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EVIDENCE ON GROWTH, INCREASING RETURNS AND THE EXTENT OF THE MARKET

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ABSTRACT

We examine two sets of economies (19th century U.S. states and 20th century less developed countries) where growth rates are positively correlated with initial levels of development to document how these dynamic increasing returns operate. We find that open economies do not display a positive connection between initial levels and later growth; instead, closed economies do display this positive correlation (*i.e.* divergence). This evidence suggests that increasing returns operate by expanding the extent of the market (as in the big push theories of Murphy, Shleifer and Vishny (1989)). For U.S. states, we also find that larger markets enhance growth by increasing the division of labor. Among LDCs, while more diversified production increases growth, diversification is negatively associated with openness for the poorest economies (as in the quality ladder theories of Boldrin and Scheinkman (1988), Young (1991) and Stokey (1991)). However, and despite the negative effect that openness has on the diversity of production and, thus, on growth, we find that openness still substantially increases growth for these poorer economies.

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I. Introduction

Following Allyn Young (1928), much of the recent theoretical work on economic growth builds on increasing returns to scale in production. Unlike models based on neoclassical production functions, these models suggest that steady-state per capita growth rates are not independent of initial conditions.[1] Romer (1983 and 1986), Lucas (1988), Murphy, Shleifer and Vishny (1989), Rebelo (1991) and others use increasing returns so that initial levels are positively correlated with later growth rates and the endogenous portion of growth continues indefinitely. Under particular assumptions, these models suggest that the the world's lead economy will display divergence over time and often they also predict that the cross-section of the world's economies will also not show convergence.

But empirical work on cross-country growth generally finds convergence, not divergence. Baumol (1986), DeLong (1988), Barro (1991), Barro and Sala-i-Martin (1992) and Mankiw, Romer and Weil (1992) document patterns of convergence in cross-country and U.S. data. Across countries, per capita GDPs do not converge unconditionally between 1960 and 1985, but they do converge once we condition on variables (such as education) that determine the steady state level of income per capita. This evidence would seem to contradict modern endogenous growth theory.[2]

In fact, the well-documented conditional convergence of Barro and Sala-I-Martin (1992) and others is more relevant for tests based on the neoclassical growth model. Endogenous growth models predict unconditional, not conditional, divergence.[3] Most of these theories also predict that increasing returns should operate only during specific time periods (*i.e.* during industrialization) or in specific countries.

[1] We use the term "neoclassical" to refer to production functions that display diminishing returns to scale.

[2] Growth theorists (see, for example, Romer (1986)) tend to avoid this contradiction by emphasizing that divergence need only appear in the time series evidence of the lead economy. In many models divergence is not predicted in a cross section.

[3] Technically, the issue is whether or not savings or schooling behavior should be treated as an exogenous variable (as Solow (1957) treats investment), or whether they should be considered as endogenously determined by other initial conditions. Barro (1991) takes a partial approach, treating schooling as only a right hand side variable but treating investment as endogenously determined by other initial conditions.

Instead of testing implications of the neoclassical growth model against the alternative hypothesis of endogenous growth, we proceed by testing the hypotheses of endogenous growth models against each other and against the alternative hypothesis that increasing returns never operate.

Our primary question is whether increasing returns occur because higher initial GDP acts to increase the demand for national products. Recent papers such as Becker and Murphy (1993) or Murphy, Shleifer and Vishny (1989) predict that growth follows initial wealth because that wealth creates a market for certain activities. According to these models, higher initial income should increase later growth rates more strongly when an economy is closed than when an economy is open. In open economies, aggregate demand is fixed by world markets and higher initial levels of income do not change effective demand. In closed economies, national income determines demand.

We address this question with two samples of economies that display *unconditional* dynamic increasing returns (U.S. states in the 19th century and the 65 poorest countries in 1960).[4] In our country sample we use income and urbanization to measure growth and the share of trade in GDP to measure openness. Across U.S. states, we use the state's levels of urbanization (following De Long and Shleifer (1993)) and manufacturing to measure development. Nineteenth century income data for U.S. states is neither reliable (despite heroic efforts by Easterlin and others) nor theoretically appropriate in economies with considerable amounts of migration between states. For the states, we use physical distance to major regional ports (and, thus, to major east coast markets)[5] and regional railroad development as our basic measures of openness.[6]

Across all of our samples, we find that increasing returns are important for closed *not* open economies. This evidence suggests that increasing returns operate by expanding the extent of the market as in big

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[4] The importance of these samples immediately tells us about that there are places where increasing returns do operate.

[5] Such physical measures could also be used for 20th century data for U.S. states or cross-country comparisons. However, the vastly improved nature of transportation makes reliance on geography much less palatable in the age of the airplane, truck and high speed ocean transport. See Pred (1980) for a more detailed discussion of these issues.

[6] Regional rail has the useful attribute of giving us time series as well as cross-sectional variation.

push theories (Rosenstein-Rodan (1943) and Murphy, Shleifer and Vishny (1989)) or theories where growth derives from the division of labor (Becker and Murphy (1993)). This finding does not support the implication of quality ladder arguments that openness is particularly damaging for economies at the very bottom of the income distribution (see Stokey (1991) or Young (1991)).

We explore further the relationship between initial levels, openness and growth with a variety of decompositions. For both the nineteenth century U.S. data and the world data, the division of labor spurs growth. In the U.S. data, initial GDP and openness increase growth in part by increasing the division of labor. For world data, initial GDP raises the division of labor, but openness deters it (as in Stokey (1991)). However, while openness acts against growth in poorer countries by reducing the division of labor, the overall connection between openness and growth for the poorest nations is strongly positive -- the direct positive effects of openness overwhelm the indirect effect that works through lost diversity.

Section II discusses the relevant theories. Section III describes the data. Section IV presents our basic empirical results starting with the openness/increasing returns connection. The next two sections present our decompositions. Section VII concludes.

II. Theories of Increasing Returns

This section presents the relevant implications of four major sets of theories of endogenous growth.

Informational Access

In Romer (1983, 1986), endogenous growth is obtained with an aggregate production function that exhibits increasing returns that are external to the investing firm. Knowledge-based growth theories may predict that openness spurs growth because of the connection of trade to information transmission (e.g. reverse engineering of traded goods, the Italian merchant Marco Polo, the Portuguese traders in 16th century Japan, or the innovations brought by European traders to native Americans).[7] But even if openness increases access to a wider set of ideas for all countries, it is not obvious how it interacts with growth at different levels of development. Two effects seem likely to drive the cross-effect between openness and initial GDP: (1) higher human capital could make it easier to take advantage of new ideas so more developed areas may benefit most from the exposure created by trade, and (2) the new ideas brought by trade might be less new to more developed countries. Evidence on the openness-initial GDP cross-effect can help determine the relative importance of these two effects but it cannot be used as a test for the role of informational spillovers more broadly.

Big Pushes

A second theory of increasing returns is the big push theory of Rosenstein-Rodan (1943) and Murphy, Shleifer and Vishny (1989). This theory emphasizes the importance of coordination and demand spillovers in generating increasing returns and multiple equilibria. Technically, the Murphy *et al.* models also rely on the existence of fixed costs (and hence increasing returns) in technology, but the emphasis of their work lies on the role that increasing levels of income play in creating a larger market for industrialized output.

According to the theory of the big push, within closed economies more initial wealth creates more demand for industrialized products which in turn induces firms to pay the fixed costs of growth. By contrast, in small open economies the demand curves facing local producers are set by world markets and uninfluenced by local wealth.[8] The big push theory predicts that growth will be related to initial wealth and access to world markets but also that the interaction between wealth and openness will be negative

[7] Of course, some European innovations, such as the Inquisition, may not have been good for growth.

[8] This type of effect might be part of the explanation for the smooth post-war Japanese business cycle. This emphasis on pecuniary externalities links growth with Keynesian (1936) macroeconomics. A natural test of the importance of pecuniary externalities for business cycles is to compare output volatility (relative to world output) for open and closed economies.

as openness eliminates the linkage between initial wealth and effective demand. We also test for the importance of the big push by checking if the extent of the market works by increasing the rate of growth of physical capital (where fixed costs are most likely to matter).

Diversity and Specialization

A third set of increasing returns theories with implications for openness emphasize the role of specialization. The connection between the division of labor and economic progress is typically associated with Smith (1976). Becker and Murphy (1993) argue for the role that the division of labor plays in increasing both the level and the growth rate of income over time.[9] A finer division of labor can speed up growth because concentration in a single task might facilitate innovation and learning by doing (as Smith suggested). The costs of acquiring new skills might also lower as the range of tasks involved diminishes.[10]

Smith's famous dictum is that the division of labor is limited by the extent of the market. If that is true, growth should be connected to initial levels only in closed economies. In open economies, the world market is what determines the extent of the market. These models predict the same negative interaction between openness and initial wealth as the big push theories, but they also predict that the positive effect of the extent of the market on later growth should lessen when we control for the division of labor.

[9] Becker and Murphy emphasize the importance of coordination as opposed to actual market size for the division of labor. However, their model also allows for the standard Smithian effects of market size. These effects become particularly close in spirit to their work when the statistical returns to scale of larger markets are taken into account, i.e. when larger markets work by diversifying idiosyncratic demand shocks to particular consumers.

[10] A supposed advantage of assembly lines is the ease of training assembly line employees.

The Quality Ladder: Specializing in the Wrong Products

A final set of theories that offer predictions on the relationship between increasing returns and openness are the quality ladder arguments of Boldrin and Scheinkman (1988), Stokey (1991), Grossman and Helpman (1991) and Young (1991), and the 19th century protectionists List (1856) and Rae (1834). Quality ladder theories are tied to the division of labor theories in that they argue that the range of goods produced is critical to growth, but in the quality ladder theories openness lessens diversity in production. Division of labor theories emphasize the importance of the higher demand for a broader range of products that comes about with increased openness; quality ladder models emphasize how openness raises the foreign supply of these products, and thus lessens the effective demand for the domestic production of those products.

