Spanish expedition arrived in the area, and founded the city of Buenos Aires at the mouth of the river Plata. The area was sparsely inhabited by nonsedentary Indians. The Spaniards could not enslave a sufficient number of Indians for food production. Starvation forced them to abandon Buenos Aires and retreat up the river to a post at Asuncion (current day Paraguay). This area was more densely settled by semi-sedentary Indians, who were enslaved by the Spaniards; the colony of Paraguay, with relatively extractive institutions, was founded. Argentina was finally colonized later, with a higher proportion of European settlers and little forced labor.

Wiegersma [1988, p. 69], on French policies in Vietnam, or Marshall [1998, pp. 492–497], on British policies in India).

2. *Whether Europeans could settle or not.* Europeans were more likely to develop institutions of private property when they settled in large numbers, for the natural reason that they themselves were affected by these institutions (i.e., their objectives coincided with encouraging good economic performance).[19] Moreover, when a large number of Europeans settled, the lower strata of the settlers demanded rights and protection similar to, or even better than, those in the home country. This made the development of effective property rights for a broad cross section of the society more likely. European settlements, in turn, were affected by population density both directly and indirectly. Population density had a direct effect on settlements, since Europeans could easily settle in large numbers in sparsely inhabited areas. The indirect effect worked through the disease environment, since malaria and yellow fever, to which Europeans lacked immunity, were endemic in many of the densely settled areas [Acemoglu, Johnson, and Robinson 2001a].[20]

Table VII provides econometric evidence on the institutional reversal. It shows the relationship between urbanization or population density in 1500 and subsequent institutions using three different measures of institutions. The first two measures refer to current institutions: protection against expropriation risk between 1985 and 1995 from Political Risk Services, which approximates how secure property rights are, and "constraints on the executive" in 1990 from Gurr's Polity III data set, which can be thought of as a proxy for how concentrated political power is in the hands of ruling groups (see Appendix 2 for detailed sources). Columns (1)–(6) of Table VII show a negative relation-

19. Extraction and European settlement patterns were mutually self-reinforcing. In areas where extractive policies were pursued, the authorities also actively discouraged settlements by Europeans, presumably because this would interfere with the extraction of resources from the locals (e.g., Coatsworth [1982]).

20. European settlements shaped both the type of institutions that developed and the structure of production. For example, while in Potosí (Bolivia) mining employed forced labor [Cole 1985] and in Brazil and the Caribbean sugar was produced by African slaves, in the United States and Australia mining companies employed free migrant labor and sugar was grown by smallholders in Queensland, Australia [Denoon 1983, Chs. 4 and 5]. Consequently, in Bolivia, Brazil, and the Caribbean, political institutions were designed to ensure the control of the laborers and slaves, while in the United States and Australia, the smallholders and the middle class had greater political rights [Cole 1985; Hughes 1988, Ch. 10].

TABLE VII
URBANIZATION, POPULATION DENSITY, AND INSTITUTIONS

	Dependent variable is:								
	Average protection against expropriation risk, 1985–1995			Constraint on executive in 1990			Constraint on executive in first year of independence		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Without additional controls									
Urbanization in 1500	−0.107		−0.001	−0.154		−0.037	−0.132		0.018
	(0.043)		(0.059)	(0.066)		(0.098)	(0.069)		(0.103)
Log population density in 1500		−0.37	−0.37		−0.49	−0.40		−0.33	−0.54
		(0.10)	(0.15)		(0.15)	(0.25)		(0.15)	(0.28)
R^2	0.14	0.16	0.25	0.12	0.12	0.18	0.31	0.16	0.37
Number of observations	42	75	42	41	84	41	42	85	42
Panel B: Controlling for latitude									
Urbanization in 1500	−0.097		−0.001	−0.159		−0.038	−0.128		0.022
	(0.042)		(0.059)	(0.067)		(0.099)	(0.070)		(0.104)
Log population density in 1500		−0.31	−0.34		−0.45	−0.41		−0.30	−0.54
		(0.10)	(0.15)		(0.16)	(0.25)		(0.16)	(0.28)
Latitude	2.87	3.53	2.57	−1.49	2.63	−1.86	1.52	2.68	1.48
	(1.48)	(1.25)	(1.41)	(2.38)	(2.01)	(2.34)	(2.54)	(2.17)	(2.46)
R^2	0.21	0.24	0.31	0.13	0.13	0.19	0.32	0.17	0.38
Number of observations	42	75	42	41	84	41	42	84	42

Standard errors are in parentheses. Regressions use data for all former colonies for which information on urbanization and population density in 1500 is available, as explained in the text. Urbanization in 1500 is percent of the population living in towns with 5000 or more people. Population density in 1500 is total population divided by arable land area from McEvedy and Jones [1978]. Average protection against expropriation risk is an evaluation of the risk that private investments will be expropriated by the government. Constraints on the executive is an assessment of the constitutional limitations on executive power. Regressions with constraints on executive in first year of independence use the earliest available date after independence, and also include the date of independence as an additional regressor. For detailed sources and descriptions see Appendix 2.

ship between our measures of prosperity in 1500 and current institutions.[21]

It is also important to know whether there was an institutional reversal during the colonial times or shortly after independence. Since the Gurr data set does not contain information for nonindependent countries, we can only look at this after independence. Columns (7)–(9) show the relationship between prosperity in 1500 and a measure of early institutions, constraint on the executive in the first year of independence, from the same data set, while also controlling for time since independence as an additional covariate. Finally, the second panel of the table includes (the absolute value of) latitude as an additional control, showing that the institutional reversal does not reflect some simple geographic pattern of institutional change.

The institutions hypothesis, combined with the institutional reversal, predicts that countries in areas that were relatively prosperous and densely settled in 1500 ended up with relatively worse institutions after the European intervention, and therefore should be relatively less prosperous today. The reversal in relative incomes that we have documented so far is consistent with this prediction.

