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ABSTRACT

This study uses state-level variation in labor productivity levels at twenty-year intervals between 1880 and 1980 to examine the relative importance of institutional and geographical influences in explaining observed and persistent differences in standards of living over time and across regions. Focusing on fundamental rather than proximate influences, we find that both institutional characteristics and some physical geography characteristics account for a high proportion of the differences in state productivity levels: states with navigable waterways, a large minerals endowment, and no slaves in 1860, on average, had higher labor productivity levels throughout the sample period. However, we find little support for two other influences that have previously received attention – climate and latitude.

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1. Introduction

A major issue in the literature on growth concerns the importance of institutional factors relative to geographical influences in determining why some countries are rich and others poor. Especially in studies that focus on the deeper rather than proximate sources of growth, debate has centered on whether a country's economic fortune is locked in by physical features or whether institutional factors, often regarded as endogenous, influence its trajectory. As a complement to the long-standing interest of economic historians in these issues (North and Thomas, 1973, Jones, 1981, Rosenberg and Birdzell, 1986, Landes, 1998, and Pomeranz, 2000), recent studies by economists (Hall and Jones, 1996, 1999) have departed from the standard methodology of accounting for the variation in growth rates and instead focused attention on explaining variation in income or productivity *levels* across countries.[1]

Recently, the debate has been sharpened by attempts to marshal a wider range of data than typically used in the empirical growth literature, and assess directly the relative influence of institutions and geography – both broadly defined – in cross-country regressions. Several authors have stressed the geographical correlates of income per capita, such as latitude, the disease environment, access to navigable water, and distance from the principal centers of the world economies (Gallup, Sachs, and Mellinger, 1999; Mellinger, Sachs, and Gallup, 1999). This approach has been advocated especially in attempts to account for the relatively poor recent performance of sub-Saharan economies (Bloom and Sachs, 1998). However, Acemoglu,

[1] For surveys of the empirical cross-country growth literature, nearly all of which examine growth rates rather than

Johnson, and Robinson (2001b) have argued that, although geographical attributes may appear correlated with economic performance, the more influential determinants are institutional in nature.[2]

This article provides a fresh empirical approach for assessing the relative importance of institutions versus geography in explaining differences in standards of living over time. We exploit the extraordinary range in productivity levels that existed across the U.S. states (Figure 1) over the past century as well as the methodological advantages that result from examining the variation *within* a country rather than across countries to advance this debate. In 1880 the United States was poised to overtake Britain as the most efficient industrial economy, and become the century-long benchmark against which all other economies' productivity performance would be compared. Yet in that year, labor productivity in the least productive state (North Carolina) was a mere 18 percent of that in the most productive (Nevada). Excluding the case of Nevada because of its early stage of settlement and very small population, a comparison with the second and third most productive states, California and New York, indicates North Carolina as being only 23.6 and 24.4 percent as productive, respectively.[3] Differences of such magnitude between countries would today only be found in comparisons between developed and developing economies.[4] Until 1940 this wide range of productivity levels narrowed only gradually, when the least productive state had a level of labor productivity 25 percent that of the most productive. Thereafter the gap narrowed more rapidly, with the least productive state reaching 61 percent of the level of the most productive in 1980. Just as the existence of large productivity gaps between

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levels, see Temple (1999) and Barro and Sala-i-Martin (1995).

[2] For related discussion, see McArthur and Sachs (2001).

[3] This wide variation persists even when states are aggregated into regions. The South Atlantic region had a level of labor productivity only 38 per cent that of the Pacific region (Mitchener and McLean, 1999).

[4] For example, GDP per worker in both Morocco and Thailand was approximately 18 percent of that in the United States in 1990.

countries constitutes a major analytical and policy challenge to growth economists, accounting for the wide disparities in state productivity differences in the late nineteenth century United States, and their persistence well into the twentieth century, poses a related challenge, and one that has not been directly addressed.[5]

Given these large productivity differences, the experience of U.S. states provides an alternative laboratory for testing whether institutions or geography matter, and one that has several advantages. By employing regional data from within a country to analyze variation in productivity levels, the approach of this paper is less susceptible to omitted variables bias than the cross-country approach.[6] Just as languages, cultures, and technology flows differ markedly across countries, institutional differences are almost certainly more pronounced across countries than across U.S. states. This is not to deny a role for institutions in explaining differences in productivity across states; indeed, institutions still play a prominent role in our story. Rather it is to point out that identifying observable differences or accounting for unobservable differences is likely to be less of a problem in our case compared to the cross-country approach. Moreover, since institutional differences are more muted within the U.S. and detailed climate data have been collected on U.S. states for quite some time, the within-country sample should permit a

[5] Since the U.S. average level of labor productivity is the weighted sum of that of the states, no account of the sustained rise in U.S. productivity levels over the past century is going to be complete without an understanding of the forces producing the changing regional contributions to that outcome. A second reason for attempting to account for the range in productivity levels across states is that the variation in state labor productivity accounts, in turn, for the major part of the variation in their living standards. Differences in the level of nominal income per capita between states in any year can be decomposed into three elements: differences in prices, labor input per capita, and a 'residual' measure of labor productivity. Only a small portion of the variation in incomes across states in any of the six years in the study is due to variation in prices - from minus one to plus 16 percent. Variation in labor input per capita contributes between 9 and 28 percent across these dates. The remaining difference in income levels (56 to 84 per cent) is attributed to variations in the average efficiency of workers. This analysis is reported in Mitchener and McLean (1999).

[6] It might be suggested that a greater degree of domestic than international labor mobility should be recognized as an important difference between interstate and cross-country analysis. However, income convergence across countries does not require migration. And the historical evidence of sustained regional segmentation within the U.S. labor market is well known (for example, Wright, 1986, 1987).

cleaner test of whether differences in geography matter for standards of living.

To our knowledge, we are the first to analyze the determinants of variation in labor productivity levels over time rather than at a single point in time. Our paper uses a limited number of deeper determinants (such as geography and institutions) rather than proximate influences (such as investment in physical and human capital) to analyze differences in state productivity levels at twenty-year intervals between 1880 and 1980. Such an approach allows us to assess whether a small number of determinants are capable of explaining the variation in productivity levels for 100 years of U.S. history and to identify the influences that persist or wane.

We find that institutional characteristics, physical geography, and resource abundance together can account for a high proportion of the variation in state productivity level differences, especially at the beginning of the period studied. Even within a country, institutions play a prominent role and appear robust to the inclusion of geographical influences: the legacy of slavery has a strong and persistent effect on productivity levels across U.S. states. However, no consistent support was found for one other influence given prominence in the cross-country regressions of income or productivity levels in recent years, namely climate. We find some evidence that a (small) reversal of fortune took place between the colonial period and present, with initially low productivity states achieving high levels by 1980. This is consistent with the view that institutions contribute to the evolution of productivity differences across regions or countries.

Following a review of literature in the next section, section 3 explains the selection of our hypothesized key determinants of differences in productivity levels across states, drawing on the insights embedded in American economic historiography as well as recent growth analyses.

Section 4 discusses the data and also presents the empirical results from our core model, together with an assessment of their robustness by considering alternative proxies for the explanatory variables. The next three sections offer extensions and further testing of our core model. In Section 5, we use our data on U.S. states to further elucidate the nexus between latitude and climate. We also more closely examine our findings for the legacy of slavery variable and consider whether this institutional variable is endogenous (Section 6). Sections 7 and 8 extend our discussion to consider the influence of colonial origins on productivity and whether there has been a "reversal of fortune" in the economic performance of U.S. states. The main contributions and wider significance of our study are summarized in a concluding section.

2. Literature and Conceptual Framework

The problem of economic development is widely acknowledged as one of "accounting for the observed pattern, across countries and across times, in levels and rates of growth of per capita income" (Lucas, 1988, p.3). However, most theoretical and empirical research has primarily focused on the second half of this agenda – growth *rates*.[7] The approach of this paper, and a small but growing newer literature, is to explain why the substantial dispersion in per capita income or productivity *levels* exists.[8] Differences across countries in productivity levels usually result from the cumulative effect of a host of prior influences operating gradually and over long periods of time. Thus it is often difficult to detect the effects of such variables on growth rates, which may be imperceptible in the short to medium term, even though their eventual impact on

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[7] The relevant literature is well surveyed in Barro and Sala-i-Martin (1995) and Temple (1999).

[8] To be sure, economic historians have long been aware of these differences in income and productivity levels, and have also participated in the search for a suitable framework to explain them. For example, see Landes (1990), Gerschenkron (1962), Engerman and Sokoloff (1997), Jones (1981), Lal (1998), and Diamond (1997).

levels can be large. Yet, because growth rates over the very long run have been uneven, these level differences between countries are increasing.[9]

The new empirical literature has focused on explaining differences in income or productivity levels across countries. Gallup, Sachs and Mellinger (1999) argue that the variation in the level of per capita income is determined by geographical factors (tropical diseases, natural resource endowment per capita, distance from world markets, and the proportion of population near coasts), and political and institutional factors (quality of government institutions, openness to trade, and legacy of colonial rule). They report that the four geographic explanatory variables alone account for 69 per cent of the variation in per capita income levels across 83 countries in 1995. And in their study of cross-country levels of output per worker for 1988, Hall and Jones (1999) demonstrate that physical capital per worker, human capital per worker, and the Solow residual (and hence output per worker) can be accounted for by "social infrastructure," an index covering the quality of government as well as openness to international trade. Since social infrastructure is endogenous, they use measures of the historical extent of western European influence as instruments for the quality of government (distance from the equator, and the extent to which English or a major European language is spoken), and a measure of predicted trade share (based on population and geography) as the instrument for openness. Most of the observed variation in levels of output per worker is accounted for by social infrastructure.[10]

More recently, Acemoglu, Johnson and Robinson (2001a, 2001b) have sought to identify

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[9] This has led to the suggestion that "divergence in relative productivity levels and living standards is the dominant feature of modern economic history" (Pritchett 1997, p.3).

[10] The importance of non-conventional influences has likewise been stressed in studies of the determinants of labor productivity levels across U.S. states in recent years. Bernard and Jones (1996) highlight the relative size of particular sectors, and note especially that states with the highest private non-farm labor productivity levels after 1963 were also those with the highest shares of output originating in mining. And in an investigation of the sources of inter-state variation in gross state product per worker in 1988, Ciccone and Hall (1996) report that more than half can be attributed to the agglomeration effects arising from the density of employment. See also Ram (1999),

the deeper and historical determinants of differential development – and hence currently differing levels of per capita income – among countries that once were colonies of the European powers. In particular, they emphasize the importance of institutions in their comparative analysis of long-run economic performance. Geography mattered only in the sense of creating different disease environments for potential settlement. The authors argue that the disease environment facing potential settlers was crucial to the type of institutions that were put in place. Where white settler mortality rates were high, European immigration was low, and the transfer of European institutions was less than where the environment was more benign, as in the temperate-zone colonies of European settlement. In the former, population density and incomes per capita were relatively high, but the institutions established by the colonizers were less conducive to long-run growth, encouraging an extractive basis for economic activity. In the latter, where pre-colonial population density and incomes both tended to be low, but subsequent European immigration high, there occurred a more comprehensive transfer of institutions which, it is hypothesized, thereby enhanced long-run growth. The authors argue that a "reversal of fortune" in economic performance of the sometime colonies has occurred, and that institutions are the critical determinant in explaining this phenomenon.

This article strikes out on a new, but related path in order to further clarify the debate over the relative importance of institutions versus geography. Our objective is to account for the substantial differences in levels of labor productivity across U.S. states in 1880 and at twenty-year intervals thereafter. For this purpose, we identify fundamental influences (which we initially assume are exogenous) and proceed directly to estimate the relationship between output per worker and these hypothesized determinants. Such an approach will indicate either of two

Beeson, DeJong, and Troesken (2001) and Homes (1998).

possibilities: that a limited number of deeper determinants account for most level differences across time and place (a result comforting to the economist's desire to develop parsimonious models of general applicability) or that these fundamental influences are more numerous, and vary by period or place.

3. Determinants of Productivity Levels

Because we are not searching for that "model" which necessarily best fits each year in the study, considering that year in isolation, the list of candidate determinants is considerably shortened. In the absence of clear guidance from theory, our selection of deeper explanatory variables draws partly on cross-country studies, which suggest that certain fundamental influences on productivity levels such as locational advantage (or disadvantage), climate (especially the advantage of temperate over tropical zones in terms of disease environment, soil fertility, and working conditions), and natural resource endowment might apply fairly generally.[11] On the other hand, many institutional factors canvassed in the cross-country growth literature (for example, language, culture, religion, legal system, or political system) are not likely to be paramount in an inquiry confined within the borders of the United States.

Several of our fundamental determinants, including our primary institutional factor, are also based on evidence and debates that have been exhaustively evaluated by historians. From this rich literature we draw especially on one old and one new theme. The well-established theme is that in a major region of the economy, the South, income levels that were depressed during the Civil War did not converge on those in the rest of the country until after the 1930s.

[11] In addition to previously cited references, see also Collier and Gunning (1999), Masters and McMillan (2000),

The reasons for this delayed catch-up appear rooted in the institutional arrangements in the South dating from the end of slavery.[12] The new theme concerns the importance of natural resource abundance. Agricultural land was abundant in the 13 colonies, and the westward territorial expansion of the United States reinforced this favorable feature of the economy. However, Wright (1990) has argued that a related phenomenon, the discovery and exploitation of mineral resources, was significant in underpinning industrial development until 1940.[13] The following subsections discuss the theoretical and historical underpinnings of the institutional and geographical characteristics that we use to analyze the variation in productivity levels across U.S. states.

3.1. The Legacy of Slavery

The trajectory of the Southern economy was disrupted by important political and social events in the mid-nineteenth century. The Civil War (a negative shock) ushered in a well-known process of relative stagnation and delayed convergence from below. From 1860 to 1880, income levels in the South fell relative to the rest of the country and relative to its own 1860 level; incomes only began to converge rapidly in the post-WWII period. Emancipation triggered post-bellum institutional changes that altered the relationships between factors of production that may have had a negative impact on the efficiency of production and hence on southern levels of income per capita. For example, former slave owners could no longer determine the number of hours worked and the type of work carried out by the free blacks, nor could they necessarily

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and Temple and Johnson (1998).

[12] See Ransom and Sutch (1977) and Wright (1986).

