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Alexander Klein,
Nicholas Crafts

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Unconditional Convergence in Manufacturing Productivity across U.S. States: What the Long-Run Data Show[1]

Alexander Klein
University of Kent

and

Nicholas Crafts
University of Sussex

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Abstract

This paper examines long-run unconditional convergence of labour productivity in manufacturing across 48 contiguous U.S. states. For that purpose, we construct a detailed panel data set of state-industry pairs with over 120 industries covering the period 1880-2007. We find that unconditional β-convergence in manufacturing productivity was pervasive and rapid – 7.6% per year in 1880-2007 – and that manufacturing accounts for most of the unconditional convergence contribution to overall productivity growth over the long run: 61% in 1880-1940 and 91% in 1958-2007. We also examined broad U.S. regions and found that in the South the contribution of unconditional β-convergence in manufacturing to aggregate productivity growth before World War II was weak not because of a slower convergence rate but a much smaller manufacturing sector.

Keywords: convergence, economic growth, U.S. economic history, manufacturing belt

JEL Codes: O47, N11, N12, R11

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I. Introduction

In a very well-known paper of the growth-regressions era, Barro and Sala-i-Martin (1992) provided an analysis of American economic growth from the 1880s to the 1980s. Their key finding was that over the long run there had been unconditional β-convergence in per capita income across U.S. states at a rate of about 2% per year. Initially poorer states had on average grown faster than and caught up with richer states and were tending to the same steady state. They suggested that their findings were consistent with a neoclassical growth model with broad capital as one of the factor inputs. The convergence finding was not disputed by economic historians, but they tended to stress that the process of catch-up growth evolved over time with the South lagging behind until the 1940s but then catching up quite rapidly (Mitchener and Mclean, 1999).

More recently, Rodrik (2013) returned to the topic of unconditional β-convergence from a world perspective for the period 1965 to 2005 and concluded that while manufacturing was characterized by unconditional convergence (at a rate of about 3% per year) other sectors were not. He suggested that there was a failure of aggregate convergence because the share of manufacturing employment was low and industrialization was slow.

It is interesting to explore whether Rodrik's insights help explain the long-run experience of unconditional convergence in the United States. Two questions arise. First, how important was unconditional convergence in manufacturing labour productivity for unconditional convergence of aggregate GDP per worker? Second, was the delayed catch-up of the South due to the small size of its manufacturing sector and/or a weak rate of unconditional convergence in southern manufacturing? To answer them, we have digitized the US Census of Manufactures at approximately decadal intervals during the period 1880 to 2007 and constructed a panel data set which provides state-industry estimates of labour productivity at the SIC 3-digit level. We report detailed results from this new data set which allows us to investigate unconditional convergence in American manufacturing over the long run and to address the questions arising from Rodrik's analysis.

In this context, it is notable that manufacturing in the United States in the late 19th century was heavily concentrated in the Manufacturing Belt with a relatively small share in the South. Only after World War II did this imbalance get corrected. Table 1 reports that 84.3% of manufacturing employment was in the Manufacturing Belt in 1880 and still 74.2% in 1930 before a fall to 42.4% in 1997. The share of the South in those years was 9.0%, 13.8% and 30.7%, respectively. It is also striking that labour productivity in manufacturing was high in what later became known as the 'Rust Belt' initially peaking at 126.18 per cent of the average for the United States in 1910, still at 107.0 per cent in 1977 but then falling sharply to 85.7 per cent in 2007.[2] Conversely, the 'Deep South' at its low point in 1930 was

[2] The 'Rust Belt' comprises Illinois, Indiana, Michigan, Ohio, Pennsylvania, and Wisconsin.

only 50.13 percent of the U.S. average and this ratio changed little between 1900 and 1940 but then rose rapidly to 96.46 per cent of the average in 1967 before plateauing subsequently (Table 2).[3]

Thus far, constrained by data limitations, the literature on convergence within the United States has only investigated manufacturing for the post-1963 period for which estimates of gross state product are available. Using these data, Barro and Sala-i-Martin (1991) found that during the period 1963-86 across American states there was strong β-convergence in labour productivity in manufacturing at a rate of 4.6% per year which was much higher than for any other sector.

Our main results are the following:

- We estimate that there was a rapid rate of unconditional β-convergence in labour productivity in the manufacturing sector. For 1880-2007, this was 7.6% per year with 1880-1940 and 1958-2007 each at about 6.5%.
- Unconditional β-convergence in manufacturing productivity was pervasive – in all SIC2 industries, in all sub-periods, in the South as well as the Manufacturing Belt, in industries from every technological epoch.
- Similarities across various subsets of the sample are more prevalent than differences but we highlight some interesting comparisons, notably convergence is slightly faster in the South than in the Manufacturing Belt both before and after WWII; over the 1958-2007 period, the rate of convergence in ICT industries (8.3%) is higher than in 1st-Industrial-Revolution (6.3%) or 2nd-Industrial-Revolution (7.0%) industries.
- Unconditional β-convergence in labour productivity is also observed at the whole economy level but at a slower rate: 1.8% per year for the whole period. This implies that manufacturing accounts for most of the unconditional convergence contribution to overall productivity growth over the long run: 61% in 1880-1940 and 91% in 1958-2007.
- The contribution of unconditional β-convergence in manufacturing to aggregate productivity growth in the South was weaker than in the Manufacturing Belt during 1880-1940 (0.36% vs. 0.62%). The reason for this is not a slower convergence rate but a much smaller manufacturing sector (9.0% vs. 28.8% of total value added in 1880).
- In 1880-1940 the South did not achieve the growth rate of real GDP per worker implied by an unconditional convergence rate of 2% à la Barro and Sala-i-Martin. Even if the manufacturing sector had accounted for a share of value added like that in the Manufacturing Belt a substantial improvement in manufacturing productivity growth would also have been required to do so.

[3] The 'Deep South' comprises Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina and Texas.

II. Literature Review

Several recent studies have revisited the seminal article by Barro and Sala-i-Martin (1992) with similar methodology and an emphasis on extending the sample period to cover later years. In summary, these papers accept that there was unconditional convergence across US states through the 1970s but subsequently the estimated values of β typically decrease in absolute value and sometimes lose statistical significance.

These Barro and Sala-i-Martin-type studies include the following all of which estimate a version of the equation

$$\Delta y/y = \alpha + \beta \log y_0 \qquad (1)$$

for the cross section of American states where $\Delta y/y$ is the average rate of per capita income or sectoral productivity growth, $\log y_0$ is the initial level of either per capita income or sectoral productivity level and the estimate of β is the main variable of interest with the estimates $\hat{\beta} < 0$ indicating an unconditional convergence.

Heckelman (2013) investigated unconditional β-convergence in per capita income over the period 1930-2009, for which his estimate of β was 1.7%, and decades within this interval. The estimate of β peaked in the 1940s at 5.3% and then fell steadily to 1.1% in the 1980s at which point statistical significance was lost with subsequent decades similar to the 1980s. Choi and Yang (2015) looked at unconditional β-convergence in labour productivity based on gross state product per worker from 1963 to 2011. They presented estimates for a rolling regression with a 25-year window and found that β fell from 1.75% for the 1977 to 2002 period to slightly negative for 1986 to 2011. Ram (2021) used BEA data on real GDP per person and found that β was much smaller in his final period 1997 to 2018 than in 1977 to 1997 and had become insignificant. German-Soto and Brock (2022) estimated unconditional β-convergence using gross state product and found a large decrease in β from 1.73% in 1963-83 to 1.01% in 1983-2015.

Rodrik (2013) used UNIDO data to examine international convergence in manufacturing for the period 1965 to 2005 and found strong evidence of unconditional β-convergence at 2.9% per year in his baseline specification. His results have recently been challenged by Herrendorf et al. (2022) who used a different data set for the period 1990 to 2018 largely based on data compiled by the Groningen Growth and Development Centre. These authors were unable to reject the null hypothesis of no unconditional β-convergence in manufacturing although they did find evidence of conditional β-convergence. They concluded that the reason for the different finding is that the Groningen data are more comprehensive and include smaller firms, the informal sector and the self-employed. We do not, however, think that similar issues are serious enough to undermine use of the Census of Manufactures for the post-1880 period for the analysis of convergence in manufacturing.

Since Barro and Sala-i-Martin (1991) unconditional convergence in U.S. manufacturing has been a somewhat neglected topic although an early paper by Bernard and Jones (1996) which looked at labour productivity in the period 1963-89 produced similar findings with β=3.1%. A recent paper (Kinfemichael and Morshed, 2019) has returned to the issue of unconditional β-convergence in US manufacturing but only for the post-1987 period. These authors reported significant estimates for β at -0.091 and -0.034 for the years 1987-1997 and 1998-2015, respectively. There was evidence of unconditional convergence in a majority of, but not all, manufacturing sectors. So, the few studies that have been published give results more similar to Rodrik (2013) than Herrendorf et al. (2022).

The delayed catch-up of the South has attracted a great deal of analysis which addresses the issue of a low level of industrialization and explores reasons for disappointing productivity performance before World War II. The legacy of slavery is generally seen as holding productivity levels down in this period; Mitchener and Mclean (2003) estimated that a state in which slaves were 10% of the population in 1860 experienced a productivity penalty of 21% in 1900 which decreased only slowly to 14% in 1940.

Wright (1986) highlighted that the South had a separate low-wage labour market until the 1940s and, accordingly, its narrow manufacturing base was in low-skill, labour intensive sectors. He pointed out, however, that labour productivity growth in Southern manufacturing was quite rapid in that period. The shock of federal labour market policies introduced in the 1930s shattered the 'old South' and triggered moves by the 'new South' to attract new industries and adopt new technologies. Caselli and Coleman (2001) found that although structural transformation was limited it accounted for 81% of the convergence in wages in the South which was achieved in the period 1880-1950. Connolly (2004) stressed that a key aspect of the 'old South' was its failure to invest in education and accumulate human capital with seriously adverse effects on productivity performance. She saw this as an obstacle to catch-up and convergence.

The literature clearly points to the limited size and scope of the manufacturing sector as retarding convergence of the pre-World War II South. It also suggests reasons why the rate of convergence within manufacturing may have been impaired. However, in neither case is there any quantification of these effects.

III. Methodology and Data Sources for Unconditional *β*-Convergence Regressions

We use the version of growth-regression methodology developed by Rodrik (2013). Nominal labour productivity for each industry is calculated by dividing nominal value added in US$ by the number of workers. We write it as v_{ijt} where *i* denotes industry, *j* the U.S. state and *t* the time period. Labour productivity growth in real terms, $\hat{y}_{ijt}$, is calculated as $\hat{y}_{ijt} = \hat{v}_{ijt} - \pi_{ijt}$, where π_{ijt} is the change in the industry-level deflator in dollar terms and the hat over the variables denotes percentage change. Real labour productivity growth in each industry is a function of state-specific conditions and a convergence effect. The convergence effect is proportional to the gap between the industry's frontier technology denoted by v_{it}^* and its initial productivity. Hence, we can write as $\hat{y}_{ijt}$ as

$$\hat{y}_{ijt} = \beta\left(\ln v_{it}^* - \ln v_{ijt}\right) + D_j \qquad (2)$$

where D_j is a dummy variable standing for all industry- and time-invariant state-specific factors. We are interested in estimating the convergence coefficient β.