Notice, however, that the institutions hypothesis and the reversal in relative incomes do not rule out an important role for geography during some earlier periods, or working through institutions. They simply suggest that institutional differences are the major source of differences in income per capita *today*. First, differences in economic prosperity in 1500 may be reflecting geographic factors (e.g., that the tropics were more productive than temperate areas) as well as differences in social organization caused by nongeographic influences. Second and more important, as we emphasized in Acemoglu, Johnson, and Robinson [2001a], a major determinant of European settlements, and therefore of institutional development, was the mortality rates faced by Europeans, which is a geographical variable. Similarly, as noted by Engerman and Sokoloff [1997, 2000], whether an area was suitable for sugar production is likely to have been important in

21. When both urbanization and log population density in 1500 are included, it is the population density variable that is significant. This supports the interpretation that it was the differences between densely and sparsely settled areas that was crucial in determining colonial institutions (though, again, this may also reflect the fact that the population density variable is measured with less measurement error).

shaping the type of institutions that Europeans introduced. However, this type of interaction between geography and institutions means that certain regions, say Central America, are poor today not as a result of their geography, but because of their institutions, and that there is not a necessary or universal link between geography and economic development.

V. Institutions and the Making of the Modern World Income Distribution

V.A. *Institutions and the Reversal*

We next provide evidence suggesting that institutional differences statistically account for the reversal in relative incomes. If the institutional reversal is the reason why there was a reversal in income levels among the former colonies, then once we account for the role of institutions appropriately, the reversal should disappear. That is, according to this view, the reversal documented in Figures I and II and Tables III, IV, V, and VI reflects the correlation between economic prosperity in 1500 and income today working through the intervening variable, institutions.

How do we establish that an intervening variable X is responsible for the correlation between Z and Y? Suppose that the true relationship between Y, and X, and Z is

$$Y = \alpha \cdot X + \beta \cdot Z + \epsilon, \tag{1}$$

where α and β are coefficients and ϵ is a disturbance term. In our case, we can think of Y as income per capita today, X as a measure of institutions, and Z as population density (or urbanization) in 1500. The variable Z is included in equation (1) either because it has a direct effect on Y or because it has an effect through some other variables not included in the analysis. The hypothesis we are interested in is that $\beta = 0$; that is, population density or urbanization in 1500 affects income today *only* via institutions.

This hypothesis obviously requires that there is a statistical relationship between X and Z. So we postulate that $X = \lambda \cdot Z + \upsilon$. To start with, suppose that ϵ is independent of X and Z and that υ is independent of Z. Now imagine a regression of Y on Z only (in our context, of income today on prosperity in 1500, similar to those we reported in Tables III, IV, V, and VI):

$Y = b \cdot Z + u_1$. As is well-known, the probability limit of the OLS estimate from this regression, $\hat{b}$, is

$$\text{plim}\hat{b} = \beta + \alpha \cdot \lambda.$$

So the results in the regressions of Tables IV, V, VI, and VII are consistent with $\beta = 0$ as long as $\alpha \neq 0$ and $\lambda \neq 0$. In this case, we would be capturing the effect of Z (population density or urbanization) on income working solely through institutions. This is the hypothesis that we are interested in testing. Under the assumptions regarding the independence of Z from ν and ϵ, and of X from ϵ, there is a simple way of testing this hypothesis, which is to run an OLS regression of Y on Z and X:

$$Y = a \cdot X + b \cdot Z + u_2 \tag{2}$$

to obtain the estimates $\hat{a}$ and $\hat{b}$. The fact that ϵ in (1) is independent of both X and Z rules out omitted variable bias, so plim$\hat{a} = \alpha$ and plim$\hat{b} = \beta$. Hence, a simple test of whether $\hat{b} = 0$ is all that is required to test our hypothesis that the effect of Z is through X alone.

In practice, there are likely to be problems due to omitted variables, endogeneity bias because Y has an effect on X, and attenuation bias because X is measured with error or corresponds poorly to the real concept that is relevant to development (which is likely to be a broad range of institutions, whereas we only have an index for a particular type of institutions). So the above procedure is not possible. However, the same logic applies as long as we have a valid instrument M for X, such that $X = \gamma \cdot M + \zeta$, and M is independent of ϵ in (1). We can then simply estimate (2) using 2SLS with the first-stage $X = c \cdot M + d \cdot Z + u_3$. Testing our hypothesis that Z has an effect on Y only through its effect on X then amounts to testing that the 2SLS estimate of b, $\tilde{b}$, is equal to 0. Intuitively, the 2SLS procedure ensures a consistent estimate of α, enabling an appropriate test for whether Z has a direct effect.

The key to the success of this strategy is a good instrument for X. In our previous work [Acemoglu, Johnson, and Robinson 2001a] we showed that mortality rates faced by settlers are a good instrument for settlements of Europeans in the colonies and the subsequent institutional development of these countries. These mortality rates are calculated from the mortality of soldiers, bishops, and sailors stationed in the colonies between the seventeenth and nineteenth centuries, and are a plausible instrument for the institutional development of the colonies, since in areas with high mortality Europeans did not settle and were more likely to develop extractive institutions. The exclusion restriction implied by this instrumental-variables strategy is that, conditional on the other controls, the mortality rates of European settlers more than 100 years ago have no effect on GDP per capita today, other than their effects through institutional development. This is plausible since these mortality rates were much higher than the mortality rates faced by the native population who had developed a high degree of immunity to the two main killers of Europeans, malaria and yellow fever.

Table VIII reports results from this type of 2SLS test using the log of settler mortality rates as an instrument for institutional development. We look at the same three institutions variables used in Table VII: protection against expropriation risk between 1985 and 1995, and constraint on the executive in 1990 and in the first year of independence. Panel A reports results from regressions that enter urbanization and log population density in 1500 as exogenous regressors in the first and the second stages, while Panel B reports the corresponding first stages. Different columns correspond to different institutions variables, or to different specifications. For comparison, Panel C reports the 2SLS coefficient on institutions with exactly the same sample as the corresponding column, but without including urbanization or population density.