Under quality ladder arguments, openness is particularly damaging for the extremely poor countries. With free trade, less developed countries will tend to specialize in low growth activities that are intensive in the use of natural resources or unskilled labor, thereby allowing middle income countries to reallocate their resources away from these low growth activities.[11] In Stokey's words "if the industries in which the less developed country has a static comparative advantage are industries in which there are limited opportunities for learning, then the effect of free trade is to speed up learning in the more developed country and to slow it down in the less developed one." Therefore, and contrary to big push and division of labor theories, quality ladder arguments predict that initial income will be more closely associated with later growth for open economies than for closed economies.

III.- The Data

This section describes our data sets and their construction.

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[11] High income countries may in fact also reduce growth as they reduce their production of high growth products and cater more to world tastes.

Construction of the Data Sets

Our cross-country data set was constructed using several different sources. The data on urbanization were assembled by hand from hard copy, and come from the 1988 edition of the *Prospects of World Urbanization.*[12] The cross-country data on population and real per capita GDP are from the Barro and Wolf (1991) data set. The trade data are from the World Bank's *World Tables*, and consists on imports and exports of goods and non-factor services. Data on educational attainment is from Barro and Lee (1993). The data on road infrastructure is from Canning and Fay (1992), and the land area data come from the 1986 edition of the *FAO Production Yearbook.*

For the U.S. states, we also used a variety of different sources. The data on state population, urbanization and labor force are from the *Historical Statistics of the United States* (1976). For population in the state's main city, we used the 1980 Census and several issues of the *Statistical Abstract of the United States*. For some states, we used direct 19th century census data. The data on the labor force engaged in manufacturing in 1880 and 1890 is from several issues of *Statistical Abstract of the United States.* For earlier years, we used the 1840 to 1870 censuses.[13]

The railroad data for 1860 to 1890, and the data on distance from the state's main city to the main regional city are from the *Statistical Abstract of the United States.* For each port, the relevant regional port was either New York, San Francisco or New Orleans, whichever was closer. The railroad data for 1840 and 1850 is from Wicker (1960). Literacy data are taken from the U.S. censuses. We had no

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[12] Data are available only for countries or areas with two million or more inhabitants in 1985.

[13] A problem with the U.S. census labor force and manufacturing data is that the population covered did not remain invariant during our sample period. Thus, while the 1840 and 1870 censuses covered the whole population, the 1850 census covered the free male labor force above 15 years of age only, and the 1860 census included free females and extended the age limit to 10 years or older. We dealt with this problem by obtaining census estimates of the slave population. To construct labor shares in manufacturing, we assumed that all slaves of 15 years of age and older were in the labor force, and that 15 percent of them were in manufacturing (we based this figure on Sokoloff (1982)). Before these corrections, Southern states displayed wild variations in their manufacturing shares. We also tried altering our assumptions about slave labor force participation rates and shares in manufacturing slightly but none of our results seemed sensitive to these alterations.

choice but using data on white literacy only as before 1860 the census provides no information on literacy rates for the slave population. Finally, we gathered data on over 300 hundred occupations from the 1850 and 1870 censuses.

Our U.S. data thus covers the decades 1840-1890. Data was not collected before 1840 because of availability problems. We stopped in 1890 because (1) massive immigration to eastern cities potentially biases our results, (2) rail development had become extremely comprehensive by 1890 so variation across regions became less meaningful, and (3) by 1890 the eastern states had achieved a similar level of development to the most developed nations in our cross-country sample. Moreover the period 1840-1890 is typically considered the era of America's "big push."

Description of the Data

Tables 1a and 1b show the five fastest and five slowest growers in our cross-country sample (both in terms of GDP and urbanization) and the corresponding initial levels of the relevant variable. While the average initial income of the fastest growers is about $ 150 (in 1980 dollars) higher than that of the slowest growers, the group shows considerable heterogeneity. It includes both relatively well-off countries as Malta and extremely poor ones as Lesotho. This is not the case with the slowest growers; all of them are in Sub-Saharan Africa.

In terms of urbanization, the distinctions are more clear-cut. The average level of initial urbanization for the fastest growers is about double that of the slowest ones. Korea is the fastest grower on both counts,[14] and only five of the twenty countries are outside Sub-Saharan Africa. Table 1c shows the five most and five least urbanized U.S. states in 1840, and table 1d does the same thing for 1890. Table 1e shows the largest and smallest spurts in urbanization growth. Table 1f shows the largest and smallest changes in urbanization over the 1840-1890 sample.

[14] There is a strong correlation between urbanization and income growth across countries. We believe this fact supports our use of urbanization in the U.S. regressions.

IV. Evidence on Increasing Returns and the Extent of the Market

There are two major ways in which our estimation differs from more standard forms, e.g. Barro (1991): (1) we often use urbanization not income as our measure of development, (2) we focus on unconditional not conditional regressions.

Urbanization vs. Income

Our emphasis on urbanization (and manufacturing) over income for U.S. state data goes against the prevailing methodology and, admittedly, urbanization is often a poor proxy for economic development.[15] However, the standard data source on state income levels (Easterlin (1960 used by Barro and Sala-i-Martin (1992)) is available only at 40 year intervals, has measurement problems, and is in nominal dollars (so differences across states might not reflect local price level differences). On the contrary, urbanization is (1) available every 10 years, (2) a simple, reliable measure, (3) invariant with respect to local price indices, and (4) reliably connected with economic development (see Bairoch (1988)).

We also favor urbanization over income in the 19th century U.S. because intrastate mobility should eliminate any welfare differences across states. The income differences that do exist should represent a combination of unobserved heterogeneity and compensating differentials. The high incomes earned in 19th century western states are much better interpreted as a compensation for the danger of the frontier and tediousness of life away from the eastern seaboard than as an index of economic development. Table 1a shows the five least urbanized states of the U.S. in 1840. Without exception these states represent some of the least developed areas of the United States in this period.

[15] The exact model that we have in mind is spelled out in the estimating framework section of the paper.

Conditional vs. Unconditional Convergence

We first focus on unconditional convergence rather than on the more traditional examination of conditional convergence. This focus is appropriate since the four theories described above concern unconditional increasing returns. An advantage of the unconditional regressions is that they are less prone to measurement error biase. When regressing GDP growth on initial GDP, measurement error creates both the standard bias, which lowers the absolute value of the coefficient on initial GDP,[16] but when measurement error is i.i.d., it also lowers the coefficient on initial GDP by

$$\frac{Var(Measurement\ Error)}{Var(Initial\ GDP)} \tag{1}$$

When conditional regressions are run, this second bias becomes

$$\frac{Var(Measurement\ Error)}{Var(Initial\ GDP\ orthogonolized\ with respect\ to\ the\ other\ controls)} \tag{2}$$

Since the denominator in (6) might be substantially smaller than that in (5), the bias towards convergence might be much higher in conditional regressions. In the case of standard growth regressions, the bias towards convergence more than triples when going from unconditional to conditional regressions.[17]

Estimating Framework

The appropriate model for using urbanization as a proxy for development is one with two sectors: a primary, unurbanized, agricultural, or low technology sector, and a secondary, urbanized, or manufacturing one. Aggregate production in each state is given by

[16] This coefficient is given by

$$\frac{Cov(GDP\ Change, Initial\ GDP)}{Var(Initial\ GDP)}$$

The first bias works by raising the denominator. The second bias operates by lowering the numerator.

[17] This extra bias may explain why divergence appears in unconditional regressions only.

$$A_i \, (L_{1i}^{\alpha} \, L_{2i}^{1-\alpha})^{s_i} \tag{3}$$

where A_i is the overall level of productivity in the state, L_{1i} and L_{2i} are the quantities of labor in the primary and secondary sectors, α measures the importance of the developed sector (the degree of development), and s_i represents some sort of state specific congestion. In equilibrium, the marginal product of labor will be equalized across states and sectors, which implies that the share of total output in the secondary sector will be given by

$$\alpha = \frac{L_{1i}}{L_{1i} + L_{2i}} \tag{4}$$

Since we are primarily interested with changes in the structure of the economy, *i.e.*, it's development from agricultural to urban, we need only look at changes in the shares of population in each sector and interpret them as changes in the coefficients of the Cobb-Douglas. More specifically, we look at

$$\alpha_{i,t+1} - \alpha_{i,t} = f(\alpha_{i,t}, O_{i,t}) \tag{5}$$

where $O_{i,t}$ represents the openness of economy i at time t. We are particularly interested in the cross-effect between $\alpha_{i,t}$ and $O_{i,t}$. The specific functional form that we run is

$$\alpha_{i,t+1} - \alpha_{i,t} = \beta_0 + \beta_1 \, \alpha_{i,t} + \beta_2 \, O_{i,t} + \beta_3 \, \alpha_{i,t} \, O_{i,t} + e_{i,t} \tag{6}$$

and we are mostly interested with the sign of β_3, the cross-effect between openness and initial development. All the regressions are weighted by initial population.

World Data

Regression (1) in Table 3 shows the raw divergence relationship for a cross-section of countries between 1960 and 1985. The countries included in our sample are all those countries with incomes of 1980 US$ 1,500 or less in 1960. There is a total of 65 countries in this basic sample. The relationship between initial levels and subsequent growth rates is fairly well known.[18] Figure 1 shows this basic relationship visually. The coefficient of 0.019 indicates that an increase of US$ 100.00 in 1960 increases the average growth rate by 0.19 percent per year.

Regression (2) shows our openness measure and the cross-effect between openness and growth. As discussed earlier, this openness measure is flawed by its endogeneity, *i.e.*, trade is not exogenously determined. However, the results show our basic point in a powerful way. The pure effect of openness on growth is moderately positive. A one standard deviation increase in the share of total trade to GDP increases the growth rate (at the average initial level of GDP per capita in 1960 of US$ 740) by 0.34 percentage points per year (0.2 standard deviations).