[13] Thereafter, the basis of growth, and especially of economic leadership relative to other early-industrializing countries, shifted to knowledge-based activities (Nelson and Wright, 1992).

influence the efficiency of production through the control of nutrition and health. Furthermore, in both the workplace and southern society at large, discrimination and legal restrictions placed on ex-slaves may have limited their access to education or their ability to secure either physical capital or land. Denying productive agents these economic opportunities may have decreased the efficiency of production in the post-bellum era. The heterogeneous institutional response to the demise of slavery throughout the South therefore might be an important underlying determinant of differences in the observed productivity levels across states. And this negative influence on efficiency may have persisted for many decades, as the economic catch-up of the southern states began only in the 1930s.[14] To proxy the legacy of slavery, we use the percentage of the state population in 1860 that were slaves.[15] As slavery has been associated with a host of factors detrimental to productivity levels long after emancipation, the expected sign on this variable would be negative.[16]

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[14] Wright (1974, 1986) has argued that the antebellum growth in the South was unsustainable, with or without the war, due to the decline in worldwide demand for cotton. Alternatively, Ransom and Sutch (1977) have focused on the labor supply effects of African Americans in response to emancipation, suggesting that the decline in Southern output is attributable to a reduction in hours worked by former slaves. These explanations, and others by Temin (1976), Fogel and Engerman (1974), Brinkley (1997), and Irwin (1994), shed light on the decline in southern per capita income after the war.

[15] Slave population data are from the U.S. Census of 1860.

[16] Explanations for the convergence of the South on national levels of income and productivity in the second half of the 20th century are wide-ranging. Indeed, a vast literature exists on mechanisms linking the presence of slavery with lowered post-bellum income and productivity levels and delayed catch-up in these performance indicators with the rest of the country over the following century. Some examples include the rise of sharecropping in southern agriculture; the reduction of labor input following the abolition of a coercive plantation labor system; the failure of southern schooling to raise literacy and education levels among freedmen; the spread of legal discrimination based on race; the limited financial endowment of the freedmen at emancipation and hence the time taken to for them to accumulate assets; the territorial monopoly of sources of credit to freedmen resulting in debt peonage lock-in over many years; and the failure of a truly national labor market to emerge which included southern labor markets until after the 1930s. Surveys of this literature can be found in Ransom and Sutch (1977), Wright (1986, 1987) and O'Brien and Shade (2001).

3.2. Minerals Endowment

Economists have reached no consensus as to whether resource abundance spurs or inhibits growth. Sachs and Warner (1995b) have shown that, since 1960, resource-abundant countries have experienced lower growth rates, suggesting that it is a curse rather than a blessing to be resource rich. One hypothesis in support of this empirical evidence is that resource-based development is likely to be accompanied by heavy government involvement, and the political process encourages wasteful rent seeking.[17] On the other hand, Wright (1990) has suggested that much of the industrial success of the United States in the late nineteenth and early twentieth century was based on its ability to exploit quickly and efficiently its mineral resource base.[18] Particularly in frontier economies, where labor and capital are often in scarce supply, having a large initial endowment of resources, especially (but not limited to) minerals and fuels, may improve the opportunities for economic agents to acquire scarce factors quickly – to grow extensively, acquiring more capital and labor so the resource base can be further exploited.[19] This suggests that a region rich in readily extractable natural resources may record higher levels of output per worker.[20]

To test for the influence of resource endowment on productivity levels it would be ideal to have a measure of total natural resource stocks by state. However, state-level data on resource

[17] Matsuyama (1992) proposes an alternative model which suggests that countries choosing to exploit their comparative advantage in natural resources may lock themselves into a long-run, low growth path if the neglected manufacturing sector has more favorable externalities. See also Redding (1999).
[18] For a broader historical discussion of the role of natural resource abundance in American economic growth, see Abramovitz and David (1996).
[19] Related themes are developed in Findlay (1995, Chapters 5 and 6).
[20] Some fairly direct support is reported by Bernard and Jones (1996) in their study of productivity by sector across U.S. states since 1963: those states with more than 20 percent of private non-farm product originating in mining have higher levels of labor productivity than non-mining states. Indirect support is provided by Gallup, Sachs and Mellinger (1999) who find that levels of per capita income across countries in 1995 are positively related to deposits of natural resources.

stocks are unavailable, and production data for some minerals are difficult to assign by state (major mines cross state borders and historical statistics often assign quantities or values to states where mining companies were located rather than where the resources were mined). Hence, we use the share of employment in mining in 1880 as a measure of natural resource abundance in a state.[21] (Summary statistics of this and other explanatory variables are reported in Table 1.) A positive sign would be consistent with the frontier economy and Wright hypotheses.

3.3. Climate

In an era where air conditioning, heating, and climate control are standard in the workplace, it is difficult to think that climate significantly reduces any state's average labor productivity. In 1880, however, weather may have severely altered both the hours worked and the level of efficiency at which one worked. The notion that climate influences work effort and thus productivity actually has a long tradition dating back at least to the 16th century and the writings of Machiavelli (Acemoglu, Johnson, and Robinson, 2001a).[22] As U.S. statistics on weather and temperature at the state level are quite detailed, we can assess the climate hypothesis more explicitly than has been possible in many cross-country studies. We used the average annual number of cooling degree days as our initial climate proxy – a measure which NOAA uses to determine the need for air conditioning in buildings.[23] Maine records the lowest value of this measure of climate, while Arizona has the highest. If heat impaired labor productivity (reflecting the disadvantages of working without air conditioning), then the expected sign on this variable will be negative; moreover, it will decline in importance over the sample period

[21] For Oklahoma, we use the figure for 1900. Our data sources are Miller and Brainerd (1957), Perloff et al (1960),

especially after 1940 as the use of air conditioning diffuses.

3.4. Locational Advantage and Trade

In country studies, the growth rate and the level of per capita income are both shown to be positively related to the openness of the economy, conventionally measured as the ratio of total trade (exports plus imports) to income.[24] Other cross-country studies have emphasized physical impediments to trade as reflected in such geographic features as access to a coast or navigable waterway or distance to some relevantly defined point in the national or international economies.[25] Between U.S. states there exist only natural barriers to trade as opposed to politically imposed impediments, so our concern is to identify an advantage due to geography that reduces transport costs or improves the efficiency of production if a state was well served by transportation and information networks.

For the period before the completion of the national railroad network freight rates for water transport were significantly lower than those for land, with ocean rates the lowest of all. Interstate trade, especially between non-contiguous states, was clearly facilitated by access to navigable water – as illustrated by the trade along the Atlantic seaboard from colonial times on, and the trade in raw materials on the Great Lakes (Taylor, 1951). International trade would also

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and the U.S. censuses. Our measure also includes any employment in the oil industry, although in 1880, this industry is in its infancy.

[22] Some of the anthropological literature, however, contends that work efficiencies may not vary significantly across temperature ranges.

[23] Each degree that the average air temperature for a given day is above 65 degrees F produces one cooling degree day. This means that if the average temperature is five degrees above 65F for a 30-day month, then that is 150 cooling degree days. Data are from the *Statistical Abstract of the United States* (1992). See Appendix table 1 for further details.

[24] For a survery of postwar evidence, see Sachs and Warner (1995a).

[25] Gallup, Sachs and Mellinger (1999) find that countries with access to navigable waterways or with primarily coastal populations have higher levels of income.

be favored in coastal states or those with navigable rivers. Even when innovations in land transportation eroded these natural advantages, path dependence may have ensured that the advantages to states with navigable waterways persisted.

What constitutes a navigable waterway (or access to the ocean) may be influenced by investment (e.g. in canals, locks, river-deepening) or by technological change (e.g. in riverboat design). Both of these may, in turn, be more likely to be undertaken in higher productivity regions or economies, suggesting the possibility of reverse causation.[26] To maintain an assumption of exogeneity, we initially define navigable waterways as an indicator variable where positive values indicate states that are coastal or border the Great Lakes. Since this variable is capturing how location can benefit trade, we expect that it will be positively related to the level of labor productivity.

4. Data and Analysis of Determinants

The dependent variable in this study, what we call labor productivity, is derived from estimates of personal income per capita for each state. To calculate labor productivity, the personal income data were first adjusted for differences in price levels across states, for each of six census years between 1880 (the first year data for western states are available) and 1980 using "relative" price indexes. This produced price-adjusted personal income per capita estimates that are calculated relative to U.S. average prices for a given year. These estimates were then further adjusted to a per worker basis using the employment-population ratio (or labor

[26] This applies particularly to the issue of whether states along the Mississippi river system should be classified as having access to navigable water, and which states in which years. Mellinger, Sachs and Gallup (1999, p.4) employ a definition of navigable rivers as those that can accommodate vessels with a minimum draft of three meters; they assert that anything smaller would not be considered "ocean-going."

input per capita) in each state. The labor productivity measure is thus (log) price-adjusted income per worker.[27]

The data set includes 47 states for 1880 and 48 for years thereafter.[28] We obtained data on our underlying determinants as well as state productivity for the six selected census years from 1880 to 1980 such that we could also measure how the effects of various factors change over a long period of time – something that previous cross-country studies examining differences in income or labor productivity levels have not examined. The sources and definitions of our key variables are given in Appendix Table 1, while the data are provided in Appendix Table 2.

Our initial identifying assumption is that the fundamental determinants are uncorrelated with the random element of our measure of labor productivity; we therefore use ordinary least squares to estimate the parameters of the relation. Given our definitions for our determinants, this identifying assumption seems reasonable. Certainly climatic factors are exogenous as is the location of a state with respect to navigable water. A strong justification (discussed below) can also been made for the exogeneity of mining activity in a state. And since slave populations are for 1860, twenty years prior to our first year of productivity data, we also assume that this institutional variable is exogenous; however, given the debate in the literature over the endogeneity of institutions, we later relax this assumption.

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[27] These data are shown in Appendix Table 2. Detailed estimation methods and data sources are provided in Mitchener and McLean (1999), especially Appendix 1, which describes the derivation of the state price relatives. Because the relative price indexes are computed at a point in time (and not over time as is the case with deflated series), the price-adjusted dollar values of the labor productivity figures across our six time periods are not directly comparable. Note also that the price variation was greatest in 1880, when a 33 percentage-point variation occurred around the U.S. average price level and, unsurprisingly, when the highest price levels were recorded in the Mountain states.

[28] Because Alaska and Hawaii only become states in 1959 and reliable data are unavailable for earlier periods, we exclude these two states from our overall analysis. No estimates for state personal income per capita are available for Oklahoma in 1880, so we exclude it from our analysis for that year. The Dakota Territories are separated out into North and South Dakota for purposes of analysis in 1880, even though they received statehood in 1889. We also refer to Montana, Washington, Idaho, Utah, Oklahoma, New Mexico, and Arizona as "states," though they were technically still territories in 1880; their boundaries did not change between territory status and statehood.

The results of the OLS regressions are reported in Table 2. Panel A shows the results for all six periods, while in Panel B we show the effect of sequentially adding the explanatory variables for 1880 only. In 1880, 1900, 1920 and 1940, the four identified determinants explain approximately 70 percent of the variation in productivity levels across states (using the adjusted R-squared). Figure 2 displays the overall fit of the equation for 1880 when the variation in state productivity levels was greatest. States above the 45-degree line produce more price-adjusted output per worker than our specification predicts, while states below the 45-degree line produce less than predicted. In the post-World War II period, the fundamental determinants are somewhat less successful, accounting for less than half of the variation in productivity in 1960 and 1980. This result may be due in part to the decline in the dispersion of labor productivity across states, making it more difficult to explain differences in productivity levels. (Expressed relative to the U.S. average, between 1940 and 1980, the standard deviation in the labor productivity across U.S. states falls from 25.8 to 11.0). It is also possible that one or more factors omitted from our specification emerged as having a significant impact on productivity levels across states only after 1940 or that underlying factors that drove economic development in its early stages (such as natural resource abundance or geographical advantages) are less important for explaining differences today. Even with these qualifications, our methodological approach of using a simple, general model to explain the variation in state productivity levels at six widely separated dates is largely borne out by the fit of the regressions. We now discuss the specific findings for each of the fundamental determinants.

4.1. Minerals Endowment

A simple plot of labor productivity in 1880 on minerals endowment (as shown in Appendix Figure 1) supports the hypothesis that natural resources enhance productivity. Including the other elements of our model does not change this result. In all years of our sample, the regression coefficient reported in Table 2 is positive. Moreover, this determinant was statistically significant at conventional levels until 1940, suggesting that states obtained a productivity advantage from their mineral abundance even after controlling for other influences.[29] In 1880, for example, 27 states had less than one percent of their workforce in mining while seven states had more than 10 percent. An increase of 10 percentage points in the share of mining in a state's employment was, in that year, associated with an increase of 11 percent in labor productivity in that state. Moreover, the coefficient on mining employment is positive and economically significant despite the fact that our measure of labor productivity already factors in state-level differences in demographic characteristics. That is, it was entirely possible that the estimated relationship between minerals endowment and labor productivity would be zero since the specification of the dependent variable already accounts for the high labor input per capita that the mining sector typically attracted.[30]

In principle, the natural resource endowment would seem unambiguously exogenous to the level of productivity: a region either possesses gold, oil, or copper or it does not. Moreover, the endowment of minerals is not evenly spread across the globe or political units. Yet the search and exploitation stages of mineral development may require levels of investment and technology that are positively related to the level of economic development. David and Wright (1997) have advanced the view that the expansion of U.S. mining in the nineteenth century which led to

[29] The positive sign is also consistent with what Bernard and Jones (1996) find for the 1980s.
[30] The demographic characteristics of many western states in the late nineteenth century – high masculinity ratios and a high percentage of people of working age – may reflect employment in resource-based industries (Mitchener and McLean, 1999).

American dominance in world production of most economically important minerals (Wright, 1990) resulted in part from the American lead in relevant scientific and technological knowledge, which in turn was the product of high U.S. incomes. However, their view is not relevant to an examination of the experience of states and regions *within* the United States. There were no barriers to the flow of capital and technology across state boundaries, and firms and individuals could take their investment and talents wherever they saw the opportunity for the highest potential return.[31] In mining, this is likely to have been where the prospect of mineral discovery was greatest, or where some prior mining activity existed.[32] In this context, the endowment of minerals is likely to be exogenous – a claim that is substantiated by regional histories: mineral discoveries famously precede economic development in many states in the Mountain and Pacific regions. We therefore interpret the positive coefficient as evidence that there were indeed productivity effects of mineral abundance in addition to the boost to income per capita that came from the favorable demography and workforce characteristics associated with mining. In the context of the development of U.S. states before 1940, to be mineral rich led to higher productivity levels.