The results are consistent with our hypothesis. In all columns we never reject the hypothesis that urbanization in 1500 or population density in 1500 has *no* direct effect once we control for the effect of institutions on income per capita, and the addition of these variables has little effect on the 2SLS estimate of the effect of institutions on income per capita. This supports our notion that the reversal in economic prosperity reflects the effect of early prosperity and population density working through the institutions and policies introduced by European colonists.

V.B. Institutions and Industrialization

Why did the reversal in relative incomes take place during the nineteenth century? To answer this question, imagine a society like the Caribbean colonies where a small elite controls all the political power. The property rights of this elite are relatively well protected, but the rest of the population has no effective property

TABLE VIII
GDP PER CAPITA AND INSTITUTIONS

	Dependent variable is log GDP per capita (PPP) in 1995					
Institutions as measured by:	Average protection against expropriation risk, 1985–1995		Constraint on executive in 1990		Constraint on executive in first year of independence	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Second-stage regressions						
Institutions	0.52	0.88	0.84	0.50	0.37	0.46
	(0.10)	(0.21)	(0.47)	(0.11)	(0.12)	(0.16)
Urbanization in 1500	−0.024		0.030		−0.023	
	(0.021)		(0.078)		(0.034)	
Log population density in 1500		−0.08		−0.10		−0.13
		(0.10)		(0.10)		(0.10)
Panel B: First-stage regressions						
Log settler mortality	−1.21	−0.47	−0.75	−0.88	−1.81	−0.78
	(0.23)	(0.14)	(0.44)	(0.20)	(0.40)	(0.25)
Urbanization in 1500	−0.042		−0.088		−0.043	
	(0.035)		(0.066)		(0.061)	
Log population density in 1500		−0.21		−0.35		−0.24
		(0.11)		(0.15)		(0.17)
R^2	0.53	0.29	0.17	0.37	0.56	0.26
Number of observations	38	64	37	67	38	67
Panel C: Coefficient on institutions without urbanization or population density in 1500						
Institutions	0.56	0.96	0.77	0.54	0.39	0.52
	(0.09)	(0.17)	(0.33)	(0.09)	(0.11)	(0.15)

Standard errors are in parentheses. Dependent variable is log GDP per capita (PPP) in 1995. The measure of institutions used in each regression is indicated at the head of each column. Urbanization in 1500 is percent of the population living in towns with 5000 or more people. Population density is calculated as total population divided by arable land area. Constraint on the executive in 1990, 1900, and the first year of independence are all from the Polity III data set. Regressions with constraint on executive in first year of independence use the earliest available date after independence, and also include the date of independence as an additional regressor.

Panel A reports the second-stage estimates from an IV regression with first-stage shown in Panel B. Panel C reports second-stage estimates from the IV regressions, which do not include urbanization or population density and which instrument for institutions using log settler mortality. Log settler mortality estimates are from Acemoglu, Johnson, and Robinson [2001a]. For detailed sources and descriptions see Appendix 2.

rights. According to our definition, this would not be a society with institutions of private property, since a broad cross section of society does not have effective property rights. Nevertheless, when the major investment opportunities are in agriculture, this may not matter too much, since the elite can invest in the land

and employ the rest of the population, and so will have relatively good incentives to increase output.

Imagine now the arrival of a new technology, for example, the opportunity to industrialize. If the elite could undertake industrial investments without losing its political power, we may expect them to take advantage of these opportunities. However, in practice there are at least three major problems. First, those with the entrepreneurial skills and ideas may not be members of the elite and may not undertake the necessary investments, because they do not have secure property rights and anticipate that they will be held up by political elites once they undertake these investments. Second, the elites may want to *block* investments in new industrial activities, because it may be these outside groups, not the elites themselves, who will benefit from these new activities. Third, they may want to block these new activities, fearing political turbulence and the threat to their political power that new technologies will bring (see Acemoglu and Robinson [2000, 2001]).[22]

This reasoning suggests that whether a society has institutions of private property or extractive institutions may matter much more when new technologies require broad-based economic participation—in other words, extractive institutions may become much more *inappropriate* with the arrival of new technologies. Early industrialization appears to require both investments from a large number of people who were not previously part of the ruling elite and the emergence of new entrepreneurs (see Engerman and Sokoloff [1997], Kahn and Sokoloff [1998], and Rothenberg [1992] for evidence that many middle-class citizens, innovators, and smallholders contributed to the process of early industrialization in the United States). Therefore, there are reasons to expect that institutional differences should matter more during the age of industry.

If this hypothesis is correct, we should expect societies with good institutions to take better advantage of the opportunity to industrialize starting in the late eighteenth century. We can test this idea using data on institutions, industrialization, and GDP from the nineteenth and early twentieth centuries. Bairoch [1982] presents estimates of industrial output for a number of countries at a variety of dates, and Maddison [1995] has esti-

22. In addition, industrialization may have been delayed in some cases because of a comparative advantage in agriculture.

mates of GDP for a larger group of countries. We take Bairoch's estimates of U. K. industrial output as a proxy for the opportunity to industrialize, since during this period the United Kingdom was the world industrial leader. We then run a panel data regression of the following form:

$$y_{it} = \mu_t + \delta_i + \pi \cdot X_{it} + \phi \cdot X_{it} \cdot UKIND_t + \epsilon_{it}, \quad (3)$$

where y_{it} is the outcome variable of interest in country i at date t. We consider industrial output per capita and income per capita as two different measures of economic success during the nineteenth century. In addition, μ_t's are a set of time effects, and δ_i's denote a set of country effects, $UKIND_t$ is industrial output in the United Kingdom at date t, and X_{it} denotes the measure of institutions in country i at date t. Our institutions variable is again constraint on the executive from the Gurr Polity III data set. As noted above, this variable is available from the date of independence for each country. Since colonial rule typically concentrated political power in the hands of a small elite, for the purpose of the regressions in this table, we assign the lowest score to countries still under colonial rule. The coefficient of interest is ϕ, which reflects whether there is an interaction between good institutions and the opportunity to industrialize. A positive and significant ϕ is interpreted as evidence in favor of the view that countries with institutions of private property took better advantage of the opportunity to industrialize. The parameter π measures the direct effect of institutions on industrialization, and is evaluated at the mean value of $UKIND_t$.

