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Productivity Growth, Convergence, and Welfare: What the Long-Run Data Show

By WILLIAM J. BAUMOL*

Maddison's 1870–1979 data are analyzed, showing the historically unprecedented growth in productivity, gross domestic product per capita and exports and the remarkable convergence of productivities of industrialized market economies, with convergence apparently shared by planned economies but not less developed countries. Productivity lag's relation to "deindustrialization," unemployment, and balance of payments is examined. The data are shown to suggest a tempered view of the slowdown in U.S. productivity growth and its lag behind other countries.

No matter how refined and how elaborate the analysis, if it rests solely on the short view it will still be... a structure built on shifting sands.

Jacob Viner [1958, pp. 112–13]

Recent years have witnessed a reemergence of interest on the part of economists and the general public in issues relating to long-run economic growth. There has been a recurrence of doubts and fears for the future—aroused in this case by the protracted slowdown in productivity growth since the late 1960's, the seeming erosion of the competitiveness of U.S. industries in world markets, and the spectre of "deindustrialization" and massive structural unemployment. These anxieties have succeeded in redirecting

attention to long-run supply-side phenomena that formerly were a central preoccupation of economists in the industrializing West, before being pushed aside in the crisis of the Great Depression and the ensuing triumph of Keynesian ideas.

Anxiety may compel attention, but it is not necessarily an aid to clear thinking. For all the interest now expressed in the subject of long-run economic growth and policies ostensibly directed to its stimulation, it does not seem to be widely recognized that adequate economic analysis of such issues calls for the careful study of economic history—if only because it is there that the pertinent evidence is to be found. Economic historians have provided the necessary materials, in the form of brilliant insights, powerful analysis, as well as a surprising profusion of long-period data. Yet none of these has received the full measure of attention they deserve from members of the economics profession at large.

To dramatize the sort of reorientation long-term information can suggest, imagine a convincing prediction that over the next century, U.S. productivity growth will permit a trebling of per capita GNP while cutting nearly by half the number of hours in the average work year, and that this will be accompanied by a sevenfold increase in exports. One might well consider this a very rosy forecast. But none of these figures is fictitious. For these developments in fact lay before the United Kingdom in 1870, just as its economic leadership began to erode.

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This paper outlines some implications of the available long-period data on productivity and related variables—some tentative, some previously noted by economic historians, and some throwing a somewhat surprising light on developments among industrialized nations since World War II. Among the main observations that will emerge here is the remarkable convergence of output per labor hour among industrialized nations. Almost all of the leading free enterprise economies have moved closer to the leader, and there is a strong inverse correlation between a country's productivity standing in 1870 and its average rate of productivity growth since then. Postwar data suggest that the convergence phenomenon also extends to both "intermediate" and centrally planned economies. Only the poorer less developed countries show no such trend.

It will also emerge that over the century, the U.S. productivity growth rate has been surprisingly steady, and despite frequently expressed fears, there is no sign recently of any *long-term* slowdown in growth of either total factor productivity or labor productivity in the United States. And while, except in wartime, *for the better part of a century*, U.S. productivity growth rates have been low relative to those of Germany, Japan, and a number of other countries, this may be no more than a manifestation of the convergence phenomenon, which requires countries that were previously behind to grow more rapidly. Thus, the paper will seek to dispel these and a number of other misapprehensions apparently widespread among those who have not studied economic history.

Nonspecialists may well be surprised at the remarkably long periods spanned in time-series contributed by Beveridge, Deane, Kuznets, Gallman, Kendrick, Abramovitz, David, and others. The Phelps Brown-Hopkins indices of prices and real wages extend over seven centuries. Maddison, Feinstein (and his colleagues), and Kendrick cover productivity, investment, and a number of other crucial variables for more than 100 years. Obviously, the magnitudes of the earlier figures are more than a little questionable, as their compilers never cease to warn us. Yet the general qualitative character of

the time paths are persuasive, given the broad consistency of the statistics, their apparent internal logic and the care exercised in collecting them. In this paper, the period used will vary with topic and data availability. In most cases, something near a century will be examined, using primarily data provided by Angus Maddison (1982) and R. C. O. Matthews, C. H. Feinstein, and J. C. Odling-Smee (1982—henceforth, M-F-O).¹

I. The Magnitude of the Accomplishment

The magnitude of the productivity achievement of the past 150 years resists intuitive grasp, and contrasts sharply with the preceding centuries. As the *Communist Manifesto* put the matter in 1848, with remarkable foresight, "The bourgeoisie, during its rule of scarce one hundred years, has created more massive and more colossal productive forces than have all preceding generations together." There obviously are no reliable measures of productivity in antiquity, but available descriptions of living standards in Ancient Rome suggest that they were in many respects higher than in eighteenth-century England (see Colin Clark, 1957, p. 677). This is probably true even for the lower classes—certainly for the free urban proletariat, and perhaps even with the inclusion of slaves. An upper-class household was served by sophisticated devices for heating and bathing not found in eighteenth-century homes of the rich. A wealthy Roman magically transported into an eighteenth-century English home would probably have been puzzled by the technology of only a few products—clocks, window panes, printed books and newspapers, and the musket over the fireplace.

¹ The Maddison absolute productivity figures will be used in preference to the M-F-O data, since the former include more years and more countries. However, the M-F-O series has one advantage. They report productivity statistics only for years which can be considered to contain peaks of business cycles, so that the calculations are not distorted by the well-known effects of the business cycle on labor productivity. Yet over the long period in question here, no remarkable differences in patterns seem to emerge from the two sets of figures.

It is true that even during the Middle Ages (see, for example, Carlo Cipolla, 1976), there was substantial technological change in the workplace and elsewhere. Ship design improved greatly. Lenses and, with them, the telescope and microscope appeared in the sixteenth century, and the eighteenth century brought the ship's chronometer which revolutionized water transport by permitting calculation of longitude. Yet, none of this led to rates of productivity growth anywhere near those of the nineteenth and twentieth centuries.