4.2. Climate

If climate affects work effort, then warmer climates should have lower productivity levels. This view suggests that the sign of the coefficient for number of cooling-degree days

[31] The important contributions (as documented by David and Wright (1997)) made by faculty and graduates of geology or mining programs at schools such as Yale, Columbia, and Harvard to the discovery and development of minerals in the far western states, well illustrates the point.

[32] An assessment of the determinants of gold discoveries across U.S. states in the late nineteenth century is contained in Eichengreen and McLean (1994), who emphasize the importance of recent settlement (by Europeans) to the timing of such finds: few occurred in states that were long settled.

would be negative. Appendix Figure 2 plots the simple relationship between climate and (log) productivity in 1880 and is suggestive of this hypothesis. However, when the additional covariates of our model are added, the negative relationship does not persist. Instead, the sign on the coefficient reported in Table 2 is positive, small in magnitude, and statistically insignificant. This suggests that climate does not account for any of the variation in productivity levels across states in any of the years in the study once the other independent influences have been included. We also considered whether climate influenced productivity via a quadratic relationship (rows 1 and 2, Table 3), but no statistically significant and negative relationship was found.

We have thus far focused on the potential benefits to productivity from altering climate. An alternative hypothesis suggests that disease ecology and agronomic processes can be influenced by climate and may, in turn, alter productivity. This has led Gallup, Sachs, and Mellinger (1999) to conclude that temperate climates are more productive.[33] Masters and McMillan (2000) suggest that ecological zones experiencing frosts have higher crop yields because frost episodes alter plant respiration, water-evaporation rates, crop spoilage, topsoil availability, and the presence of pests and parasites. Similarly, vector and waterborne diseases that flourish in warmer climates, and which affect human health and productivity if endemic, are frustrated by frosts. To test for these relationships, we considered two further proxies that emphasize the importance of climate's effects through health and agronomic systems: total accumulation of snow and ice pellets and the number of days in a year when the minimum temperature was at or below 32F.[34] The results shown in the rows 3 and 4 of Table 3 do not support this alternative hypothesis. A positive sign on these two measures would be consistent with this alternative climate hypothesis. In years where the sign is positive, the coefficient is

[33] For variation in the disease ecology across states, see Brinkley (1997), Coehlo and McGuire (1997), and

statistically insignificant at conventional levels.

4.3. Locational Advantage and Trade

In contrast to the results for climate, Table 2 supports the proposition that physical geography has an independent influence on productivity levels. States that border the ocean or Great Lakes have significantly higher productivity in all years in this study. In 1880, the locational advantage is associated with a 24 percent lift in labor productivity. This advantage fluctuates between 18 and 33 percent through 1940, but declines in magnitude to around 10 percent in the last 40 years of the sample period. Our result is consistent with cross-country studies that show that access to navigable waterways is associated with higher income or productivity levels. Despite the ascendancy of rail, road, and air transport, having access to a navigable waterway appears to lock in long-term productivity advantages.

This finding was also subjected to sensitivity analysis, by varying the definition of access to navigable water. Table 4 reports the results from substituting six alternative measures for this physical feature of a state. To save space we do not report the 36 regressions – just the coefficients on the alternative proxy variables for access to navigable water from each regression. A comparison of the results reported in the first row of Table 4 with those in Table 2 indicates that the removal of the states bordering the Great Lakes (leaving only those with access to the ocean) reduces the size of the effect in both 1880 and 1980, but otherwise does not affect this determinant. The second row considers the effects of the Great Lakes only. Access to the Great Lakes is important to the explanation of differences in state productivity levels in four of

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Bleakley (2002). For a longer run perspective across countries, see Jones (1981).

the six periods, although the size of the coefficients is somewhat smaller than having access to an ocean. The positive and significant coefficient on Great Lakes is consistent with historical studies that have emphasized how access to the Great Lakes facilitated interregional and overseas trade. The Great Lakes greatly expanded the usefulness of canal systems (especially New York's), lowered freight rates, and permitted goods from the West to flow directly eastward.[35] Bulky or heavy agricultural products like wheat and corn, or natural resources, such as lumber and lead, were predominantly carried by water, with the Great Lakes figuring centrally in their eastward movement to oceans or to eastern cities; rail, on the other hand, typically carried livestock, hides, and general merchandise (Taylor, 1951). When the variable is defined to take into account access to navigable rivers, by itself or together with access to the ocean or Great Lakes (rows 3-6), the estimated coefficients are almost never statistically significant.[36] It appears that, at least by 1880, any productivity advantage of having access to river transport and communication that may have existed before the railroad era had already been lost. In contrast, the locational advantage of the Great Lakes likely persisted since they served a complementary role (as a conduit for bulky and heavy products) even as railroad tonnage increased.

4.4. Legacy of Slavery

Finally, the negative and statistically significant coefficient on 1860 slave population shown in Table 2 strongly confirms the hypothesis that slavery had lasting and pernicious effects on levels of state productivity. (The univariate relationship between 1880 (log) productivity and

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[34] Data are from the *Statistical Abstract of the United States* (1992). See Appendix Table 1 for further details.
[35] Tonnage on the Erie Canal continued to grow despite railroad competition and did not peak until the 1880s (Taylor, 1951).
[36] We are grateful to Andrew Mellinger for assistance with these data.

the legacy of slavery variable is displayed in Appendix Figure 3.) The estimates in Table 2 indicate that as late as 1940, more than seven decades after emancipation, a state whose population was 10 percent slaves in 1860 would have a 14 percent lower level of productivity. A subsidiary hypothesis was that any measurable impact of the legacy of slavery in 1880 would fade as the institutions inhibiting more efficient economic arrangements in the post-bellum South underwent gradual change. Somewhat surprisingly, the legacy of slavery variable exerts a negative and significant influence on state labor productivity for the entire century, but as predicted, the magnitude of the coefficients on this variable declines over time. Since our data are at 20-year intervals, some caution should be exercised in terms of pinpointing the precise decline in this variable's influence. But there is support here for the view that only in recent decades has the distinct and independent drag on southern economic efficiency, originating in the slave-plantation era, finally lifted (Wright, 1987).

To check the robustness of our legacy of slavery finding, we considered an alternative measure: the number of slaves owned by slaveholders with 20 or more slaves in 1860 as a percent of the total state population.[37] This proxy captures the relative importance of plantation slaveholding, recognizing the debate about the productivity consequences of scale economies in antebellum agriculture (see, for example, Irwin (1994)). If the greatest dislocation to the institutional arrangements in the post-bellum South was associated with the end of the plantation system, then this alternative measure of the legacy of slavery may more precisely capture its impact on productivity levels in 1880. A comparison of the results in Panel A of Table 5 with those in Table 2 shows no change in sign and almost no change in significance in any year.

To test whether the legacy of slavery variable is simply capturing a "southern effect,"

[37] These data are also from the U.S. Census of 1860.

instead of a measure of the intensity of slavery in a state, we re-estimated the core model including interaction effects. Specifically, in Panel B of Table 5 we interact a dummy variable (where one indicates a slaveholding state) with each of the (non-slave) explanatory variables and include these with the other explanatory variables used in the original analysis. Since all but one of the 18 interaction terms (across all years) has a coefficient that is insignificant at the 5-percent level, we can reject the hypothesis that the legacy of slavery variable is standing in for a generic "southern effect."

As a final robustness check, we test whether our legacy of slavery variable is in fact picking up some omitted influence from the importance of river transport and communications. Some of the states with slaves in 1860 were also states with access to navigable portions of the Mississippi river system. In Table 6 we report two tests designed to assess this hypothesis. In Panel A the core model is re-estimated excluding the access to navigable water variable. The coefficient on slavery is unchanged in sign and remains significant at the one percent level until 1960. In Panel B we drop slavery from the core model and substitute access to river as the proxy for access to navigable water. The access to navigable river is not significant in any of the six regressions even at the ten percent level, while the overall explanatory power of the model has fallen sharply in all years. We conclude that our slavery variable is not simply reflecting an omitted influence of river transport and communication.

5. On Latitude and Climate

We justified including a measure of climate as an explanatory variable because of its potential impact on hours of work and the level of efficiency at which one works or its influence on diseases and soil fertility. A number of cross-country studies have also found latitude to be an important factor in accounting for differences in cross-country income growth rates and income or labor productivity levels. Hall and Jones (1996, 1999) argue that national economies located in temperate zones tend to be more successful than those in tropical regions. Using the distance from the equator as a proxy for climate, they find that temperate climates favor productivity.[38] On the other hand, Nordhaus (1994) finds that latitude contributes only small, but measurable differences in income across countries.

We did not initially focus on latitude as a measure of climate partly because we had reliable climate statistics that were better suited for tests of the climate hypotheses. Moreover, latitude is highly correlated with our legacy of slavery variable, and we had solid grounds for retaining a direct measure of the regional productivity effect of the legacy of slavery. However, given the prominence it has been assigned in related studies, it is valuable to assess whether latitude is a good proxy for climate – at least for the case of U.S. states.

The latitude (degrees from the equator) was chosen as that of the largest city in the state in the relevant year, so this varied (slightly) between the years in this study. The values of the other climate measures did not vary, as they are based on city data (usually for multiple cities) using meteorological observations averaged over many years. In Table 7 the direct correlation is displayed between latitude and each of the five other measures of climate. The correlation with latitude varies according to the selected measure of climate, but all the correlations are quite strong. This leaves open the question of which climatic feature is most relevant to the determination of productivity levels, and does not rule out the possibility that latitude is a good proxy for the effect of a region's climate on its level of productive efficiency.

[38] Gallup, Sachs and Mellinger (1999) arrive at a similar conclusion with respect to climate and levels of income per

6. Endogeneity of Institutions?

Thus far, we have offered a simple framework for understanding the differences in levels of labor productivity across U.S. states and over time, and have tested whether a core set of underlying determinants provides insight into this issue. The estimation approach we have employed requires that the hypothesized determinants of productivity levels in each state be exogenous. We have argued that our measures of geography across U.S. states (climate, minerals endowment, and access to navigable waterways) are unambiguously independent of the level of productivity or of economic development more generally in 1880 and later years. Our additional assumption in section 4 was that the legacy of slavery (measured by 1860 slave population) was also exogenous. However, there is an extensive debate in the growth literature as to whether institutions are truly exogenous to the level of development, and this issue has recently spilled over into the literature on measuring differences in levels of productivity across countries (Acemoglu, Johnson, and Robinson, 2001a, 2001b and McArthur and Sachs, 2001). This subsection therefore considers whether the legacy of slavery is an endogenous variable.

Acemoglu, Johnson, and Robinson (2001a, 2001b) have suggested that the mortality of British soldiers and priests is a reasonable instrument for addressing the endogeneity of institutions in cross-country regressions. They argue that the susceptibility of British settlers to the disease environment influenced whether (former) colonies adopted extractive or wealth-creating institutions, and these institutions in turn explain observed differences in productivity levels. Within a country, where institutional differences are less pronounced, the causal

capita. See also Masters and McMillan (2000), Mellinger, Sachs and Gallup (1999), and Ram (1999). Diamond connection between disease and institutional adaptation may operate differently or not apply at all. In the context of the U.S. states, settler mortality may have influenced the labor supply of (future) states, and hence the states where the institution of slavery took hold. As Coehlo and McGuire (1997) have noted, the importation of African slaves occurred in larger numbers in British colonies (such as the future Southern states of the U.S.) where it was more difficult to attract European settlers because of climates that fostered malaria, hookworm, and other tropical diseases to which European settlers lacked genetic resistance. On the other hand, African slaves faced higher mortality rates in the northern colonies due to cold-weather diseases; investments in European indentured servants were therefore more profitable than slaves in these colonies. Given the unwillingness of European settlers to migrate to southern colonies due to higher mortality risk in these regions, the importation (and breeding) of slaves from tropical West Africa presented itself as a cost-effective way for European settlers to overcome what otherwise would have been a labor shortage in the production of agricultural crops such as rice, indigo, and tobacco. Hence *within* the United States, it is possible that both settler mortality and climate (as it relates to the disease environment and crop choice) determined the adoption of slavery.[39]

In cross-country regressions, Acemoglu, Johnson, and Robinson (2001b) use soldier mortality of non-native soldiers to proxy for the relationship between settler mortality and the "virgin-soil" disease environment. For their U.S. data point, they draw on soldier mortality estimates derived from the records of disease mortality collected by the U.S. Surgeon General's Office for the periods 1829-38 and 1839-54. These soldier mortality data are also reported for

(1997) claims to identify a link between longitude and latitude and productivity over the very long run.

[39] Given that slavery is the key institutional difference across U.S. states, it is somewhat puzzling (given slavery's exploitative and coercive nature) that Acemoglu, Johnson, and Robinson code the United States as uniformly adopting non-extractive institutions. Surely labor contracts that deny liberty and mobility, and fail to protect an individual's economic choices would be classified as extractive institutions. The explanation advanced for the U.S. states also differs from their work on countries in another way: the disease environment antithetical to European

individual forts (Lawson, 1840, 1856), which we used to compute mortality at the state level.[40] Since these records are for a period pre-dating major medical advances in fighting tropical diseases, previous research has assumed that they are a reasonable proxy for the mortality that 17th- or 18th-century settlers would have faced in the United States.

In Table 8 we present the results of instrumental variable (IV) regressions using soldier mortality as an instrument for the legacy of slavery. (Appendix Figure 4 displays the relationship between soldier mortality and the percentage of slaves in 1860.) The preliminary results suggest that the legacy of slavery variable remains robust to IV specification – at least for the 1880 to 1940 period. Given that the OLS version also explains less of the variation in productivity levels in 1960 and 1980, it is not terribly surprising that the model's R-squared using the IV specification is poor after 1940, especially since the coefficient on the legacy of slavery variable declines in economic significance in either specification. One serious caveat to using the U.S. Surgeon General data to proxy for differences in the mortality risk of settlement is that the records are based on data for U.S. soldiers and not British or non-U.S. soldiers. Acemoglu, Johnson, and Robinson's use of soldier mortality as an instrumental variable is predicated on the notion that there has been no biological adaptation to the disease environment; this is a valid assumption if the soldiers are non-native and have not developed a resistance to disease or figured out (non-medical) ways to reduce the incidence of tropical diseases.[41] Using the mortality of U.S.-born soldiers as a proxy for the disease risk that Europeans settling in the

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settlement in the U.S. is not necessarily correlated with population density.