The top panel of Table IX reports regressions of equation (3) with industrial output per capita as the left-hand-side variable (see the note to the table for more details). Column (1) reports a regression using only pre-1950 data. The interaction term ϕ is estimated to be 0.132, and is highly significant with a standard error of 0.26. Note that Bairoch's estimate of total U. K. industrialization, which is normalized to 100 in 1900, rose from 16 to 115 between 1800 and 1913. In the meantime, the U. S. per capita production grew from 9 to 126, whereas India's per capita industrial production *fell* from 6 to 2. Since the average difference between the constraint on the executive in the United States and India over this period is approximately 6, the estimate implies that the U. S. industrial output per capita should have increased by 78 points more than India's, which is over half the actual difference.

In column (2) we extend the data through 1980, again with no effect on the coefficient, which stays at 0.132. In columns (3) and (4) we investigate whether independence impacts on industrialization, and whether our procedure of assigning the lowest score to countries still under colonial rule may be driving our results. In column (3) we include a dummy for whether the country is independent, and also interact this dummy with U. K. industrialization. These variables are insignificant, and the coefficient on the interaction between U. K. industrialization and institutions, ϕ, is unchanged (0.145 with standard error 0.035). In column (4) we drop all observations from countries still under colonial rule, and this again has no effect on the results (ϕ is now estimated to be 0.160 with standard error 0.048).

In columns (5) and (6) we use average institutions for each country, $\bar{X}_i$, rather than institutions at date t, so the equation becomes

$$y_{it} = \mu_t + \delta_i + \phi \cdot \bar{X}_i \cdot UKIND_t + \epsilon_{it}.$$

This specification may give more sensible results if either variations in institutions from year to year are endogenous with respect to changes in industrialization or income, or are subject to measurement error. ϕ is now estimated to be larger, suggesting that measurement error is a more important problem than the endogeneity of the changes in institutions.

An advantage of the specification in columns (5) and (6) is that it allows us to instrument for the regressor of interest $\bar{X}_i \cdot UKIND_t$, using the interaction between U. K. industrialization and our instrument for institutions, log settler mortality M_i (so the instrument here is $M_i \cdot UKIND_t$). Once again, institutions might differ across countries because more productive or otherwise different countries have different institutions, and in this case, the interaction between industrialization and institutions could be capturing the direct effects of these characteristics on economic performance. To the extent that log settler mortality is a good instrument for institutions, the interaction between log settler mortality and U. K. industrialization will be a good instrument for the interaction between institutions and U. K. industrialization. The instrumental-variables procedure will then deal with the endogeneity of institutions, the omitted variables bias, and also the attenuation bias due to measurement error. The

TABLE IX
THE INTERACTION OF U. K. INDUSTRIALIZATION AND INSTITUTIONS

	Former colonies, using only pre-1950 data (1)	Former colonies, using data through 1980 (all data) (2)	Former colonies, using only pre-1950 data (3)	Former colonies, using only data pre-1950 and for independent countries (4)	Former colonies, with average institutions for each country, using only pre-1950 data (5)	Former colonies, with average institutions for each country, using only pre-1590 data (6)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (7)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (8)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (9)	Former colonies, with average institutions for each country, instrumenting using settler mortality, only pre-1950 data (10)
Panel A: Dependent variable is industrial production per capita										
U. K. industrialization *institutions	0.132	0.132	0.145	0.160	0.202	0.206	0.168	0.169	0.156	0.158
	(0.026)	(0.027)	(0.035)	(0.048)	(0.019)	(0.022)	(0.030)	(0.032)	(0.065)	(0.065)
Institutions	8.97	−3.36	10.51	7.48						
	(2.30)	(4.46)	(3.50)	(9.51)						
Independence			−14.3			−6.4		1.1		2.0
			(22.9)			(11.4)		(12.6)		(14.2)
U. K. industrialization *independence			−0.12			−0.042		0.046		0.06
			(0.21)			(0.12)		(0.13)		(0.17)
U. K. industrialization *latitude									0.13	0.12
									(0.50)	(0.48)
R^2	0.75	0.74	0.75	0.84	0.89	0.89	0.88	0.88	0.87	0.87
Number of observations	59	75	59	32	59	59	59	59	59	59

Panel B: Dependent variable is log GDP per capita

Log U. K. industrialization	0.078	0.060	0.073	0.079	0.135	0.130	0.159	0.150	0.116	0.111
*institutions	(0.022)	(0.017)	(0.027)	(0.025)	(0.021)	(0.026)	(0.032)	(0.038)	(0.067)	(0.073)
Institutions	−0.027	−0.084	−0.10	−0.11						
	(0.025)	(0.028)	(0.04)	(0.04)						
Independence			0.67			0.12		0.10		0.019
			(0.27)			(0.13)		(0.13)		(0.16)
Log U. K. industrialization			0.035			−0.008		−0.042		0.016
*independence			(0.12)			(0.093)		(0.11)		(0.14)
Log U. K. industrialization									0.42	0.42
*latitude									(0.49)	(0.54)
R^2	0.95	0.92	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.96
Number of observations	79	131	79	46	79	79	79	79	79	79

Standard errors are in parentheses. All columns report panel regressions with country and period dummies included. Dependent variable in Panel A is industrial output per capita 1750–1980 from Bairoch [1982]. Dependent variable in Panel B is log GDP per capita 1830–1980 from Maddison [1995]. The institutions variable is "Constraint on the executive," which is an assessment of the constitutional limitations on executive power. The independent variable of interest is total U. K. industrial output interacted with constraint on the executive in each country from the Polity III data set. The main effect of institutions is evaluated at the mean value of U. K. industrialization. Polity III provides information only for independent countries; if a country was a colony at a particular date, we assign the lowest value of constraints on the executive, which is 1. Average institutions are calculated over the values in Polity III for 1750, 1800, 1830, 1860, 1880, 1913, and 1928.