We assume that there is a common U.S. dollar inflation rate for each individual industry up an idiosyncratic error term, hence $\pi_{ijt} = \pi_{it} + \varepsilon_{ijt}$. This is a reasonable assumption since manufacturing goods are tradable, there are no tariffs or other external barriers to trade across U.S. states and manufacturing goods face common U.S. prices. Practically, of course, there are reasons why prices might differ across U.S. states even for tradables, but these wedges would introduce differences in price levels, not inflation rates. This, together with equation (2), allows us to express the growth of industry nominal labour productivity as:

$$\hat{v}_{ijt} = -\beta\left(\ln v_{ijt} - \ln v_{it}^*\right) + \pi_{it} + D_j + \varepsilon_{ijt} \qquad (3)$$

where ε_{ijt} captures all other idiosyncratic effects on labour productivity growth and we assume that it is uncorrelated with other explanatory variables. Rearranging terms, we obtain an estimating equation

$$\hat{v}_{ijt} = -\beta \ln v_{ijt} + (\pi_{it} + \beta \ln v_{it}^*) + D_j + \varepsilon_{ijt} \qquad (4).$$

Equivalently, we can express this equation as

$$\hat{v}_{ijt} = -\beta \ln v_{ijt} + D_{it} + D_j + \varepsilon_{ijt} \qquad (5)$$

where $D_{it} = (\pi_{it} + \beta \ln v_{it}^*)$. This means that we can regress the growth of nominal labour productivity on the initial level of labour productivity, industry × time period fixed effects D_{it} and state fixed effects D_j. In addition, we include separate industry and period fixed effects to control for any additional omitted variables. In this specification, the estimate of β is a measure of conditional convergence since we explicitly control for state fixed effects. Excluding the state fixed effects and checking if the estimate of β is negative and statistically significant provides a test of unconditional convergence. We estimate equation (5) by OLS with standard errors clustered at the state level. We also use two-way clustering at state-industry level, as will be discussed in Section 4.

We analyse unconditional convergence of manufacturing labour productivity at SIC 3-digit level across 48 U.S. states in every decade between 1880 and 2007 in the following years: 1880, 1890, 1900, 1910, 1920, 1930, 1940, 1947, 1958, 1967, 1977, 1987, 1997, and 2007. The construction of state-industry labour productivity figures require data on employment or number of hours worked, and value added by U.S. states at SIC 2- and SIC 3-digit level industries The data on U.S. state-industry employment, hours worked, and value added were collected from the U.S. Census of Manufactures.

Calculating labour productivity over the period of 127 years presents two challenges. First, we need to harmonize SIC 2- and SIC 3-digit level industries across time. Harmonization of the data for the post-World War II period is straightforward as the Census of Manufactures reports the SIC industrial categories and a great deal of information was published about the changes in SIC classifications between 1947 and 2007. However, SIC codes were not reported in the Censuses before 1947 for which we use the assignment of industries into 3-digit categories constructed by Klein and Crafts (2020) and by Crafts and Klein (2021) for the years 1880, 1890, 1900, 1910, 1920, 1930, and 1940. Details of the harmonization of SIC 3-digit industries are in the Appendix. Second, if information published by the Census would have allowed the disclosure of the details for individual plants, the Census either withheld the data or reported the data in employment classes. Hence, in some cases we have incomplete state-industry data. Fortunately, the data are in the form of matrices with rows being totals for U.S. states and columns totals for U.S. industries. This allows us to take advantage of a methodology developed by Golan et al. (1994). They used a maximum entropy procedure to recover missing data with information about row and column sums as well as information contained in the multi-sectoral matrices. In our case, we use across-state and across-industry adding-up constraints to recover missing information on state-industry employment and plant data.

We also estimate unconditional productivity growth convergence for U.S states:

$$\hat{y}_{it}^{GDP} = \beta \ln y_{it}^{GDP} + D_t + \varepsilon_{it} \qquad (6)$$

where $\hat{y}_{it}^{GDP}$ is the growth rate of state real GDP per worker, y_{it}^{GDP} is the initial state real GDP per worker, D_t are time-period fixed effects, and ε_{it} is the error term. We estimate (6) using OLS with heteroscedasticity-robust standard errors.

GDP per worker was calculated using state-level GDP and total employment data. Employment data was calculated from Perloff et al (1960) and U.S. Bureau of Economic Analysis Regional Data; state-level GDPs in 1880-1910 come from Klein (2013), 1920 from Easterlin (1957), and 1930-2007 from U.S. Bureau of Economic Analysis Regional Data. Real GDP per worker was calculated by deflating the nominal figures with U.S. GDP deflator from Johnston and Williamson (2018).

IV. Estimation Results

IV.A. Manufacturing: Baseline Results and Robustness Checks

Table 3 shows the results for the baseline specification. The dependent variable is the average annual labour productivity growth rate of SIC 3-digit manufacturing industries in 10-year intervals except for the years 1940-1947 and 1947-1958 when the intervals are seven and eleven years respectively. The regressors are the log of initial labour productivity, industry × time period fixed effects as specified in equation (5) together with as set of separate industry and period fixed effects. We pair each specification with its conditional variant which includes state fixed effects. Labour productivity is measured by value added per worker.[4] Standard errors are clustered at the state level in all specifications.

Column (1) shows the baseline unconditional convergence result. The estimated coefficient β is highly statistically significant with a magnitude of 7.6%. This specification pools together all decades between 1880 and 2007. When a linear trend variable is interacted with the log of initial labour productivity in column (2) the estimated coefficient is not statistically significant. We have further examined the issue of time-varying parameter heterogeneity by following Kremer et al. (2022) and considering convergence over fixed intervals of time. The specification in column (3) thus interacts the log of initial labour productivity with decadal dummies. We see that all the estimated decadal β-coefficients are highly statistically significant and negative. The pattern of β-coefficients is an oscillation around the value of 6% before and after World War II rather than a clear downward trend. When we estimated the specification in column (1) for the period 1880-1940 and 1958-2007, respectively, the estimated coefficients are virtually the same: 0.0647 (se=0.004) for the former and 0.0654 (se=0.003) for the latter period. It is notable, however, that we observe quite a steep rise in unconditional convergence from 5.5% in 1930-1940 to 10.6% in 1940-1947 and 9.4% in 1947-1958, followed by a considerable drop to 6.8% in 1958-1967 and then generally being below 8% until 2007.[5] Each regression specification in Table 3 is paired with a corresponding conditional convergence version in which we have added state fixed effects. The results are presented in columns (4)-(6). The statistical significance, signs, and the overall time-pattern are preserved. The magnitude of the estimated β coefficients is generally slightly larger, but the differences are very small.

We examine the robustness of these results in Table A1. First, there might be a concern that the unconditional convergence established in the baseline results is driven by a few industries with either an exceptionally fast or very slow labour productivity growth. Therefore, columns (1)-(3) in Table A1 exclude industries with the labour productivity growth in the tenth and ninetieth percentile. Unconditional convergence is preserved, though the estimated β-coefficients are lower, usually about half the size of those in the baseline – similar results were found by Rodrik (2013). Unlike the baseline results, however, column (2) shows that there is a declining trend of unconditional β-convergence between 1880 and 2007. Also, whilst the coefficients still vary across decades, the increase in the convergence rate across World War II is not as marked as in the baseline result. This may explain why we find a statistically significant interaction term between the time trend and initial labour productivity in column (2). This indicates that the industries in which labour productivity growth rate is between the

[4] We also ran regressions in which labour productivity is measured by value-added per hour worked. The results are qualitatively similar and are available on request.
[5] An F-test of the difference between the estimated β coefficients for the period 1930-1940 and 1940-1947 gives $F(2, 47) = 173.55$, statistically significant d at 1%, and between 1947-1958 and 1958-1967 gives $F(2, 47) = 117.42$, again a significant difference at 1%.

10th and 90th percentiles experienced decreasing convergence between 1880 and 2007 at a rate of 0.1%, unlike the entire manufacturing sector.

A second robustness check is conducted using a balanced state-industry data set. The number of industries in US states was changing over time especially as new industries entered the sample and our results could be affected by this. Therefore, columns (4)-(6) show the estimation results when we re-run the baseline specification on a balanced sample. The statistical significance and the evolution of β-coefficients across decades are the same as in the baseline case with the already highlighted increase in unconditional convergence in the years 1940-1947 and 1947-1958.

The third robustness check examines whether the baseline results are driven by the averaging period. The baseline results consider convergence over fixed periods of ten years between 1880 and 2007. A natural question is whether a longer time interval should be considered. Therefore, we have extended the fixed time periods to twenty years, re-estimated the baseline specification, and we present the results in columns (7)-(9). We see that signs and statistical significance remain the same as well as the time pattern of the estimated β-coefficients. The increased rate of convergence across World War II is still noticeable, though less striking. A more visible trait is the similarity of the convergence rate before and after World War II, a feature of the baseline results as well.

The fourth robustness check examines two-way clustering. In the main results, we cluster standard errors at state-level. However, there is also industry-specific clustering since each SIC 3-digit industry belongs to a higher, SIC 2-digit class and error terms might be correlated within SIC 2-digit groups. Therefore, we also estimate all specifications with a two-way cluster-robust estimator at state and SIC 2-digit level. Since the size of industry-level clusters can vary, we use a wild-bootstrapping method proposed by MacKinnon and Webb (2017) and implemented by Roodman et al (2019). Overall, the regression results show that statistical significance is virtually unchanged.

IV.B. Manufacturing: Heterogeneity across Industries

Another way how to examine the data is to scrutinize the heterogeneity of unconditional convergence across subsets of industries. This serves not only as another type of robustness check but is also informative. Specifically, the manufacturing sector in our period experienced substantial technological changes: industries that had emerged during the first industrial revolution in the first half of the nineteenth century in the era of steam as a general purpose technology were joined, at the turn of the twentieth century, by the new industries of the second industrial revolution which brought the new general purpose technologies of electricity and internal combustion engines, and then, after World War II, by ICT industries with electronics and computers as the latest general purpose technology. How different 'industrial revolutions' affected the process of unconditional convergence is an empirical question which our data is ready to answer. We classify SIC 3-digit industries as first, second, and ICT revolution industries based on Mowery and Rosenberg (1999) and estimate the same specification as in

Table 3 for each type for 1880-2007 in the first two cases and 1958-2007 for the ICT industries. Each specification is again matched with its conditional convergence counterpart. The results are presented in Tables 4, 5, and 6, respectively. We conducted similar robustness checks as for the baseline results. The overall patterns are the same, so we discuss the main results and leave the robustness regressions to the appendix, Tables A2-A4.

For first industrial revolution industries, Table 4 reports a very similar story to Table 3. The β-coefficients are statistically significant at one percent. The rate of unconditional convergence presented in column (1) is 7.3%. There is no discernible trend towards faster or slower convergence, as indicated by the insignificant coefficient in column (2). Again, we observe a substantial and statistically significant increase in unconditional convergence in the years 1940-1958 from 5.4% in 1930-1940 to 9.4% in 1940-1947 and 9% in 1947-1958, but then a considerable decrease to 6.5% in 1958-1967 and generally lower than 8% all the way until 2007. The magnitudes of the β-coefficients before and after World War II seem to oscillate around 7%. We have re-run the specification in column (1) for the period 1880-1940 and 1958-2007 and found that the estimated β-coefficients are -0.064 (se=0.0038) and -0.063 (se=0.003), respectively. As was the case with the baseline results, each regression in Table 4 is paired with the conditional convergence version that includes state fixed effects. We see that the statistical significance, signs, and the overall time-pattern are preserved. The magnitude of the estimated β-coefficients is generally slightly larger.

Table 5 presents the results for the industries of the second industrial revolution. The rate of unconditional convergence reported in column (1) is 8.5%, larger than for the industries of the first industrial revolution. There is a slight trend towards slower convergence, as indicated by the significant coefficient in column (2), though significance is only at 10%. Similar estimates to those in Table 3 and 4 emerge: (i) a substantial and statistically significant increase in the convergence rate in the decades 1940-1947 and 1947-1958; (ii) a similar speed of convergence in the pre- and post-World War II decades in column (3) with the magnitude of the estimated β-coefficient oscillating between 6% and 7.6%. We re-estimated the specification in column (1) for the period 1880-1940 and 1958-2007 respectively and the results show that the estimated β-coefficient is -0.068 (se=0.005) in the former and -0.0697 (se=0.004) in the latter case. Conditional convergence results are presented in columns (4)-(6). We see that the statistical significance, signs, and the overall time-pattern are preserved except for the interaction between the linear trend and the initial labour productivity in column (5) which is now insignificant. The magnitude of the estimated β-coefficients is again very similar.

Convergence rates for the ICT industries are estimated in Table 6. The signs and statistical significance have similarities to those in Table 4 and 5 with the estimated coefficients mostly statistically significant, and the signs confirming convergence. The rate of unconditional convergence is 8.3% and that of conditional convergence 8.7%. However, there are some notable differences. In comparison with the industries of the first and second industrial revolution the unconditional convergence rates are larger.