Nonhistorians do not usually recognize that initially the Industrial Revolution was a fairly minor affair for the economy as a whole. At first, much of the new equipment was confined to textile production (though some progress in fields such as iron making had also occurred). And, as David Landes (1969) indicates,² an entrepreneur could undertake the new types of textile operations with little capital, perhaps only a few hundred pounds, which (using the Phelps Brown-Hopkins data) translates into some 100,000 1980 dollars. Jeffrey Williamson (1983) tells us that in England during the first half-century of the Industrial Revolution, real per capita income grew only about 0.3 percent per annum,³ in contrast with the nearly 3 percent achieved in the Third World in the 1970's (despite the decade's economic crises).

²"The early machines, complicated though they were to contemporaries, were nevertheless modest, rudimentary, wooden contrivances which could be built for surprisingly small sums. A forty-spindle jenny cost perhaps £6 in 1772; scrubbing and carding machines cost £1 for each inch of roller width; a clubbing billy with thirty spindles cost £10.10s" (Landes, pp. 64-65). This suggests at least the possibility (pointed out by Landes) that part of the reason investment was low is that not very much capital may have been required.

³This observation does not quite seem to square with Charles Feinstein's estimates (1972, pp. 82-94) which indicate that while output per worker in the United Kingdom increased 0.2 percent per year between 1761 and 1800, between 1801 and 1830 the growth rate leaped up to 1.4 percent per annum. He estimates that total factor productivity behaved similarly. However, between 1801 and 1810, total annual investment fell to 10 percent of gross domestic product, in comparison with its 14 percent rate in the immediately preceding and succeeding periods.

TABLE 1—TOTAL GROWTH FROM 1870 TO 1979^a
PRODUCTIVITY, GDP PER CAPITA, AND EXPORTS
SIXTEEN INDUSTRIALIZED COUNTRIES^b

	Real GDP per Work-Hour	Real GDP per Capita	Volume of Exports
Australia	398	221	—
United Kingdom	585	310	930
Switzerland	830	471	4,400
Belgium	887	439	6,250
Netherlands	910	429	8,040
Canada	1,050	766	9,860
United States	1,080	693	9,240
Denmark	1,098	684	6,750
Italy	1,225	503	6,210
Austria	1,270	643	4,740
Germany	1,510	824	3,730
Norway	1,560	873	7,740
France	1,590	694	4,140
Finland	1,710	1,016	6,240
Sweden	2,060	1,083	5,070
Japan	2,480	1,661	293,060

Source: Angus Maddison (1982, pp. 8, 212, 248-53).

^aIn 1970 U.S. dollars.

^bShown in percent.

Table 1 shows the remarkable contrast of developments since 1870 for Maddison's 16 countries. We see (col. 1) that growth in output per work-hour ranged for the next 110 years from approximately 400 percent for Australia all the way to 2500 percent (in the case of Japan). The 1100 percent increase of labor productivity in the United States placed it somewhat below the middle of the group, and even the United Kingdom managed a 600 percent rise. Thus, after not manifesting any substantial long-period increase for at least 15 centuries, in the course of 11 decades the median increase in productivity among the 16 industrialized leaders in Maddison's sample was about 1150 percent. The rise in productivity was sufficient to permit output per capita (col. 2) to increase more than 300 percent in the United Kingdom, 800 percent in West Germany, 1700 percent in Japan, and nearly 700 percent in France and the United States. Using Robert Summers and Alan Heston's sophisticated international comparison data (1984), this implies that in 1870, U.S. output per capita was comparable to 1980 output per capita in Honduras and the Philippines, and slightly below that of China, Bolivia, and Egypt!

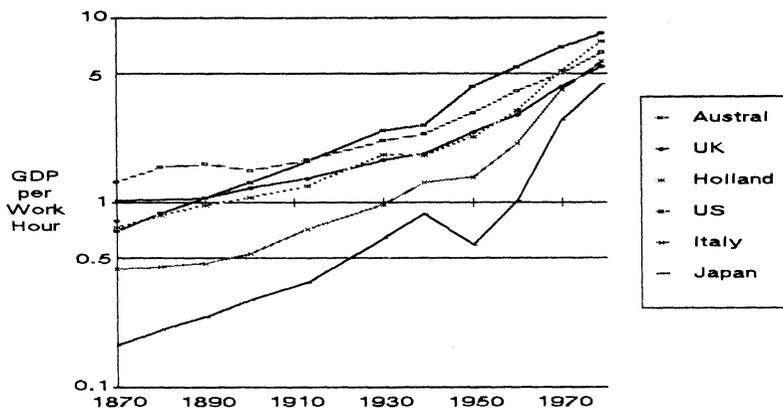


FIGURE 1. GROSS DOMESTIC PRODUCT PER WORK-HOUR, 1870-1979

Source: Maddison (p. 212)

The growth rates of other pertinent variables were also remarkable. One more example will suffice to show this. Table 1, which also shows the rise in volume of exports from 1870 to 1979 (col. 3) indicates that the median increase was over 6000 percent.

II. The Convergence of National Productivity Levels

There is a long and reasonably illustrious tradition among economic historians centered on the phenomenon of convergence. While the literature devoted to the subject is complex and multifaceted, as revealed by the recent reconsideration of these ideas by Moses Abramovitz (1985), one central theme is that forces accelerating the growth of nations who were latecomers to industrialization and economic development give rise to a long-run tendency towards convergence of levels of per capita product or, alternatively, of per worker product. Such ideas found expression in the works of Alexander Gerschenkron (see, for example, 1952), who saw his own views on the advantages of "relative backwardness" as having been anticipated in important respects by Thorstein Veblen's writings on the penalties of being the industrial leader (1915). Although such propositions also have been challenged and qualified (for example, Edward Ames and Nathan Rosenberg, 1963), it is difficult to dismiss the idea of convergence on the basis

of the historical experience of the industrialized world. (For more recent discussions, see also the paper by Robin Marris, with comments by Feinstein and Matthews in Matthews, 1982, pp. 12-13, 128-147; as well as Dennis Mueller, 1983.)