The cross-effect between GDP and openness is very strong. For an open economy with a share of trade in GDP of 0.49 (slightly above the mean), there is no relationship between GDP and GDP growth. For a low trade, closed economy (with a trade share of 0.22, one standard deviation below the mean), a US$ 100.00 increase in the level of initial GDP raises the growth rate by about 0.19 percentage points per year.

Figures 2 and 3 show this result visually. Figure 2 shows the relationship between growth and initial GDP in low trade closed economies. Figure 3 shows that such relationship does not hold for high trade open countries. In regression (3), we introduce continent dummies and we control for primary school enrollment in 1960. The magnitude of the cross-effect rises once these controls are included.[19] For a smaller set of countries, regression (4) reproduces regression (3) but using the *initial* share of trade in GDP instead of the average over 1960 to 1985. The results are consistent with those of previous regressions.

Regressions (5)-(7) perform the same exercise as regressions (1)-(3) but using urbanization rates as a measure of development. Regression (5) shows the raw divergence relationship for the same cross-section of countries between 1960 and 1985. The coefficient on initial urbanization indicates that, in our sample,

[18] It can be seen in Figure 2 of Barro and Sala-I-Martin (1992).

[19] We have also run these regressions with non-linear specifications of GDP as an explanatory variable and the results remained almost unchanged.

a 10 percent increase in the initial level of this variable is associated with 4 percentage points faster increase in urbanization over the period.

Regression (6) shows that once again the cross-effect is negative and strong. For a moderately open economy with a share of trade in GDP of 0.46 (3 percentage points above the mean), there is no relationship between initial urbanization and subsequent changes. For a relatively closed economy (with a trade share of 0.22, one standard deviation below the mean), a 10 percent increase in the level of initial urbanization leads to a 4 percent increase in urbanization over the period.

Figure 4 displays this strong positive relationship for the closed economies in our 65 least developed countries. Figure 5 shows that there is no relationship between changes and initial levels for the open economies. Again, regression (7) verifies that our results are robust to controlling for regional and educational variables. Regression (8) shows that our results are not sensitive to using the share of trade from 1960 to 1985 as our measure of openness.

U.S. Data

Table 4 contains similar regressions for our U.S. states sample. This table shows results for a pooled sample of states over the period 1840-1890. The decade 1860-1870 has been eliminated due to the Civil War.[20] We have included fixed effects for each decade and allowed for correlation across decades in the shocks to states by estimating a stacked set of growth regressions with SUR techniques (state specific random effects are a particular form of this methodology with an assumed form of correlation across decades). The SUR methodology ensures that a state's growth rate between 1870 and 1880 and a state's growth rate between 1880 and 1890 are not treated as independent observations.[21]

Our dependent variable is the decadal change in the share of urbanized population in the state. The first regression in Table 4 documents the basic positive relationship between urbanization growth and initial levels of urbanization. The time dummies tell us that the 1840-1850 and the 1880-1890 decades

[20] The results become substantially stronger if that decade is included.

[21] In fact there is not that much correlation between decadal growth rates across states.

were the periods of strongest urbanization growth of the second half of the 19th century. The coefficient on initial urbanization in regression (9) is positive and highly significant, and indicates that a 10 percent increase in the amount of initial urbanization leads to about 1 percent increase in the share of urbanized population over a ten year period.

Our first measure of openness is a distance dummy which takes a value of 0 if a state was within 250 miles of a major regional port (San Francisco, New York and New Orleans all qualify as major regional ports), and a value of 1 otherwise.[22] Regression (10) finds that (by this measure) openness is negatively related to urbanization growth. A state that is far from major regional ports experiences a fall in the rate of urbanization of 2.27 percent per decade (holding initial urbanization constant at zero). However, as the rate of urbanization increases, this negative effect of distance disappears. By the time initial urbanization is at 13 percent, distance is irrelevant for growth. In other words, there is a strong positive cross-effect between *lack* of openness and initial levels. This results are, of course, consistent with our previous finding of a negative cross-effect between openness and initial levels for world data.

Regression (11) repeats the experiment including a South dummy. Given the remarkable series of events that affected the American South (shocks to cotton prices in the 1850s, the civil war, Reconstruction, etc.), it seems reasonable to examine whether the results withstand the inclusion of this regional dummy. The cross-effect is still significantly positive, but its coefficient drops in half. Some of the effect we find is conceivably a result of political experiences affecting the South's performance, but much seems to be unrelated to the South itself. In an experiment such as this one, we would expect the inclusion of regional dummies to substantially reduce distance related coefficients (since both distance and regional dummies are geographic variables) even if there had never been a Civil War.

Regression (12) looks at an alternative measure of openness: the extent of rail development in the states

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[22] We examined different measures of distance and found that our results were essentially robust to alternative specifications. Our decision to look at distance as a discrete rather than as a continuous variable is dictated by (1) our theoretical discussion that focused on a sharp difference between open and closed economies and (2) our lack of a clear theory of distance which gives us any preferable functional form (we found no papers that suggest a linear functional form relating openness to growth). Small changes in the specification of the functional form seem to make no difference in our results. The list of "open" and "closed" states according to this classification are listed in Appendix 2.

that belong to the same census region as the state, with the exclusion of the state in question.[23] States surrounded by neighbors with highly developed transportation systems constituted larger potential markets for the state in question. In addition, they facilitated access from the main production sites in the state to major regional ports. These arguments justify using regional rail development as a proxy for state openness. Here again we see a very powerful negative cross-effect between openness and growth. Initial urbanization only matters for states in regions with poorly developed railroad networks.

Regression (13) allows the relationship between changes and initial levels to be non-linear. We use a spline function with breaks at relatively arbitrary points (urbanization rates of 50 percent is the break between high and low urbanization). The positive coefficient on initial urbanization is higher for low urbanization rates. Both state and world data indicate this type of concavity. Even more interesting is that the coefficient on initial urbanization is even stronger once we look at the interaction between low urbanization and distance. The coefficient increases by 50 percent. There is no cross-effect between urbanization and distance for high urbanization states because all of the states with more than 50 percent urbanization rates are situated close to a major port. Regression (14) looks at an unbalanced panel. This avoids our random effects-style methodology (that requires a balanced panel) and simply pools all the available data together. The cross-effect between distance and initial urbanization is highest for this regression.[24]

Table 5 shows results for changes in the share of the labor force employed in manufacturing and changes in the share of urbanized population living in the state's largest city. The manufacturing regressions only cover the 1870-90 decades as we do not have reliable manufacturing data for the earlier periods. Unlike urbanization, manufacturing shares mean revert for states that are near major ports, but display divergence for closed economy states.

Since manufacturing seems to display strong decreasing returns at higher levels, we worried that some of the distance/initial share connection might only be capturing the stronger positive connection between

[23] There are 9 census regions: Pacific, Mountain, West North Central, East North Central, Middle Atlantic, New England, South Atlantic, East South Central, and West South Central.

[24] However, interpreting the standard errors is not simple as we incorrectly treat state urbanization changes as independent over time.

manufacturing and manufacturing growth at lower levels of manufacturing. To examine this possibility, we used a spline function in regression (16). The cross-effects were reduced but are still significant in these regressions. Regression (17) repeats the same experiment but using regional railroad density as a measure of openness. Again, the openness/initial levels cross-effect is negative and significant at all levels of manufacturing.

We found a positive cross-effect with distance and a negative (but insignificant) cross-effect with regional railroad density for regressions using the change in the share of urbanized population in the state's largest city as our left hand side variable. These regressions are interesting because we might believe that the definition of urban place (over 2,500 inhabitants) is too restrictive to capture what is meant by urbanized. We might also be interested in whether distance is related to local, city-specific increasing returns.

In connection with this last issue, these results are a further confirmation of Krugman (1991) and Krugman and Livas (1993). Since dynamic increasing returns exist only for cities that are difficult to serve with external trade, it becomes plausible to believe that local demand spillovers may be driving the growth of these cities. These regressions are also complementary of the results in Ades and Glaeser (1993), who provide supportive evidence for Krugman and Livas' theory for the connection between closed economies and urban concentration.

Summary

These results document a negative cross-effect between initial levels of development (whether measured by income, rates of urbanization or shares of the labor force in manufacturing) and openness. This type of finding provides strong support for increasing returns theories that build on aggregate demand spillovers (as in Murphy, Shleifer and Vishny (1989)) or for theories that emphasize the importance of division of labor (as in Becker and Murphy (1993)). These findings are not supportive, however, of theories such as Stokey (1991) or Young (1991) which argue that openness is particularly damaging for less developed countries. Our main conclusion from this section is that increasing returns operate mostly for less developed economies by expanding the size of the market.

V. The Division of Labor, Human Capital and Infrastructure

In the previous section, we focused on the interaction between level of development and openness as a means of distinguishing between theories of increasing returns, *i.e.*, these three variables tried to establish that initial growth spurred subsequent growth by increasing the extent of the market. We will subsequently refer to our three previous variables (initial levels, openness and the interaction) as extent of the market variables. Here, we are interested in testing further between the basic theories by including other variables related to initial conditions: (1) diversity of production, (2) human capital, and (3) physical infrastructure. Following Murphy, Shleifer and Vishny (1992), we examine whether the extent of the market variables remain significant when controlling for these variables and we decompose the effect of the basic variables into direct effects and indirect effects going through the new variables.

The main variable that will help distinguish among the three theories is the diversity of production variable. Both quality ladder and division of labor theories predict a strong effect of the range of products on growth. In quality ladder models, more products suggest more high growth products; in division of labor theories, more products and occupations suggest more division of labor. But while in quality ladder arguments openness reduces the variety of products, in division of labor models openness increases the range of products. We will also be looking at the possibility that human capital or physical infrastructure are behind the connection of growth with the extent of the market.