Over the 1958 to 2007 period for ICT industries the rate of 8.3% compared with 6.3% and 6.97% for first and second industrial revolution industries in the same period, respectively. The ICT industries also exhibit different convergence behaviour in the decade 1997-2007: the rate of convergence increases whilst it decreases for other two categories.

A different way to examine the heterogeneity of unconditional β-convergence across industries is to estimate equation (5) on an industry-by-industry basis for each of SIC two-digit industrial category. Table 7 shows the results for the entire period 1880-2007 as well as the sub periods 1880-1940 and 1958-2007 respectively. All the results show strong and statistically significant unconditional convergence with the estimates ranging from 4% for leather products (SIC-31) in 1880-1940 to 9.2% for industrial machinery and computer equipment (SIC-35) in 1880-2007. An interesting pattern is revealed when we compare 1880-1940 with 1958-2007: out of twenty SIC2-digit industrial groups, ten experienced a decrease in the rate of unconditional convergence while ten saw an increase. Industries in which unconditional convergence accelerated were mostly those which emerged during the second industrial and ICT revolutions, though notable exceptions are chemicals (SIC-28) and machinery (SIC-35). Overall, the pattern displayed in Table 7 reaffirms our earlier results: there is pervasive unconditional convergence.

IV.C. Manufacturing: Heterogeneity across Regions

The twentieth-century industrial geography of the United States was marked by large spatial disparities between the Manufacturing Belt and the South, as well as a reversal of fortunes between these two broad regions when the Manufacturing Belt, once the geographical centre of U.S. industrial production, lost its dominant position as industries migrated to the South (cf. Tables 1 and 2). In this context, it is interesting to compare the process of unconditional convergence over the long run in these regions. Therefore, we have estimated equation (5) with two interaction terms. One is between the initial log of labour productivity and a dummy variable indicating whether an industry is in the Manufacturing Belt or not, and the other interaction term is between the initial log of labour productivity and a dummy variable indicating whether an industry is in the U.S. South. The estimated β-coefficient for the Manufacturing Belt region is then the sum of the baseline β-coefficient and the Manufacturing Belt interaction term, and similarly for the U.S. South.

Table 8 presents the results. The estimates are for the entire period 1880-2007 and for the sub periods 1880-1840 and 1958-2007, respectively.[6] The β-coefficient in 1880-2007 is about 7.7% in the Manufacturing Belt and 7.8% in the U.S. South, very similar to the U.S. β-coefficient of 7.6% reported in Table 3. For the periods 1880-1940 and 1958-2007, respectively, we see that the South had slightly higher absolute value of β-coefficients than the Manufacturing Belt. Also, when we compare pre- and post-World War II estimates, unconditional convergence is slightly faster in the earlier period in both

[6] We also made estimates with decadal dummies and found similar patterns to those reported in Table 3.

the Manufacturing Belt and the South. The magnitude of the interaction terms, whilst often significant, is very small, ranging from 0.01% to 0.2%. This suggests that unconditional convergence in these broad regions differed very little. As with the baseline results and estimates for industries of different vintages, we conducted a series of robustness checks which are reported in the Appendix, Table A5. We see that the statistical significance and the magnitude of the β-coefficients are very similar to the same robustness checks reported for the baseline results in Table A1. Overall, the results further confirm our earlier findings that U.S. manufacturing shows strong and pervasive unconditional convergence.

Unconditional convergence is also observed in all SIC 2-digit industries in both the Manufacturing Belt and the South in both the pre- and post-World War II eras, as is reported in Table 9A and 9B. There is quite a wide range of estimated β-convergence rates, notably in the South in 1880-1940 where the spread is from 4.0% in SIC-36, Electrical Equipment, to 11.4% in SIC-35, Industrial and Commercial Machinery, but all industries in that period are above the Rodrik (2013) benchmark of 2.9% and all are significant at the 5% level or better.

V. The Contribution of Manufacturing Convergence to Aggregate Convergence

In this section we account for the contribution of unconditional convergence in manufacturing productivity to unconditional convergence of GDP per worker at the level of the entire United States as well as the Manufacturing Belt and the South, respectively.

V.A. A Basic Accounting Framework

The labour productivity growth rate in manufacturing sector *m* can be written as

$$\frac{\dot{y_m}}{y_m} = g + \beta_m(\ln y_m^* - \ln y_m) \qquad (7)$$

where the left-hand side of the equation is the growth rate of labour productivity in manufacturing sector m, $\ln y_m^*$ is the log of the productivity frontier in manufacturing, $\ln y_m$ is the log of average manufacturing labour productivity, β_m is the convergence coefficient in manufacturing and g is the underlying long-term balanced growth rate. Since we are interested in convergence, with no loss of generality we can set $g = 0$. Without g, equation (7) then captures the notion of convergence: the manufacturing productivity growth rate is positively related to distance from the frontier. The predicted growth rate is calculated as

$$\hat{y}_m = \hat{\beta}_m(\ln y_m^* - \ln y_m) \qquad (8)$$

where $\hat{\beta}_m$ is the estimated unconditional β-convergence coefficient in manufacturing obtained by estimating the unconditional convergence regression (5). Using equation (8), the component of the predicted productivity growth of the aggregate economy due to the predicted productivity growth of the manufacturing sector is

$$VA^m \, \hat{\beta}_m \, (\ln y_m^* - \ln y_m \,) \qquad (9)$$

where VA^m is the share of manufacturing value-added in total GDP.

To obtain the relative importance of this predicted manufacturing productivity growth from convergence, or, in other words, due to closing of the gap to the frontier, we need to conduct similar calculations for the aggregate economy. Hence, the labour productivity growth rate of the whole economy can be written as

$$\frac{\dot{y}_{GDP_{pw}}}{y_{GDP_{pw}}} = \beta_{GDP_{pw}} \left(\ln y_{GDP_{pw}}^* - \ln y_{GDP_{pw}} \right) \qquad (10)$$

where the left-hand side of the equation is the growth rate of labour productivity in the whole economy, $\ln y_{GDP_{pw}}^*$ is the log of the GDP/worker frontier, $\ln y_{GDP_{pw}}$ is the log of the average GDP per worker, and β_{GDP} is the convergence coefficient we obtain by estimating equation (6). Predicted growth from closing the gap to the frontier can be expressed as

$$\hat{y}_{GDP_{pw}} = \hat{\beta}_{GDP_{pw}} \left(\ln y_{GDP_{pw}}^* - \ln y_{GDP_{pw}} \right) \qquad (11)$$

where $\hat{\beta}_{GDP_{pw}}$ is the estimated convergence coefficient for the entire economy obtained by estimating equation (6). The importance of manufacturing convergence for the convergence of the entire economy is then calculated as the ratio of (9) to (11). The data for this calculation come from the same sources as in Section 3, complemented by GDP and employment data taken from Carter et al. (2006) which are used to calculate $y_{GDP_{pw}}$ and VA^m. The labour productivity frontiers for the manufacturing sector and the entire economy – y_m^* and $y_{GDP_{pw}}^*$ – are taken to be the 90th percentile of their respective distributions.

V.B. Manufacturing Productivity Growth from Unconditional Convergence

In Table 10, we report calculations for the formula in equation (9) together with actual manufacturing labour productivity growth rates. In the period 1880-1940, the predicted manufacturing productivity growth from unconditional convergence is 2.03%, 2.16% and 4.03% in the U.S., Manufacturing Belt and the South, respectively. The relatively high figure for the South comes from its greater distance to the frontier rather than a difference in the estimated *β*-convergence rate. However, the predicted contribution of manufacturing productivity convergence to overall labour productivity growth in the South is lower than that in the Manufacturing Belt (0.36% versus 0.62%) because the manufacturing sector was small – only 9.01% of total value added in 1880. It is also noteworthy that actual labour productivity growth in manufacturing in the South is only 2.31% per year which is a long way below the predicted productivity growth (4.03% per year) from convergence.

For the period 1958-2007, the picture is quite different. The predicted manufacturing productivity growth from unconditional convergence is 0.95%, 0.90% and 1.71% in the U.S., Manufacturing Belt and the South, respectively. In every case, although convergence continues at a similar rate to the earlier period, the distance to the frontier is now much smaller. The predicted contribution of manufacturing productivity convergence to overall labour productivity growth is now a bit bigger in the South than in the Manufacturing Belt in the context of the increased size of the sector which accounted for 24.19% of total value added in 1958. Actual labour productivity in manufacturing in the South in this second period is well above the predicted convergence contribution at 3.24% per year.

V.C. Whole Economy: Unconditional Convergence in Real GDP per Worker[7]

We report estimates for unconditional convergence regression (6) for real GDP per worker for all US states in Table 11. This can be thought of as refining and updating the estimates of Barro and Sala-i-Martin (1991) (1992). Taking advantage of the research of Klein (2013), which developed state-level estimates of personal income for 1890 and 1910 to supplement the original research of Easterlin (1957), we can estimate equations for every decade between 1880 and 1920. We also add estimates for two further decades at the end of the 20th century, and we estimate our regressions on a per worker rather than a per capita basis. The full set of new decadal estimates are presented in the Appendix, Table A6.

For the whole period 1880-2007, we obtain results which are quite similar to those of Barro and Sala-i-Martin for the period 1880-1988: our estimate of unconditional β-convergence is 1.84% per year, as can be seen in column (1), and Barro and Sala-i-Martin's estimate is 1.75%.[8] We have also estimated equation (6) for 1880-1940 and 1958-2007 respectively, and the convergence rate, reported in columns (2) and (3), is estimated at 1.47% and 1.56% per year, respectively. In common with recent studies cited in the literature review, our decadal estimates show a substantial slowdown in β-convergence in the late 20th century (Table A6).

As in section IV.C, we tried to investigate differences in the convergence of the Manufacturing Belt and the South by estimating a version of equation (6) for the periods 1880-2007, 1880-1940, and 1958-2007 with additional interaction terms: one between the initial level of GDP per worker and a dummy variable for the states in the Manufacturing Belt, and the other between the initial level of GDP per worker and a dummy variable for the states in the South. The results from these regressions show that unconditional β-convergence between 1880 and 2007 of the Manufacturing Belt and the South was 2.1%. In 1958-2007, β was 1.61% and 1.60% respectively. Unfortunately, the estimates for 1880-1940, which show unconditional β-convergence at a very rapid rate in both regions, are severely affected by multicollinearity. We present the results in Table A7 in the Appendix where we also describe this problem in detail.

A possible alternative could be to estimate unconditional convergence regressions for states in the South and the Manufacturing Belt separately. This, however, generates β-convergence estimates that reflect convergence *within* these regions, not relative to the United States – thus making them quite imperfect

[7] Real GDP is approximated by real personal income which approximates real GDP estimated from the income side. Personal income was also the basis for the papers by Barro and Sala-i-Martin (1991) (1992).

[8] See Barro and Sala-i-Martin (1992) Table 1, page 231.

substitutes. The estimates are presented in the Appendix in Table A8. For the Manufacturing Belt, β-convergence is 1.35% and 0.41% in 1880-1940 and 1958-2007 respectively, and 1.01% and 2.98% for the South in the same periods.

Overall, the estimation results show that in 1880-2007 as well as in the sub-periods 1880-1940, and 1958-2007, the United States experienced unconditional β-convergence in real GDP per worker. Similarly, the Manufacturing Belt and the South witnessed unconditional β-convergence between 1880 and 2007 and in the post-World War II decades between 1958-2007. As for the pre-World War II years, both regions appear to have experienced unconditional β-convergence but we are unable to obtain reliable estimates of β.

Table 12 reports predicted growth of GDP per worker due to unconditional convergence for the United States in 1880-1940 and 1958-2007 based on the regressions reported in Table 11. Predicted growth in column (3) is obtained by multiplying the estimated rate of β-convergence by the distance to the frontier. Comparing this with actual growth rates in column (4), we see that in 1880-1940, the predicted convergence contribution for the United States is 0.74 out of the actual growth rate of 1.10 percentage points. In the period 1958-2007, the contribution was lower, namely, 0.31 out of 1.72 percentage points since states were nearer to the productivity frontier. As for the South and the Manufacturing Belt in 1958-2007, the figures in Table 12 show that the predicted growth rate due to convergence in the South is 0.69 whilst its actual growth rate was 2.10 percentage points; in the Manufacturing Belt, the predicted growth rate due to convergence was 0.19 whilst the actual growth was 1.70 percentage points.