[40] Soldier mortality is expressed as a percent of "mean strength." See Appendix Table 1 for data sources and a description of our computations and Appendix Table 2 for the state estimates of soldier mortality.

[41] Curiously, Acemoglu, Johnson, and Robinson (2001b) fail to point out that some soldier mortality rates in their study, including those for the United States, are not based on British soldiers, but indigenous soldiers; although this omission may matter less across countries. See Curtin (1989) for further discussion of the cross-country mortality data. Curtin also notes that soldiers were able to figure out relatively quickly non-medical ways of reducing the incidence of disease (such as moving to higher or less damp locations), and that these adjustments likely had a

(future) U.S. states in the 17th and 18th centuries faced therefore may be too strong of an assumption. The IV estimates shown in Table 8 should therefore be viewed as suggestive (especially given the small sample sizes) rather than conclusive.[42]

Moreover, additional econometric tests suggest that the legacy of slavery variable is not endogenous, and that the OLS model is not inconsistent. A Hausman test comparing the instrumental variable regression and the OLS regression does not reject the null hypothesis that OLS is a consistent estimator for the model (prob > chi-squared = 0.94). The alternative test suggested by Davidson and MacKinnon (1993, pp.236-42) also fails to reject the null hypothesis that the OLS specification is inconsistent (prob > F = 0.42). Given our reservations about using soldier mortality as an instrument for the legacy of slavery, these model specification tests provide further justification for preferring the OLS specification.

7. Colonial Origins of Development

European colonists who settled the Americas carried with them their inherited ideals and customs about landholding and land tenure practices, taxation, civil law, and crime and law enforcement. Despite certain shared experiences as Europeans, their attitudes towards these and

significant impact on soldier mortality rates.

[42] Due to our concerns about the applicability of the U.S. soldier mortality data, we considered constructing alternative instruments. Our most promising alternative instrumental variable for the legacy of slavery was the percentage of churches or congregations in a state that were tolerant towards slavery (see Appendix Table 1). Across the nascent U.S. states, European colonists belonged to a variety of Christian sects, some of which were less tolerant of slavery. As has been well documented (Hall, 1930 and Steckel, 2000), Puritans, Quakers, and Congregationalists objected to slavery on moral grounds, and later played a role in the Northern abolitionist movement. On the other hand, Presbyterians, Protestants, Episcopalians, Lutherans, and Catholics were more tolerant of its presence, and viewed the scriptures as taking no moral position on it. Since attitudes toward slavery varied across Christian sects in 1790, and since these attitudes are unlikely to be correlated with the error term in labor productivity regressions, this variable looked promising. However, the R-squared in the first-stage regression did not improve when this variable was added, suggesting that it is not a very good instrument, and the variable itself was statistically insignificant in the first stage regression.

the laws that competing sovereigns initially enforced differed considerably.[43] For example, differences in landholding practices varied. In areas initially under Spanish dominion, private property rights were established by virtue of land grants, title, and residency; in contrast, in areas of French influence such as Louisiana, land was granted without fee but not guaranteed by any official deed. Such differences may have persisted and this legacy of colonial origins may have in turn exerted an influence on productivity even after the United States was formed.

In Table 9, we incorporate institutional differences that may have arisen due to differences in the heritage of early settlement by focusing on the four major groups that influenced colonial settlement in the part of North America that would become the United States: England, Spain, France and Holland. An indicator variable takes a value of one in each state where, prior to statehood, the area had ties with one of these North American colonial powers (except for England, which is the omitted country). The results presented in earlier tables are robust to the addition of colonial influence in all years, and suggest no significant influence from this source prior to 1940. For these years, the coefficients for the colonial legacy variables are (with one exception) statistically insignificant. The positive and significant signs on Spanish Settler in 1960 and 1980 almost certainly reflect the favorable post-war growth experience of the Sunbelt states (nearly all of whom had significant early Spanish settlement). We conclude there is no clear evidence of any direct link between this measure of colonial origins and subsequent productivity levels across states.

8. Reversal of Fortune?

[43] For a detailed discussion of these differences, see Cooke (1993).

In this section, analogous to the recent cross-country work of Acemoglu, Johnson and Robinson (2001a), we explore whether there has been a reversal of fortune in the prosperity of U.S. states. They argue that, where there was extensive European settlement (in countries such as the United States, Canada, Australia and New Zealand), there occurred a comprehensive transfer of institutions that were conducive to long-run economic growth. Where there was little settlement by Europeans, the institutional transfer was much less, and colonial institutions were more oriented towards the extraction than creation of wealth. The upshot has been that the settler economies have prospered relative to those colonies that did not attract large numbers of Europeans. Since the latter were probably richer in pre-colonial times, there has been a "reversal of fortune" in the histories of these economies.

The comparative economic growth performance of regions or states of the United States over the very long run offers the opportunity to assess the reversal of fortune hypothesis from a new perspective. However, adapting the reversal hypothesis to the experience of U.S. states requires taking into account several historical factors that complicate the application of this theory to a cross-state context. First, in contrast to the analysis of countries, all of the original U.S. states were major recipients of European settlers. Expanding the geographical coverage to all states and not just the original British colonies, the experience of European settlement also looks quite different from what Acemoglu, Johnson, and Robinson describe as taking place at the country level. The sparsely populated areas west of the Appalachians remained largely unsettled during the colonial period. The lack of initial settlement in these areas occurred in spite of the fact that the land was made even more sparsely populated by the arrival of Europeans. Their presence on the North American continent (even in small numbers) had a large negative impact on populations of Native Americans due to the diseases they brought with them. These diseases swept across the area that would become the United States, and this should have increased the possibilities for settlement, but competing land claims by rival European governments, uncertainty over property rights, and geographical barriers likely limited the scope of initial settlement in other parts of the future United States. Finally, with the exception of slavery, differences between extractive and wealth-promoting institutions across states are more muted than across countries.

Our test of the reversal of fortune hypothesis is therefore performed to assess the relative importance of institutions relative to geographical factors. If geography is relatively more important than institutions in accounting for economic performance over the long run, then those states that were relatively rich in earlier periods will still be rich today. In contrast, if institutions are more important for economic performance a reversal of fortune will take place.

We examine this hypothesis by first considering the period from 1880 to 1980, and noting whether the states which had relatively high (low) productivity levels in 1880 are now states with relatively low (high) levels of productivity. The correlation is positive and statistically significant ($p = 0.048$) and the Spearman rank correlation coefficient between the labor productivity figures for 1880 and 1980 is 0.4253 (the p value for a test of independence is 0.0029). The positive signs in these tests suggest that no reversal of fortune took place over the 100-year period of this study. The first row of Table 10 reports a regression of 1980 log productivity on 1880 log productivity. The coefficient on 1880 log productivity is positive even when we include the other conditioning variables of our core model. While the Western states converged from above between 1880 and 1940, and the Southern states made significant gains relative to the U.S. average after 1940, there was not a dramatic reshuffling of the rank of states over this 100-year period.

A somewhat more speculative test, but also more in the spirit of the approach used in the cross-country literature, requires that we frame the reversal of fortune hypothesis as a comparison of the American *colonial* period with the present. An obvious shortcoming of this test is that we have to abandon our measure of price-adjusted income per worker for something that may only crudely proxy the economic performance of the (future) U.S. states during the period of initial European settlement. Following Acemoglu, Johnson, and Robinson (2001a, 2001b), we use population density as a proxy for the level of productivity of a (future) state. As Table 11 shows, state population density (urbanization) rates and the log of price-adjusted income per worker are positively correlated for our original sample period of 1880 to 1980, suggesting that these may be reasonable proxies for labor productivity in periods when labor productivity data are not available.[44] A serious drawback to using population density as a proxy for labor productivity in the colonial period is that the data are, at best, highly speculative because no censuses of Native Americans residing in what would become the United States were attempted until well after the United States was a country, and because the precise impact on Native Americans of diseases that European settlers brought with them is unknown. Estimates of indigenous populations residing in the (future) United States at the time of contact vary enormously, are highly dependent on the assumptions made by researchers (including estimates of mortality due to smallpox, measles, and other diseases), and consequently paint very different pictures of population density at the time of European settlement (Daniels, 1992).

Despite a long and contentious debate about the size of the indigenous population in America, very little research has attempted to build up estimates at a tribal level – a necessary

[44] We also substituted population density and urbanization for labor productivity into the regressions reported in Table 2. For 1880, the signs for the legacy of slavery variable and access to navigable waterways remain the same and the coefficients are still significant; however, in the urbanization regression mining is insignificant and in the population density regression it enters with the opposite sign.

prerequisite for determining population density or urbanization at the state level. Given that the extant data for constructing state populations are limited and fragile, our estimates of population density during the colonial period (a more reliable measure than urbanization given what little is known about specific, pre-Colombian settled populations of Native Americans) are therefore quite speculative. Our procedure for compiling these estimates and adding them to the stock of early European settlers and blacks (including slaves) in the United States is described in detail in Appendix Table 1.

The correlation between population density in the colonial period and labor productivity in 1980 is weakly negative for both the 1700 and 1770 estimates of population density (Table 11), suggesting that there may have been some reversal in economic fortune. This reversal stands in contrast to the persistence observed in the post-1880 period (Figure 3); however, the result is sensitive to outliers. Although the sign does not change, the statistical significance and size of the negative coefficient are much smaller when Rhode Island (the state with the greatest colonial population density in 1700 and 1770) is removed from the sample.[45] To test the reversal hypothesis more systematically, we regress 1980 labor productivity on colonial population density and a constant, and then add additional covariates to control for the geographical factors as well as the colonial origin of a state. To save space, only the coefficient on population density is reported, but it is reported for both 1700 and 1770 (rows 2 and 3 of Table 10) to see if the results are sensitive to the influx of European settlement between these two dates. The sign on population density is negative and statistically significant using either the 1700 or 1770 figures. The reversal of incomes persists when we include the additional covariates from our core model

[45] The coefficient on population density is -0.002 (s.e. = 0.003) in 1700 and –0.0006 (s.e. = 0.001) in 1770 when Rhode Island is excluded from the sample. The population density estimate for Rhode Island in 1700 is driven in large part by a large native population relative to the state's area, but it is much higher than any other state in 1770, even if we consider the population density figures that exclude Native Americans (52.6).

(and as the last column shows, this is not simply a proxy for the colonial origins of a state); however, the overall effect is quite small. With an average population density per square mile of 5.75 people in 1770, a one-standard deviation reduction in 1770 population density is associated with approximately a 2-3 percent boost to labor productivity in 1980. The figure is only slightly larger (around 7 percent) if we consider 1700 population density, and in either case, the result is still sensitive to the outlier state, Rhode Island. Over the longer period of several centuries, the data suggest that some reversal of fortune may have occurred across U.S. states, but the effect is smaller when compared to what has been found across countries. Comparing our results to the cross-country literature, a 10 percent higher population density in 1700 or 1770 is associated with 1980 state labor productivity being 1.3 – 1.4 percent lower; the same increase in colonial population density for a country would lead to current income per capita being around 4 percent lower (Acemoglu, Johnson, and Robinson, 2001a).

Finally, we can also take advantage of the fact that our study spans one hundred years of U.S. history to identify whether the reversal of fortune had taken place by 1880 and to pin down whether the reversal had materialized by the end of the nineteenth century, perhaps as the result of the spread of European agricultural technologies from the 16th to 18th centuries (McCusker and Menard, 1985). In the second panel of Table 10, we regress 1880 log labor productivity on the population density estimates from the colonial period. The results suggest that states that were rich in the colonial period were still rich as of 1880.

9. Conclusion

In the search for convincing explanations of massive and persistent differences in productivity levels, and hence of living standards, we find in the historical experience of the United States a fruitful natural extension to the cross-country approach. Indeed, the analysis of states may offer a more fertile testing ground for competing hypotheses because, unlike countries, states share a common language, a similar culture, and likely have the same access to new technologies. Such features have often been difficult to control for in cross-country analysis.

This paper was motivated by the empirical observation that labor productivity levels showed considerable variation across U.S. states at six census years from 1880 to 1980. In 1880 the differences were quite substantial, with the lowest-ranked state having a level of labor productivity only 18 per cent of that of the highest-ranked; whereas by 1980 the lowest-ranked state had risen to 60 percent of the top performer.

To account for this productivity dispersion, we have tested a number of hypotheses drawn from both the growth and economic history literatures. Our results suggest that a small number of exogenous variables (institutional, resource, and geographic characteristics) do extremely well in capturing the variation in productivity levels across states for 100 years of U.S. history. The relationship is especially strong through 1940, where our specification accounts for approximately 70 percent of the variation in productivity levels across states.

The experience of the U.S. states suggests that both geography and institutions matter. Consistent with historians' emphasis on institutional impediments, we find that the legacy of slavery has a persistently pernicious effect on productivity levels well into the 20th century. From 1880 to 1940, slavery had a significant effect on state labor productivity; states with slave populations of 10% had productivity levels that were on average 14 to 20 percent lower than those without slaves over this period. This finding is also consistent with cross-country studies that have emphasized the role of institutions in explaining differences in incomes (Acemoglu, Johnson, and Robinson (2001a, 2001b). On the other hand, productivity levels were positively associated with both mineral abundance and geographic features suited to transportation. While some studies have found growth *rates* to be negatively correlated with natural resource abundance, our positive relationship with productivity *levels* seems quite plausible; particularly in frontier economies, having a large initial endowment of resources may have propelled the acquisition of scare factors (capital and labor), and permitted further exploitation of resources. Over the course of development, states may have been able to overcome the tyranny of geography by constructing locks and deepening rivers; nevertheless, we find that states initially blessed with a seaport or located on the Great Lakes possessed a built-in advantage for trade (and settlement), which resulted in long-term benefits to their productivity levels. As a result of the importance of these geographic factors, state productivity levels do not show evidence of reversal since 1880. Finally, in contrast to some of the cross-country literature, we find no systematic role for climate. In part, this may reflect the smaller degree of variation of this factor *within* a country.

