Causal Influences on Productivity Performance 1820-1992: A Global Perspective*

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Abstract

This paper has three main purposes: a) it uses a comparative quantitative framework to demonstrate the pace of economic growth in different parts of the world economy since 1820, and to identify the major causes which have been operative; b) it analyses the different approaches which economists have developed to interpret proximate growth causality; and (c) it reviews the role of institutions and other deeper and less measurable influences on growth performance.

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Since 1820, world per capita income has risen eight-fold. There have been four main causal influences which go a long way to explain why such a large increase has been feasible. These are: (a) technological progress; (b) accumulation of physical capital in which technical progress usually needs to be embodied; (c) improvement in human skills, education, and organising ability; and (d) closer integration of individual national economies through trade in goods and services, investment, intellectual and entrepreneurial interaction. In the literature on economic growth, there are also three other elements considered to have had an important causal role. These are economies of scale, structural change, and the relative scarcity or abundance of natural resources. All of these causal influences have been interactive so it is not easy to separate the specific role of each.

Technical Progress

Technological progress has been the most fundamental element of change. It is also the most difficult to measure in a summarising statistic, though it is easy to illustrate its long-term impact. This has probably been greatest in transport and communications. In 1820, the carriage of goods was mainly in vehicles drawn by horses or other pack animals, by canal barge or by sailing vessels. In the nineteenth century railways and steam ships were very important substitutes. In the twentieth, motor and air transport developed on a large scale. Speedier movement and lower costs raised productivity, increased interspatial specialisation, and reduced interregional price spreads. The development of passenger transport transformed people's lives. In 1820, the journey from Paris to Lyon took five days by public transport. Most people could not afford a carriage and did not have a horse, so they travelled mainly on foot, and the distances which could be covered were limited. Now, the train to Lyon takes two hours. In the advanced capitalist countries, most families have at least one car, and in other parts of the world, public transport by bus or railway is usually available. Similarly with communications. In 1820, hand-written letters were an important means of communication for government and a small educated class. Carrier pigeons provided a quicker source of information over limited distances. But an exchange of letters between Europe and America took several weeks and between Europe and Asia several months. Now there are worldwide telephone networks, faxes, computer links and E-mail. In 1820, British newspaper sales

amounted to 29 million, i.e. about 1.4 newspapers per year per head of population. Now most families throughout the world have daily access to news and entertainment on radio and television.

The spread of electricity and the use of power have also helped to transform production processes. Household stocks of electrical and transport equipment are complementary to the capital of producers in many ways. Thus the mobility of households and widespread use of refrigerators have had a major impact on the nature and location of capital invested in retailing.

Technological innovation at the beginning of the nineteenth century was largely done by individual inventors or small-scale entrepreneurs, but now the great bulk of it is carried out by large-scale firms with substantial budgets for R and D, as well as by governments.

The processes of innovation and adaptation of known techniques to local conditions are carried out on a world-wide basis, but a special role has been played by the "lead" countries. The UK was the country with the highest level of productivity in the nineteenth century[1] and bore a major responsibility for pushing out the frontiers of technology. The process of diffusion and transfer was helped substantially by considerable effort of mimicry and adaptation, and a lesser degree of innovation. Some innovation did take place in follower countries, e.g. German developments in the chemical industry, but the British economy operated, on average, nearest to "best practice" technology. However, average British practice was well below "best practice" because the economy (like all others) operated with a capital stock of many vintages. It is usually only the operations with the newest capital which represent "best practice".

Throughout the nineteenth century and until 1913, UK productivity levels were above those of all the other European countries, so although they were closer followers than most of the world, their average technical distance from the UK was substantial.

In the twentieth century the American margin of leadership over the other advanced countries became bigger than that of the UK in the nineteenth, and its rate of progress (as measured by labour and total factor productivity performance) between 1913 and 1973 was much faster than the UK ever achieved. This is a major reason why the world economy was able to grow faster in the twentieth century than in the nineteenth. The frontiers of technology were being pushed out faster than before.

Since 1950 the margin of US productivity leadership has been substantially eroded. The advanced capitalist countries of Europe have drawn much closer to US levels of productivity.