Estimating Framework

The estimating framework simply uses equation (4). Instead of assuming that growth is a function of openness and initial levels only, we assume that growth is related to initial levels, openness and other variables that were previously omitted. However, these new variables might also be correlated with openness and initial levels. We can then decompose our previous estimates of the effects of openness, initial levels and the cross-effect into the direct effects and the indirect effects operating through our previously omitted variables. More precisely, we assume that

$$\alpha_{i,t+1}-\alpha_{i,t} = f[Z(\alpha_{i,t},O_{i,t}),\alpha_{i,t},O_{i,t}] \tag{7}$$

where Z is the vector of variables that were omitted from (4). The particular functional form that we estimate is

$$\alpha_{i,t+1}-\alpha_{i,t} = \beta_0+\delta Z_t(\alpha_{i,t},O_{i,t})+\beta_1\ \alpha_{i,t}+\beta_2\ O_{i,t}+\beta_3\ \alpha_{i,t}\ O_{i,t}+e_{i,t} \tag{8}$$

where $e_{i,t}$ is a noise term. We also assume that

$$Z_t(\alpha_{i,t},O_{i,t})=\gamma_0+\gamma_1\alpha_{i,t}+\gamma_2 O_{i,t}+\gamma_3\alpha_{i,t}O_{i,t}+\eta_{i,t} \tag{9}$$

The total effect of initial levels on further growth can therefore be decomposed into a direct effect of β_1, and an indirect effect operating through Z of $\delta\gamma_1$. Similarly, the total effect of openness on growth is given by a direct effect of β_2 and an indirect effect of $\delta\gamma_2$. Finally, the interaction can be decomposed into a direct effect of β_3 and an indirect effect of $\delta\gamma_3$. These effects add up to the coefficients estimated in (4).

These decompositions have the interpretation of asking how much initial levels or openness work directly on growth and how much their effects work indirectly by raising the levels of other variables that are correlated with growth. We can then ask, for example, how much of the cross-effect between openness and growth works directly and how much it affects growth by allowing a thinner division of labor among tasks. We consider three possible sources of increasing returns: (1) human capital spillovers (meant to be related to the knowledge stories outlined above), (2) physical infrastructure, and (3) the division of labor.

World Data

Table 6a shows the regressions used for the decompositions that we do with world data. The variables in the Z vector are the share of the population with complete secondary schooling, a measure of diversity of exports (taken from the UN Handbook of International Trade and Development Statistics[25]) and the road density of the country.[26] The rarity of these variables (when combined with our already small subset) required us to look at only 43 countries.

Regression (24) displays our basic finding: for world data, the direct effects of the extent of the market variables remain significant and large. Diversification of exports are also important for growth. A one standard deviation increase in the initial level of the index of export diversity raises per capita GDP growth by 0.9 percentage points per year. This finding lends support both to quality ladder and division of labor theories. On the contrary, neither initial stocks of education nor road density affect growth for this sample.[27]

Regression (25) shows that more developed nations and more open nations both have more schooled individuals (the causality with openness is completely in question) and the cross-effect is negative (as in the case of the state data). This regression was similar to our state results for white literacy rates. Regression (26) shows that our road networks variable seems to be unconnected to the extent of the market.

Regression (27) shows that (at the mean level of openness) per capita GDP is positively associated with export diversity. Also, openness seems to have negative effects on diversity, particularly for poorer

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[25] This "Hirschmann" index of diversity is given by

$$EXPSP_{i,t} = \frac{m}{m-100} - \frac{100}{m-100}\sqrt{\sum_{j=1}^{j=n}\left(\frac{x_j}{X}\right)^2} \quad where$$

i is the country index, n is the number of commodities, m is the minimum value of the index (which is given by the ratio of 100 into the square root of n), x_j is the value of exports of commodity j, and X is the total value of exports. A directly comparable measure to the one we use below for the state data is not to our knowledge available.

[26] To keep the size of our sample at a reasonable level, we use roads density in 1970 instead of 1960. For the smaller set of countries that have road data for both 1960 and 1970, the correlation between these two variables is 0.98. Road density is measured as the ratio of total km. of roads to land area. The data was taken from Canning and Fay (1993).

[27] This lack of importance of the education variable goes against most previous work, e.g. Barro (1991). Our results differ from his primarily because of our sample. When industrialized countries are also included in the regressions, we find that education has a much more important effect.

countries. As in Boldrin and Scheinkman (1988) or Stokey (1991), openness reduces the range of products sold. As we found in regression (24), this reduction of diversity in turn reduces growth. Here, the supply effect of openness (i.e. outside suppliers reduce product range) must be dominating the demand side effect (larger markets allow a larger product range). Finally, the cross-effect between openness and growth is positive, which suggests that trade increases diversity for more developed countries. We take these results as providing some support for quality ladder stories. While there is a negative effect of openness on diversification for poorer countries, the overall effect of openness on growth for these poorer countries is strongly positive. The direct effect of openness on growth for these nations overwhelms the much smaller indirect effect of openness on growth that operates through specialization of production.

U.S. Data

Data availability limits our decades to 1850-1860 and 1870-1880. Again, we look at changes in the degree of urbanization as a function of initial urbanization, our distance dummy and the cross-effect between the two. We are interested both in the decomposition of initial levels and in the cross-effect between urbanization and distance.

Our human capital variable is the white literacy rate of the state in 1850 and 1870. Our measure of physical infrastructure is railroad density *of the state in question.* Our measure of specialization is a "Dixit-Stiglitz" variety index created by using occupational data hand collected from the 1850 and 1870 censuses. The specific functional form that we use for this last variable is given by

$$DS_{i,t} = \left[\sum_j \left(\frac{employment_{ij,t}}{aggregate\ employment_{i,t}} \right)^{1/2} \right]^2 \tag{10}$$

where i is the state, and j is the occupation.

This measure of specialization might be somewhat sensitive to the definitions used in each census to define each category of employment. Because these definitions changed over census years, we rescaled the indices of specialization obtained by subtracting from the corresponding value for each state-decade the decadal sample mean and dividing by the decadal standard deviation. Thus, our measure of specialization keeps the same mean and standard deviation over both periods. This specialization measure is ideal for capturing the division of labor -- it strongly weights the presence of obscure professions. It seems much less ideal for measuring quality ladder effects, but it should also be related to the range of products being produced in a state.

Regression (24) in Table 7a shows the results of running changes in the share of urbanized population on time fixed effects, the extent of the market variables, physical infrastructure (measured by railroads in the state), white literacy levels and our measure of division of labor. In these regressions, the direct effects of the extent of the market disappear statistically. Human capital does predict later growth but only weakly. Railroads and the division of labor are both extremely strong predictors of later state growth. A one standard deviation increase in the Dixit-Stiglitz diversification measure raises the change in the share of urbanized population by about 2.5 percentage points.

Regressions (25) and (27) show that both initial levels of urbanization and the cross-effect are correlated with higher levels of literacy and specialization. This last regression strongly supports the basic Smithian notion that the division of labor is limited by the extent of the market and it is through this division of labor that growth occurs. Regression (26) shows that while local railroad density is not related to the cross-effect, it is extremely strongly correlated with initial urbanization. The stock of physical infrastructure (which is strongly related to later growth) thus seems to be connected to initial levels of development, but not merely to the extent of the market. While these regressions certainly leave room for big push theories, they most strongly suggest that growth in U.S. states was associated with the division of labor and that this division of labor was only possible in states with either a high degree of initial development or access to ports.

The full decomposition is performed in Table 7b. The positive effect of initial urbanization occurs mainly through initial specialization and local railroads density. The negative effect of distance works mainly through lower specialization, and somewhat less through lower human capital. In this sample, openness increases the degree of diversification of products, contrary to the predictions of quality ladder stories. The positive cross-effect mainly operates through increased specialization and higher levels of human capital. These high human capital people then act to further growth directly through their work and by generating knowledge spillovers.[28]

The difference between these results and those in the world sample may come from the difference in the proxy used for specialization. In the U.S. data, the diversification measure was accurately picking up the presence of highly specialized occupations. In the world data, the measure is more closely linked to the degree of specialization in a few export products and it does not necessarily capture the internal division of labor within the country.[29] The overall conclusion of this section is that in both samples the division of labor sped later growth. However the samples disagree about what creates the divison of labor. In the U.S. sample, urbanization and openness both increased the degree of division of labor and the cross effect between those two variables lowered the division of labor; basic Smithian notions about the division of labor being limited by the extent of the market are strongly supported. In the world sample. In the world sample, the arguments of quality ladder theorists are supported. The division of labor rises with openness only for the richer countries. Poorer countries produces a smaller range of products when they are exposed to larger markets.

VI. Decomposing Growth in Physical Capital, Human Capital and Technology

This subsection decomposes GDP growth into the growth of physical capital, human capital and technology. We are not interested here in whether or not the extent of the market variables work through increasing initial levels of specialization or initial levels of human capital. Instead, we want to know whether the extent of the market raises growth through (1) accumulation of physical capital, (2) accumulation of human capital, or (3) technological progress. We are decomposing growth into these three different forces not through the traditional growth accounting methods but, rather, using a decomposition borrowed from the labor literature. We begin by ascertaining the effect of levels of

[28] The large empirical literature relating initial human capital levels and growth across U.S. areas includes Glaeser, Scheinkman and Shleifer (1993), Simon and Nardinelli (1993) and others.

[29] In fact, this specialization of exports in a single good may lead towards a better division of labor within the country.

physical and human capital on levels of production with a cross-sectional levels regression. Then we use those coefficients to decompose growth into human and physical capital accumulation and growth of the residual (which is similar to the basic Solow residual).[30] We then examine how the extent of the market variables affect the growth of physical and human capital.