Using 1870-1973 data on gross domestic product (*GDP*) per work-year for 7 industrialized countries, M-F-O have shown graphically that those nations' productivity levels have tended to approach ever closer to one another. The same phenomenon for 6 countries is illustrated in Figure 1 in a semi-log representation based on Maddison's data for 1870-1979, which provide estimates of output per work-hour for 16 countries.⁴

The convergence toward the vanguard (led in the first decades by Australia—see Richard Caves and Laurence Krause, 1984—and the United Kingdom and, approximately since World War I, by the United

⁴Space prevents extensive consideration of Paul Romer's (1985) objection to the evidence offered for the convergence hypothesis provided here and elsewhere, i.e., that the sample of countries studied is an *ex post* selection of successful economies. Successes, by definition, are those which have done best relative to the leader. However, the Summers-Heston 1950-80 data for 72 countries represented in Figure 3 do permit an *ex ante* selection. Tests ranking countries both by 1950 and by 1960 *GDP* levels confirm that even an *ex ante* sample of the wealthiest countries yields a pattern of convergence which, while less pronounced than that calculated from an *ex post* group, is still unambiguous.

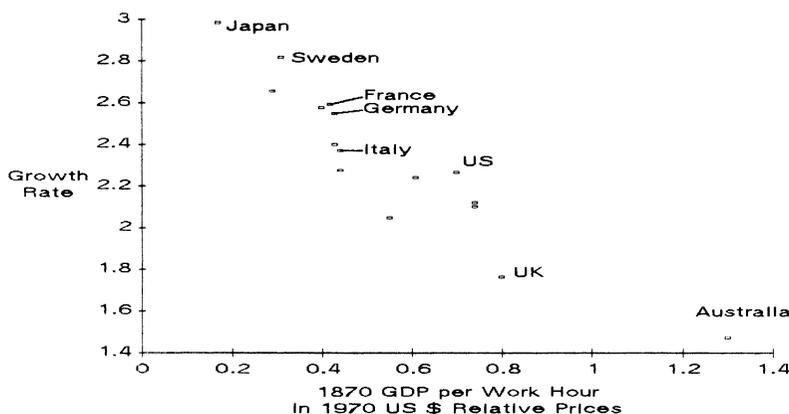


FIGURE 2. PRODUCTIVITY GROWTH RATE, 1870-1979 VS. 1870 LEVEL

Source: Maddison (p. 212)

States) is sharper than it may appear to the naked eye. In 1870, the ratio of output per work-hour in Australia, then the leader in Maddison's sample, was about eight times as great as Japan's (the laggard). By 1979, that ratio for the leader (the United States) to the laggard (still Japan) had fallen to about 2. The ratio of the standard deviation from the mean of *GDP* per work-hour for the 16 countries has also fallen quite steadily, except for a brief but sharp rise during World War II.

The convergence phenomenon and its pervasiveness is confirmed by Figure 2, on which my discussion will focus. The horizontal axis indicates each Maddison country's absolute level of *GDP* per work-hour in 1870. The vertical axis represents the growth rate of *GDP* per work-hour in the 110 years since 1870. The high inverse correlation between the two is evident. Indeed, we obtain an equation (subject to all sorts of statistical reservations)⁵

$$\begin{aligned} \text{Growth Rate (1870-1979)} \\ = 5.25 - 0.75 \ln(\text{GDP per WorkHr, 1870}), \\ R^2 = 0.88. \end{aligned}$$

⁵The high correlation should not be taken too seriously. Aside from the reasons why its explanation may be misunderstood that are presently discussed in the text, the tight fit of the data points is undoubtedly ascribable in good part to several biasing features of

That is, with a very high correlation coefficient, the higher a country's productivity level in 1870 the more slowly that level grew in the following century.

the underlying calculation. First, the 1870 figures were calculated by Maddison using backward extrapolation of growth rates, and hence their correlation is hardly surprising. Second, since growth rate, r , is calculated by solving $y_t = e^{rt}y_0$ for r , to obtain $r = (\ln y_t - \ln y_0)/t$, where $y_t = \text{GDP per capita in period } t$, a regression equation $r = f(y_0)$ contains the same variable, y_0 on both sides of the equation, thus tending to produce a spurious appearance of close relationship. Indeed, if the convergence process were perfect, so that we would have $y_t = k$ with k the same for every country in the sample, every dot in the diagram would necessarily perfectly fit the curve $r = \ln k / t - \ln y_0 / t$, and the r^2 would be unity, identically. As we will see, however, the 72-country data depicted in Figure 3 hardly constitute a close fit (the R^2 is virtually zero), and do not even yield a negatively sloping regression line. Thus, a relationship such as that in Figure 2 is no tautology, nor even a foregone conclusion.

In addition, if the 1870 productivity levels are measured with considerable error, this must result in some significant downward bias in the regression coefficient on $\ln(\text{GDP per WorkHr, 1870})$. This is a point distinct from the one concerning the size of the correlation coefficient, although the latter is affected by the fact that relatively large measurement errors in the 1870 productivity levels enter as inversely correlated measurement errors in the 1870-1979 growth rate. The argument that this bias is not sufficient to induce a negative correlation in the 72-country sample may not be wholly germane, as the relative seriousness of the measurement errors in the initial and terminal observations may be much the same for observations confined to the period 1950-80.

TABLE 2—RELATIVE GROWTH IN REAL WAGES,
GDP PER WORK-HOUR AND CAPITAL STOCK,
UNITED KINGDOM AND GERMANY, 1860–1980

	Period	Ratio: German Increase to U.K. Increase ^b
Real Wages	1860–1980	4.25
GDP per Labor Hour	1870–1979	2.35
Capital Stock ^a	1870–1979	6.26
Capital Stock per Worker	1870–1979	3.8
Capital Stock per Capita	1870–1979	5.4

Sources: Real wages, same as in fn. 6; all other data from Maddison.