We have contributed to the analysis of why levels of labor productivity differ across space and time, complementing the more orthodox economic analysis of the reasons for variation in rates of growth. We have argued the case for a direct attack on the deeper determinants of levels of productivity, though we recognize the difficulty of the task given the paucity of clear theoretical guidance in the growth literature, and are aware of the ensuing methodological limitations. The challenge facing growth economists is to better explain why there are high- and low-productivity economies, and hence rich and poor societies. In responding to this challenge, we have suggested that the historical experience of U.S. states offers a valuable source of pertinent evidence for developing models that explain these differences. Our cross-state and historical approach thus complements the cross-country studies relating to recent years.

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***Table 1*. Descriptive Statistics and Univariate Relationships**

Panel A: Sample Descriptive Statistics

	Mean	**Standard deviation**	**Minimum**	**Maximum**
Percentage of 1880 workforce in mining	5.20	9.80	0.00	38.50
Average number of cooling degree days (100's)	11.59	8.49	2.68	41.62
Percentage of 1860 population in slavery	10.50	17.90	0.00	57.20
Percentage of 1860 population in slavery on large plantations	5.20	10.90	0.00	38.50

Panel B: Univariate Regressions for 1880

Dependent Variable: Log Price-Adjusted Income per Worker

Percentage of workforce in mining in 1880	0.016***			
	(0.005)			
	[0.004]			
Average number of cooling degree days (100's)		-0.027**		
		(0.012)		
		[0.025]		
Percentage of 1860 population in slavery			-0.019***	
			(0.002)	
			[0.000]	
Access to ocean or Great Lakes				-0.054
				(0.120)
				[0.656]
Adjusted R-Squared	0.14	0.30	0.65	0.00
Number of observations	47	47	47	47

Notes: White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent, respectively. A constant term was also included (not reported). See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 2*. Explaining Productivity Levels Across U.S. States**
Dependent Variable: Log Price-Adjusted Income per Worker

Panel A: Core Model — ***Panel B***: Additional Regressions for 1880

Independent Variable	**1880**	**1900**	**1920**	**1940**	**1960**	**1980**				
Constant	6.106***	6.182***	7.306***	7.046***	8.549***	9.717***	6.018***	6.332***	6.285***	6.106***
	(0.075)	(0.059)	(0.049)	(0.059)	(0.042)	(0.056)	(0.070)	(0.112)	(0.049)	(0.075)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of workforce in mining in 1880	0.011**	0.008*	0.005***	0.006*	0.001	0.002	0.016***	0.015**	0.006	0.011**
	(0.005)	(0.004)	(0.001)	(0.003)	(0.002)	(0.002)	(0.005)	(0.007)	(0.005)	(0.005)
	[0.039]	[0.058]	[0.001]	[0.068]	[0.633]	[0.351]	[0.004]	[0.040]	[0.185]	[0.039]
Average number of cooling degree days (100's)	-0.0001	0.003	0.002	0.002	0.005	0.007*		-0.027**	-0.003	0.000
	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)		(0.008)	(0.005)	(0.004)
	[0.979]	[0.460]	[0.446]	[0.567]	[0.139]	[0.061]		[0.003]	[0.498]	[0.979]
Percentage of 1860 population in slavery	-0.019***	-0.021***	-0.015***	-0.014***	-0.006***	-0.003**			-0.017***	-0.019***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)			(0.003)	(0.002)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.044]			[0.000]	[0.000]
Access to ocean or Great Lakes	0.238***	0.197***	0.183***	0.331***	0.106***	0.087**				0.238***
	(0.072)	(0.063)	(0.052)	(0.050)	(0.029)	(0.039)				(0.072)
	[0.002]	[0.003]	[0.000]	[0.000]	[0.001]	[0.029]				[0.002]
Adjusted R-Squared	0.71	0.77	0.79	0.68	0.42	0.13	0.12	0.40	0.65	0.71
Number of observations	47	48	48	48	48	48	47	47	47	47

Notes: White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square Brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 3*. Sensitivity Tests for Climate**

Dependent Variable: Log Price-Adjusted Income per Worker

	1880	1900	1920	1940	1960	1980
Cooling Degree Days (100's)	-0.008	-0.003	0.009	0.007	0.019*	0.017
(with quadratic term included)	(0.019)	(0.017)	(0.013)	(0.014)	(0.009)	(0.013)
	[0.669]	[0.861]	[0.497]	[0.595]	[0.031]	[0.186]
Cooling Degree Days Squared (100,000's)	0.002	0.001	-0.002	-0.001	-0.003	-0.002
	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)	(0.003)
	[0.645]	[0.699]	[0.553]	[0.699]	[0.123]	[0.433]
Ice and Snowfall Accumulation (inches)	1.89E-04	3.04E-04	-1.17E-03	0.000	-0.001*	-0.002**
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	[0.912]	[0.840]	[0.229]	[0.770]	[0.091]	[0.035]
Minimum Temperature (days)	5.15E-05	5.82E-06	-0.001*	-0.001	-0.001**	-0.001***
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)
	[0.950]	[0.993]	[0.099]	[0.443]	[0.036]	[0.004]

Notes: This table reports the estimated coefficients for alternative specifications and measures of climate when they are substituted for the benchmark definition of climate (cooling degree days) used in table 2. The first two rows show an alternative specification which includes a quadratic term, while the second two report coefficients using alternative measures emphasizing the effects of frost and freezing. White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the10-percent, 5-percent, and 1-percent levels, respectively. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 4*. Sensitivity Tests for Access to Navigable Waterway**

	1880	1900	1920	1940	1960	1980
Access to ocean	0.173**	0.155**	0.178***	0.293***	0.075**	0.032
	(0.069)	(0.059)	(0.044)	(0.056)	(0.036)	(0.042)
	[0.016]	[0.012]	[0.000]	[0.000]	[0.045]	[0.456]
Access to Great Lake	0.159**	0.124*	0.075	0.114	0.061*	0.108***
	(0.074)	(0.067)	(0.064)	(0.092)	(0.035)	(0.037)
	[0.038]	[0.072]	[0.249]	[0.221]	[0.093]	[0.006]
Access to River	0.011	-0.005	-0.040	-0.163**	-0.030	0.021
	(0.078)	(0.065)	(0.052)	(0.069)	(0.035)	(0.039)
	[0.891]	[0.934]	[0.443]	[0.023]	[0.387]	[0.595]
Access to ocean or River	0.127	0.095	0.086	0.093	0.006	0.011
	(0.118)	(0.069)	(0.067)	(0.105)	(0.055)	(0.074)
	[0.287]	[0.175]	[0.203]	[0.380]	[0.913]	[0.881]
Access to Great Lake or River	0.061	0.027	0.001	-0.115	-0.004	0.059
	(0.080)	(0.064)	(0.052)	(0.074)	(0.037)	(0.039)
	[0.454]	[0.668]	[0.984]	[0.127]	[0.912]	[0.140]
Access to ocean or Great Lake	0.1990	0.124	0.128	0.174	0.058	0.080
or River	(0.136)	(0.075)	(0.076)	(0.107)	(0.053)	(0.080)
	[0.149]	[0.106]	[0.102]	[0.112]	[0.275]	[0.325]

Notes: This table reports the estimated coefficients for various measures of locational advantage when they are substituted for the benchmark definition used in table 2 for access to navigable waterways (by ocean or Great Lakes.) White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 5*. Testing for the Impact of Slavery**
Dependent Variable: Log Price-Adjusted Income per Worker

Panel A: Robustness test of legacy of slavery: substituting large plantation slave population

Independent Variable	1880	1900	1920	1940	1960	1980
Constant	6.076***	6.146***	7.280***	7.016***	8.537***	9.713***
	(0.077)	(0.061)	(0.051)	(0.060)	(0.041)	(0.057)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of 1880 workforce in mining	0.013**	0.011**	0.007**	0.007**	0.002	0.002
	(0.005)	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)
	[0.012]	[0.017]	[0.000]	[0.019]	[0.397]	[0.249]
Average number of cooling degree days (100's)	-0.003	0.000	0.000	0.001	0.005	0.007*
	(0.005)	(0.003)	(0.002)	(0.004)	(0.003)	(0.004)
	[0.454]	[0.977]	[0.892]	[0.733]	[0.146]	[0.061]
Percentage of 1860 population in slavery on large plantations	-0.028***	-0.032***	-0.023***	-0.022***	-0.010***	-0.004*
	(0.005)	(0.004)	(0.003)	(0.003)	(0.002)	(0.002)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.051]
Access to ocean or Great Lakes	0.263***	0.225***	0.204***	0.355***	0.115***	0.090**
	(0.071)	(0.065)	(0.047)	(0.053)	(0.031)	(0.041)
	[0.001]	[0.001]	[0.000]	[0.000]	[0.001]	[0.032]
Adjusted R-Squared	0.66	0.73	0.75	0.67	0.39	0.11
Number of observations	47	48	48	48	48	48

***Table 5*. Testing for the Impact of Slavery**

Dependent Variable: Log Price-Adjusted Income per Worker

Panel B: Specification test for the impact of slavery

Independent Variable	1880	1900	1920	1940	1960	1980
Constant	6.104***	6.220***	7.329***	7.049***	8.573***	9.741***
	(0.094)	(0.069)	(0.057)	(0.066)	(0.044)	(0.065)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of workforce 1880 in mining	0.012**	0.008*	0.005***	0.006**	0.001	0.002
	(0.006)	(0.005)	(0.002)	(0.003)	(0.002)	(0.002)
	[0.045]	[0.094]	[0.003]	[0.050]	[0.685]	[0.340]
Slave dummy times percentage of workforce 1880 in mining	0.153	0.435	0.624	1.055*	0.344	-0.005
	(0.793)	(0.827)	(0.576)	(0.612)	(0.256)	(0.221)
	[0.848]	[0.602]	[0.285]	[0.093]	[0.187]	[0.981]
Average number of cooling degree days (100's)	-0.002	0.000	0.001	0.000	0.004	0.005
	(0.005)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
	[0.655]	[0.974]	[0.728]	[0.950]	[0.271]	[0.143]
Slave dummy times average number of cooling degree days (100's)	0.000	0.000	0.000	0.000	0.000*	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.433]	[0.199]	[0.337]	[0.200]	[0.057]	[0.034]
Percentage of 1860 population in slavery	-0.021**	-0.031***	-0.023***	-0.022***	-0.013***	-0.007**
	(0.009)	(0.008)	(0.005)	(0.007)	(0.003)	(0.003)
	[0.026]	[0.001]	[0.000]	[0.002]	[0.000]	[0.023]
Access to ocean or Great Lakes	0.259***	0.175**	0.161***	0.334***	0.089**	0.082
	(0.092)	(0.076)	(0.052)	(0.062)	(0.036)	(0.053)
	[0.008]	[0.027]	[0.003]	[0.000]	[0.017]	[0.126]
Slave dummy times access to ocean or Great Lakes	-0.004	0.001	0.004	0.000	0.001	-0.002
	(0.006)	(0.006)	(0.002)	(0.003)	(0.002)	(0.002)
	[0.465]	[0.820]	[0.143]	[0.951]	[0.427]	[0.447]
Adjusted R-Squared	0.69	0.77	0.79	0.68	0.43	0.15
Number of observations	47	48	48	48	48	48

Notes: White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 6*. Impact of Slavery and Navigable River**

Dependent Variable: Log Price-Adjusted Income per Worker

Panel A: The Impact of Slavery Omitting Navigable Water

Independent Variable	**1880**	**1900**	**1920**	**1940**	**1960**	**1980**
Constant	6.285***	6.330***	7.445***	7.295***	8.629***	9.783***
	(0.049)	(0.039)	(0.034)	(0.059)	(0.032)	(0.038)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of workforce in mining in 1880	0.006	0.005	0.002	0.000	-0.001	0.000
	(0.005)	(0.004)	(0.001)	(0.004)	(0.002)	(0.001)
	[0.185]	[0.203]	[0.144]	[0.954]	[0.611]	[0.998]
Average number of cooling degree days (100's)	-0.003	0.000	-0.001	-0.003	0.004	0.006*
	(0.005)	(0.005)	(0.002)	(0.005)	(0.003)	(0.003)
	[0.498]	[0.941]	[0.731]	[0.564]	[0.198]	[0.059]
Percentage of 1860 population in slavery	-0.017***	-0.019***	-0.013***	-0.011***	-0.005***	-0.002*
	(0.003)	(0.003)	(0.001)	(0.003)	(0.001)	(0.001)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.075]
Adjusted R-Squared	0.65	0.74	0.72	0.44	0.31	0.04
Number of observations	47	48	48	48	48	48

Panel B: Test for Navigable River as a Proxy for Slavery

Independent Variable	**1880**	**1900**	**1920**	**1940**	**1960**	**1980**
Constant	6.298***	6.345***	7.471***	7.376***	8.646***	9.775***
	(0.126)	(0.119)	(0.081)	(0.084)	(0.039)	(0.042)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of workforce in mining in 1880	0.016*	0.016*	0.009*	0.004	0.002	0.001
	(0.007)	(0.007)	(0.004)	(0.004)	(0.002)	(0.002)
	[0.036]	[0.034]	[0.033]	[0.375]	[0.395]	[0.363]
Average number of cooling degree days (100's)	-0.027***	-0.026***	-0.019***	-0.017***	-0.004*	0.003
	(0.009)	(0.009)	(0.006)	(0.005)	(0.002)	(0.002)
	[0.003]	[0.004]	[0.002]	[0.003]	[0.097]	[0.139]
Access to River	0.072	0.083	0.022	-0.109	-0.005	0.030
	(0.090)	(0.091)	(0.067)	(0.077)	(0.039)	(0.038)
	[0.429]	[0.366]	[0.743]	[0.164]	[0.899]	[0.441]
Adjusted R-Squared	0.39	0.38	0.36	0.26	0.01	0.01
Number of observations	47	48	48	48	48	48