Estimating Framework

We assume that the level of urbanization or income in economy i at time t is given by

$$\alpha_{i,t} = A_t\ F(H_{i,t}, K_{i,t}) \tag{11}$$

and we specifically assume the following functional form for our regressions

$$\alpha_{i,t} = A_t + \delta_1\ H_{i,t} + \delta_2\ K_{i,t} + \nu_{i,t} \tag{12}$$

where $H_{i,t}$ and $K_{i,t}$ measure human and physical capital in economy i at time t, and ν is the error term in the regression.[31] The underlying assumption is that the level of development is restricted by the availability of physical and human capital, and by the overall level of technology.

If δ_1 and δ_2 are time invariant, we can decompose the changes in urbanization or per capita income into

$$\alpha_{i,t+1} - \alpha_{i,t} = A_{t+1} - A_t + \delta_1\ (H_{i,t+1} - H_{i,t}) + \delta_2\ (K_{i,t+1} - K_{i,t}) + \nu_{i,t+1} - \nu_{i,t} \tag{13}$$

The first term in this decomposition is constant across countries or states of the U.S. and drops out in the regressions. The second and third terms reflect those changes in urbanization or income that are explained by human and physical capital accumulation. The final term reflects the residual change.

We then regress these individual components on our standard initial variables and examine through which channels these initial variables affect later growth. Specifically, we regress

[30] This type of decomposition is similar to Glaeser (1993).

[31] We assume a linear specification in the logs of physical and human capital as in a standard Cobb-Douglas technology. We do not, however, constrain the coefficients to add to one since we are not assuming that we have accurately captured all of the factors of production.

$$H_{i,t+1} - H_{i,t} = \lambda_0^h + \lambda_1^h \alpha_{i,t} + \lambda_2^h O_{i,t} + \lambda_3^h \alpha_{i,t} O_{i,t} + \epsilon_{i,t}^h \quad (14)$$

$$K_{i,t+1} - K_{i,t} = \lambda_0^k + \lambda_1^k \alpha_{i,t} + \lambda_2^k O_{i,t} + \lambda_3^k \alpha_{i,t} O_{i,t} + \epsilon_{i,t}^k \quad (15)$$

and

$$\nu_{i,t+1} - \nu_{i,t} = \lambda_0^v + \lambda_1^v \alpha_{i,t} + \lambda_2^v O_{i,t} + \lambda_3^v \alpha_{i,t} O_{i,t} + \epsilon_{i,t}^v \quad (16)$$

We can then decompose the effects of initial urbanization or GDP, openness and the interaction into their different components. Thus, the total effect of initial development, openness and the interaction between the two are given, respectively, by

$$\delta_1 \lambda_1^h + \delta_2 \lambda_1^k + \lambda_1^v \quad (17)$$

$$\delta_1 \lambda_1^h + \delta_2 \lambda_1^k + \lambda_1^v \quad (18)$$

and

$$\delta_1 \lambda_3^h + \delta_2 \lambda_3^k + \lambda_3^v \quad (19)$$

The intuition for these decompositions is simple. We are dividing the effect of initial development, openness and their interaction into their effects operating through human capital accumulation, physical capital accumulation, and changes in productivity.

For the purposes of this section, we combine initial development, openness and the cross-effect into a single "extent of the market" variable. This variable is formed by taking a weighted average of these three sub-variables. The weights come from running the basic growth regressions (i.e. regressions (1) and (7)) for the sub-sample under examination. This combination is meant to simplify the intuition.

World Data

For our cross-country sample, we used actual capital stock estimates from Canning and Fay (1992) as our measure of physical capital. Human capital is measured by the share of the population over 25 years of age with complete primary schooling (from Barro and Lee (1993). Table 8a shows that levels of GDP are much more associated with physical capital than with the stock of human capital. The decomposition shown in Table 8b reveals that the extent of the market worked much more through physical than through human capital. The results from this decomposition thus lend support to big push ideas: the importance of larger markets lies in creating the conditions for physical capital investment rather than in providing the incentives for investing in human capital. However, the growth of the residual is by far the most important channel through which the extent of the market affects growth: almost 80 percent of the extent of the market operates through this last channel. This finding suggests that the main effect of larger markets is to allow for improvements in the level of technology.

U.S. Data

In Table 9a, regression (32) shows that both white literacy and railroad density (our measures of human and physical capital) are positively correlated with levels of urbanization. A one percent increase in the white literacy rate raises the level of urbanization by 1.3 percent. A one standard deviation increase in railroad density within the state increases the share of urbanized population by 12 percent. Regressions (33)-(35) are the auxiliary regressions that we use for our decomposition. This decomposition is shown in Table 9b. We find that the effect of the extent of the market on technological change explains about less than a fifth of the total. Human capital is instead not associated with larger initial market size. Finally, we find that most of the effect of the extent of the market operates through the accumulation of physical infrastructure. In other words, large market size increased growth by spurring physical investment in railroads. These results lend support again to big push arguments, which stress the importance of investments with large fixed costs to explain increasing returns.[32]

In the

[32] We should remind the reader that there might be something particular about this form of investment that relates to urbanization. Since urbanization specifically measures a form of population concentration, and railroad development specifically measures the development of transportation, an alternative interpretation of this result is that the concentration of population leads to transportation improvements.

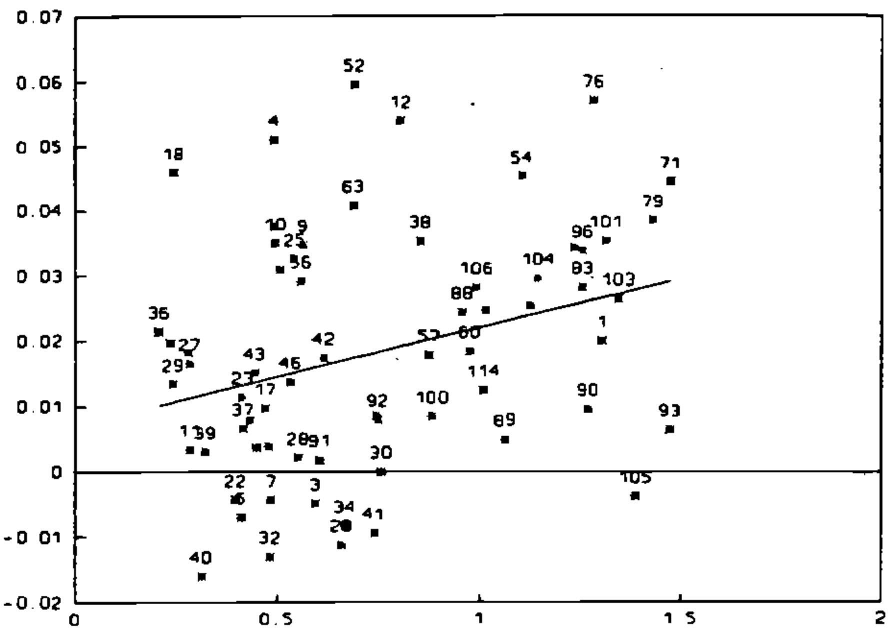
VII. Conclusion

This paper presents a variety of evidence on the connection between initial levels of development and later growth. We found that a positive connection between levels and later growth is much stronger in closed rather than open economies. This evidence provides support to the notions that the size of the market matters for growth because of access to global ideas, because a larger market allows for investment in large fixed cost investments and because the division of labor is limited by the extent of the market. The evidence does not support quality ladder type of theories, or other protectionist theories that suggest that isolation from world markets is particularly good for poor economies.

We found in a set of decompositions that diversity in occupations (for U.S. states) or exports (for countries) both enhanced growth. Openness and market size increased occupational diversity in the U.S. and much of the effect of the extent of the market on growth seems to work through bigger markets creating a finer division of labor. Openness and market-size did not increase diversity of exports. Just as in Stokey (1991) or Young (1991), openness decreased the range of products for many countries. However, we still found that our openness variables speeded growth for poorer countries despite the costs associated with losing export diversity. Our last set of decompositions suggested that the extent of the market may work through the division of labor, but it seems to enhance growth mainly by speeding investment in physical infrastructure. We found our two sets of evidence supporting both division of labor theories and theories emphasizing the role of market size in allowing for big physical investment.

This work does cast doubt on the protectionist suggestions of quality ladder theories. While our results do support their idea that protectionism allows a broader range of products to be produced, our results also suggest that protectionism has other problems which overwhelm this product range effect. Our work cannot determine how exactly protectionism detracts from growth for poorer countries. Potential explanations include (1) growth requires markets or (2) isolation exacerbates political problems or (3) closedness means separation from international pools of technology, but future work will be needed to determine which mechanism is actually in effect.