^aNet nonresidential fixed tangible capital stock.

^b(German 1979 figure/German 1870 figure)/(U.K. 1979 figure/U.K. 1870 figure) with appropriate modification of the dates for the wage figures.

III. Implications of the Inverse Correlation: Public Goods Property of Productivity Policy

The strong inverse correlation between the 1870 productivity levels of the 16 nations and their subsequent productivity growth record seems to have a startling implication. Of course, hindsight always permits “forecasts” of great accuracy—that itself is not surprising. Rather, what is striking is the apparent implication that *only one variable*, a country’s 1870 GDP per work-hour, or its relation to that of the productivity leader, matters to any substantial degree, and that other variables have only a peripheral influence. It seems not to have mattered much whether or not a particular country had free markets, a high propensity to invest, or used policy to stimulate growth. Whatever its behavior, that nation was apparently fated to land close to its predestined position in Figure 2.

However, a plausible alternative interpretation is that while national policies and behavior patterns do substantially affect productivity growth, the spillovers from leader economies to followers are large—at least among the group of industrial nations. If country *A*’s extraordinary investment level and superior record of innovation enhances

its own productivity, it will almost automatically do the same in the long run for industrialized country *B*, though perhaps to a somewhat more limited extent. In other words, for such nations a successful productivity-enhancing measure has the nature of a public good. And because the fruits of each industrialized country’s productivity-enhancement efforts are ultimately shared by others, each country remains in what appears to be its predestined *relative* place along the growth curve of Figure 2. I will note later some considerations which might lead one to doubt that the less developed countries will benefit comparably from this sharing process.

This sharing of productivity growth benefits by industrialized countries involves both innovation and investment. The innovation-sharing process is straightforward. If industry in country *A* benefits from a significant innovation, those industries in other countries which produce competing products will find themselves under pressure to obtain access to the innovation, or to an imitation or to some other substitute. Industrialized countries, whose product lines overlap substantially and which sell a good deal in markets where foreign producers of similar items are also present, will find themselves constantly running in this Schumpeterian race, while those less developed countries which supply few products competing with those of the industrialized economies will not participate to the same degree.

There is reason to suspect that the pressures for rapidity in imitation of innovation in industrial countries have been growing. The explosion in exports reported in Table 1 has given them a considerably larger share of gross national product than they had in 1870. This suggests that more of each nation’s output faces the direct competition of foreign rivals. Thus, the penalties for failure to keep abreast of innovations *in other countries* and to imitate them where appropriate have grown.

Second, the means required for successful imitations have improved and expanded enormously. World communications are now practically instantaneous, but required weeks

and even months at the birth of the Industrial Revolution. While today meetings of scientists and technicians are widely encouraged, earlier mercantilistic practices entailed measures by each country to prevent other nations from learning its industrial techniques, and the emigration of specialized workers was often forbidden. Though figures in this arena are difficult to interpret, much less substantiate, one estimate claims that employment in "information activities" in the United States has grown from less than 1 percent of the labor force in 1830 to some 45 percent today (James Beniger, forthcoming, p. 364, leaning heavily on Marc Porat, 1977). Presumably, growth of the information sector in other industrialized nations has been similar. This must surely facilitate and speed the innovative, counterinnovative, and imitative tasks of the entrepreneur. The combination of direct U.S. manufacturing investment in Europe, and the technology transfer activities of multinational corporations in the postwar era were also of great significance (see, for example, David Teece, 1976). All of this, incidentally, suggests that as the forces making for convergence were stronger in the postwar era than previously, the rate of convergence should have been higher. The evidence assembled by Abramovitz (1985) on the basis of Maddison's data indicates that this is in fact what has happened.

The process that has just been described, then, provides mutual benefits, but it inherently helps productivity laggards more than leaders. For the laggards have more to learn from the leaders, and that is why the process makes for convergence.

Like innovation, investment, generally considered the second main source of growth in labor productivity, may also exhibit international public good properties. Suppose two industrialized countries, *A* and *B*, each produce two traded products: say automobiles and shoes, with the former more capital intensive. If *A*'s investment rate is greater than *B*'s then, with time, *A*'s output mix will shift toward the cars while *B*'s will move toward shoes. The increased demand for auto workers in *A* will raise their real wages, while *A*'s increased demand for imports of

B's shoes will raise real wages in *B*, and will raise the *value* of gross domestic product per labor hour in that country. Thus, even investment in country *A* automatically tends to have a spillover effect on value productivity and real wages in those other countries that produce and trade in a similar array of goods.

While, strictly speaking, the factor-price equalization theorem is not applicable to my discussion because it assumes, among other things, that technology is identical in all the countries involved, it does suggest why (for the reasons just discussed) a high investment rate may fail to bring a relative wage advantage to the investing country. In practice, the conditions of the theorem are not satisfied precisely, so countries in which investment rates are relatively high do seem to obtain increased relative real wages.⁶ Yet the analysis suggests that the absolute benefits are contagious—that one country's successful investment policy will also raise productivity and living standards in other industrialized countries.⁷

⁶The case of Germany and Britain is a suggestive illustration. From 1870 to 1979, according to Maddison (pp. 227, 231) German net nonresidential fixed tangible capital stock grew thirtyfold while that of the United Kingdom grew only sixfold. Landes (p. 124) reports (with the appropriate warning, "*caveat lector*") that real U.K. wages in about 1860 have been estimated to be some 2.5 times those in Germany, while according to the U.S. Bureau of Labor Statistics (unpublished figures), in 1980 German real wages were 1.7 times those in the United Kingdom. Of course, I am not suggesting that correlation implies causation, or that one such case even provides a usable correlation. Still, the orders of magnitude of the figures are probably right and it is hard to believe that superior German investment rates had nothing to do with the relative lag in British wages.