***Table 7*. Climate, Latitude, and Productivity**

The Relationship Between Latitude and Climate

Correlation Matrix	**Cooling Degree Days**	**Heating Degree Days**	**Sum of Cooling and Heating Days**	**Snowfall**	**Minimum Temperature**	**Latitude**
Cooling Degree Days	1.00					
Heating Degree Days	-0.84	1.00				
Sum of Cooling & Heating Days	-0.63	0.95	1.00			
Ice and Snowfall Accumulation	-0.72	0.87	0.84	1.00		
Minimum Temperature	-0.77	0.94	0.91	0.83	1.00	
Latitude	-0.85	0.90	0.79	0.73	0.76	1.00

Notes: See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 8*. Instrumental Variables Regressions**

Dependent Variable: Log Price-Adjusted Income per Worker

Independent Variable	**1880**	**1900**	**1920**	**1940**	**1960**	**1980**	***First-stage Regression***
Constant	6.152***	6.200***	7.336***	7.092***	8.598***	9.766***	-14.911***
	(0.106)	(0.076)	(0.045)	(0.068)	(0.038)	(0.045)	(4.902)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.004]
Percentage of workforce in mining in 1880	0.013**	0.009**	0.007***	0.007**	0.003	0.003	-0.2345
	(0.006)	(0.004)	(0.002)	(0.003)	(0.002)	(0.002)	(0.202)
	[0.027]	[0.046]	[0.002]	[0.034]	[0.231]	[0.108]	[0.251]
Average number of cooling degree days (100's)	-0.008	0.000	-0.003	-0.005	-0.002	0.000	1.004***
	(0.010)	(0.006)	(0.004)	(0.007)	(0.004)	(0.004)	(0.249)
	[0.428]	[0.996]	[0.476]	[0.464]	[0.533]	[0.964]	[0.000]
Percentage of 1860 population in slavery	-0.013**	-0.019***	-0.012***	-0.009*	-0.001	0.003	
	(0.006)	(0.005)	(0.003)	(0.005)	(0.003)	(0.003)	
	[0.044]	[0.000]	[0.001]	[0.080]	[0.766]	[0.342]	
Access to ocean or Great Lakes	0.197**	0.181**	0.156***	0.287***	0.060	0.042	3.678*
	(0.091)	(0.081)	(0.045)	(0.059)	(0.038)	(0.043)	(1.506)
	[0.037]	[0.031]	[0.001]	[0.000]	[0.124]	[0.343]	[0.019]
Soldier Mortality							4.204***
							(1.561)
							[0.010]
Adjusted R-Squared	0.70	0.79	0.79	0.66	0.20	0.01	0.59
Number of observations	47	48	48	48	48	48	48

Notes: Soldier mortality is used as an instrumental variable for the percentage of 1860 population who were slaves. White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 9*. The Impact of Settler Origins on GDP per Capita**

Dependent Variable: Log Price-Adjusted Income per Worker

Independent Variable	1880	1900	1920	1940	1960	1980
Constant	5.978***	6.095***	7.330***	7.123***	8.536***	9.670***
	(0.127)	(0.093)	(0.075)	(0.077)	(0.043)	(0.049)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Percentage of workforce in mining in 1880	0.012**	0.009**	0.004**	0.004	0.000	0.001
	(0.005)	(0.004)	(0.002)	(0.003)	(0.001)	(0.001)
	[0.019]	[0.036]	[0.010]	[0.180]	[0.855]	[0.728]
Average number of cooling degree days (100's)	-0.001	0.002	0.001	0.000	0.003	0.005
	(0.005)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)
	[0.871]	[0.653]	[0.834]	[0.922]	[0.318]	[0.119]
Percentage of 1860 population in slavery	-0.019***	-0.021***	-0.015***	-0.013***	-0.006***	-0.003**
	(0.002)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.030]
Access to ocean or Great Lakes	0.275***	0.228***	0.161***	0.273***	0.109***	0.111***
	(0.084)	(0.067)	(0.049)	(0.051)	(0.032)	(0.039)
	[0.002]	[0.002]	[0.002]	[0.000]	[0.001]	[0.006]
French Settler	0.095	0.059	-0.042	-0.108*	-0.015	0.016
	(0.084)	(0.063)	(0.048)	(0.050)	(0.030)	(0.031)
	[0.265]	[0.351]	[0.379]	[0.038]	[0.621]	[0.599]
Spanish Settler	0.091	0.088	0.048	0.067	0.105***	0.130***
	(0.080)	(0.067)	(0.048)	(0.054)	(0.027)	(0.032)
	[0.261]	[0.197]	[0.321]	[0.224]	[0.000]	[0.000]
Dutch Settler	0.183**	0.109	0.086	0.152**	0.064	0.050
	(0.090)	(0.080)	(0.068)	(0.070)	(0.049)	(0.063)
	[0.050]	[0.182]	[0.211]	[0.036]	[0.200]	[0.426]
Adjusted R-Squared	0.71	0.77	0.80	0.73	0.54	0.31
Number of observations	47	48	48	48	48	48

Notes: White's consistent covariance estimator is used. Standard errors are in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. Data on settlement are based on Maddex (1998) and Cooke (1993). See Appendix Table 1 for a full description of the data sources and variable definitions.

Table 10. **Testing the Reversal of Fortune Hypothesis**

Panel A: Dependent Variable, Log Price-Adjusted Income per Worker in 1980

Proxy for Labor Productivity	Constant only	Including Access to to Ocean or Great Lakes	Including Minimum Temp	Including Percent of workforce in Mining	Including Settler Origin Dummies
Price-adjusted income per Worker in 1880	0.084**	0.088**	0.174***	0.176***	0.171***
	(0.042)	(0.041)	(0.055)	(0.054)	(0.054)
	[0.050]	[0.039]	[0.003]	[0.002]	[0.003]
Population Density, 1700	-0.005***	-0.007***	-0.006***	-0.006***	-0.005**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
	[0.000]	[0.000]	[0.000]	[0.001]	[0.050]
Population Density, 1770	-0.002**	-0.002***	-0.002***	-0.002**	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	[0.028]	[0.002]	[0.010]	[0.014]	[0.127]
Adjusted R-Squared	.09/.04/.03	.14/.09/.09	.35/.12/.13	.35/.15/.15	.44/.29/.28
Number of observations	47/48/48	47/48/48	47/48/48	47/48/48	47/48/48

Panel B: Dependent Variable, Log Price-Adjusted Income per Worker in 1880

Proxy for Labor Productivity	Constant only	Including Access to to Ocean or Great Lakes	Including Minimum Temp	Including Percent of workforce in Mining	Including Settler Origin Dummies
Population Density, 1700	0.020***	0.023***	0.015**	0.016**	0.025**
	(0.007)	(0.009)	(0.007)	(0.007)	(0.010)
	[0.006]	[0.011]	[0.047]	[0.027]	[0.017]
Population Density, 1770	0.007***	0.008***	0.006**	0.006**	0.009**
	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
	[0.004]	[0.008]	[0.036]	[0.018]	[0.011]
Adjusted R-Squared	.04/.05	.06/.07	.33/.33	.46/.47	.54/.55
Number of observations	47	47	47	47	47

Notes: White's consistent covariance estimator is used. Standard errors are shown in parentheses and p-values are shown in square brackets. One, two, or three stars on a coefficient indicates significance at the 10-percent, 5-percent and 1-percent levels, respectively. Population density is computed as persons per square mile in 1700, and includes European settlers and indigenous populations. See Appendix Table 1 for a full description of the data sources and variable definitions.

***Table 11*. Urbanization, Labor Productivity, and Population Density**

<u>**Correlation Coefficient**</u>	Pop. Density <u>1880</u>	Pop. Density <u>1900</u>	Pop. Density <u>1920</u>	Pop. Density <u>1940</u>	Pop. Density <u>1960</u>	Pop. Density <u>1980</u>
Urbanization, 1880	0.8321					
Urbanization, 1900		0.7875				
Urbanization, 1920			0.7465			
Urbanization, 1940				0.7411		
Urbanization, 1960					0.5781	
Urbanization, 1980						0.4891
Labor Productivity, 1880	0.2968					
Labor Productivity, 1900		0.23				
Labor Productivity, 1920			0.271			
Labor Productivity, 1940				0.41		
Labor Productivity, 1960					0.266	
Labor Productivity, 1980						0.067
	Labor Productivity <u>1880</u>	Labor Productivity <u>1900</u>	Labor Productivity <u>1920</u>	Labor Productivity <u>1940</u>	Labor Productivity <u>1960</u>	Labor Productivity <u>1980</u>
Urbanization, 1880	0.6563					
Urbanization, 1900		0.6155				
Urbanization, 1920			0.6477			
Urbanization, 1940				0.77		
Urbanization, 1960					0.7817	
Urbanization, 1980						0.677
Population Density 1700	0.2076					-0.1886
Population Density 1770	0.2265					-0.1801

Notes: Urbanization is the fraction of a state's population that is resides in municipalities with populations greater than 2,500 persons. Population density is computed as persons per square mile, and for 1700 and 1770, Includes both European settlers and indigenous populations. Labor Productivity is log price-adjusted income per worker. See Appendix Table 1 for a full description of the data sources and variable definitions.

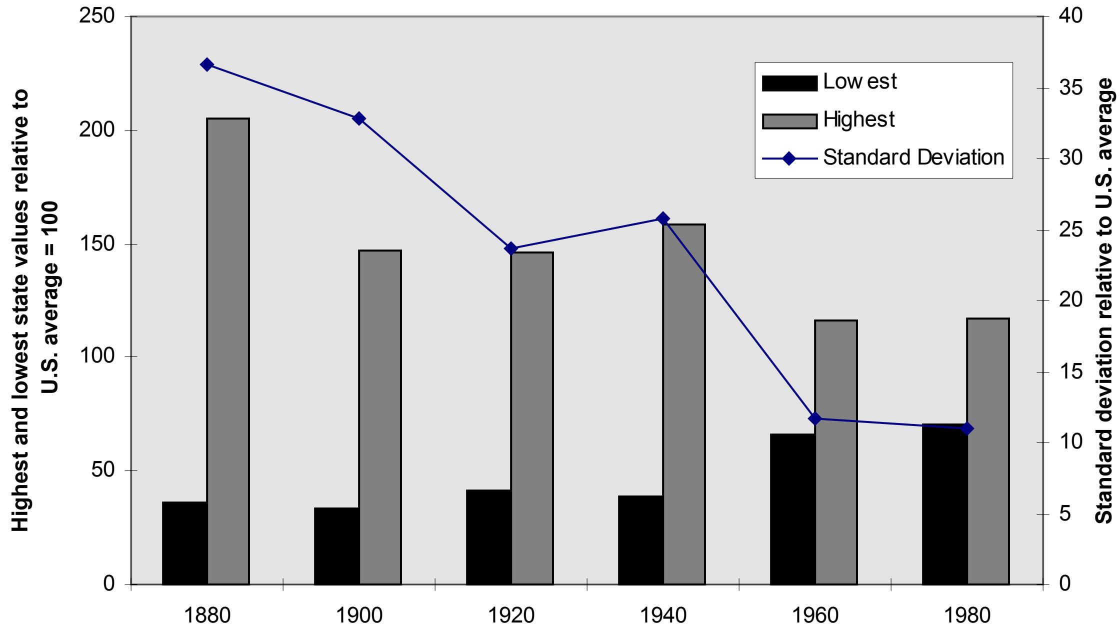


Figure 1. **Price-adjusted state income per worker**
(Relative to U.S. Average)