Figure 1. Per Capita GDP Growth 1960-85 vs. Per Capita GDP in 1960
(Full Sample)

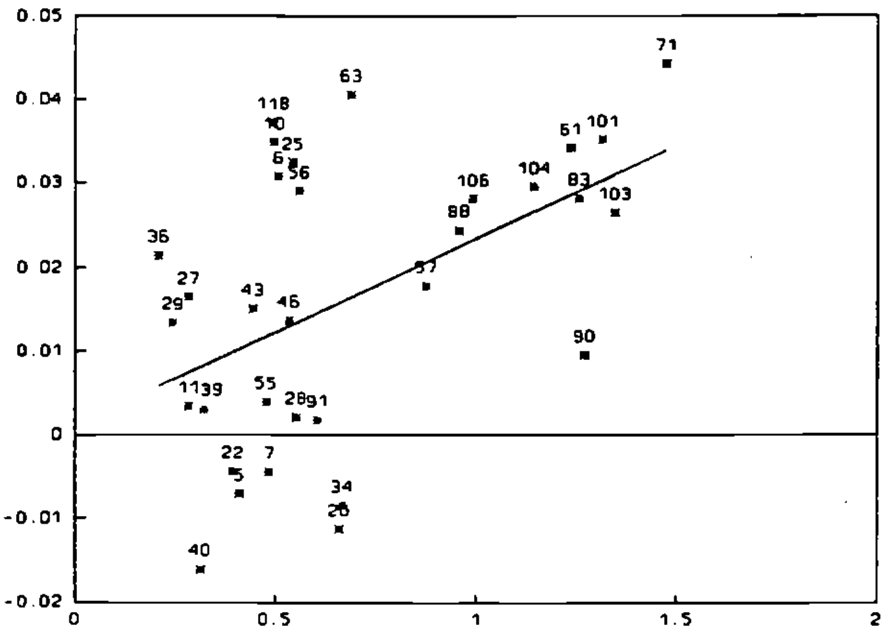


Per Capita GDP Growth 1960-85 = 0.0071 + 0.0194 GDP60

(0.0040) (0.0055)

n=65 R^2=0.15

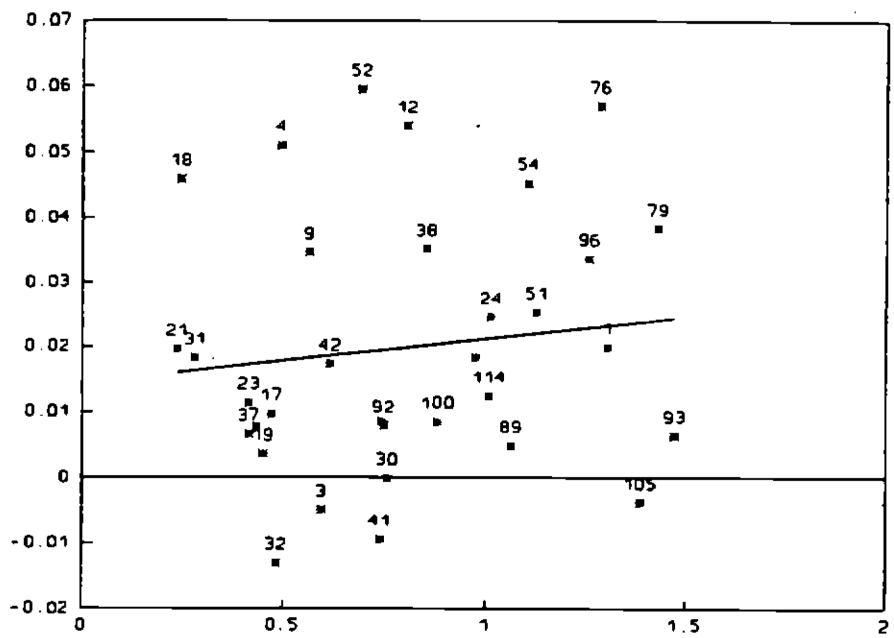
Figure 2. Per Capita GDP Growth 1960-85 vs. Per Capita GDP in 1960
(Low Trade Sample)



$$\text{Per Capita GDP Growth 1960-85} = \underset{(0.005)}{0.0060} + \underset{(0.0073)}{0.0204}\ \text{GDP60}$$

$n=32$ Adj. $R^2=0.18$

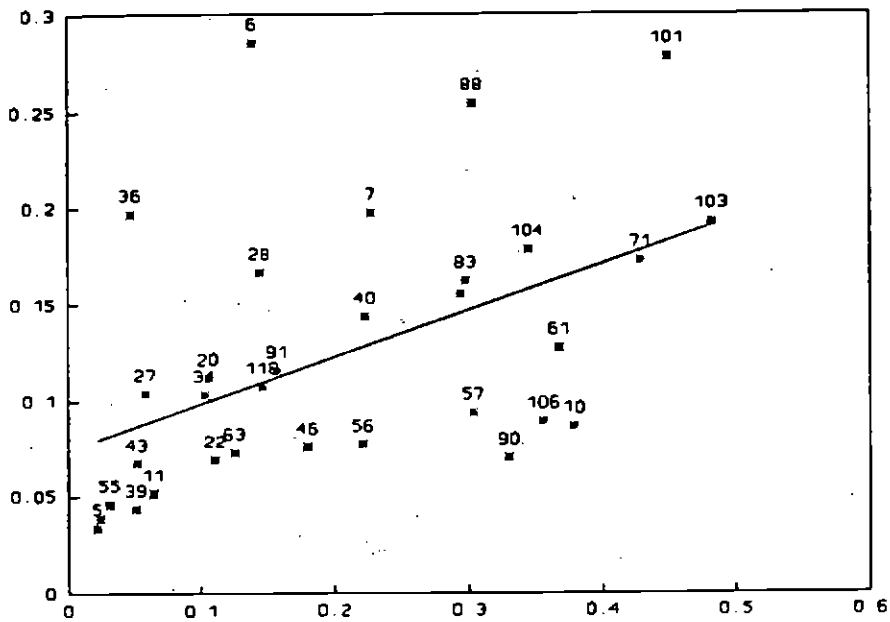
Figure 3. Per Capita GDP Growth 1960-85 vs. Per Capita GDP in 1960
(High Trade Sample)



Per Capita GDP Growth 1960-85 = 0.0228 + 0.0052 GDP60
(0.0107) (0.012)

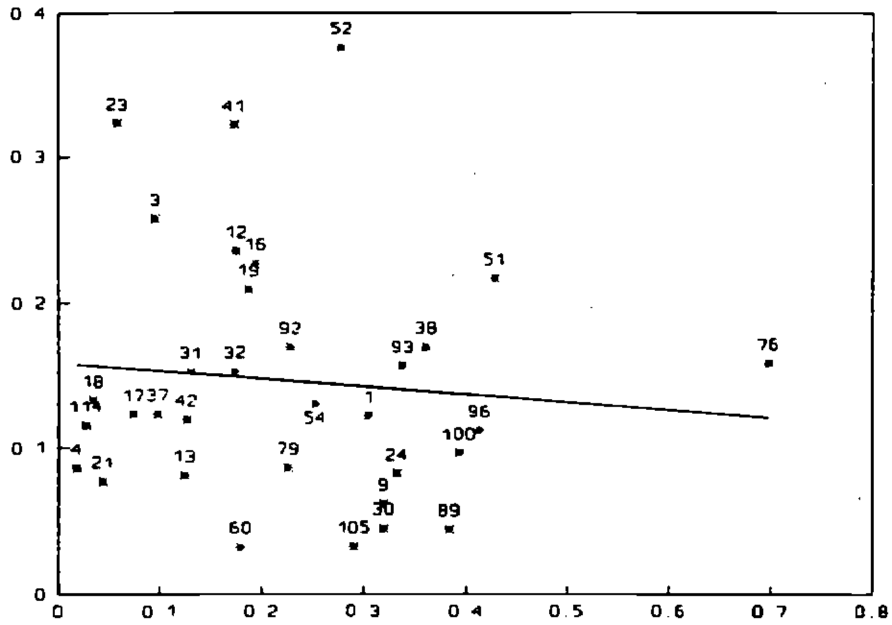
n=33 Adj.R^2=-0.0258

Figure 4. Change in Urbanization 1960-85 vs. Urbanization in 1960
(Low Trade Sample)



Change in Urbanization 1960-85 = 0.0303 + 0.385 Urbanization 1960
(0.017) (0.0761)
n=32 R^2=0.44

Figure 5. Change in Urbanization 1960-85 vs. Urbanization in 1960
(High Trade Sample)



Change in Urbanization 1960-85 = 0.135 - 0.179 Urbanization 1960
(0.055) (0.208)

n=33 Adj. R^2=-0.0081

Table 1a
Description of the Data

State	Annual Per Capita GDP Growth 1960-1985	Per Capita GDP in 1960
	Five Fastest Growers	
Korea	6.0	690
Malta	5.7	1280
Gabon	5.4	804
Benin	5.1	595
Lesotho	4.6	245
	Five Slowest Growers	
Zaire	-1.6	314
Somalia	-1.3	483
Madagascar	-1.1	659
Zambia	-0.9	740
Sudan	-0.8	667

TABLE 1b
Description of the Data

State	Change in Percentage of Urbanized Population 1960-1985	Percentage Urbanization in 1960
	Five Fastest Growers	
Korea	38	28
Mauritania	32	5
Zambia	41	17
Cameroon	29	14
Brazil	28	45
	Five Slowest Growers	
Sri Lanka	3	18
Guyana	3	29
Burundi	3	2
Rwanda	4	2
Uganda	4	5

TABLE 1c
Description of the Data

State	Total Population	Percentage Urban
	Five Most Urbanized U.S. States in 1840	
Rhode Island	109,000	44
Massachusetts	738,000	38
Louisiana	352,000	30
Maryland	470,000	24
New York	2,429,000	19
	Five Least Urbanized U.S. States in 1840	
Arkansas	98,000	0
Florida	54,000	0
Iowa	43,000	0
Vermont	292,000	0
Wisconsin	31,000	0

TABLE 1d
Description of the Data

State	Total Population	Percentage Urban
	Five Most Urbanized U.S. States in 1890	
Rhode Island	346,000	85
Massachusetts	2,239,000	82
New York	6,003,000	65
New Jersey	1,445,000	62
Connecticut	746,000	50
	Five Least Urbanized U.S. States in 1890	
Mississippi	1,290,000	5
Arkansas	1,128,000	6
North Carolina	1,618,000	7
Alabama	1,513,000	10
South Carolina	1,151,000	10

TABLE 1e
Description of the Data

State	Change in Percentage	Decade
	Five Largest Decadal Increases in the Percentage of Urbanized Population	
New Jersey	15	1850-1860
Illinois	14	1880-1890
Massachusetts	13	1840-1850
Rhode Island	12	1840-1850
Rhode Island	11	1860-1870
	Five Largest Decadal Declines in the Percentage of Urbanized Population	
Louisiana	4	1840-1850
Louisiana	2.5	1870-1880
South Carolina	1	1870-1880
Mississippi	0.9	1870-1880
Alabama	0.9	1870-1880