We can also obtain an estimate of the percentage of this predicted growth from convergence in U.S. GDP per worker which accrues from unconditional convergence in manufacturing labour productivity using the estimates in column (5) of Table 10. Thus, in 1880-1940, unconditional convergence in manufacturing accounted for 61 per cent (0.45/0.74) of aggregate unconditional convergence and 91 per cent (0.29/0.31) in 1958-2007. This suggests that unconditional convergence in manufacturing played a dominant role in aggregate U.S. unconditional convergence in labour productivity over the long run which aligns with the discussion of convergence experience in Rodrik (2013).

VI. The Delayed Catch-Up of the South

Table 13 shows that labour productivity in the South was 51% of the U.S. level in 1880 and was still only 55% in 1930 even though there was strong unconditional β-convergence in Southern manufacturing labour productivity at 7% per year during 1880-1940. Rapid catch-up was delayed until the later decades of the 20th century but by 1977 the South was at 88% and in 2007 at 94% of the US level. This section investigates the importance of the small share of value added in the manufacturing sector in this experience to see if Rodrik's suggestion that unsuccessful catch-up stems from an inability to develop a substantial industrial sector applies to the American South before World War II.

We cannot implement the accounting framework of section V because we were not able to obtain reliable estimates of the rate of unconditional β-convergence in real GDP per worker for the South in 1880-1940 – indeed, strictly speaking, we do not know whether there was unconditional convergence in the South. It is, however, possible to calculate the growth contributions from convergence that would have accrued from assumed values of β multiplied by distance to the frontier and this is done in Table 14 where they are reported as 'benchmark' growth rates. The assumed values are based on empirical estimates for the long-run convergence rate in the U.S. and on calibration of a neoclassical growth model.

A striking feature of Table 14 is that actual labour productivity growth in the South of 1.43% per year in 1880-1940 is below all the benchmarks in Panel C, the lowest of which is 1.68%. The neoclassical growth model benchmark at 2.43% (column 1 and row 6) is a full percentage point above what the South achieved. Normally, in that model, we might expect actual growth to exceed the convergence contribution as the formula in Table 14 reminds us. This suggests a significant growth failure in the South. This is underlined by the performance of the Manufacturing Belt. In that region, the benchmark growth rates due to convergence (Panel C), are of course, much lower because of greater proximity to the frontier but, notably, actual labour productivity growth of 1.15% comfortably exceeded all these benchmarks.

The disappointing productivity growth performance of the South might seem surprising given the strong unconditional convergence rate of its manufacturing sector; we estimated β = 7.0% in 1880-1940 (Table 8). However, the manufacturing sector in the South was small in this period and accounted for only 9.01% of value added in 1880. Predicted aggregate GDP per worker growth due to unconditional convergence in manufacturing productivity was only 0.36% (Table 10, column 5). If the South had achieved 'benchmark' GDP per worker growth rate of 1.68% per year based on the lowest assumed value for β (1.47%), less than a quarter of the growth contribution of convergence (0.36/1.68) would have been due to manufacturing, quite untypical of the U.S. in the 20th century.

What if 7% β-convergence in manufacturing had been achieved in a larger manufacturing sector? A simple arithmetic counterfactual calculation based on Table 10 reveals that if the manufacturing sector in the South had comprised 28.79% of total value added as in the Manufacturing Belt, its predicted convergence contribution to aggregate productivity growth would have been 0.2879*4.03 = 1.16 rather than 0.36 percentage points per year. If we assume that the non-manufacturing sector is downsized to 71.21% of value added and maintained its productivity growth at the historical rate of 1.34% per year, then growth of real GDP per worker in the South would be predicted to be 1.16 + 0.95 = 2.11% per year. This is similar to the benchmark growth rate for β = 1.84 shown in Table 13 but well below the 2.43% which the calibrated growth model indicated. Nevertheless, the verdict of growth failure would then be less appropriate. However, this counterfactual calculation is based on a predicted manufacturing labour productivity growth rate of 4.03% per year which is way above the actual rate of 2.31% in the South in 1880-1940 (Table 10, column 6).

The delayed catch-up of the South can be attributed partly to a lack of industrialization which matches Rodrik's emphasis on unconditional convergence in manufacturing and on the need for a large manufacturing sector to promote catch-up growth. But this was not the whole story: better productivity performance in manufacturing was also required, not just a larger manufacturing sector.[9] This view is reinforced by the experience of 1958-2007. In that period, the improved growth performance achieved by the South was based very largely on a much stronger contribution from the manufacturing sector based both on a larger share of value added and much faster productivity growth.[10]

VII. Discussion

As we have seen in the previous section, the impressive unconditional convergence of manufacturing in the South in 1880-1940 did not translate into convergence at the level of the entire Southern economy. Table 10 suggests that the small size of the manufacturing sector was an important reason for this. This section will explore why the share of value added in manufacturing remained small. We emphasize the role of geography as a factor that has been underestimated.

The low share of the manufacturing sector in the South has been long noticed in the literature. Prior to the Civil War, the nature of the Southern slave economy is the primary reason, as discussed in a voluminous literature.[11] Reasons why manufacturing remained a small sector after the Civil War were presented in Wright (1986). He argued that Southern industry was concentrated in low-wage, low-skilled sectors. In addition, he noted that even though the pace of industrial growth was about 7% per year in 1869-1909, this had a limited impact because most Southern industry was concentrated in resource intensive industries such as lumber and timber products with very few industrial linkages. The isolated Southern low-wage labour market was seen by Southern business leaders as in their interests.[12]

We expand on this explanation by highlighting the position of the Southern manufacturing relative to the centre of U.S manufacturing production – the Manufacturing Belt. We argue that in the decades after the Civil War, a large manufacturing sector was unlikely to develop in the context of low market

[9] Simply re-balancing the Southern economy to make manufacturing 28.79% of value-added but leaving productivity growth rates at their historical averages would have delivered overall labour productivity growth of (0.2879*2.31) + (0.7121*1.34) = 1.62 which is below all the benchmark rates in Table 14, row (6).

[10] The rate of growth of real GDP per worker was 2.10% in 1958-2007 compared with 1.43% in 1880-1940 (Tables 12 and 13). The share of manufacturing in GDP was 24.2% and 9.01%, respectively, and the manufacturing productivity growth rates were 3.24% and 2.31%, respectively (Table 10). The contribution of manufacturing productivity growth to overall productivity growth rose from 0.208% to 0.784% accounting for most of the increase between the two periods.

[11] Useful references are in Wright (1986).

[12] Gavin Wright writes about it as follows: "On the eve of the Great Depression, the South appeared to have settled into a lasting political-economic equilibrium, dominated by an elite planter class with a powerful stake in white supremacy and regional isolation." (Wright 2013, p. 56).

potential in the South. The locational advantage of the Manufacturing Belt facilitated the sustainability of the low-wage labour market that suited the Southern elite so well.

The Manufacturing Belt, which dominated the U.S. manufacturing sector until the 1960s, emerged by the post-Civil War decades as the centre of U.S industrialization.[13] Initially, the region took advantage of its natural resources. Once established as an important location of manufacturing activities, the Manufacturing Belt came to dominate manufacturing production after the Civil War. Plausible reasons for this domination can be found in the economic geography arguments put forward by Krugman (1991). In a nutshell, as economies of scale in manufacturing became significant in the later decades of the nineteenth century, transport costs fell considerably with the spread of the railway network. The subsequent increase in market potential encouraged spatial concentration in much of manufacturing. Inter-regional trade became important and cemented the position of the Manufacturing Belt as the unrivalled centre of U.S. industrial production until the second half of the twentieth century.[14] Market potential played a major role in turning initial advantage into a long-lasting manufacturing success. The South, handicapped by slavery and its aftermath, missed the boat.

Qualitative arguments to this effect were set out in Meyer (1983) (1989) and econometric evidence was provided by Klein and Crafts (2012). Indeed, the quantitative evidence shows that the Belt's large manufacturing sector was accompanied by a large market potential: the top twenty U.S. states with the largest market potential include seventeen located in this region, as reported in Klein and Crafts (2012, Table 4). The market potential of the Manufacturing Belt in 1880, expressed in millions of US$, was almost three times (US$410.5/US$150.45) that of the South. Furthermore, Klein and Crafts (2012) showed that large market potential was a major cause of the concentration of manufacturing production in the Belt and that the economic factors underpinning this included internal economies of scale and forward industrial linkages.[15]

At the same time, the South with its low market potential was unattractive to the manufacturing producers. This retarded industrial advancement and locked the South in the low-wage, low-skilled sector equilibrium with a small manufacturing sector. Accordingly, it failed to deliver aggregate convergence. To illustrate this reasoning with a counterfactual calculation, we use the procedure in Klein and Crafts (2012, Table 14), which shows the implications of a hypothetical increase in market potential based on their econometric estimates. Suppose that the level of market potential of Alabama, Georgia, Mississippi, and Texas in 1880 increased to that of Michigan. The model predicts that manufacturing employment would have risen substantially and so would the counterfactual share of manufacturing value added in GDP: 22.6%, 23.5%, 21.9% and 35.2% in Alabama, Georgia, Mississippi, and Texas, respectively. In turn, using the approach of Table 10 this would have then

[13] A recent survey of the relevant research is provided in Klein (2023).
[14] Quantitative evidence is presented in Crafts and Klein (2021).
[15] A neoclassical analysis of manufacturing location came to similar conclusions (Kim, 1998).

delivered a convergence contribution to aggregate growth in the range 1.2% to 1.3% per year during 1880-1940 in these states.

Discussions of the transformation of the South in the second half of the 20th century emphasize 'regime change' under the pressure of federally-imposed increases in labour costs which saw state governments in the South turn to aggressive policies to attract new industries and northern capital (Cobb, 1982; Wright, 2005). The Southern population became much more urban and better educated (Crown and Wheat, 1995). Manufacturing became a much more important part of the Southern economy and there was a large decline in the share of agriculture from 44.7% of employment in 1930 to 7.1% in 1967. Caselli and Coleman (2001) found that 57% of the convergence in Southern relative to Northern income per worker came from the reallocation of labour out of agriculture.

However, changes in the relative attractiveness of different regions for the location of industry stemming from technological change also played a significant role. The configuration which sustained the dominant position of the Manufacturing Belt was eroded by high wage costs, strong unions, a reduction in average plant size, and declining transportation costs due to trucking and the Interstate Highway System (Holmes, 1998; Glaeser and Kohlhase, 2004; Crafts and Klein 2021; Barde and Klein 2021). Market potential lost its key role in determining the location of manufacturing plants.

Conclusions

We have constructed a dataset which for the first time permits a long-run and very detailed analysis of convergence in labour productivity across US states. We cover 120 industries over 127 years in states with diverse political and institutional structures. The remarkable finding is that unconditional convergence in manufacturing was pervasive – in every period, in each industry, and in the South as well as the North. Moreover, the rate of convergence was rapid, typically more than 6% per year.

We also examine unconditional convergence in whole economy real GDP per worker. Over the whole period, we find that this obtained at a rate of 1.8% per year. We estimate that across all U.S. states in the long run most of this aggregate convergence has accrued from unconditional convergence in manufacturing, as might be expected by a reader of Rodrik (2013).

The 'Old South' experienced a delayed catch-up in labour productivity through the 1930s. Although it experienced strong convergence in manufacturing, the manufacturing sector was small and concentrated in low-skill, labour intensive industries. The South was held back by its lack of industrialization but also needed much stronger productivity growth within sectors. A Rodrik-type diagnosis of its failure to catch-up captures an important part but not the whole of the problem.

In the 'Old South' period, the small size of the manufacturing sector was consistent with the ambitions of the elite planter class, but it also reflected the dominant locational advantages of the Manufacturing Belt. These were sustained by its much greater market potential which was attractive to industries which benefited from scale economies and valued proximity to their customers.

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Tables

Table 1. Shares of Manufacturing Employment in U.S. Regions 1880-2007 (%).