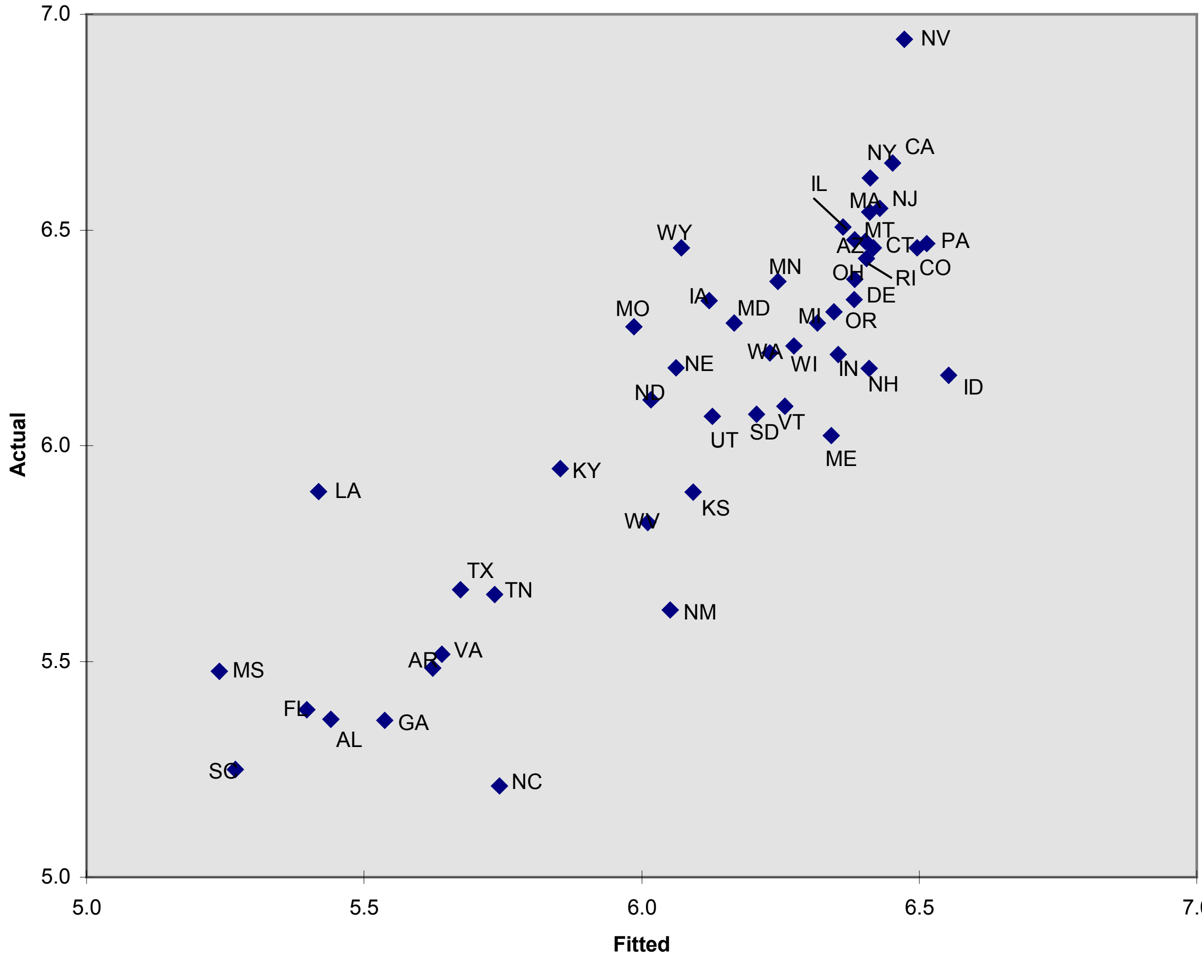
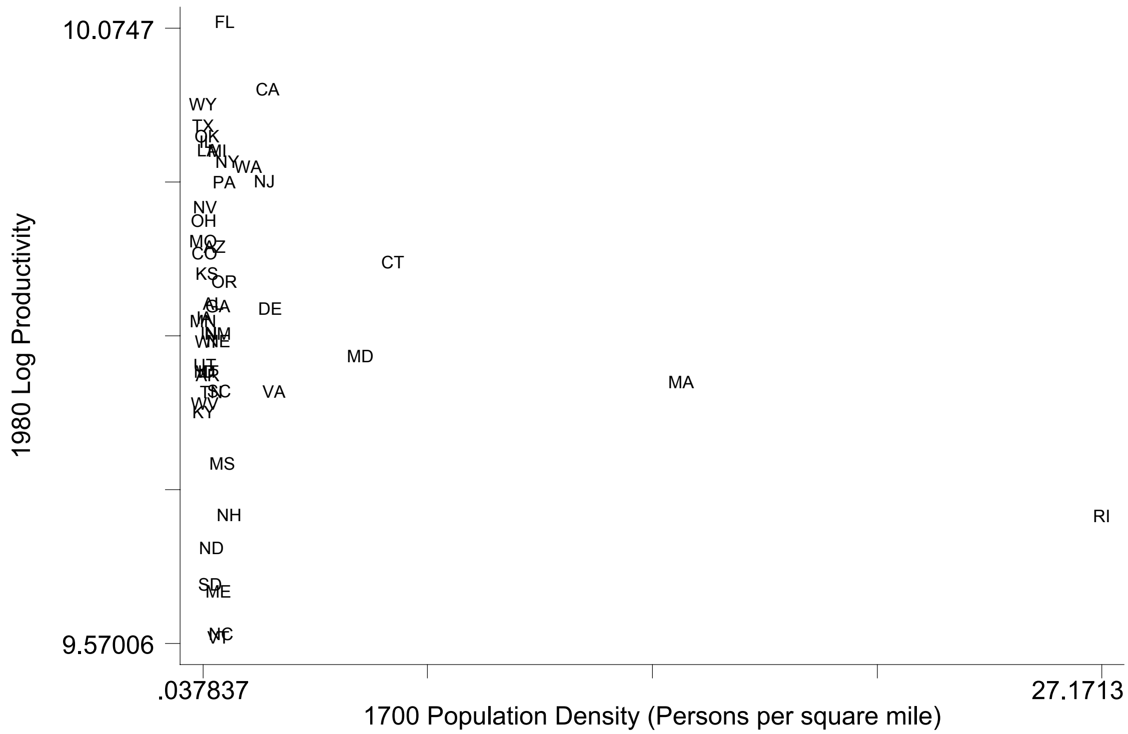


***Figure 2*. Labor productivity levels in 1880: actual and predicted**
(Logs)

Figure 3. Reversal of Fortune and Persistence



Appendix Table 1. Data Description and Sources

Labor productivity (price-adjusted personal income per worker):

Personal income per capita in each state has been adjusted for the variation in price levels across states in each of 1880, 1900, 1920, 1940, 1960 and 1980. Due to limitations of the available data, this adjustment cannot be made across these years, and hence to a common base year (thus accounting for our use of the term 'price-adjusted' rather than 'deflated' or 'real'). The price-adjusted per capita income is then converted to a per worker basis (that is, allowing for variation across states in the age distribution and workforce participation rates of both males and females). The resulting series is therefore a measure of average labor productivity in each state and year rather than a measure of real gross state product per capita. A full description of the sources and estimation methods employed is provided in Mitchener and McLean (1999).

Percentage of the workforce employed in mining in 1880:

The data on mining employment by state in 1880 are from Miller and Brainerd (1957), Table L-5, pp.623-631.

Climate Data:

Climate and temperature data are based on a standard 30-year period from 1961 through 1990. The average number of cooling degree days is computed as the number of days in which the average air temperature rose above 65 degrees F times the number of degrees on those days which the average daily air temperature exceeded 65 over the year. The average number of heating degree days is computed as the number of days in which the average air temperature was below 65 degrees F times the number of degrees on those days which the average daily air temperature was below 65. The sum of cooling and heating days is the sum of these two series. For all three series, the data reported in 100s of degree days. Minimum temperature is the average number of days per year where the average temperature is 32F or less. Ice and snowfall accumulation is the average total inches of snow and ice pellets per year (trace accumulations are counted as zero). Data for U.S. cities are used to compute state averages and are from the *Statistical Abstract of the United States* (1992, pp.226-9). In states where multiple cities were listed, the simple arithmetic average was computed to arrive at a state estimate.

Latitude:

Latitude is measured as degrees from the equator, and is taken relative to the state's largest city. The measure can vary slightly over our 6 periods as a result of changes in the largest city for a given state. Data are from *Rand McNally World Atlas*. State "centroid" data from the National Center for Geographic Information and Analysis (ftp://ncgia.ucsb.edu/publications/tech_reports/95/95-6/data) were used as an alternative measure, and yielded similar results to those reported in the tables.

Percentage of 1860 population in slavery, and in slavery on large plantations:

Respectively, these are defined as the total number of slaves as a percentage of the total population of each state in 1860 and the number of slaves owned by slaveholders having more than 20 slaves as a percentage of the total population of each state in 1860. Data on the total number of slaves and the number of slaves per slaveholder were obtained from census returns in *Agriculture of the United States in 1860: The Eighth Census* (Washington: Government Printing Office, 1864), p.247.

Access to ocean/Great Lakes/river:

An indicator variable takes the value of one if a state borders the ocean/Great Lake/river, and zero if it does not. Various combinations of these three forms of access to navigable water are used. The data on states with access to navigable rivers were kindly provided by Andrew Mellinger of the Center for International Development at Harvard University.

Soldier Mortality:

Soldier mortality rates at the state level are calculated as percentages. They are derived using U.S. soldier mortality data for individual forts as reported in Lawson (1840, 1856). Quarterly data were collected by the U.S. Surgeon General and Adjutant General's Offices for 1829-38 and by the U.S. Surgeon General's Office for 1839-54. Yearly mortality rates for each fort are computed by dividing the number of deaths each year by the average, annual "mean strength" of soldiers. Mean strength represents the population of soldiers stationed at a fort. (We exclude cholera outbreaks that swept through Europe and the US in the 19th century since prevention of the spread of the disease was a matter of sanitation and unrelated to the climatic environment). The annual estimates are then averaged using all existing data for a state. In states where more than one fort was located, the arithmetic mean of the forts located in that state are used to compute state mortality. If a state had no forts (15 for the 1839-54 period), the average of bordering states within a similar climatic zone (based on rainfall, snow accumulation, mean temperature, and minimum temperature) was used as the state's mortality figure. For the 1829-38 period, Lawson reports two sets of records on deaths, the adjutant general's and medical returns; we computed mortality figures using both data sets. In table 5, we report the results using medical returns since this is what is used for the 1839-54 period and because this series excludes deaths from accidental causes or detachments. If the adjutant general's series is used instead, the results do not differ significantly from those reported in table 5.

Christian Sects Tolerant of Slavery:

This is computed as the percentage of Christian churches in a state in 1790 that were more tolerant of slavery. The term church is defined in the data as a congregation of people who meet periodically for religious services. The maximum interval between meetings is generally no more than several months. Itinerant ministries or temporary ones are not included in these figures. The meeting place may be a building, although the definition does not make the structure the emphasis, but rather the act of meeting regularly. Data on churches are from Paullin (1932, plate 80). The classification of Christian sects as tolerant of slavery is based on Hall (1930) and Steckel (2000).

Colonial origin of state:

A series of indicator variables which take on positive values if a state, prior to statehood, had ties with that colonial power (except England, which is the omitted country). Data are based on Maddex (1998) and Cooke (1993).

Population Density Estimates for the Colonial Period, 1700 and 1770:

There is a long and contentious debate among anthropologists, historians, demographers, and ethnologists concerning the population of Native Americans or North American Indians at the time of European contact. The estimates vary enormously, ranging from as little as 1 million to as much as 17 million for all of North America (See John D. Daniels (1992) for a discussion). To a large extent, the imprecise measurement reflects a lack of historical evidence: none of the American Indians at the time of European contact kept written records, so researchers rely on incomplete and often inaccurate accounts of contemporary Europeans. Consequently, there is no single, agreed upon methodology for estimating tribal populations when the records are defective or lacking specificity. Moreover, the precise impact of European diseases on the native population are unknown, and differences in opinion concerning the epidemiological impact invite widely different "corrections" to population estimates.

The lack of scholarly agreement on the indigenous population at the time of European contact and the subsequent effects of disease pose a serious impediment for estimating population density by state in 1700, a time at which European settlers were living alongside Native Americans. The debate over which numbers to use is simplified by the fact that few scholars have actually published tribal-level estimates of Native American populations. In fact, despite their limitations, Mooney's (1928) estimates are still the most complete and detailed tribal estimates published, and many scholars have used his work as a starting point for their estimates. Using revised tribal estimates that are part of a massive, but still unfinished, scholarly undertaking entitled the *Handbook of North American Indians* (edited by Sturtevant, (1978-)), Ubelaker (1988) has revised Mooney's estimates and reported them on a regional basis. Unfortunately, he has not provided these data on a more disaggregate level.

The tribe-based estimates of Mooney, Ubelaker, and others in their scholarly tradition tend to be on the low range of the figures reported above, but for our purposes this is unimportant. Our objective is not to measure accurately the total population of Native Americans in the entire United States, but to estimate the relative populations *within* each future state, so that population density in 1700 can be calculated. We therefore make an important simplifying assumption so that we can use tribal-based estimates of Native Americans as a starting point for calculating population density in 1700. We assume that European diseases had an approximately equal impact on tribal populations, so that the relative sizes of tribes are left unaffected. Clearly, this is a strong assumption, but will have to suffice until epidemiological evidence is translated to individual tribal population counts. Tribal populations and locations of tribes at the time of European contact are obtained from the series edited by Sturtevant (1978-). To date, this source lacks detailed information on the Southeast region, so we obtained estimates from Malinowski (1998). The tribal population counts were then aggregated to a state level based on the maps shown in Sturtevant (1978-). When tribes spanned multiple states, they were assigned fractions based on the percentage of their range within a state or based on more detailed historical information provided in Sturtevant (1978-) about where the population resided. These estimates were then aggregated to a regional level and compared to Ubelaker's estimates. Ubelaker's figures include tribes in Mexico and Canada, but after adjusting for this difference, the figures were fairly similar. Our aggregate estimate of Native American population at the time of contact lies between the Mooney and Ubelaker estimates. Since European contact with *specific* North American tribes actually spanned centuries, we make the assumption that there was little population growth for indigenous populations prior to contact. This allows us to use the population figure at the time of contact and apply it to 1700.

We calculated population density (persons per square mile) by summing the estimates of Native Americans with those for European settlers and free and slave black populations and dividing the total by the area figures from the *Statistical Abstract of the United States* (1992, table 340, p.205). Population of European colonists and blacks by state are from U.S. Department of Commerce (1975, table Z1-19), McCusker and Menard (1985, p.136) for Maryland and Virginia, and U.S. Department of Commerce (1909, p.9) for imputed estimates of New Hampshire and Maine. We consider two dates, 1700 and 1770, reflecting the growth of European settlers in the 18th century; however, because our figures for Native Americans only approximate the populations at the time of European contact, we use the same figure for this portion of a state's population at both dates.

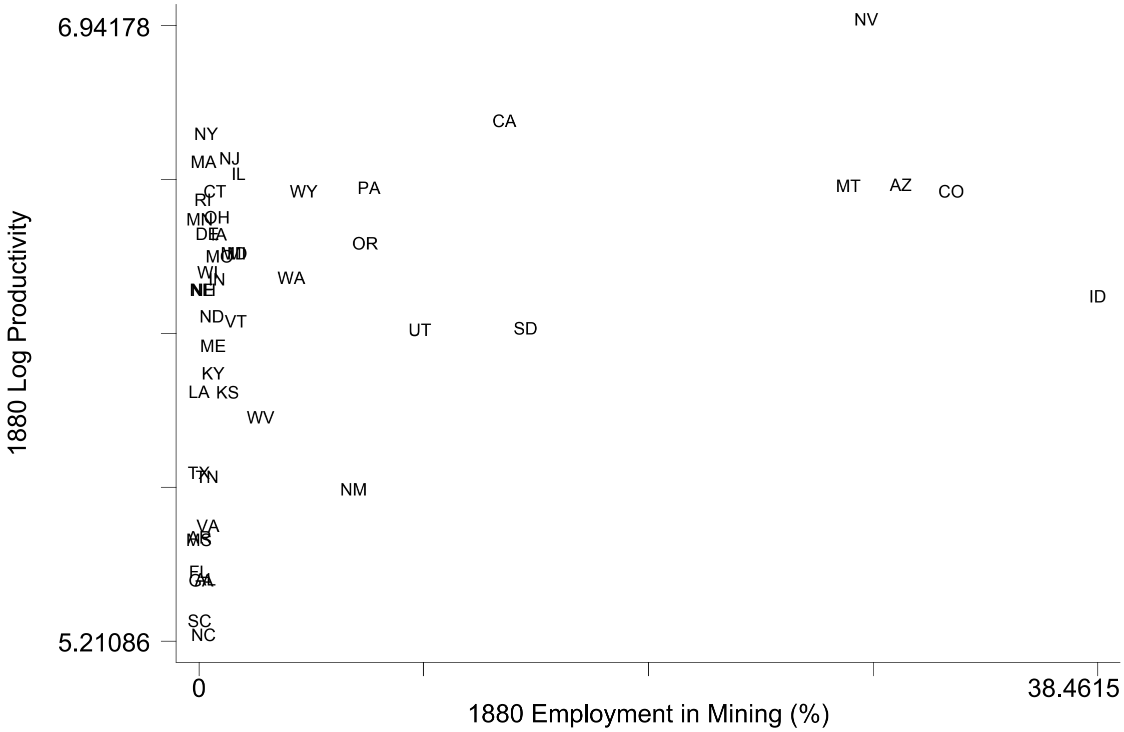
Urbanization and Population Density, 1880 to 1980:

Urbanization is the fraction of a state's population residing in urban areas. Urban areas are defined by the U.S. Census as those places containing more than 2,500 persons. Population density is thousands of persons per square mile for 1880 to 1980. Data on urbanization are from U.S. Department of Commerce (1975, Series A202) and the *Statistical Abstract of the United States* (1985, table 12, p.12). Data on population density are computed using state population data from U.S. Department of Commerce (1975, Series A7 and A195) and the *Statistical Abstract of the United States* (1992, table 25, p.22), and state area data from the *Statistical Abstract of the United States* (1992, table 340, p.205).