TABLE 1f
Description of the Data

State	Change in Percentage	Urbanization in 1840
	Five Largest Changes in the Percentage of Urbanized Population 1840-1890	
New Jersey	52	11
New York	46	19
Massachusetts	44	38
Illinois	43	2
Rhode Island	41	44
	Five Smallest Changes in the Percentage of Urbanized Population 1840-1890	
Louisiana	-4	30
Mississippi	4	1
South Carolina	4	6
North Carolina	5	2
Arkansas	6	10

TABLE 2a
World Summary Statistics

Variable	Obs	Mean	Std. Dev	Minimum	Maximum
Per Capita GDP in 1960 in thousands of 1980 US$ at PPP prices (GDP60)	65	0.74	0.37	0.21	1.47
Average Per Capita GDP Growth 1960-85 (GR6085)	65	0.018	0.018	-0.016	0.06
Openness (OPEN)	65	0.43	0.22	0.09	1.22
Urbanization in 1960 (URBAN60)	65	0.22	0.14	0.018	0.70
Change in the Share of Urbanized Population 1960-85 (URCH)	65	0.14	0.078	0.032	0.38
Percentage of Total Population with Complete Secondary Education in 1960 (SSC60)	54	0.017	0.019	0.0001	0.078
Capital Stock per Capita in 1960 (KAPC60)	54	1380.5	1067.1	78.10	3937.2
Roads Density in 1970 (RDDEN70)	43	2974	18522	5.48	121600
Export Specialization, Division of Labor (EXPSP)	43	0.48	0.18	0.008	0.844

TABLE 2b
World Simple Correlations

	GDP60	GR6085	OPEN	URBAN60	URCH	SSC60	KAPC60	RDDEN70	EXPSP
GDP60									
Growth in GDP 60-85	.300 (.015)								
Openness	.158 (.207)	.163 (.195)							
Urbanized % 1960	.748 (.0001)	.368 (.003)	.080 (.525)						
Urbanized % Change	0.088 (.485)	.194 (.122)	.131 (.299)	.159 (.206)					
Secondary Schooling 1960	0.541 (.000)	0.523 (.000)	0.227 (.143)	0.724 (.000)	0.185 (.235)				
Capital 1960	0.748 (.000)	0.235 (.135)	0.453 (.003)	0.587 (.000)	0.200 (.205)	0.508 (.000)			
Road Density	0.212 (.173)	0.340 (.026)	0.307 (.045)	0.514 (.000)	0.037 (.816)	0.540 (.000)	0.369 (.016)		
Division of Labor	0.083 (.595)	0.448 (.003)	-0.209 (.179)	0.079 (.617)	0.091 (.562)	0.198 (.204)	-0.026 (.871)	0.189 (.225)	

Note: The significance probability of the correlation under the null hypothesis that the statistic is zero is shown in parenthesis.

TABLE 2c
U.S. Summary Statistics

Variable	Obs	Mean	Std. Dev	Minimum	Maximum
Population in 1870 (POP70)	29	1214	981	125	4382
Urbanization in 1870 (UR70)	29	0.23	0.18	0.024	0.74
Change in Share of Urbanized Population 1870-80 (URCH)	29	0.033	0.035	-0.025	0.107
Local Railroads Density in 1870 (RAIL70)	29	61.85	47.90	4.85	187.20
Regional Railroads Density (EXRL70)	29	47.60	30.52	2.50	115.34
Land Area (LAREA)	29	36.43	20.59	1.058	69.322
Share of Urbanized Population in Main City in 1870 (MCITSH70)	29	0.11	0.10	0.01	0.34
Change of the Share of Urbanized Population in Main City 1870-80 (MCITCH)	29	0.006	0.021	-0.033	0.061
White Literacy Rate in 1870 (WLR70)	29	0.93	0.031	0.85	0.98
Occupational Dixit-Stiglitz Index for 1870 (DS70)	29	0	1	-1.36	1.84
Share of the Labor Force in Manufacturing (MAN70)	42	0.14	0.13	0.014	0.56
Change in the Share of the Labor Force in Manufacturing (1870-80) (MANCH)	42	-0.007	0.030	-0.088	0.0623

TABLE 2d
U.S. Simple Correlations

	POP70	UR70	URCH	RAIL70	EXRL70	AREA	MCIT70	MCITCH	WLR70	DS70	MAN70	MANCH
Populat'n 1870												
Urbanized % 1870	.237 (.215)											
Urbanized % Change	.188 (.329)	.649 (.000)										
Railroads 1870	.168 (.384)	.770 (.000)	.849 (.000)									
Regional Rail 1870	.344 (.067)	.480 (.008)	.590 (.000)	.477 (.009)								
Land Area	.390 (.037)	-.527 (.003)	-.531 (.003)	-.704 (.000)	-.333 (.088)							
Main City Populat'n	.251 (.190)	.767 (.000)	.335 (.075)	.404 (.030)	.188 (.328)	-.367 (.050)						
Main City Growth	.221 (.250)	.661 (.000)	.724 (.000)	.620 (.000)	.486 (.008)	-.416 (.024)	.494 (.007)					
White Literacy	.212 (.270)	.373 (.047)	.488 (.007)	.378 (.043)	.593 (.000)	-.185 (.337)	.187 (.332)	.290 (.127)				
Division of Labor	.373 (.046)	.870 (.000)	.799 (.000)	.832 (.000)	.653 (.000)	-.527 (.003)	.648 (.000)	.579 (.001)	.580 (.001)			
Manufact-uring	.013 (.950)	.866 (.000)	.704 (.000)	.828 (.000)	.566 (.002)	-.705 (.000)	.527 (.004)	.637 (.000)	.434 (.021)	.825 (.000)		
Manuf. Change	.151 (.444)	.153 (.437)	.412 (.030)	.306 (.114)	.254 (.192)	-.242 (.215)	.068 (.729)	.323 (.093)	.054 (.785)	.286 (.140)	.019 (.924)	

Note: The significance probability of the correlation under the null hypothesis that the statistic is zero is shown in parenthesis.

TABLE 3

Dependent Variable:	Average Per Capita GDP Growth 1960-85				Change in Urbanization 1960-85			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	.0071 (.0040)	-.0095 (.0072)	-.0191 (.0061)	-.0101 (.0078)	3.767 (1.636)	-7.327 (2.927)	-6.713 (3.611)	-6.037 (3.504
Per Capita GDP in 1960	.0194 (.0055)	.0341 (.0100)	.0345 (.0096)	.0280 (.0124)				
Openness[1]		.0802 (.0283)	.1404 (.0216)	.0812 (.0270)		49.78 (11.28)	32.11 (12.71)	17.10 (11.47
Per Capita GDP in 1960 * Openness		-.0701 (.0357)	-.1252 (.0268)	-.0779 (.0289)				
Urbanization in 1960					.3792 (.0709)	.7551 (.1285)	.5327 (.1828)	.5603 (.1764
Urbanization in 1960 * Openness						-1.641 (.4785)	-1.056 (.5275)	-.9358 (.4412
Primary School Enrollment in 1960			.0139 (.0070)	.0146 (.0107)			6.195 (4.231)	8.034 (4.894
Sub-Saharan Africa Dummy			-.0234 (.0037)	-.0231 (.0059)			5.658 (2.241)	7.869 (2.700
Latin American Dummy			-.0058 (.0051)	-.0061 (.0068)			3.787 (3.225)	2.849 (3.338
Number of Observations	65	65	65	56	65	65	65	56
Adjusted R^2	0.15	0.25	0.66	0.45	0.30	0.47	0.51	0.50

Note: Standard errors are in parentheses.

[1] In regressions (4) and (8), Openness is defined as the share of trade in GDP in 1960.

TABLE 4

Dependent Variable: Decadal Change in the Share of Urbanized Population (1840-1890)	(9)	(10)	(11)	(12)	(13)	(14) (Unbal)
1840 Fixed Effect	.0382 (.0059)	.0419 (.0090)	.0748 (.0084)	.0248 (.0063)	.0457 (.0097)	0.0456 (.0087)
1850 Fixed Effect	.0036 (.0068)	.0450 (.0097)	.0756 (.0093)	.0153 (.0077)	.0418 (.0138)	.0412 (.0085)
1870 Fixed Effect	.0101 (.0066)	.0146 (.0102)	.0562 (.0112)	-.0217 (.0090)	.0106 (.0112)	.0076 (.0091)
1880 Fixed Effect	.0385 (.0075)	.0406 (.1068)	.0858 (.0122)	.0068 (.0098)	.0390 (.0112)	.0378 (.0093)
Initial Urbanization	.0917 (.0198)	.0710 (.0223)	.0020 (.0239)	.1918 (.0317)		.0917 (.0200)
Distance Dummy		-.0227 (.0109)	-.0224 (.0090)		-.0194 (.0116)	-.0224 (.0092)
Distance Dummy * Initial Urbanization		.1722 (.0429)	.0870 (.0042)			.2010 (.0378)
Initial Regional Railroads Density				.0007 (.0001)		
Initial Regional Railroads Density*Initial Urbanization				-.0020 (.0003)		
South Dummy			-.0413 (.0071)			
Initial Urbanization * Low Urbanization Dummy					.0914 (.0281)	
Initial Urbanization * High Urbanization Dummy					.0621 (.0223)	
Initial Urbanization * Low Urbanization Dummy * Distance Dummy					.1465 (.0451)	
Initial Urbanization * High Urbanization Dummy * Distance Dummy						
Number of Observations	116	116	116	116	116	160
Adjusted R^2	0.24	0.40	0.61	0.43	0.43	0.82

Note: Standard errors are in parentheses.