	1880	1890	1900	1910	1920	1930	1940	1947	1958	1967	1977	1987	1997	2007
Manufacturing Belt	**84.3**	**80.9**	**79.1**	**76.5**	**77.1**	**74.2**	**71.7**	**70.5**	**62.1**	**59.1**	**51.6**	**46.5**	**42.4**	**40.8**
New England	24.0	19.6	17.8	17.1	15.4	12.7	12.2	10.7	8.9	8.4	7.2	7.4	5.8	5.3
Middle Atlantic	37.5	35.7	34.4	33.7	32.6	29.7	28.1	27.5	24.6	21.7	17.5	15.0	11.9	11.1
East North Central	19.1	22.3	23.8	22.9	26.7	29.2	28.5	29.5	25.9	26.3	24.6	21.7	23.1	22.7
South Atlantic (part)	3.7	3.3	3.0	2.9	2.4	2.6	3.0	2.8	2.8	2.7	2.3	2.4	1.7	1.7
South	**9.0**	**9.4**	**11.5**	**13.7**	**12.0**	**13.8**	**16.4**	**17.1**	**18.5**	**21.6**	**26.4**	**28.2**	**30.7**	**30.4**
South Atlantic (part)	5.2	4.2	5.9	7.0	6.2	7.0	9.0	8.7	8.9	10.5	12.5	14.0	14.5	13.4
East South Central	2.7	3.3	3.5	3.9	3.2	3.9	4.4	4.8	5.0	5.9	7.3	7.5	8.1	7.8
West South Central (part)	1.0	1.8	2.1	2.8	2.7	2.8	3.0	3.6	4.5	5.1	6.6	6.7	8.1	9.2
Rest of US	**6.7**	**9.7**	**9.4**	**9.8**	**10.9**	**12.0**	**11.8**	**12.4**	**19.4**	**19.3**	**22.1**	**25.3**	**26.9**	**28.8**
West South Central (part)	0.0	0.0	0.04	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.1
West North Central	4.5	6.5	5.9	5.4	5.0	5.3	5.0	5.5	7.2	6.6	6.8	7.6	8.1	9.0
Mountain	0.4	0.6	0.8	1.0	0.9	1.1	0.9	1.2	1.8	2.1	2.9	3.4	4.0	4.6
Pacific	1.7	2.6	2.6	3.2	4.7	5.3	5.6	5.2	9.8	9.9	11.5	13.2	13.9	14.1
United States	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: U.S. Census of Manufactures.

Notes: South Atlantic states inside the Manufacturing Belt are Delaware, Maryland, and West Virginia; West South-Central inside 'rest of US' is Oklahoma. Employment is total number of employees except in 1880 and 1947 when employment is total number of wage earners.

Table 2: Relative Labour Productivity in Manufacturing: Broad U.S. Regions 1900-2007, U.S.=100%

	1900	1910	1920	1930	1940	1947	1958	1967	1977	1987	1997	2007
Manufacturing Belt	101.19%	102.02%	101.06%	106.65%	105.13%	102.03%	101.71%	102.36%	104.56%	102.09%	93.39%	91.09%
Rust Belt	*110.76%*	*126.18%*	*109.94%*	*116.06%*	*112.94%*	*106.16%*	*108.66%*	*106.88%*	*107.00%*	*99.30%*	*89.21%*	*85.68%*
U.S. South	65.53%	67.71%	77.83%	59.62%	66.54%	77.77%	84.97%	88.71%	88.15%	89.64%	92.04%	92.88%
Deep South	*55.58%*	*61.33%*	*61.23%*	*50.13%*	*58.04%*	*75.60%*	*87.14%*	*96.46%*	*93.67%*	*93.95%*	*101.34%*	*98.08%*
Rest of United States	133.61%	124.99%	117.11%	108.59%	117.66%	119.86%	111.76%	106.69%	104.60%	109.24%	120.75%	121.19%

Sources: U.S. Census of Manufactures, Kendrick (1961), NBER-CES Manufacturing Industry Database.

Note: This table shows labour productivity of U.S. regions expressed as percentage of U.S. average. Labour productivity is calculated as the weighted average of labour productivity in SIC3-digit industries in which weights are employment shares. Labour productivity is defined as value added per worker. Nominal values were deflated with SIC 3-digit industry level deflators: 1900-1958 were calculated using Kendrick (1961) and U.S. Census of Manufactures; 1958-2007 were calculated using NBER-CES Manufacturing Industry database.

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

Rust Belt states: Illinois, Indiana, Michigan, Ohio, Pennsylvania, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Deep South: Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina, Texas

Table 3: Convergence in U.S. Manufacturing 1880-2007, All SIC 3-Digit Industries: Baseline Results.

	Value added per worker					
	(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	-0.076***	-0.079***		-0.079***	-0.082***	
	[0.004]	[0.005]		[0.004]	[0.005]	
(Log initial productivity) x Time trend		0.0003			0.0004	
		[0.0004]			[0.00035]	
(Log initial productivity) x 1880			-0.061***			-0.065***
			[0.004]			[0.003]
(Log initial productivity) x 1890			-0.066***			-0.069***
			[0.003]			[0.003]
(Log initial productivity) x 1900			-0.063***			-0.067***
			[0.003]			[0.003]
(Log initial productivity) x 1910			-0.066***			-0.071***
			[0.004]			[0.004]
(Log initial productivity) x 1920			-0.074***			-0.077***
			[0.011]			[0.010]
(Log initial productivity) x 1930			-0.055***			-0.061***
			[0.004]			[0.004]
(Log initial productivity) x 1940			-0.106***			-0.112***
			[0.006]			[0.006]
(Log initial productivity) x 1947			-0.094***			-0.098***
			[0.006]			[0.007]
(Log initial productivity) x 1958			-0.068***			-0.074***
			[0.006]			[0.005]
(Log initial productivity) x 1967			-0.064***			-0.069***
			[0.003]			[0.003]
(Log initial productivity) x 1977			-0.070***			-0.074***
			[0.003]			[0.003]
(Log initial productivity) x 1987			-0.075***			-0.078***
			[0.005]			[0.005]
(Log initial productivity) x 1997			-0.054***			-0.056***
			[0.004]			[0.004]
State fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	43,070	43,070	43,070	43,070	43,070	43,070
R-squared	0.588	0.588	0.599	0.599	0.599	0.609

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labour productivity on the initial level of labour productivity, industry and period fixed effects, industry × time period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level.

*** p<0.01, ** p<0.05, * p<0.10

Table 4: Convergence in U.S. Manufacturing 1880-2007, First Industrial Revolution Industries.

	Value added per worker					
	(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	-0.073***	-0.075***		-0.077***	-0.079***	
	[0.004]	[0.005]		[0.004]	[0.004]	
(Log initial productivity) x Time trend		0.0002			0.00026	
		[0.00045]			[0.00042]	
(Log initial productivity) x 1880			-0.060***			-0.063***
			[0.004]			[0.003]
(Log initial productivity) x 1890			-0.064***			-0.067***
			[0.003]			[0.003]
(Log initial productivity) x 1900			-0.062***			-0.066***
			[0.004]			[0.004]
(Log initial productivity) x 1910			-0.067***			-0.074***
			[0.004]			[0.004]
(Log initial productivity) x 1920			-0.075***			-0.079***
			[0.010]			[0.009]
(Log initial productivity) x 1930			-0.054***			-0.061***
			[0.005]			[0.004]
(Log initial productivity) x 1940			-0.094***			-0.100***
			[0.007]			[0.007]
(Log initial productivity) x 1947			-0.090***			-0.095***
			[0.006]			[0.007]
(Log initial productivity) x 1958			-0.065***			-0.071***
			[0.006]			[0.005]
(Log initial productivity) x 1967			-0.063***			-0.068***
			[0.004]			[0.004]
(Log initial productivity) x 1977			-0.069***			-0.073***
			[0.004]			[0.004]
(Log initial productivity) x 1987			-0.076***			-0.078***
			[0.004]			[0.004]
(Log initial productivity) x 1997			-0.049***			-0.051***
			[0.006]			[0.006]
State fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	30,891	30,891	30,891	30,891	30,891	30,891
R-squared	0.588	0.588	0.597	0.599	0.599	0.607

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labour productivity on the initial level of labour productivity, industry and period fixed effects, industry × time period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level. Labour productivity is defined as value added per worker. Industry classification is based on Mowery and Rosenberg (1999).
*** p<0.01, ** p<0.05, * p<0.10

Table 5: Convergence in U.S. Manufacturing 1880-2007, Second Industrial Revolution Industries.

	Value added per worker					
	(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	-0.085***	-0.096***		-0.087***	-0.096***	
	[0.005]	[0.008]		[0.004]	[0.007]	
(Log initial productivity) x Time trend		0.001*			0.001	
		[0.001]			[0.001]	
(Log initial productivity) x 1880			-0.069***			-0.073***
			[0.008]			[0.008]
(Log initial productivity) x 1890			-0.074***			-0.076***
			[0.005]			[0.005]
(Log initial productivity) x 1900			-0.072***			-0.074***
			[0.006]			[0.005]
(Log initial productivity) x 1910			-0.060***			-0.062***
			[0.008]			[0.009]
(Log initial productivity) x 1920			-0.068***			-0.072***
			[0.015]			[0.015]
(Log initial productivity) x 1930			-0.059***			-0.062***
			[0.009]			[0.009]
(Log initial productivity) x 1940			-0.149***			-0.153***
			[0.010]			[0.010]
(Log initial productivity) x 1947			-0.103***			-0.104***
			[0.006]			[0.007]
(Log initial productivity) x 1958			-0.076***			-0.084***
			[0.008]			[0.006]
(Log initial productivity) x 1967			-0.066***			-0.072***
			[0.004]			[0.004]
(Log initial productivity) x 1977			-0.073***			-0.078***
			[0.004]			[0.004]
(Log initial productivity) x 1987			-0.076***			-0.079***
			[0.007]			[0.008]
(Log initial productivity) x 1997			-0.061***			-0.063***
			[0.006]			[0.006]
State fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	10,706	10,706	10,706	10,706	10,706	10,706
R-squared	0.598	0.598	0.617	0.612	0.613	0.629

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labour productivity on the initial level of labour productivity, industry and period fixed effects, industry × time period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level. Labour productivity is defined as value added per worker. Industry classification is based on Mowery and Rosenberg (1999).
*** p<0.01, ** p<0.05, * p<0.10

Table 6: Convergence in U.S. Manufacturing 1958-2007, ICT Industries.

	Value added per worker					
	(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	-0.083***	-0.134***		-0.087***	-0.113***	
	[0.006]	[0.024]		[0.005]	[0.021]	
(Log initial productivity) x Time trend		0.005**			0.002	
		[0.002]			[0.002]	
(Log initial productivity) x 1958			-0.084***			-0.099***
			[0.015]			[0.016]
(Log initial productivity) x 1967			-0.071***			-0.077***
			[0.008]			[0.008]
(Log initial productivity) x 1977			-0.064***			-0.074***
			[0.009]			[0.009]
(Log initial productivity) x 1987			-0.066***			-0.078***
			[0.014]			[0.013]
(Log initial productivity) x 1997			-0.076***			-0.085***
			[0.010]			[0.010]
State fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,473	1,473	1,473	1,473	1,473	1,473
R-squared	0.513	0.518	0.358	0.564	0.565	0.453

Sources: U.S. Census of Manufactures: 1958, 1967, 1977, 1987, 1997, 2007

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labour productivity on the initial level of labour productivity, industry and period fixed effects, industry × time period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level. Labour productivity is defined as value added per worker. Industry classification is based on Mowery and Rosenberg (1999).
***p<0.01, ** p<0.05, * p<0.10

Table 7: Beta-Coefficients by Industry: United States.