We have an unbalanced panel with the following observations. For industrial output we have data on Australia, Brazil, Canada, India, Mexico, New Zealand, South Africa, and the United States. In the panel regressions for GDP per capita before 1950, we have data on these countries (except South Africa) plus Argentina, Bangladesh, Burma/Myanmar, Chile, Colombia, Egypt, Ghana, India, Indonesia, Pakistan, Peru, and Venezuela. In addition, for the regression using GDP per capita data through 1980, we are also able to include Ethiopia, Ivory Coast, Kenya, Morocco, Nigeria, South Africa, Tanzania, and Zaire. We have data for the following dates: 1750, 1800, 1830, 1860, 1880, 1913, 1928, 1953, and 1980, although not for all countries for all dates. For detailed sources and descriptions see Appendix 2.

2SLS estimates reported in columns (7) and (8) are very similar to the OLS estimates in columns (5) and (6), and are highly significant.[23]

In columns (9) and (10) we add the interaction between latitude and industrialization. This is useful because, if the reason why the United States surged ahead relative to India or South America during the nineteenth century is its geographic advantage, our measures of institutions might be proxying for this, incorrectly assigning the role of geography to institutions. The results give no support to this view: the estimates of ϕ are affected little and remain significant, while the interaction between industrialization and latitude is insignificant. Panel B of Table IX repeats these regressions using log GDP per capita as the left-hand-side variable (the interaction term is now as $M_i \cdot \ln(UKIND_t)$ since the left-hand-side variable is log of GDP per capita). The results are broadly similar to those in Panel A.

Overall, these results provide support for the view that institutions played an important role in the process of economic growth and in the surge of industrialization among the formerly poor colonies, and via this channel, account for a significant fraction of current income differences.

VI. Conclusion

Among the areas colonized by European powers during the past 500 years, those that were relatively rich in 1500 are now relatively poor. Given the crude nature of the proxies for prosperity 500 years ago, some degree of caution is required, but the broad patterns in the data seem uncontroversial. Civilizations in Meso-America, the Andes, India, and Southeast Asia were richer than those located in North America, Australia, New Zealand, or

23. Despite our instrumental-variables strategy, the interaction between institutions and the opportunity to industrialize may capture the possible interaction between industrialization and some country characteristics correlated with our instrument. For example, with an argument along the lines of Nelson and Phelps [1966] or Acemoglu and Zilibotti [2001], one might argue that industrial technologies were appropriate only for societies with sufficient human capital, and that there were systematic cross-country differences in human capital correlated with institutional differences. This interpretation is consistent with our approach, since the correlation between institutions and human capital most likely reflects the fact that in societies with extractive institutions the masses typically did not or could not obtain education. In other words, low levels of human capital may have been a primary mechanism through which extractive institutions delayed industrialization.

the southern cone of Latin America. The intervention of Europe reversed this pattern. This is a first-order fact, both for understanding economic and political development over the past 500 years, and for evaluating various theories of long-run development.

This reversal in relative incomes is inconsistent with the simple geography hypothesis which explains the bulk of the income differences across countries by the direct effect of geographic differences, thus predicting a high degree of persistence in economic outcomes. We also show that the timing and nature of the reversal do not offer support to sophisticated geography views, which emphasize the time-varying effects of geography. Instead, the reversal in relative incomes over the past 500 years appears to reflect the effect of institutions (and the institutional reversal caused by European colonialism) on income today.

Why did European colonialism lead to an institutional reversal? And how did this institutional reversal cause the reversal in relative incomes and the subsequent divergence in income per capita across the various colonies? We argued that the institutional reversal resulted from the differential profitability of alternative colonization strategies in different environments. In prosperous and densely settled areas, Europeans introduced or maintained already-existing extractive institutions to force the local population to work in mines and plantations, and took over existing tax and tribute systems. In contrast, in previously sparsely settled areas, Europeans settled in large numbers and created institutions of private property, providing secure property rights to a broad cross section of the society and encouraging commerce and industry. This institutional reversal laid the seeds of the reversal in relative incomes. But most likely, the scale of the reversal and the subsequent divergence in incomes are due to the emergence of the opportunity to industrialize during the nineteenth century. While societies with extractive institutions or those with highly hierarchical structures could exploit available agricultural technologies relatively effectively, the spread of industrial technology required the participation of a broad cross section of the society—the smallholders, the middle class, and the entrepreneurs. The age of industry, therefore, created a considerable advantage for societies with institutions of private property. Consistent with this view, we documented that these societies took much better advantage of the opportunity to industrialize.

Appendix 1: Urbanization Estimates

This is a shortened version of the Appendix in Acemoglu, Johnson, and Robinson [2001b].

1. Urbanization in 1500

Our base estimates for 1500 consist of Bairoch's [1988] assessment of urbanization augmented by the work of Eggimann [1999]. Merging these two series requires us to convert Eggimann's estimates, based on a minimum population threshold of 20,000, into Bairoch-equivalent urbanization estimates, based on a minimum population threshold of 5000.

To construct our base data, we run a regression of Bairoch estimates on Eggimann estimates for all countries where they overlap in 1900 (the year for which we have the largest number of Bairoch estimates for non-European countries). There are thirteen countries for which we have good overlapping data. This regression yields a constant of 6.6 and a coefficient of 0.67.

We use these results to convert from Eggimann to Bairoch-equivalent urbanization estimates in Colombia, Ecuador, Guatemala (and other parts of Central America), Mexico, and Peru in the Americas. We also use this method for all North African countries and for India (and the rest of the Indian subcontinent), Indonesia, Malaysia, Laos, Burma/Myanmar, and Vietnam in Asia. See Appendix 2 for the precise numbers we use.