TABLE 5

Dependent Variable: Decadal Change in Share of:	Share of Labor Force in Manufacturing (1870-1890)			Share of Urbanized Population In Main City (1850-1890)	
	(15)	(16)	(17)	(18)	(19)
1850 Fixed Effect				.0418 (.0101)	.0202 (.0088)
1870 Fixed Effect	.0134 (.0092)	-.0068 (.0085)	-.0214 (.0079)	.0119 (.0087)	-.0165 (.0067)
1880 Fixed Effect	.0427 (.0081)	.0192 (.0080)	.0027 (.0070)	.0190 (.0095)	-.0139 (.0087)
Initial Share of Labor Force in Manufacturing	-.0844 (.0275)				
Distance Dummy	-.0190 (.0100)	-.0014 (.0094)		.0316 (.0103)	
Distance Dummy * Initial Manufacturing Share	.2048 (.0574)				
Initial Regional Railroads Density			.0007 (.0001)		.0003 (.0001)
Initial Manufacturing Share * Low Manufacturing Dummy		.0648 (.0355)	.1195 (.0697)		
Initial Manufacturing Share * High Manufacturing Dummy		-.0699 (.0224)	.138 (.0683)		
Initial Manufacturing Share * Low Manufacturing Dummy * Distance Dummy		.1009 (.0586)			
Initial Manufacturing Share * High Manufacturing Dummy * Distance Dummy		.0900 (.0664)			
Initial Manufacturing Share * Low Manufacturing Dummy * Regional Railroads Density			-.0026 (.0006)		
Initial Manufacturing Share * High Manufacturing Dummy * Regional Railroads Density			-.0038 (.0009)		
Initial Main City Share				.0434 (.0344)	.1204 (.0425)
Initial Main City * Distance Dummy				.2527 (.0933)	
Initial Main City * Regional Railroads Density					-.0005 (.0005)
Number of Observations	84	84	84	87	87
Adjusted R^2	0.06	0.27	0.44	0.21	0.16

TABLE 6a

Dependent Variable:	Average Per Capita GDP Growth 1960-85	Share of Population with Complete Secondary Education in 1960	Roads Density in 1970	Specialization in 1960
	(20)	(21)	(22)	(23)
Intercept	-.0561 (.0231)	-.0223 (.0073)	13338.0 (1692.4)	1.0272 (.0710)
Per Capita GDP in 1960	.0472 (.0187)	.0544 (.0103)	-1817.0 (2391.7)	-.3923 (.1004)
Openness	.1544 (.0451)	.0619 (.0282)	-5332.6 (6589.4)	-1.3944 (.2765)
Per Capita GDP in 1960 * Openness	-.1288 (.0492)	-.0799 (.0349)	8296.0 (8131.9)	1.1560 (.3413)
Share of Population with Complete Secondary Schooling in 1960	.1577 (.1889)			
Roads Density in 1970	9.8E-8 (7.4E-7)			
Initial Division of Labor	.0472 (.0191)			
Number of Observations	43	43	43	43
Adjusted R^2	0.41	0.50	-0.04	0.50

Note: Standard errors are in parentheses.

TABLE 6b

Decomposition of the Effect on Per Capita GDP Growth of:	Initial per Capita GDP	Openness	Interaction between Initial per Capita GDP and Openness
Direct Effect	0.0472	0.1544	-0.1288
Primary Schooling	0.0086	0,0098	-0.0126
Roads Density	-0.0002	-0.0005	0.0008
Initial Division of Labor	-0.0185	-0.0658	0.0546
Total Indirect	0.0057	0.0001	-0.0298
Total Effect	0.0529	0:1545	-0.1586

TABLE 7a

Dependent Variable:	Decadal Change in Share of Urbanized Population: (1850-60 and 1870-80)	White Literacy Rate (1850 and 1870)	Local Railroads Density (1850 and 1870)	Specialization (1850 and 1870)
	(24)	(25)	(26)	(27)
1850 Fixed Effect	-.1864 (.1291)	.9498 (.0089)	-17.025 (9.035)	.0215 (.2365)
1870 Fixed Effect	-.1999 (.1260)	.9154 (.0099)	9.044 (11.923)	-.9610 (.2390)
Initial Urbanization	-.0855 (.0368)	.0647 (.0238)	207.016 (28.508)	4.9709 (.5649)
Distance Dummy	.0035 (.0121)	-.0467 (.0110)	11.852 (11.308)	-.7118 (.2826)
Distance Dummy * Initial Urbanization	-.0097 (.0627)	.3358 (.0528)	-23.994 (67.188)	3.7387 (1.2513)
Initial White Literacy Rate	.2403 (.1349)			
Initial Local Railroads Density	.0004 (.0001)			
Initial Division of Labor	.0258 (.0050)			
Number of Observations	58	58	58	58
Adjusted R^2	0.76	0.58	0.61	0.73

Note: Standard errors are in parentheses.

TABLE 7b

Decomposition of the Effect on Decadal Changes in the Share of Urbanized Population (1850-60 and 1870-80) of:	Initial Urbanization	Distance	Interaction between Initial Urbanization and Distance
Direct Effect	-0.0855	0.0035	-0.0097
Initial White Literacy Rate	0.0155	-0.0112	0.0807
Initial Local Railroads Density	0.0828	0.0047	-0.0096
Initial Division of Labor	0.1282	-0.0184	0.0965
Total Indirect	0.2265	-0.0249	0.1676
Total Effect	0.1410	-0.0214	0.1579

TABLE 8a

Dependent Variable:	Log of Per Capita GDP in 1960 and 1985	Change in Log of Percentage Population with Complete Secondary Schooling (1960-85)	Change in Log of Capital Stock per Capita (1960-85)	Change in residual from regressio (28)
	(28)	(29)	(30)	(31)
Intercept		2.6945 (.3000)	-.0693 (.2154)	-1.2990 (.1715)
1960 Fixed Effect	-4.0116 (.3061)			
1985 Fixed Effect	-4.0206 (.2990)			
Log of 1960 Complete Secondary Schooling	.0540 (.0304)			
Log of 1960 Capital Stock per Capita	.5662 (.0322)			
1960 Extent of the Market		-54.7697 (11.416)	32.052 (8.1966)	56.271 (6.5291)
Number of Observations	108	54	54	54
Adjusted R^2	0.81	0.29	0.21	0.58

Note: Standard errors are in parentheses.

TABLE 8b

Decomposition of the Effect on Log of Per Capita GDP Changes (1960-85) of:	Extent of the Market
Growth of Human Capital Channel	-2.96
Growth of Physical Infrastructure Channel	18.15
Unexplained Increase in Productivity	56.27
Total Effect	71.46

TABLE 9a

Dependent Variable:	Urbanization in 1850, 1860, 1870 and 1880	Decadal Change in White Literacy Rate (1850-60 and 1870-80)	Decadal Change in Local Railroads Density (1850-60 and 1870-80)	Decadal Change in Residual from regression (32)
	(32)	(33)	(34)	(35)
1850 Fixed Effect	-1.1584 (.3357)	.0090 (.0018)	21.764 (3.364)	-.0026 (.0098)
1860 Fixed Effect	-1.1880 (.3352)			
1870 Fixed Effect	-1.1568 (.3260)	.0127 (.0018)	16.049 (3.723)	-.0068 (.0088)
1880 Fixed Effect	-1.2118 (.3255)			
Contemporaneous White Literacy Rate	1.3288 (.3565)			
Contemporaneous Local Railroads Density	.0026 (.00026)			
Contemporaneous Extent of the Market		-.1279 (.0425)	431.80 (86.313)	.2025 (.2082)
Number of Observations	116	58	58	58
Adjusted R^2	0.64	0.08	0.25	-0.02

Note: Standard errors are in parentheses.

TABLE 9b

Decomposition of the Effect on Decadal Changes in the Share of Urbanized Population (1850-60 and 1870-80) of:	Extent of the Market
Growth of Human Capital Channel	-0.1699
Growth of Physical Infrastructure Channel	1.1227
Unexplained Increase in Productivity	0.2025
Total Effect	1.1553

Appendix 1: 65 country sample

Country Code	Country Name
1	Algeria
3	Benin
4	Botswana
5	Burundi
6	Cameroon
7	Central African Republic
9	Congo
10	Egypt
11	Ethiopia
12	Gabon
13	Gambia
16	Ivory Coast
17	Kenya
18	Lesotho
19	Liberia
20	Madagascar
21	Malawi
22	Mali
23	Mauritania
24	Mauritius
25	Morocco
27	Niger
28	Nigeria
29	Rwanda
30	Senegal
31	Sierra Leone
32	Somalia
34	Sudan
36	Tanzania
37	Togo
38	Tunisia
39	Uganda
40	Zaire
41	Zambia
42	Zimbabwe
43	Bangladesh
46	India
51	Jordan
52	Korea
54	Malaysia
55	Nepal
56	Pakistan
57	Philippines
60	Sri Lanka
61	Syria
63	Thailand
71	Greece
76	Malta
79	Portugal
83	Turkey
88	Dominican Republic

89	El Salvador
90	Guatemala
91	Haiti
92	Honduras
93	Jamaica
96	Panama
100	Bolivia
101	Brazil
103	Colombia
104	Ecuador
105	Guyana
106	Paraguay
114	Papua New Guinea
118	Indonesia

Appendix 2: Open and Closed States in the 29 State Sample (using distance from major regional port).

Open States

Alabama
Connecticut
Delaware
Louisiana
Maryland
Massachusetts
Mississippi
New Jersey
New York
Pennsylvania
Rhode Island

Closed States

Arkansas
Florida
Georgia
Illinois
Indiana
Iowa
Kentucky
Maine
Michigan
Missouri
New Hampshire
North Carolina
Ohio
South Carolina
Tennessee
Vermont
Virginia
Wisconsin

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