SIC Code	Manufacturing industry	Beta coefficient	Significance	Beta coefficient	Significance	Beta coefficient	Significance
		1880-2007		**1880-1940**		**1958-2007**	
20	Food and Kindred Products	-0.071	***	-0.064	***	-0.066	***
21	Tobacco Products	-0.066	***	-0.051	***	-0.082	***
22	Textile Mill Products	-0.066	***	-0.066	***	-0.059	***
23	Apparel, Finished Products from Fabrics & Similar Materials	-0.066	***	-0.067	***	-0.058	***
24	Lumber and Wood Products, Except Furniture	-0.060	***	-0.060	***	-0.053	***
25	Furniture and Fixtures	-0.072	***	-0.069	***	-0.061	***
26	Paper and Allied Products	-0.072	***	-0.071	***	-0.064	***
27	Printing, Publishing and Allied Industries	-0.070	***	-0.053	***	-0.060	***
28	Chemicals and Allied Products	-0.075	***	-0.063	***	-0.055	***
29	Petroleum Refining and Related Industries	-0.079	***	-0.068	***	-0.061	***
30	Rubber and Miscellaneous Plastic Products	-0.076	***	-0.065	***	-0.072	***
31	Leather and Leather Products	-0.069	***	-0.041	***	-0.072	***
32	Stone, Clay, Glass, and Concrete Products	-0.085	***	-0.060	***	-0.074	***
33	Primary Metal Industries	-0.091	***	-0.081	***	-0.084	***
34	Fabricated Metal Products	-0.085	***	-0.060	***	-0.081	***
35	Industrial and Commercial Machinery and Computer Equipment	-0.092	***	-0.077	***	-0.074	***
36	Electronic & Other Electrical Equipment & Components	-0.085	***	-0.069	***	-0.073	***
37	Transportation Equipment	-0.087	***	-0.068	***	-0.069	***
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	-0.080	***	-0.072	***	-0.080	***
39	Miscellaneous Manufacturing Industries	-0.078	***	-0.069	***	-0.063	***

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Note: this table shows beta-coefficients from unconditional regression equation run for each SIC 2-digit group separately.

*** p<0.01, ** p<0.05, * p<0.10

Table 8: Convergence in U.S. Manufacturing, All SIC 3-Digit Industries. Broad Regions: Manufacturing Belt, and U.S. South.

		1880-2007	1880-1940	1958-2007
		(1)	(2)	(3)
Log initial productivity	(1)	-0.07741***	-0.06843***	-0.06582***
		[0.004]	[0.003]	[0.003]
(Log initial productivity) x Manufacturing belt dummy	(2)	-0.00011	-0.00066**	-0.00012
		[0.000]	[0.000]	[0.000]
(Log initial productivity) x U.S. South dummy	(3)	-0.00074***	-0.00246***	-0.00042*
		[0.000]	[0.000]	[0.000]
Beta-convergence: Manufacturing Belt	(1) + (2)	-0.07752	-0.06909	-0.06595
Beta-convergence: U.S South	(1) + (3)	-0.07815	-0.07089	-0.06624
Period fixed effects		Yes	Yes	Yes
Number of observations		43,070	11,508	23,125
R-squared		0.59	0.626	0.426

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labour productivity on the initial level of labour productivity, industry and period fixed effects, industry × time period fixed effects and interaction between the initial level of labour productivity and broad region dummy variables. Standard errors are clustered at state level. Labour productivity is defined as value added per worker. Broad regions are defined as:

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table 9A: Convergence in U.S. Manufacturing by SIC 2-Digit Industry and Broad Regions, 1880-1940.

SIC Code	Manufacturing industry	Beta coefficient	Significance	Beta coefficient	Significance
		Manufacturing Belt		**U.S. South**	
20	Food and Kindred Products	-0.059	***	-0.067	***
21	Tobacco Products	-0.074	***	-0.054	**
22	Textile Mill Products	-0.076	***	-0.058	***
23	Apparel, Finished Products from Fabrics & Similar Materials	-0.061	***	-0.094	***
24	Lumber and Wood Products, Except Furniture	-0.050	***	-0.045	***
25	Furniture and Fixtures	-0.052	***	-0.086	***
26	Paper and Allied Products	-0.072	***	-0.056	**
27	Printing, Publishing and Allied Industries	-0.045	***	-0.064	***
28	Chemicals and Allied Products	-0.059	***	-0.098	***
29	Petroleum Refining and Related Industries	-0.086	***	-0.050	**
30	Rubber and Miscellaneous Plastic Products	-0.071	***		
31	Leather and Leather Products	-0.047	***	-0.061	***
32	Stone, Clay, Glass, and Concrete Products	-0.064	***	-0.071	***
33	Primary Metal Industries	-0.079	***	-0.076	***
34	Fabricated Metal Products	-0.064	***	-0.054	**
35	Industrial and Commercial Machinery and Computer Equipment	-0.078	***	-0.114	***
36	Electronic & Other Electrical Equipment & Components	-0.078	***	-0.040	***
37	Transportation Equipment	-0.080	***	-0.092	***
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	-0.068	***	-0.075	***
39	Miscellaneous Manufacturing Industries	-0.081	***	-0.077	***

Sources: U.S. Census of Manufactures: every ten years 1880-1940.
Note: This table shows beta-coefficients from unconditional labour productivity convergence regressions run for each SIC 2-digit group separately.
*** p<0.01, ** p<0.05, * p<0.10. Broad regions are defined as:
Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin
U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table 9B: Convergence in U.S. Manufacturing by SIC 2-Digit Industry and Broad Regions, 1958-2007.

SIC Code	Manufacturing industry	Beta coefficient	Significance	Beta coefficient	Significance
		Manufacturing Belt		**U.S. South**	
20	Food and Kindred Products	-0.048	***	-0.082	***
21	Tobacco Products	-0.075	***	-0.075	***
22	Textile Mill Products	-0.066	***	-0.055	***
23	Apparel, Finished Products from Fabrics & Similar Materials	-0.062	***	-0.058	***
24	Lumber and Wood Products, Except Furniture	-0.057	***	-0.063	***
25	Furniture and Fixtures	-0.050	***	-0.093	***
26	Paper and Allied Products	-0.053	***	-0.069	***
27	Printing, Publishing and Allied Industries	-0.047	***	-0.077	***
28	Chemicals and Allied Products	-0.040	***	-0.046	***
29	Petroleum Refining and Related Industries	-0.054	***	-0.057	***
30	Rubber and Miscellaneous Plastic Products	-0.060	***	-0.074	***
31	Leather and Leather Products	-0.085	***	-0.082	***
32	Stone, Clay, Glass, and Concrete Products	-0.071	***	-0.071	***
33	Primary Metal Industries	-0.078	***	-0.095	***
34	Fabricated Metal Products	-0.070	***	-0.080	***
35	Industrial and Commercial Machinery and Computer Equipment	-0.071	***	-0.076	***
36	Electronic & Other Electrical Equipment & Components	-0.069	***	-0.064	***
37	Transportation Equipment	-0.072	***	-0.057	***
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	-0.081	***	-0.072	***
39	Miscellaneous Manufacturing Industries	-0.070	***	-0.087	***

Sources: U.S. Census of Manufactures 1958, and every ten years 1967-2007.
Note: This table shows beta-coefficients from unconditional labour productivity convergence regressions run for each SIC 2-digit group separately. *** p<0.01, ** p<0.05, * p<0.10. Broad regions are defined as:
Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin
U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table 10: Predicted Labour Productivity Growth due to Unconditional Convergence in Manufacturing, 1880-1940 and 1958-2007.

	(1)	(2)	(3)	(4)	(5)	(6)
	Manufacturing share in economy	Beta convergence estimate	Distance to frontier	Predicted manufacturing productivity growth due to convergence	Predicted GDP/worker growth due to manufacturing convergence	Actual manufacturing labour productivity growth
	VA share	β_m	$lny_m^* - lny_m$	(2) x (3)	(1) x (4)	
				1880-1940		
U.S.	22.08%	0.064	0.3146	2.03%	0.45%	2.37%
Manufacturing Belt	28.79%	0.069	0.3155	2.16%	0.62%	2.42%
South	9.01%	0.070	0.573	4.03%	0.36%	2.31%
				1958-2007		
U.S.	29.99%	0.0654	0.146	0.95%	0.29%	2.80%
Manufacturing Belt	37.52%	0.0659	0.136	0.90%	0.34%	2.66%
South	24.19%	0.0662	0.258	1.71%	0.41%	3.24%

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007, and 1958

Note: Value-added shares (VA Share) and distance to frontier are values at the beginning of the period.

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

The mining states Arizona, Colorado, Montana, Nevada, and Wyoming are excluded from the calculation of productivity frontier in manufacturing.

Table 11: Unconditional Convergence of GDP per Worker in U.S.

	1880-2007	1880-1940	1958-2007
	(1)	(2)	(3)
Log initial productivity	-0.0184***	-0.0147***	-0.0156***
	[0.003]	[0.003]	[0.003]
Period fixed effects	Yes	Yes	Yes
Number of observations	621	285	240
R-squared	0.564	0.286	0.424

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis Regional Data, Johnston and Williamson (2018).
Note: In this table, we present the results of regressions in which the growth rates of state real GDP per worker are regressed on the initial level of state real GDP per worker, and time-period fixed effects.

Table 12: Predicted Growth of GDP per Worker due to Unconditional Convergence, 1880-1940, 1958-2007.

	(1)	(2)	(3)	(4)
	Beta convergence estimate	Distance to frontier	Predicted aggregate growth	Actual GDP per worker growth rates
	β_{GDPpw}	lny_{GDP}^{*} - lny_{GDP}	(1) x (2)	
Panel A: 1880-1940				
United States	1.47	0.501	0.74%	1.10%
Panel B: 1958-2007				
United States	1.56	0.202	0.31%	1.72%
Manufacturing Belt	1.61	0.121	0.19%	1.70%
South	1.60	0.431	0.69%	2.10%

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis, Regional Data, Johnston and Williamson (2018).

Note: This table shows the calculations of the predicted growth in GDP per worker due to unconditional convergence. Distance to frontier is evaluated at the beginning of the period. Broad regions are defined as:
Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin
U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table 13: Real GDP per worker by Broad Regions: 1880-2007.

	1880	1890	1900	1910	1920	1930	1940	1947	1958	1967	1977	1987	1997	2007
	Real GDP per worker in 2000 $US													
Manufacturing Belt	9,970	10,871	11,513	11,790	13,259	16,818	18,625	22,978	26,449	32,068	39,033	44,362	51,894	59,642
U.S. South	4,132	5,341	4,872	5,598	7,161	7,528	10,035	15,775	19,075	23,679	31,759	37,713	43,939	52,382
Rest of U.S.	8,972	10,865	10,647	11,975	11,728	13,148	15,729	22,408	25,580	29,680	36,033	40,825	45,948	55,033
United States	8,099	9,417	9,517	10,125	11,416	13,724	15,826	21,053	24,349	29,250	36,153	41,367	47,606	55,859
	90^{th} percentile of real GDP per worker in 2000 $US													
U.S Frontier	12,911	13,921	13,584	13,152	13,784	17,825	20,744	24,849	28,092	33,995	40,425	45,793	53,131	64,561
	Percentage from U.S.													
Manufacturing Belt	123.09%	115.44%	120.97%	116.45%	116.14%	122.55%	117.69%	109.14%	108.62%	109.63%	107.96%	107.24%	109.01%	106.77%
U.S. South	51.02%	56.71%	51.19%	55.29%	62.73%	54.85%	63.41%	74.93%	78.34%	80.96%	87.85%	91.17%	92.30%	93.78%
Rest of U.S.	110.78%	115.37%	111.86%	118.27%	102.74%	95.81%	99.39%	106.43%	105.06%	101.47%	99.67%	98.69%	96.52%	98.52%

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis Regional Data, Johnston and Williamson (2018).

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table 14: GDP per Worker Growth Rates for Alternative β-benchmarks, Manufacturing Belt, U.S. South, 1880-1940.

		(1)	(2)	(3)	(4)	(5)
	Panel A:	Alternative β-benchmarks for Manufacturing Belt and South in 1880-1940				
(1)	Manufacturing Belt	2.07	1.47	1.75	1.84	2.00
(2)	South	2.12	1.47	1.75	1.84	2.00
	Panel B:	Distance to frontier in 1880: $(ln_{GDPpw*} - ln_{GDPpw})$				
(3)	Manufacturing Belt			0.357		
(4)	South			1.144		
	Panel C:	Benchmark GDP per worker growth rates: Panel A x Panel B				
(5)	Manufacturing Belt	0.74%	0.52%	0.62%	0.66%	0.71%
(6)	South	2.43%	1.68%	2.00%	2.10%	2.29%
	Panel D:	Actual GDP per worker growth rates: 1880-1940				
(7)	Manufacturing Belt			1.15%		
(8)	South			1.43%		

Source: Easterlin (1957), Perloff et al. (1960), U.S. Bureau of Economic Analysis, Regional Data, Barro and Sala-i-Martin (1992), Klein (2013), Johnston and Williamson (2018).