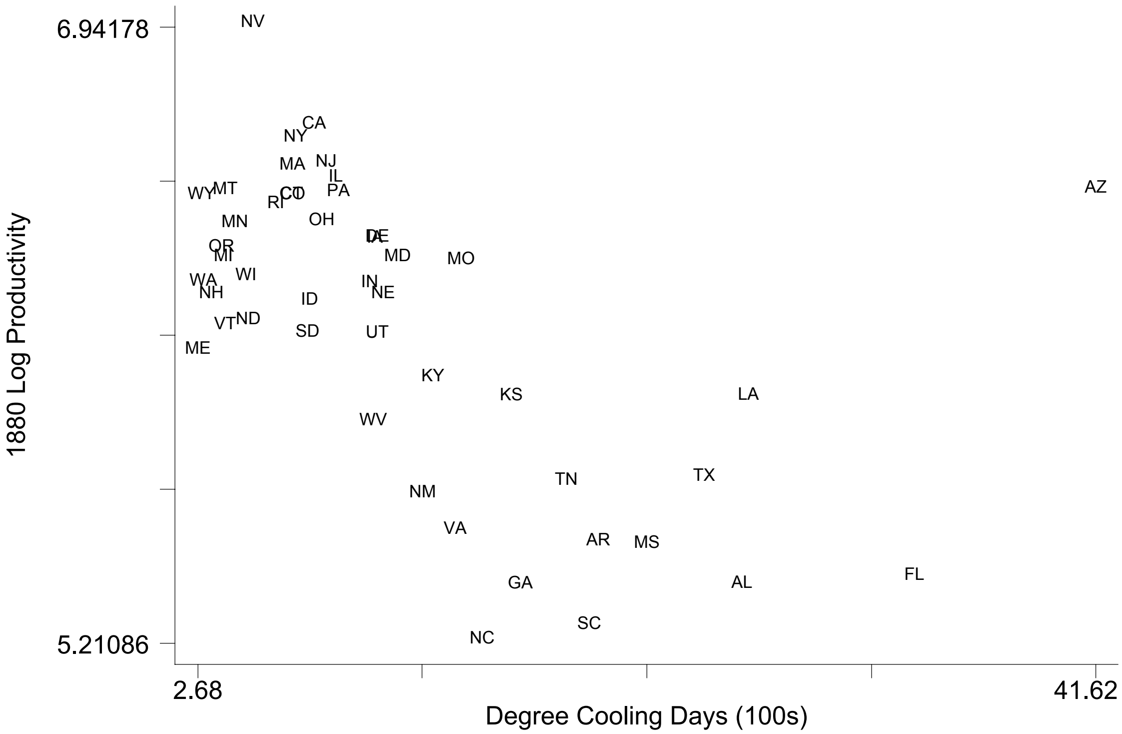
Appendix Table 2 - Data for Basic Model

State	Labour Productivity (Price-adjusted income per worker)						Percentage of Workforce in Mining 1880	Average No. of Cooling Degree Days	Percentage of 1860 Population in Slavery	Access to Navigable Water (Ocean=O, Lake=L, River=R)	Percentage of 1860 Population on Large Slave Plantations	Percentage of Cotton Harvested Mechanically	Settler Origin (English=E, French=F, Spanish=S, Dutch=D)	Average Annual Soldier Mortality in 1829-38, 1839-54 (Percent)
	1880	1900	1920	1940	1960	1980								
AL	214.1	212.5	796.9	785.0	4854.2	18835.8	0.3	2627	45.1	O	28.4	8.0	F,S	3.4
AZ	650.1	689.8	1747.5	1331.3	5553.0	19744.2	30.0	4162	0.0	-	0.0	73.0	S	1.8
AR	241.0	235.6	927.4	748.5	4621.9	17768.4	0.0	2005	25.5	R	13.2	42.0	F,S	3.4
CA	777.1	754.9	2223.0	1846.1	6652.5	22471.8	13.1	773	0.0	O,R	0.0	87.0	S	3.1
CO	638.6	733.5	1817.6	1389.3	6312.9	19633.4	32.2	679	0.0	-	0.0	0.0	F,S	1.9
CT	638.4	604.7	1727.4	1942.7	6557.0	19494.3	0.7	677	0.0	O	0.0	0.0	E	1.0
DE	566.0	589.9	1794.1	2309.3	6881.6	18761.8	0.4	1046	1.6	O	0.0	0.0	E,D	3.0
FL	218.8	269.1	1040.5	1221.0	5821.3	23734.1	0.0	3375	44.1	O	25.6	10.0	E,S	3.2
GA	213.5	206.8	857.2	861.8	4868.3	18802.0	0.1	1667	43.7	O	24.1	14.0	E,S	3.7
ID	474.9	479.4	1771.8	1270.7	4952.6	17810.0	38.5	754	0.0	-	0.0	0.0	E	1.6
IL	669.6	729.2	2042.1	1746.2	6342.8	21513.9	1.7	867	0.0	L,R	0.0	0.0	E,F	1.3
IN	498.4	545.5	1610.2	1456.3	5511.0	18388.1	0.8	1014	0.0	L,R	0.0	0.0	E,F	2.1
IA	565.0	625.4	1585.7	1300.4	5428.6	18623.1	0.9	1036	0.0	R	0.0	0.0	E,F	1.1
KS	362.5	530.8	1670.8	1138.1	5850.3	19314.5	1.2	1628	0.0	R	0.0	0.0	E,F	1.6
KY	382.6	382.0	1117.6	891.2	4926.4	17235.7	0.6	1288	19.5	R	3.8	0.0	F	4.1
LA	362.7	331.9	1283.6	1026.8	5641.1	21362.0	0.0	2655	46.9	O,R	33.9	49.0	F,S	4.1
ME	413.1	464.5	1558.5	1361.3	4761.6	14880.0	0.6	268	0.0	O	0.0	0.0	E,F	1.4
MD	536.1	559.9	1809.2	1618.2	5820.8	18044.7	1.5	1137	13.2	O	4.2	0.0	E	2.1
MA	693.1	677.6	1891.2	1743.2	5746.2	17665.2	0.2	678	0.0	O	0.0	0.0	E	1.0
MI	536.2	528.0	1641.0	1631.8	6610.3	21355.5	1.6	379	0.0	L	0.0	0.0	E,F	1.1
MN	590.2	619.9	1522.0	1280.9	5500.0	18563.6	0.0	431	0.0	L,R	0.0	0.0	E,F,S	0.9
MS	239.2	213.8	686.9	570.0	3911.2	16516.2	0.0	2215	55.2	O,R	36.3	40.0	E,F	4.0
MO	531.8	565.3	1513.3	1292.5	5738.8	19831.7	0.9	1411	9.7	R	1.2	56.0	F,S	4.1
MT	647.9	738.7	1643.2	1384.2	5369.4	17810.2	27.8	388	0.0	-	0.0	0.0	E,F,S	1.2
NE	483.0	632.9	1585.2	1155.1	5627.2	18266.4	0.1	1072	0.1	R	0.0	0.0	F,S	1.1
NV	1034.6	776.8	1976.0	2011.9	6233.7	20390.3	28.6	508	0.0	-	0.0	0.0	S	2.1
NH	482.9	494.0	1478.9	1412.4	5047.8	15840.5	0.2	328	0.0	O	0.0	0.0	E	1.1
NJ	699.5	668.2	2015.6	1818.1	6499.3	20838.7	1.3	826	0.0	O	0.0	0.0	E,D	2.4
NM	275.8	408.7	1370.5	1075.1	6063.1	18382.7	6.6	1244	0.0	-	0.0	64.0	S	2.4
NY	750.7	778.5	2438.5	1922.8	6177.8	21165.7	0.3	693	0.0	O,L	0.0	0.0	E,D	1.7
NC	183.3	182.0	984.0	823.7	4287.2	14360.2	0.2	1500	33.3	O	15.9	12.0	E	2.5
ND	448.9	536.5	1441.7	930.8	4912.6	15416.5	0.6	488	0.0	-	0.0	0.0	F	1.1
OH	593.4	624.8	1842.0	1619.6	6226.2	20167.1	0.8	805	0.0	L,R	0.0	0.0	E,F	2.3
OK	-	317.7	1407.2	1040.7	5819.4	21609.7	1.9	1859	0.0	R	0.0	64.0	F,S	2.8
OR	550.5	570.0	1920.4	1507.3	5749.6	19183.8	7.1	371	0.0	O,R	0.0	0.0	F	1.6
PA	644.2	635.2	1953.8	1623.3	6030.9	20808.6	7.3	878	0.0	L	0.0	0.0	E,D	1.7
RI	622.4	617.6	1745.2	1582.6	5043.3	15827.3	0.2	606	0.0	O	0.0	0.0	E	0.9
SC	190.6	176.4	805.7	803.9	4227.2	17533.2	0.1	1966	57.2	O	37.9	6.0	E	2.6
SD	433.9	559.8	1596.5	934.6	4920.3	14964.9	14.0	744	0.0	R	0.0	0.0	F	1.0
TN	285.9	284.3	1000.1	904.0	4520.0	17515.9	0.4	1867	24.8	R	8.9	19.0	E,F	3.4
TX	289.0	389.6	1371.3	1086.3	5743.5	21794.1	0.0	2466	30.2	O	13.0	58.0	S	4.0
UT	431.8	558.9	1629.5	1397.2	5812.7	17907.1	9.5	1047	0.1	-	0.0	0.0	S	2.1
VT	442.1	454.3	1413.4	1293.1	4775.9	14329.3	1.6	388	0.0	-	0.0	0.0	E,F,D	1.1
VA	248.8	286.8	1132.6	1150.5	5021.3	17526.5	0.4	1385	38.7	O	19.4	1.0	E	2.2
WA	500.2	606.6	1896.6	1545.8	6039.3	21077.3	4.0	294	0.0	O,R	0.0	0.0	E,S	1.6
WV	337.8	363.4	1535.5	1171.2	5146.3	17352.4	2.7	1031	4.9	R	2.3	0.0	E	2.5
WI	508.1	523.7	1537.4	1345.4	5511.9	18257.5	0.4	479	0.0	L,R	0.0	0.0	E,F	1.2
WY	638.3	574.7	2093.6	1430.5	5886.5	22184.2	4.5	285	0.0	-	0.0	0.0	F,S	1.1

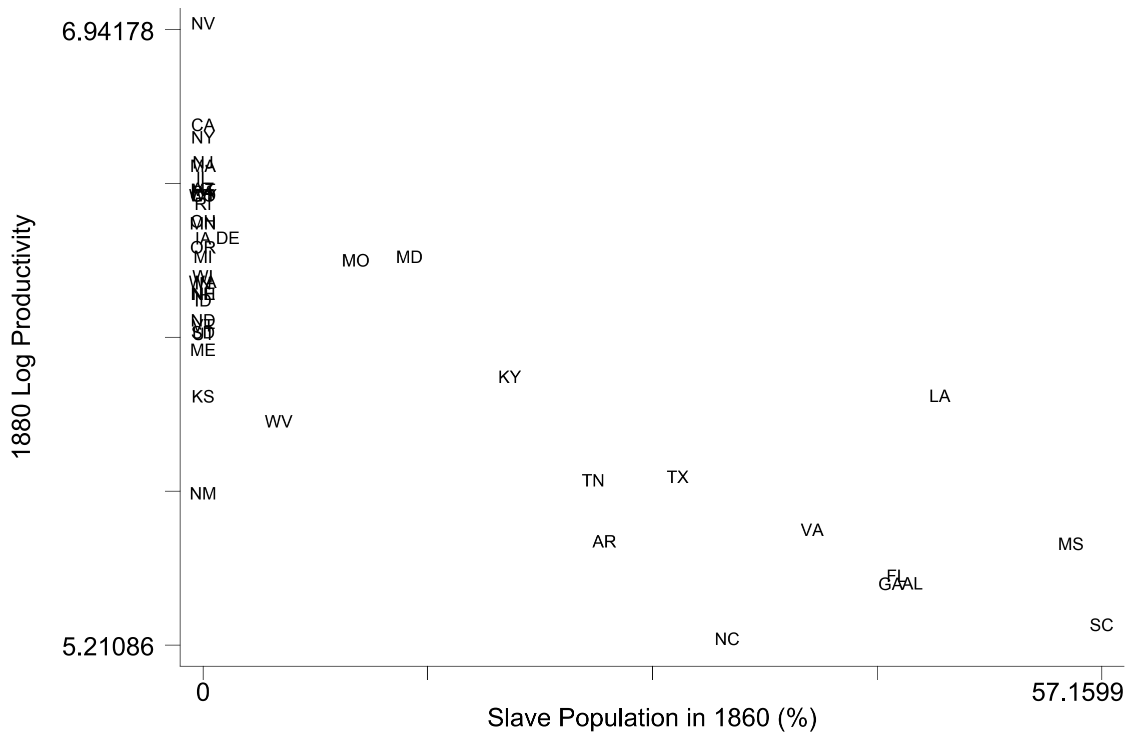
Appendix Figure 1. Productivity and Minerals Endowment in 1880



Appendix Figure 2. Productivity in 1880 and Climate



Appendix Figure 3. Productivity in 1880 and the Legacy of Slavery



Appendix Figure 4. The Legacy of Slavery and Soldier Mortality