⁷It must be conceded that the longer-run data do not seem to offer impressive support for the hypothesis that the forces of factor-price equalization have, albeit imperfectly, extended the benefits of exceptional rates of investment from those economies that carried out the successful investment programs to other industrialized economies. Since we have estimates of relative real wages, capital stock, and other pertinent variables for the United Kingdom and Germany, these have been compared in Table 2. If the public goods attribute hypothesis about the effects of investment in one country were valid and if factor-price equalization were an effective force, we would expect the relative rise in

Thus, effective growth policy does contribute to a nation's living standards, but it may also help other industrialized countries and to almost the same degree; meaning that relative deviations from the patterns indicated in Figure 2 will be fairly small, just as the diagram shows. (However, see Abramovitz, 1985, for a discussion of the counter-hypothesis, that growth of a leader creates "backwash" effects inhibiting growth of the followers.)

All this raises an obvious policy issue. If productivity growth does indeed have such public good properties, what will induce each country to invest the socially optimal effort and other resources in productivity growth, when it can instead hope to be a free rider? In part, the answer is that in Western capitalistic economies, investment is decentralized and individual firms can gain little by free riding on the actions of investors in other economies, so that the problem does not appear to be a serious one at the national policy level.

IV. Is Convergence Ubiquitous?

Does convergence of productivity levels extend beyond the free-market industrialized countries? Or is the convergence "club" a very exclusive organization? While century-long data are not available for any large number of countries, Summers and Heston provide pertinent figures for the 30-year period 1950–80 (data for more countries are available for briefer periods).⁸ Instead of labor productivity figures, they give output per capita, whose trends can with considerable reservations be used as a rough proxy for those in productivity, as Maddison's figures confirm.

German real wages and in productivity to be small (on some criterion) in comparison with the relative increase in its capital stock. However, the figures do not seem to exhibit such a pattern.

⁸There are at least two sources of such data: the World Bank and the University of Pennsylvania group. Here I report only data drawn from the latter, since

Figure 3 tells the story. Constructed just like Figure 2, it plots the 1950–80 real growth rates of *GDP* per capita for all 72 Summers-Heston countries against the initial (1950) level of this variable. The points form no tight relationship, and unlike those for the industrial countries, the dots show no negatively sloping pattern. Indeed, a regression yields a slightly positive slope. Thus, rather than sharing in convergence, some of the poorest countries have also been growing most slowly.

Figure 3 brings out the patterns more clearly by surrounding the set of points representing Maddison's 16 countries with a thin boundary and the centrally planned economy points⁹ with a heavier boundary. We see that the Maddison country points lie near a sort of upper-right-hand boundary, meaning that most of them had the high incomes in 1950 (as was to be expected) and, for any given per capita income, the highest growth rates between 1950 and 1980. This region is very long, narrow, and negatively sloped, with the absolute slope declining toward the right. As in the Figure 2 productivity data for a 110-year period, this is exactly the shape one expects with convergence. Second, we see that the centrally planned economies are members of a convergence club of their own, forming a negatively sloping region lying below and to the left of the Maddison countries. The relationship is less tight, so convergence within the group is less pronounced, but it is clearly there.

their international comparisons have been carried out with unique sophistication and insight. Instead of translating the different currencies into one another using inadequate exchange rate comparisons, they use carefully constructed indices of relative purchasing power. I have also replicated my calculations using World Bank data and obtained exactly the same qualitative results.

⁹The centrally planned economies are Bulgaria, China, Czechoslovakia, East Germany, Hungary, Poland, Romania, USSR, and Yugoslavia. The 5 countries with relatively high 1950 incomes included neither in Maddison's sample nor in the planned group are, in descending order of *GDP* per capita, Luxemburg, New Zealand, Iceland, Venezuela, and Argentina. The countries with negative growth rates are Uganda and Nigeria.

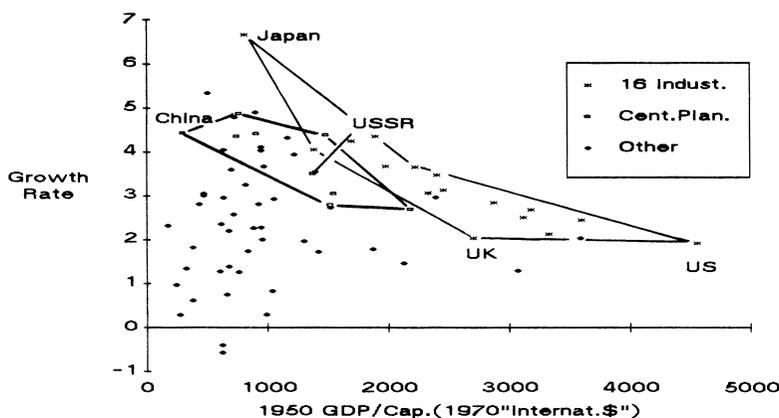


FIGURE 3. GROWTH RATE, 1950-80, GROSS DOMESTIC PRODUCT PER CAPITA VS. 1950 LEVEL, 72 COUNTRIES

Source: Summers and Heston

Finally, there is the region of remaining points (aside from the rightmost non-Maddison points in the graph) which lies close to the origin of the graph and occupies something like a distorted circle without any apparent slope. The points closest to the origin are less developed countries which were poor in 1950, and have grown relatively slowly since. They show no convergence among themselves, much less with other groups.

A few numbers suggest the difference in performance of various subgroups of the 72 countries. Using a four-set classification Summers, I. B. Kravis and Heston (1984, p. 254) provide Gini coefficients by decade from 1950 to 1980. For their set of industrialized countries, this coefficient falls precipitously from 0.302 in 1950 to 0.129 in 1980—a sharp drop in inequality. For the centrally planned economies the drop is much smaller—from 0.381 to 0.301. The middle-income group exhibits an even smaller decline, from 0.269 to 0.258. But the low-income countries underwent a small *rise* over the period, from 0.103 to 0.112, and the world as a whole experienced a tiny rise from 0.493 to 0.498.