There are a number of countries for which Bairoch determines that there was no real urbanization or no pre-European "settled agriculture." In these cases, a reasonable interpretation of Bairoch is that there was no urban population using his definition. In our baseline data we therefore assume zero urbanization for the following countries: Argentina, Brazil, Canada, Chile, Guyana, Paraguay, Uruguay, the United States, and Australia.

For countries where Bairoch determines there was some low level of urbanization, associated with fairly primitive agriculture, he assesses that the urbanization rate was 3 percent. We use this estimate for Cuba, the Dominican Republic, Haiti, and Jamaica in the Americas. We also use this estimate for Hong Kong, the Philippines, and Singapore in Asia and for New Zealand. In the Appendix of Acemoglu, Johnson, and Robinson [2001b], we present qualitative evidence documenting the low levels of urbanization in countries with assigned values of 0 percent or 3 percent urbanization in our baseline data.

While the data on sub-Saharan Africa are worse than for any other region, it is clear that urbanization before 1500 was at a higher level than North America or Australia (see the Appendix of Acemoglu, Johnson, and Robinson [2001b] for detailed discussion and sources). Given the weakness and incompleteness of data for sub-Saharan Africa, we do not include any estimates in our baseline urbanization data set. We do, however, include all of sub-Saharan Africa in our baseline population density data.

We have checked the robustness of our results using alternative methods of converting Eggimann estimates into Bairoch-equivalent numbers. We have calculated conversion ratios at the regional level (e.g., for North Africa and the Andean region separately). We have also constructed an alternative series using a conversion rate of 2, as suggested by Davis' and Zipf's Laws (see Bairoch [1988], Chapter 9.)[24] We have also used Bairoch's overall assessment of urbanization for broad regions, e.g., Asia, without the more detailed information from Eggimann (see the Appendix in Acemoglu, Johnson, and Robinson [2001b] for more detail). We have also used estimates just from Bairoch, just from Eggimann, and just from Chandler. See Table IV for relevant regressions.

Our baseline estimates and the most plausible alternative series are shown in Appendix 2. We have also calculated urbanization rates for all European countries and non-European countries that were never colonized. We have also checked Bairoch's estimates carefully for these countries against the work of Bairoch, Batou, and Chèvre [1988], Chandler and Fox [1974], de Vries [1984], and Hohenberg and Lees [1985]. Our discussion of urbanization in European and never colonized countries is not reported here to conserve space, but it is available from the authors.

2. *Urbanization from 1500 to 2000*

Eggimann's data only cover countries that are now part of the "Third World." He therefore does not provide any information on the timing of urbanization changes in settler colonies. Bairoch does have some information on urbanization in the United States, Canada, and Australia, but only from 1800 [Bairoch 1988, Table 13.4, p. 221]. For a more complete picture of urbanization from 800 to 1850 across a wide range of countries, we therefore rely

24. We are using a conservative version of Davis' law. See the Appendix in Acemoglu, Johnson, and Robinson [2001b] for a more detailed discussion.

primarily on Chandler's estimates. We should emphasize, however, that wherever there is overlapping information, these estimates are broadly consistent with the findings of Eggimann and Bairoch.[25] As before, we convert urban population numbers into urbanization using population estimates from McEvedy and Jones [1978].

Chandler's data enable us to see changes in urbanization over time across countries, but because his series ends in 1850 (or 1861 for the Americas), we cannot follow the most important trends into the twentieth century. In addition, Chandler's data are reported at 50-year intervals from 1700 (100-year intervals before that), which is only enough to show the broad pattern.

We therefore supplement the analysis with data from two other sources. The UN [1969] provides detailed urbanization data from 1920, focusing on localities with 20,000 or more inhabitants (i.e., the same criterion as Chandler uses outside of Asia). However, this still leaves a gap between 1850 and 1920.

We complete this composite series using data from Mitchell [1993, 1995]. His urbanization data start in 1750, provide information every ten years from 1790 for most countries, and run to 1980. The only disadvantage of this series is the relatively late starting date. The criterion for inclusion in Mitchell's series is also a little different—cities that had at least 200,000 inhabitants around 1970—but this seems to produce broadly consistent estimates for overlapping observations. We use these data both to complete the Chandler series for Mexico, India, and the United States (see Figure IVa) and to provide alternative estimates for the timing of urbanization changes within the Americas.

The data shown in Figure IVa are from Chandler (through 1850), Mitchell (for 1900), and the UN (for 1920 and 1930), converted to Bairoch-equivalent units using the conservative Zipf-Davis adjustment (i.e., multiplying the estimates by 2).

25. The only point of disagreement is whether there was any urbanization in the area now occupied by the United States in 1500. Chandler lists one town (Nanih Waiya) but does not give its population. He also does not indicate any urbanization either before or after this date. Bairoch argues there was no pre-European urbanization and the latest archaeological evidence suggests villages rather than towns [Fagan 2000]. We therefore follow Bairoch in assigning a value of zero. For supportive evidence see Waldman [1985, p. 30].

APPENDIX 2: VARIABLE DEFINITIONS AND SOURCES

Variable	Description	Source
Log GDP per capita (PPP) in 1995	Logarithm of GDP per capita, on Purchasing Power Parity Basis, in 1995.	World Bank, World Development Indicators, CD-Rom, 1999. Data on Suriname is from the 2000 version of this same source.
Log GDP per capita in 1900 and 1950	Logarithm of GDP per capita in 1900 and 1950.	Maddison [1995] for 1950; Bairoch [1978] for 1900.
Industrial output per capita	Index of industrialization with Britain in 1900 equal to 100.	Bairoch [1982].
Total U. K. industrial output	Index equal to 100 in 1900.	Bairoch [1982].
Log population density in 1 A.D., 1000, and 1500 (also log population in 1500 and log arable land in 1500)	Logarithm of population density (total population divided by total arable land) in 1 A.D., 1000, 1500.	McEvedy and Jones [1978].
Urbanization in 1960 and 1995	Percent of population living in urban areas in 1960 and 1995, as defined by the UN (typically 20,000 minimum inhabitants).	World Bank, World Development Indicators, CD-Rom, 1999. For more detail, see p. 159 of the World Bank's World Development Indicators 1999 (hard copy).
Urbanization in 1000, 1500, and 1700	Percent of population living in urban areas with a population of at least 5000 in 1000, 1500, and 1700.	Bairoch and supplemental sources, as described in Appendix 1.
European settlements in 1800 and 1900	Percent of population that was European or of European descent in 1800 and 1900. Ranges from 0 to 0.99 in our base sample.	McEvedy and Jones [1978] and other sources listed in Appendix Table 5 of Acemoglu, Johnson, and Robinson [2000].
Average protection against expropriation risk, 1985–1995	Risk of expropriation of private foreign investment by government, from 0 to 10, where a higher score means less risk. We calculated the mean value for the scores in all years from 1985 to 1995.	Data set obtained directly from Political Risk Services, September 1999. These data were previously used by Knack and Keefer [1995] and were organized in electronic form by the IRIS Center (University of Maryland). The original compilers of these data are Political Risk Services.