Note: this table computes benchmark GDP per worker growth rates. The benchmark growth rates are calculated by multiplying the distance to frontier (row 3 and 4) by the convergence rate β in rows (1) and (2). Growth rates are calculated as average annual growth rates.

The benchmark values of β for the years 1880-1940 are obtained as follows: column (1) is from a calibrated neoclassical growth model, column (2) estimated for U.S. in 1880-1940 in Table 11, column (3) is the estimate in Barro and Sala-i-Martin (1992) for U.S. in 1880-1988, column (4) is the estimate for U.S. in 1880-2007 in Table 11, and column (5) is Barro and Sala-i-Martin's 2% 'empirical rule'. The growth-model calibration in column (1) follows Acemoglu (2009, p.81, equation 3.11) who derives the growth rate of GDP per worker:

$$\frac{\dot{y}_{GDP_{pw}}}{y_{GDP_{pw}}} \approx g - (1-\alpha)(\delta + g + n)\left(\ln y^*_{GDP_{pw}} - \ln y_{GDP_{pw}}\right)$$

where α is the elasticity of output with respect to capital, δ is the rate of depreciation, g is the rate of labour-augmenting technical progress, n is the rate of growth of the labour force, and $\left(\ln y^*_{GDP_{pw}} - \ln y_{GDP_{pw}}\right)$ is the productivity frontier gap. In the Solow model, there are two sources of growth: the first is technological progress g and the second is convergence. Focusing on convergence, formula (12) allows us to calculate β-convergence using the appropriate values for α, δ, g, and n. Following Barro and Sala-i-Martin (1992) we assume that α, g, and δ are the same in all states. We assume $\delta = 5\%$ (Field, 1985) and g = 1.8% (Bakker et al., 2019). We set α= 0.75 based on the discussion in Barro and Sala-i-Martin (1992) who see this as a reasonable value if capital is taken to be 'broad capital'. The rate of labour force growth n is 1.48% in the Manufacturing Belt and 1.68% in the South (Perloff et al., 1960). The projected rate of β-convergence is then calculated as $(1 - \alpha)(\delta + g + n)$ which yields 2.07% for the Manufacturing Belt and 2.12% for the South. Broad regions are defined as follows:

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Appendix

This appendix contains a discussion of the harmonization of SIC three-digit industries, an explanation of the multicollinearity problem raised in section V.C, and numerous robustness checks discussed in the main part of the paper,

Harmonization of industries

Harmonization of SIC three-digit industries was needed, especially for the year 1947 which presented the biggest challenge. Several industries which were coded as SIC four-digit industries became three-digit industries in later census, hence they needed to be recoded. For 1947, Industry SIC261 had to be adjusted by subtracting SIC2611, SIC286 by subtracting SIC2823 and 2825, and SIC346 by subtracting SIC347. For 1958, SIC264 was added to SIC267 to make it consistent with the subsequent censuses. For that year, as well as for the years 1967 and 1977, SIC303 and SIC307 were reclassified to SIC305 and SIC308 respectively. For 1977 and 1987, SIC264 was recoded as SIC267, and SIC383 was added to SIC382. Furthermore, SIC303 and 304 were added up to create SIC305.

Multicollinearity

The multicollinearity problem which occurs when estimating regression equation (6) for the period 1880-1940 with the interaction effects between the initial GDP per worker (in this case GDP per worker in 1880) and dummy variables indicating a state in the Manufacturing Belt and the South, respectively, can be seen in column (5) in Table A7. We see that the baseline β-estimate is 0.0268 for the whole United States, almost twice the β-estimate of 0.147 in column (1) when equation (6) is estimated without the interaction terms. This result is clearly driven by one of the interaction terms. A table below presents estimates of equation (6) in which the interaction terms were entered separately. We see from column (3) that the interaction between the initial GDP per worker and the South dummy is the main reason for the large magnitude of the baseline β-estimate.

Statistical tests were performed to confirm the multicollinearity problem. First, we calculated pairwise correlation coefficients between initial GDP per worker and the interaction terms in every decade between 1880 and 1940. In all cases, the interaction between the initial GDP per worker and the South dummy was the stronger, with the pairwise correlation ranging from 0.64 to 0.74 and statistically significant at one percent level. On the other hand, the interaction term with the Manufacturing Belt dummy was less than half the size and either insignificant or significant at the five percent level at best. Then we calculated a series of Farrar-Glauber multicollinearity tests which include chi-square and F-tests as implemented by a Stata command 'lmcol'. The null hypotheses are that there is no multicollinearity. The chi-square test yielded the value of 264.507 which meant that we could reject the null hypothesis at one percent significance level. The F-test for the interaction term with the South dummy had the value of 179.463 which meant that we could also reject the null hypothesis at one percent significance level. All this provides confirmation that the regression with the interaction terms for the period 1880-1940 suffers from a severe multicollinearity problem which is driven mainly by the interaction term with the South dummy.

The reason why the interaction term between the initial GDP per worker and the South dummy is highly correlated with the initial GDP per worker in the period 1880-1940 becomes clear when we rank U.S. states by their GDP per worker in 1880. The bottom part of the GDP per worker distribution is dominated by the southern states and New Mexico. This means that the lower part of the distribution of GDP per work across all U.S. states consists almost solely of the southern states, and there is a very high correlation between the initial GDP per worker and the interaction term of the initial GDP per worker with the South dummy. This is not the case after World War II. Doing the same exercise for 1958, we find other states such as such as South Dakota, Maine and Oklahoma are among those with the lowest GDP per capita. This means that the bottom part of the distribution of state GDP per worker does not comprise only the southern states, hence we don't observe a strong correlation between the initial GDP per worker and the South dummy as we do in the period 1880-1940.

Multicollinearity Problem: Unconditional Convergence of GDP per Worker in U.S., Manufacturing Belt, and the South, 1880-1940.

	(1)	(2)	(3)	(4)
Log initial productivity	-0.014668***	-0.017066***	-0.026561***	-0.026759***
	[0.003]	[0.003]	[0.005]	[0.005]
(Log initial productivity) x Manufacturing belt dummy		0.000599***		0.000369**
		[0.000]		[0.000]
(Log initial productivity) x South dummy			-0.001628***	-0.001453***
			[0.000]	[0.000]
Constant	0.146908***	0.166213***	0.256460***	0.256563***
	[0.027]	[0.028]	[0.044]	[0.045]
Year fixed effects	Yes	Yes	Yes	Yes
Observations	285	285	285	285
R-squared	0.286	0.312	0.35	0.359

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis, Johnston and Williamson (2018).
Note: In this table, we present the results of regressions in which the growth rate of state real GDP per worker are regressed on the initial level of state real GDP per worker, an interaction between the initial level of state real GDP per worker and a broad region dummy, and time-period fixed effects. Robust standard errors are reported. Broad regions are:
Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin
U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia.

Table A1: Robustness Checks. Convergence in U.S. Manufacturing 1880-2007, All SIC 3-Digit Industries: Baseline Results.

	Excluding observations with the highest and the lowest 10% values for growth			Balanced panel data			Average annual growth in next two decades			Two-Way Clustering		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log initial productivity	-0.036***	-0.043***		-0.069***	-0.073***		-0.039***	-0.038***		-0.076***	-0.079***	
	[0.001]	[0.002]		[0.003]	[0.006]		[0.001]	[0.002]		[-17.608]	[-12.9627]	
(Log initial productivity) x Time trend		0.001***			0.001			-0.0001			0.0003	
		[0.00025]			[0.001]			[0.0002]			[0.568]	
(Log initial productivity) x 1880			-0.033***			-0.063***			-0.037***			-0.061***
			[0.003]			[0.005]			[0.001]			[-11.9467]
(Log initial productivity) x 1890			-0.034***			-0.073***						-0.066***
			[0.003]			[0.004]						[-23.6467]
(Log initial productivity) x 1900			-0.037***			-0.068***			-0.037***			-0.063***
			[0.003]			[0.005]			[0.001]			[-13.8169]
(Log initial productivity) x 1910			-0.045***			-0.069***						-0.066***
			[0.003]			[0.005]						[-16.4204]
(Log initial productivity) x 1920			-0.035***			-0.080***			-0.041***			-0.074**
			[0.003]			[0.014]			[0.003]			[-7.1898]
(Log initial productivity) x 1930			-0.030***			-0.056***						-0.055***
			[0.004]			[0.005]						[-11.8981]
(Log initial productivity) x 1940			-0.041***			-0.096***			-0.043***			-0.106***
			[0.004]			[0.006]			[0.002]			[-13.5531]
(Log initial productivity) x 1947			-0.051***			-0.074***						-0.094***
			[0.003]			[0.006]						[-14.3022]
(Log initial productivity) x 1958			-0.029***			-0.058***			-0.038***			-0.068***
			[0.002]			[0.006]			[0.002]			[-9.7393]
(Log initial productivity) x 1967			-0.036***			-0.065***						-0.064***
			[0.002]			[0.005]						[-17.553]
(Log initial productivity) x 1977			-0.032***			-0.061***			-0.038***			-0.070***
			[0.002]			[0.007]			[0.002]			[-26.0866]
(Log initial productivity) x 1987			-0.036***			-0.070***						-0.075***
			[0.003]			[0.005]						[-14.5985]
(Log initial productivity) x 1997			-0.021***			-0.056***						-0.054***
			[0.002]			[0.010]						[-12.3146]
State fixed effects	No	No	No	No	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	34,456	34,456	34,456	10,920	10,920	10,920	16,690	16,690	16,690	43,070	43,070	43,070
R-squared	0.5	0.501	0.507	0.633	0.633	0.636	0.721	0.721	0.721	0.588	0.588	0.599

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labor productivity on the initial level of labor productivity, industry and period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level except for columns (10)-(12).Labor productivity is defined as value added per worker. Two-way clustering is done at state level and SIC2-digit level; t-statistics reported in the brackets were bootstrapped with 999 replications with Stata command *boottest* written by Roodman, Nielsen and MacKinnon (2019).

Table A2: Robustness Checks. Convergence in U.S. Manufacturing 1880-2007, First Industrial Revolution Industries.

	Excluding observations with the highest and the lowest 10% values for growth			Balanced panel data			Average annual growth in next two decades			Two-Way Clustering		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log initial productivity	-0.033***	-0.041***		-0.069***	-0.071***		-0.039***	-0.037***		-0.073***	-0.075***	
	[0.001]	[0.002]		[0.003]	[0.006]		[0.001]	[0.002]		[-17.6189]	[-13.9982]	
(Log initial productivity) x Time trend		0.001***			0			0			0.0002	
		[0.000]			[0.001]			[0.000]			[0.3257]	
(Log initial productivity) x 1880			-0.033***			-0.058***			-0.037***			-0.060***
			[0.002]			[0.005]			[0.002]			[-11.1671]
(Log initial productivity) x 1890			-0.035***			-0.073***						-0.064***
			[0.003]			[0.005]						[-20.8617]
(Log initial productivity) x 1900			-0.036***			-0.065***			-0.036***			-0.062***
			[0.003]			[0.006]			[0.001]			[-11.5645]
(Log initial productivity) x 1910			-0.044***			-0.072***						-0.067***
			[0.003]			[0.006]						[-20.956]
(Log initial productivity) x 1920			-0.036***			-0.081***			-0.041***			-0.075***
			[0.004]			[0.013]			[0.004]			[-7.8095]
(Log initial productivity) x 1930			-0.034***			-0.052***						-0.054***
			[0.004]			[0.006]						[-10.8196]
(Log initial productivity) x 1940			-0.034***			-0.095***			-0.042***			-0.094***
			[0.005]			[0.007]			[0.002]			[-15.0067]
(Log initial productivity) x 1947			-0.045***			-0.075***						-0.090***
			[0.004]			[0.006]						[-13.1703]
(Log initial productivity) x 1958			-0.026***			-0.060***			-0.037***			-0.065***
			[0.002]			[0.006]			[0.002]			[-10.2129]
(Log initial productivity) x 1967			-0.035***			-0.065***						-0.063***
			[0.003]			[0.006]						[-14.4478]
(Log initial productivity) x 1977			-0.029***			-0.061***			-0.040***			-0.069***
			[0.003]			[0.007]			[0.003]			[-21.4571]
(Log initial productivity) x 1987			-0.035***			-0.072***						-0.076***
			[0.002]			[0.005]						[-17.6129]
(Log initial productivity) x 1997			-0.019***			-0.056***						-0.049***
			[0.003]			[0.012]						[-8.571]
State fixed effects	No	No	No	No	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	24,711	24,711	24,711	9,516	9,516	9,516	12,209	12,209	12,209	30,891	30,891	30,891
R-squared	0.52	0.521	0.525	0.622	0.622	0.626	0.719	0.719	0.719	0.588	0.588	0.597

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labor productivity on the initial level of labor productivity, industry and period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level except for columns (10)-(12).Labor productivity is defined as value added per worker. Two-way clustering is done at state level and SIC2-digit level; t-statistics reported in the brackets were bootstrapped with 999 replications with Stata command *boottest* written by Roodman, Nielsen and MacKinnon (2019). Industry classification is based on Mowery and Rosenberg (1999).