There has also been little convergence among the groups. For the entire period, Summers et al. report (p. 245) an average annual growth rate in per capita real *GDP*

of 3.1 percent for industrialized countries, 3.6 percent for centrally planned economies, 3.0 percent for middle-income market economies, and only 1.5 percent for the low-income group, with a world average growth rate of 2.7 percent.

This suggests that there is more than one convergence club. Rather, there are perhaps three, with the centrally planned and the intermediate groups somewhat inferior in performance to that of the free-market industrialized countries. It is also clear that the poorer less developed countries are still largely barred from the homogenization processes. Since any search for “the causes” of a complex economic phenomenon of reality is likely to prove fruitless, no attempt will be made here to explain systematically why poorer less developed countries have benefited to a relatively small degree from the public good properties of the innovations and investments of other nations. But part of the explanation may well be related to product mix and education. A less developed country that produces no cars cannot benefit from the invention and adoption of a better car-producing robot in Japan (though it does benefit to a lesser degree from new textile and rice-growing technology), nor can it benefit from the factor-price equalization effect

of the accompanying Japanese investments, since it cannot shift labor force out of its (nonexistent) auto industry as the theorem's logic requires. Lack of education and the associated skills prevent both the presence of high-tech industries and the effective imitation (adoption) of the Japanese innovation. Obviously, there is much more to any reasonably fuller explanation of the exclusion of many less developed countries from the convergence process, but that is not my purpose here.

V. The Record of the United States

The long-run data call for a reevaluation of the past productivity performance of the United States, which is rather different from what is widely believed. Figure 4 plots for 4 countries growth rates of *GDP* per work-hour derived from Maddison. It confirms, of course, that U.S. labor productivity growth has been lower than that of several other countries in recent decades. But it also indicates that this U.S. growth rate has just been middling for the better part of a century, not only in the past 15 or 20 years. This is confirmed by M-F-O (p. 31) whose data show that between 1899 and 1913, in terms of *GDP* per work year, the U.S. growth rate was already lower than that of Sweden, France, Germany, Italy, and Japan. Its growth rate was also below theirs (except for France) in 1924–37. While U.S. labor productivity grew rapidly relative to other nations during both world wars, this is attributable in good part to a slowdown in the growth of other countries. Thus, the mediocre U.S. relative performance in growth in labor productivity is an old story, not just a post-war phenomenon.

Figure 2—the graph with the inverse correlation between initial productivity level and its subsequent growth in Maddison's countries— suggests an explanation of the relatively undistinguished U.S. performance. The convergence of productivity levels in industrialized countries inevitably condemned those with high 1870 productivity levels to relatively slow growth since then. This attributes much of the modesty of the U.S. productivity growth to the high level it had

achieved earlier. Indeed, U.S. performance was notably better than this view suggests. While in 1870, U.S. *GDP* per work-hour ranked fifth from the top among Maddison's 16 countries, its subsequent productivity growth was seventh, not fifth, from the bottom. And while my regression equation between initial productivity and its subsequent growth predicts that the United States should have achieved about a tenfold growth in its labor productivity since 1870, its actual achievement was some 20 percent higher than this. On this interpretation, then, rather than a manifestation of failure, the growth rate of the United States over the course of the 110 years represents a mild achievement in comparison with what might have been expected from the convergence relationship.

Next let us consider the slowdown hypothesis—the assertion that U.S. productivity has fallen sharply below its past. The U.S. figures provided by John Kendrick (see U.S. Bureau of Census, 1973), like the Maddison data, exhibit no major break in the *long-run* U.S. trend and no sign of a long-run slowdown (similar conclusions were reached by Michael Darby, 1984). In Figure 1, the time-series (semilog) representation of Maddison's figures on levels of labor productivity, the curve for the United States is remarkably close to a straight line, except for the dip in the 1930's. A graph of Kendrick's data is almost identical in pattern. In Figure 4, a century of U.S. growth rate in labor productivity clearly exhibits neither a downward long-term trend nor a marked recent dip below its historical level. The mild shortfall shown for the past few years must also be reevaluated because the last year in the graph was a period of recession, which usually depresses productivity. More recent data may well wipe out much of the small fall below historical levels.

True, there has undoubtedly been a protracted fall off from the early postwar peak, and it certainly was pronounced. But it is that peak which looks like the aberration, and the decline from it may well prove to be a return to historical growth rates in labor productivity. In this connection, it is noteworthy (Figure 4) that the duration and amplitude of the great leap above historical

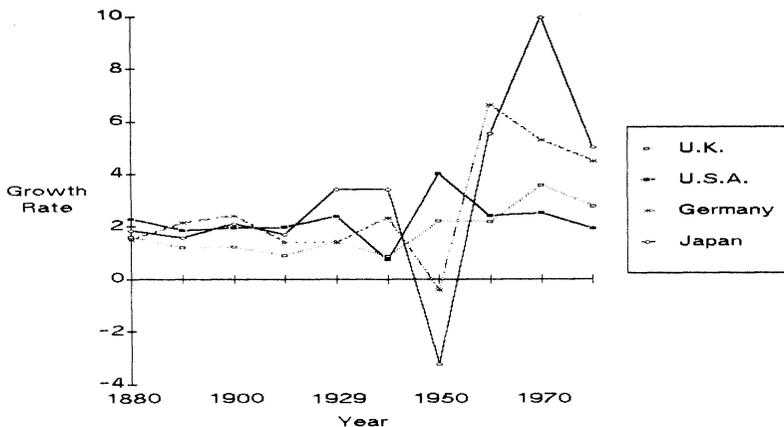


FIGURE 4. GROWTH RATES, GROSS DOMESTIC PRODUCT PER WORK-HOUR, 1870-1979

Source: Maddison (p. 212)

U.S. productivity growth in the war and early postwar years were just about as great as the previous shortfalls during the Great Depression. This encourages reinterpretation of the postwar growth period as one of temporary catch-up, merely making up for opportunities previously foregone. Perhaps the accumulated innovative ideas, unused because of the depression, as well as frustrated savings goals, fueled an outburst of innovation and investment when business conditions permitted. With time, as the backlog of ideas and investable funds was depleted, productivity growth rates declined to their normal levels. (On all this, see Abramovitz, 1979.)