APPENDIX 2
(CONTINUED)

Variable	Description	Source
Constraint on executive in 1970, 1990, and first year of independence	A seven-category scale, from 1 to 7, with a higher score indicating more constraints. Score of 1 indicates unlimited authority; score of 3 indicates slight to moderate limitations; score of 5 indicates substantial limitations; score of 7 indicates executive parity or subordination. Scores of 2, 4, and 6 indicate intermediate values.	Polity III data set, downloaded from Inter-University Consortium for Political and Social Research. Variable described in Gurr [1997].
Percent of European descent in 1975 religion variables	Percent of population that was European or of European descent in 1975. Ranges from 0 to 1 in our base sample.	McEvedy and Jones [1978].
	Percentage of the population that belonged in 1980 (or for 1990–1995 for countries formed more recently) to the following religions: Roman Catholic, Protestant, Muslim, and "other."	La Porta et al. [1999].
Colonial dummies	Dummy variable indicating whether country was a British, French, German, Spanish, Italian, Belgian, Dutch, or Portuguese colony.	La Porta et al. [1999].
Temperature variables	Temperature variables are average temperature, minimum monthly high, maximum monthly high, minimum monthly low, and maximum monthly low, all in centigrade.	Parker [1997].

Humidity variables	Humidity variables are morning minimum, morning maximum, afternoon minimum, and afternoon maximum, all in percent	Parker [1997].
Soil quality	Measures of soil quality/climate are steppe (low latitude), desert (low latitude), steppe (middle latitude), desert (middle latitude), dry steppe wasteland, desert dry winter, and highland.	Parker [1997].
Natural resources	Measures of natural resources are percent of world gold reserves today, percent of world iron reserves today, percent of world zinc reserves today, percent of world silver reserves today, and oil resources (thousands of barrels per capita today).	Parker [1997].
Coal	Dummy variable equal to 1 if country has produced coal since 1800.	World Resources Institute [1998] and Etemad and Toutain [1991].
Landlocked	Dummy variable equal to 1 if country does not adjoin the sea.	Parker [1997].
Island	Dummy variable equal to 1 if country is an island.	DK Publishing [1997].
Latitude	Absolute value of the latitude of the country, scaled to take values between 0 and 1, where 0 is the equator.	La Porta et al. [1999].
Log mortality	Log of estimated settler mortality. Settler mortality is calculated from the mortality rates of European-born soldiers, sailors, and bishops when stationed in colonies. It measures the effects of local diseases on people without inherited or acquired immunities.	Acemoglu, Johnson, and Robinson [2001a], based on Curtin [1989] and other sources.

APPENDIX 3

	Base urbanization estimate in 1500	Source of base urbanization estimate in 1500	Urbanization estimate in 1500 using only information from Bairoch	Urbanization estimate in 1500 using only information from Eggimann	Urbanization estimate in 1500 using only information from Chandler	Davis-Zipf adjustment applied to Eggimann series	Population density in 1500		Population density in 1500		Population density in 1500
	Former colonies included in our base sample for urbanization							Former colonies included in base sample for population density but not for urbanization			
Argentina	0.0	Bairoch	0.0	0.0	0.0	0.0	0.11	Angola	1.50	Sudan	14.03
Australia	0.0	Bairoch	0.0	0.0	0.0	0.0	0.03	Bahamas	1.46	Suriname	0.21
Bangladesh	8.5	Eggimann converted to Bairoch	9.0	2.9	.	5.8	23.70	Barbados	1.46	Tanzania	1.98
Belize	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Benin	4.23	Togo	4.23
Bolivia	10.6	Eggimann (Ecuador and Bolivia) converted to Bairoch	12.0	6.0	.	12.0	0.83	Botswana	0.14	Trinidad and Tobago	1.46
Brazil	0.0	Bairoch	0.0	0.1	.	0.2	0.12	Burkina Faso	4.23	Uganda	7.51
Canada	0.0	Bairoch	0.0	0.0	0.0	0.0	0.02	Burundi	25.00	Zaire	1.50
Chile	0.0	Bairoch	0.0	0.0	0.0	0.0	0.80	Cameroon	1.50	Zambia	0.79
Colombia	7.9	Eggimann converted to Bairoch	7.0	2.0	2.0	4.0	0.96	Cape Verde	0.50	Zimbabwe	0.79
Costa Rica	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	.	7.6	1.54	Central African Republic	1.50		
Dominican Republic	3.0	Bairoch	3.0	0.0	.	0.0	1.46	Chad	1.00		