Table A3: Robustness Checks. Convergence in U.S. Manufacturing 1880-2007, Second Industrial Revolution Industries.

	Excluding observations with the highest and the lowest 10% values for growth			Balanced panel data			Average annual growth in next two decades			Two-Way Clustering		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log initial productivity	-0.041***	-0.046***		-0.071***	-0.091***		-0.040***	-0.041***		-0.085***	-0.096***	
	[0.002]	[0.005]		[0.005]	[0.008]		[0.001]	[0.002]		[-18.5282]	[-10.832]	
(Log initial productivity) x Time trend		0.001			0.003***			0			0.001	
		[0.001]			[0.001]			[0.000]			[1.569]	
(Log initial productivity) x 1880			-0.028***			-0.095***			-0.037***			-0.069***
			[0.007]			[0.014]			[0.002]			[-6.7622]
(Log initial productivity) x 1890			-0.029***			-0.084***						-0.074***
			[0.006]			[0.012]						[-13.0336]
(Log initial productivity) x 1900			-0.044***			-0.089***			-0.040***			-0.072***
			[0.006]			[0.010]			[0.004]			[-10.5506]
(Log initial productivity) x 1910			-0.045***			-0.050***						-0.060***
			[0.005]			[0.007]						[-5.5937]
(Log initial productivity) x 1920			-0.034***			-0.067**			-0.044***			-0.068***
			[0.006]			[0.029]			[0.002]			[-6.7137]
(Log initial productivity) x 1930			-0.018*			-0.072***						-0.059***
			[0.009]			[0.012]						[-4.2601]
(Log initial productivity) x 1940			-0.064***			-0.101***			-0.046***			-0.149***
			[0.004]			[0.017]			[0.002]			[-18.3194]
(Log initial productivity) x 1947			-0.062***			-0.057***						-0.103***
			[0.004]			[0.016]						[-18.5526]
(Log initial productivity) x 1958			-0.037***			-0.047***			-0.039***			-0.076***
			[0.004]			[0.017]			[0.002]			[-7.7665]
(Log initial productivity) x 1967			-0.040***			-0.064***						-0.066***
			[0.003]			[0.010]						[-12.6315]
(Log initial productivity) x 1977			-0.041***			-0.056***			-0.036***			-0.073***
			[0.003]			[0.011]			[0.003]			[-16.5638]
(Log initial productivity) x 1987			-0.040***			-0.051***						-0.076***
			[0.004]			[0.017]						[-10.7736]
(Log initial productivity) x 1997			-0.026***			-0.055***						-0.061***
			[0.003]			[0.018]						[-11.3102]
State fixed effects	No	No	No	No	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	8,564	8,564	8,564	1,404	1,404	1,404	3,988	3,988	3,988	10,706	10,706	10,706
R-squared	0.455	0.455	0.47	0.712	0.716	0.721	0.703	0.703	0.704	0.598	0.598	0.617

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labor productivity on the initial level of labor productivity, industry and period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level except for columns (10)-(12).Labor productivity is defined as value added per worker. Two-way clustering is done at state level and SIC2-digit level; t-statistics reported in the brackets were bootstrapped with 999 replications with Stata command *boottest* written by Roodman, Nielsen and MacKinnon (2019). Industry classification is based on Mowery and Rosenberg (1999).

Table A4: Robustness Checks. Convergence in U.S. Manufacturing 1958-2007, ICT Industries.

	Excluding observations with the highest and the lowest 10% values for growth			Average annual growth in next two decades			Two-Way Clustering		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log initial productivity	-0.033***	-0.124***		-0.039***	-0.059**		-0.083***	-0.134**	
	[0.004]	[0.021]		[0.004]	[0.025]		[-32.3219]	[-6.1586]	
(Log initial productivity) x Time trend		0.008***			0.002			0.005	
		[0.002]			[0.003]			[2.4284]	
(Log initial productivity) x 1958			-0.045***			-0.046***			-0.084***
			[0.005]			[0.004]			[-9.7042]
(Log initial productivity) x 1967			-0.043***						-0.071***
			[0.006]						[-18.6042]
(Log initial productivity) x 1977			-0.028***			-0.034***			-0.064**
			[0.008]			[0.007]			[-4.6719]
(Log initial productivity) x 1987			-0.018						-0.066**
			[0.012]						[-6.1117]
(Log initial productivity) x 1997			-0.013*						-0.076***
			[0.007]						[-7.4992]
State fixed effects	No	No	No	No	No	No	No	No	No
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,177	1,177	1,177	493	493	493	1,473	1,473	1,473
R-squared	0.359	0.391	0.314	0.623	0.624	0.612	0.513	0.518	0.358

Sources: U.S. Census of Manufactures: 1958, 1967, 1977, 1987, 1997, 2007.

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labor productivity on the initial level of labor productivity, industry and period fixed effects. We add state fixed effects to estimate conditional convergence. Standard errors are clustered at state level except for columns (10)-(12).Labor productivity is defined as value added per worker. Two-way clustering is done at state level and SIC2-digit level; t-statistics reported in the brackets were bootstrapped with 999 replications with Stata command boottest written by Roodman, Nielsen and MacKinnon (2019). Industry classification is based on Mowery and Rosenberg (1999).

Table A5: Robustness Checks. Convergence in U.S. Manufacturing 1880-2007, All SIC 3-Digit Industries: Broad Regions.

	Excluding observations with the highest and the lowest 10% values for growth	Balanced panel data	Average annual growth in next two decades
	(1)	(2)	(3)
Log initial productivity	-0.03615***	-0.07095***	-0.03953***
	[0.001]	[0.003]	[0.001]
(Log initial productivity) x Manufacturing belt dummy	0.00002	0.00005	-0.00004
	[0.000]	[0.000]	[0.000]
(Log initial productivity) x U.S. South dummy	-0.00024*	-0.00115***	-0.00043***
	[0.000]	[0.000]	[0.000]
Period fixed effects	Yes	Yes	Yes
Period x industry fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Number of observations	34,456	10,920	16,690
R-squared	0.501	0.638	0.722

Sources: U.S. Census of Manufactures: every ten years 1880-1940, 1967-2007; 1947, 1958

Notes: In this table we present regression results from a regression in which we regress the growth of nominal labor productivity on the initial level of labor productivity, industry and period fixed effects, and industry × time period fixed effects. Standard errors are clustered at state level. Labor productivity is defined as value added per worker. Two-way clustering is done at state level and SIC2-digit level. Broad regions are defined as:

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table A6: Unconditional Convergence of Per Worker Income in U.S. States 1880-2007 by Decades.

	(1)	(2)	(3)
Log initial productivity	-0.0184***	-0.0148**	
	[0.005]	[0.005]	
(Log initial productivity) x Time trend		-0.0008	
		[0.001]	
(Log initial productivity) x 1880			-0.0194***
			[0.005]
(Log initial productivity) x 1890			-0.008
			[0.013]
(Log initial productivity) x 1900			-0.0178***
			[0.004]
(Log initial productivity) x 1910			-0.0289***
			[0.004]
(Log initial productivity) x 1920			0.0188***
			[0.006]
(Log initial productivity) x 1930			-0.0181***
			[0.003]
(Log initial productivity) x 1940			-0.0581***
			[0.005]
(Log initial productivity) x 1947			-0.0172***
			[0.005]
(Log initial productivity) x 1958			-0.0320***
			[0.005]
(Log initial productivity) x 1967			-0.0229***
			[0.003]
(Log initial productivity) x 1977			-0.0119**
			[0.005]
(Log initial productivity) x 1987			0.0245***
			[0.007]
(Log initial productivity) x 1997			-0.0088***
			[0.003]
Period fixed effects	Yes	Yes	Yes
Number of observations	621	621	621
R-squared	0.962	0.962	0.97

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis Regional Data, Johnston and Williamson (2018).
Note: In this table, we present the results of regressions in which the growth rate of state real GDP
per worker are regressed on the initial state real GDP per worker, and time-period fixed effects.
*** p<0.01, ** p<0.05, * p<0.10

Table A7: Unconditional Convergence of GDP per Worker in U.S., Manufacturing Belt, and U.S. South.

		1880-2007	1880-1940	1958-2007	1880-2007	1880-1940	1958-2007
		United States			Broad region interaction effects		
		(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	(1)	-0.0184***	-0.0147***	-0.0156***	-0.0213***	-0.0268***	-0.0165***
		[0.003]	[0.003]	[0.003]	[0.003]	[0.005]	[0.003]
(Log initial productivity) x Manufacturing belt dummy	(2)				0.0002**	0.0004**	0.0004***
					[0.000]	[0.000]	[0.000]
(Log initial productivity) x U.S. South dummy	(3)				-0.0002	-0.0015***	0.0005***
					[0.000]	[0.000]	[0.000]
Beta-convergence: Manufacturing Belt	(4) = (1)+(2)				-0.0211	-0.0264	-0.0161
Beta-convergence: U.S South	(5) = (1)+(3)				-0.0211	-0.0283	-0.016
Period fixed effects		Yes	Yes	Yes	Yes	Yes	Yes
Number of observations		621	285	240	621	285	240
R-squared		0.564	0.286	0.424	0.57	0.359	0.522

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis Regional Data, Johnston and Williamson (2018).

Note: In this table, we present the results of regressions in which the growth rate of state real GDP per worker are regressed on the initial level of state real GDP per worker, an interaction between the initial level of state real GDP per worker and a broad region dummy, and time-period fixed effects in columns (1)-(3) and then on broad region dummy variables in columns (4)-(6). Robust standard errors are reported. Broad regions are:

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia

Table A8: Unconditional Convergence of GDP per Worker in U.S., Manufacturing Belt, and U.S. South: Within Region Estimates.

	1880-2007	1880-1940	1958-2007	1880-2007	1880-1940	1958-2007
	Manufacturing Belt			U.S. South		
	(1)	(2)	(3)	(4)	(5)	(6)
Log initial productivity	-0.0143***	-0.0135***	-0.0041	-0.0161***	-0.0101*	-0.0298***
	[0.003]	[0.004]	[0.005]	[0.005]	[0.005]	[0.006]
Period fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	221	102	85	156	72	60
R-squared	0.986	0.984	0.967	0.979	0.959	0.987

Source: Easterlin (1957), Klein (2013), Perloff et al. (1960), U.S. Bureau of Economic Analysis Regional Data, Johnston and Williamson (2018).
Note: In this table, we present the results of regressions in which the growth rate of state real GDP per worker are regressed on the initial level of state real GDP per worker and time-period fixed effects. Robust standard errors are reported. Broad regions are:

Manufacturing Belt states: Connecticut, Delaware, Illinois, Indiana, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, Wisconsin

U.S. South: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, Virginia