VI. Productivity, Unemployment, and Deindustrialization

The long-term data also permit us to dispose of some other popular views, several of which economic theory has long ago shown to be myths. It is widely feared that rapid labor productivity growth will destroy jobs, even in the long run. Second, somewhat inconsistently, it is feared that if an economy's productivity growth lags behind that of other countries, it will lose jobs to foreign workers, its industry will suffer, and its balance of payments will face chronic deficits (these last

alleged consequences are sometimes called "deindustrialization"). Economists will not be surprised that the data do not support any of these conclusions.¹⁰

The long-run unemployment allegation implies that the twelvefold increase in U.S. output per work-hour and the sevenfold and sixteenfold increases in the United Kingdom and Germany, respectively, must have had a devastating effect on their labor demands. Even with a 50 percent cut in annual work-hours, employment could have fallen by 5/6, relative to population, without a decline in gross domestic product per capita.

The data confirm that nothing of the sort actually occurred. M-F-O's figures for unemployment rates for the United Kingdom, the United States, and Germany from 1874 to 1973 indicate that, while unemployment rates averaged about 4 percent before World War II, they had, if anything, fallen somewhat below that level in the period 1952-73. This is so despite the substantial rise in the ratio of number of persons in the labor force to total population which, according to Maddison's figures, went up in all 3 countries from

¹⁰For a systematic study that rejects the deindustrialization theses for postwar United States, see Robert Lawrence (1984).

an unweighted mean of 34 percent in 1870 to 45 percent in 1979.

The same data also undermine the (nearly) opposite apprehension—that a laggard in productivity growth is subject to extraordinary unemployment problems. The M-F-O figures (p. 94) show a fall in U.K. unemployment rates from 4.7 percent from 1873 to 1913 to some 3 percent, on average, in 1952–73. Of course, unemployment rates have since risen sharply, but this is not evidence of a long-term trend.

There is no more substance to the view of many noneconomists that a persistent lag in a nation's productivity growth will place it at a competitive disadvantage in international trade, excluding it increasingly from export markets, with devastating effects upon its export industries and its balance of payments. Economic analysis denies much of this. Balance of payments will ultimately be brought into equilibrium whatever a nation's productivity performance and, since trade depends heavily on comparative rather than absolute advantage, it need have little effect on exports. Instead, the exchange rate and the standard of living of the country with lagging productivity will bear the brunt of the burden as it is forced, increasingly, to compete by means of relatively low wages. It is true that the United Kingdom's share of world manufacturing exports has fallen sharply from 43 percent of the world's total in 1880 all the way down to 9 percent of the total in 1973 (M-F-O, p. 425). But Britain's net exports of goods and services (the balance of visible trade) has moved fairly steadily in its favor since the 1870's (M-F-O, p. 443).

In addition, the absolute volume of U.K. exports rose spectacularly. As Table 1 reports, between 1870 and 1979 British exports increased about tenfold, and from 1855 to 1973 U.K. exports of *goods* increased 13 times (M-F-O, p. 427).

Nor has the United Kingdom been forced to deindustrialize internally. Maddison's figures (p. 205) on the share of the labor force in industry do show that Britain declined from first place among his 16 countries in 1870 to fourth place (behind Germany, Austria, and Switzerland) in 1979. But industry's share of employment in the

United Kingdom was still 88 percent of that of the leader's (Germany), and the United Kingdom continued ahead of Sweden, France, the United States, Belgium, and Japan.¹¹ If this is deindustrialization, it certainly is not extreme.

There remains the question whether the U.K.'s decreased share of world exports damaged its economic welfare severely. That is, if Germany, Japan and Italy had not outpaced U.K. productivity growth and so had not increased their share of world trade at the U.K.'s expense, would an average Englishman have been far better off? The easy conclusion that he would is disputed by D. N. McCloskey (at least for the period 1870–1913) in a thoughtful paper (1981, pp. 173–83). First, whatever portion of Britain's output was not exported as a result must have added to domestic consumption or investment. The *net* loss on this score (the net producer's surplus on the exports) may have been negligible. In addition, growing productivity in Japan, Germany and elsewhere enables a British subject to import cameras, TV sets, and many other items far more cheaply than if the productivity of other countries had stagnated. There must also have been an upward shift in the demand curves for British goods by those countries because of their rising incomes. McCloskey concludes that reports of the detrimental effect on the U.K. living standard of the productivity record of its industrialized rivals have been greatly exaggerated.

VII. Concluding Comment

This paper is an exercise in interpretation of data supplied by others. I have examined no primary sources and have not attempted to supply, or even to revise, sets of statistics (though I have undertaken to cross check my results where several parallel data sets were available). Yet the data were able to provide

¹¹ Here, too, there has been a considerable narrowing of range. In 1870, with data for 4 countries missing, the share of workers in industry extended from 9.7 percent (Finland) to 42.3 (United Kingdom), with several countries near 20 percent and several in the high 30's. By 1979, that range ran only from a low of 28.7 percent (Canada) to a high of 44 percent (Germany).

some suggestive conclusions which need not be repeated here.

Above all, it seems to me the paper has reaffirmed that the study of economic history is not simply a manifestation of "idle curiosity" (to use Veblen's characterization of the motive for academic research). The long run does matter. It matters in several ways, at least one of them confirmed by the preceding discussion.