Algeria	14.0	Eggimann converted to Bairoch	.	11.0	11.0	22.0	7.00	Comoros	4.48
Ecuador	10.6	Eggimann (Ecuador and Bolivia) converted to Bairoch	12.0	6.0	5.0	12.0	2.17	Congo	1.50
Egypt	14.6	Eggimann converted to Bairoch	.	11.9	12.4	23.8	100.46	Cote d'Ivoire	4.23
Guatemala	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Dominica	1.46
Guyana	0.0	Bairoch	0.0	0.0	.	0.0	0.21	Eritria	2.00
Hong Kong	3.0	Bairoch	3.0	0.0	0.0	0.0	0.09	Ethiopia	6.67
Honduras	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Gabon	1.50
Haiti	3.0	Bairoch	3.0	0.0	.	0.0	1.32	Gambia	4.23
Indonesia	7.3	Eggimann (Indonesia and Malaysia) converted to Bairoch	9.0	1.0	0.5	2.0	4.28	Ghana	4.23
India	8.5	Eggimann converted to Bairoch	9.0	2.9	1.8	5.8	23.70	Grenada	1.46
Jamaica	3.0	Bairoch	3.0	0.0	.	0.0	4.62	Guinea	4.23
Laos	7.3	Eggimann (Laos and Vietnam) converted to Bairoch	9.0	10.0	10.0	20.0	1.73	Kenya	2.64
Sri Lanka	8.5	Eggimann converted to Bairoch	9.0	2.9	.	5.8	15.47	Lesotho	0.49
Morocco	17.8	Eggimann converted to Bairoch	.	16.7	21.3	33.3	9.08	Madagascar	1.20
Mexico	14.8	Eggimann converted to Bairoch	7.0	12.3	6.5	24.6	2.62	Malawi	0.79

APPENDIX 3
(CONTINUED)

	Base urbanization estimate in 1500	Source of base urbanization estimate in 1500	Urbanization estimate in 1500 using only information from Bairoch	Urbanization estimate in 1500 using only information from Eggimann	Urbanization estimate in 1500 using only information from Chandler	Davis-Zipf adjustment applied to Eggimann series	Population density in 1500		Population density in 1500	Population density in 1500
	Former colonies included in our base sample for urbanization							Former colonies included in base sample for population density but not for urbanization		
Malaysia	7.3	Eggimann (Indonesia and Malaysia) converted to Bairoch	9.0	1.0	0.5	2.0	1.22	Mali	1.00	
Nicaragua	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Mauritania	3.00	
New Zealand	3.0	Bairoch	3.0	0.0	.	0.0	0.37	Mozambique	1.28	
Pakistan	8.5	Eggimann converted to Bairoch	9.0	2.9	.	5.8	23.70	Namibia	0.14	
Panama	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Nepal	13.99	
Peru	10.5	Eggimann converted to Bairoch	12.0	5.8	2.5	11.6	1.56	Niger	1.00	
Philippines	3.0	Bairoch	3.0	0.0	.	0.0	1.68	Nigeria	4.23	
Paraguay	0.0	Bairoch	0.0	0.0	.	0.0	0.50	Rwanda	25.00	
Singapore	3.0	Bairoch	3.0	0.0	0.0	0.0	0.09	Swaziland	0.49	

El Salvador	9.2	Eggimann (3.8%) converted to Bairoch	7.0	18.0	19.6	7.6	1.54	Senegal	4.23
Tunisia	12.3	Eggimann converted to Bairoch	.	8.1	11.3	16.3	11.70	Sierra Leone	4.23
Uruguay	0.0	Bairoch	0.0	0.0	.	0.0	0.11	South Africa	0.49
U. S. A.	0.0	Bairoch	0.0	0.0	0.0	0.0	0.09	St. Lucia	1.46
Venezuela	0.0	Bairoch	0.0	0.0	.	0.0	0.44	St. Vincent	1.46
Vietnam	7.3	Eggimann (Laos and Vietnam) converted to Bairoch	9.0	10.0	2.0	20.0	6.14	St. Kitts and Nevis	1.46

Our base urbanization estimates are constructed using information from Bairoch and a conversion from Eggimann's estimates to Bairoch-equivalent estimates (as explained in the text and Appendix 1). Bairoch-only estimates use 9 percent for all Asian countries, 7 percent for Central America and Colombia, 12 percent for Andean countries, 3 percent for countries with minimal urbanization, and 0 percent for all other countries in our base sample. Eggimann-only estimates are not adjusted to Bairoch-equivalent units, and we use zero for countries in his data set without any urban population in 1500. Chandler-only estimates are not adjusted to Bairoch-equivalent units, and we use a value of zero for countries that are in his data set and for which he does not indicate any urban population in 1500. The Davis-Zipf adjustment doubles Eggimann's estimates but uses a low estimate for Central America (details are in the Appendix of Acemoglu, Johnson, and Robinson [2001b]. Population density numbers are calculated from population in McEvedy and Jones [1978]. We divide estimated population in 1500 by land area in 1995 (from World Bank [1999]), adjusted for arable land area using the estimates in McEvedy and Jones [1978]. Where McEvedy and Jones [1978] only provide a regional population estimate, we use their regional land area estimate adjusted for arable land.

In some cases McEvedy and Jones [1978] only provide regional estimates of population in 1500. We therefore use regional averages of population density for: West Africa (Senegal, Gambia, Guinea, Sierra Leone, Ivory Coast, Ghana, Burkina Faso, Togo, Benin, and Nigeria); West-Central Africa (Cameroon, Central African Republic, Gabon, Congo, Zaire, and Angola); Rwanda and Burundi; South-Central Africa (Zambia, Zimbabwe, and Malawi); South Africa, Swaziland, and Lesotho; Namibia and Botswana; the Sahel States (Mauritania, Mali, Niger, and Chad—based on qualitative evidence we assume a slightly higher population density in Mauritania); Eritrea and Ethiopia (based on qualitative evidence we assume a higher population density in Ethiopia); Central America (Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, and Panama); Guyana and Suriname are calculated from the average for all the Guyanas; and Pakistan, India, and Bangladesh are calculated from the average for the Indian subcontinent. The population density in Uruguay is assumed to be the same as in Argentina in 1500. Singapore and Hong Kong are assumed to have the same population density as the United States in 1500. Smaller Caribbean islands are assumed to have the same population density as the Dominican Republic in 1500.

A period (.) denotes missing data. For further discussion of sources, see Appendix 1.

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