First, important current issues are, I believe, the product of path-dependent processes whose mathematical expression must take the form of functionals rather than mere functions, meaning that we cannot understand current phenomena such as the relative productive capacities of different economies without systematic examination of earlier events which affect the present and will continue to exercise profound effects tomorrow. (This, in my view of the matter, is a major element in the Hegelian and Marxian view of the importance of history.)

Second, the long run matters, because policies designed with only short-run problems and consequences in mind are all too likely to backfire once the immediate crisis is past. (This and the next point were, I believe, the main sources of Viner's preoccupation with the long run.)

Third, focus upon short-run phenomena such as recessions may lead an investigator to ignore more powerful and persistent forces such as those that were the primary concern of the classical economists.

Finally, and most pertinent to the discussion here, the long run is important because it is not sensible for economists and policymakers to attempt to discern long-run trends and their outcomes from the flow of short-run developments, which may be dominated by transient conditions. The validity of this view is surely confirmed at several points in this article, perhaps most dramatically by the way history places in perspective the recent developments in U.S. productivity which have been the focus of so much alarm.

REFERENCES

- Abramovitz, Moses**, "Rapid Growth Potential and its Realization: The Experience of the Capitalist Economies in the Postwar Period," in Edmond Malinvaud, ed., *Economic Growth and Resources, Proceedings of the Fifth World Congress of the International Economic Association*, Vol. I, London: Macmillan, 1979.
- _____, "Catching Up and Falling Behind," delivered at the Economic History Association, September 20, 1985.
- Ames, Edward and Rosenberg, Nathan**, "Changing Technological Leadership and Industrial Growth," *Economic Journal*, March 1963, 73, 13-31.
- Beniger, James R.**, *The Control Revolution: Technological and Economic Origins of the Information Society*, Cambridge: Harvard University Press, forthcoming.
- Caves, Richard E. and Krause, Lawrence B.**, *The Australian Economy: A View From the North*, Washington: The Brookings Institution, 1984.
- Cipolla, Carlo M.**, *Before the Industrial Revolution: European Society and Economy, 1000-1700*, New York: W. W. Norton, 1976.
- Clark, Colin**, *The Conditions of Economic Progress*, 3rd ed., London: Macmillan, 1957.
- Darby, Michael**, "The U.S. Productivity Slowdown: A Case of Statistical Myopia," *American Economic Review*, June 1984, 74, 301-322.
- David, Paul A.**, "Invention and Accumulation in America's Economic Growth: A Nineteenth-Century Parable," in K. Brunner and A. H. Meltzer, eds., *International Organization, National Policies and Economic Development*, Amsterdam: North-Holland, 1977, 179-228.
- Deane, Phyllis and Cole, W. A.**, *British Economic Growth 1688-1959*, Cambridge: Cambridge University Press, 1962.
- Feinstein, Charles**, *National Income, Expenditure and Output of the United Kingdom, 1855-1965*, Cambridge: Cambridge University Press, 1972.
- Gerschenkron, Alexander**, "Economic Backwardness in Historical Perspective," in Bert F. Hoselitz, ed., *The Progress of Underdeveloped Areas*, Chicago: University of Chicago Press, 1952.
- Landes, David S.**, *The Unbound Prometheus*, Cambridge: Cambridge University Press, 1969.
- Lawrence, Robert Z.**, *Can America Compete?*,

Abramovitz, Moses, "Rapid Growth Potential and its Realization: The Experience of the Capitalist Economies in the Postwar

- Washington: The Brookings Institution, 1984.
- McCloskey, D. N.**, *Enterprise and Trade in Victorian Britain*, London: Allen & Unwin, 1981.
- Maddison, Angus**, *Phases of Capitalist Development*, New York: Oxford University Press, 1982.
- Marx, Karl and Engels, Friedrich**, *Manifesto of the Communist Party* (1848), London: Lawrence and Wishart, 1946.
- Matthews, R. C. O.**, *Slower Growth in the Western World*, London: Heinemann, 1982.
- _____, **Feinstein, C. H. and Odling-Smee, J. C.**, *British Economic Growth, 1856–1973*, Stanford: Stanford University Press, 1982.
- Mueller, Dennis C.**, *The Political Economy of Growth*, New Haven: Yale University Press, 1983.
- Phelps Brown, E. H. and Hopkins, S. V.**, “Seven Centuries of Building Wages,” *Economica*, August 1955, 22, 195–206.
- _____, and _____, “Seven Centuries of the Prices of Consumables,” *Economica*, November 1956, 23, 296–314.
- Porat, Marc Uri**, “The Information Economy, Definitions and Measurement,” Office of Telecommunications, Special Publication 77–12(1), U.S. Department of Commerce, Washington, 1977.
- Romer, Paul M.**, “Increasing Returns and Long Run Growth,” Working Paper No. 27, University of Rochester, October 1985.
- Summers, Robert and Heston, Alan**, “Improved International Comparisons of Real Product and its Composition, 1950–1980,” *Review of Income and Wealth*, June 1984, 30, 207–262.
- _____, **Kravis, I. B and Heston, Alan**, “Changes in World Income Distribution,” *Journal of Policy Modeling*, May 1986, 6, 237–269.
- Teece, David J.**, *The Multinational Corporation and the Resources Cost of International Technology Transfer*, Cambridge: Ballinger, 1976.
- Veblen, Thorstein**, *Imperial Germany and the Industrial Revolution*, New York: Macmillan, 1915.
- Viner, Jacob**, *The Long View and the Short*, Glencoe: Free Press, 1958.
- Williamson, Jeffrey G.**, “Why was British Growth So Slow During the Industrial Revolution?,” unpublished, Harvard Institute of Economic Research, 1983.
- U.S. Bureau of Census**, *Long Term Economic Growth 1860–1970*, Washington, June 1973.