This is also true of the most dynamic sectors of the Japanese economy, but its level of performance is very uneven, and its average productivity is significantly lower than that of western Europe.

One would have expected some acceleration in the rate of technical progress as more countries operate near to the frontier, but in fact it seems to have slowed down significantly in the past twenty years (a point developed further below).

In the analysis of technical progress, the leader-follower dichotomy is, in my view, fundamental. The two successive lead countries had a substantial lead over the advanced follower countries of Western Europe from 1820 until quite recently. Their lead over most countries of Latin America, Asia, and Africa was, and is, very much bigger. We can therefore get some idea of the changing pace of technical advance only by close inspection of performance in the lead country. Follower countries can draw upon the lead country's fund of technology by building up their stocks of physical and human capital, opening their economies to facilitate trade, and by possessing institutions which nurture absorptive capital). Effective access to lead-country technology is certainly not a free good. If the follower countries do the right things, they may have an easier ride than the leaders had. But one should not interpret the rapid growth that catch-up situations may involve as an acceleration of technical progress.

Japan is the archetypal case of a successful "follower". In order to narrow the gap between itself and the leader, it changed its political, social and economic institutions in 1867, took several decades to create a huge stock of physical and human capital, and mounted a very substantial private and governmental effort to promote technical transfer and adaptation. The process of gap-narrowing and accelerated capital accumulation was concentrated on the period after 1950, both in Japan and in the West European follower countries. As a result they recorded very large increases in labour and total factor productivity at this time. This is often interpreted as an acceleration of technical progress. In fact it was mainly a process of technological catch-up. As long as there is a distinguishable lead country, it is its performance which provides the real clue to the pace of technical progress.

Although it is very difficult to assess the pace of technical progress directly, some rough indication can be derived from the growth accounting for the two successive lead countries (see Table 6 below).

The Accumulation of Physical Capital

If there had been no technical progress, the accumulation of physical capital since 1820 would have been relatively modest. Investment would largely have been devoted to replacing worn-out machinery and buildings with new and identical replicas, and increasing the stock to accommodate the needs of an expanding work force. The major incentive to accumulate has arisen because new technology brings new products and better ways of producing older products. Figure 1 illustrates the huge increases in capital stock which have accompanied capitalist development in the UK, USA and Japan. Table 1 also shows the situation in France, Germany and the Netherlands. Table 2 shows ratios of non-residential capital stock to GDP in the six countries.

Estimates of capital stock over the whole period since 1820 are available only for the UK and the USA. It is possible to build up estimates of reasonable quality by the perpetual inventory method, i.e. by cumulating new investment of different kinds, deducting old assets which are scrapped, with standard assumptions on asset lives and adjustment for war damage if necessary. This way one arrives at estimates of gross stock (which I prefer). Net stock can be calculated by deducting depreciation rather than scrapping. For the UK, Feinstein's investment estimates (see Feinstein and Pollard 1988) go back to the eighteenth century. For the USA, investment series start later, so the capital stock estimates for 1820-40 are based on Gallman's (1986) wealth survey material.

Over the period 1820 to 1992, the US stock of non-residential structures increased nearly 800-fold. A good deal of this was capital "widening", i.e. provision for the needs of a work force that increased 38-fold, but there was also a very substantial capital "deepening". Non-residential structures increased 21-fold per person employed. The increase in the stock of machinery and equipment was much larger. The 1992 stock was about 5,400 times as big as that of 1820; per worker, there was a 141-fold increase. In 1820 machinery was important in only a few parts of the economy, in 1992 it was found in large quantities in factory, field and office. In 1820, only 7 per cent of non-residential capital was machinery and equipment, in 1992, the ratio was 35 per cent.

In the UK, the capital stock grew much more slowly than in the United States. This was mainly because the employment increase was much smaller. Nevertheless, the increase in structures per worker was 15-fold, and in machinery and equipment 97-fold.

For Japan, our estimates of capital stock start only in 1890 when the country had a much lower income level than the USA, and only a tiny fraction of its levels of capital per worker.

In the process of catching-up with the USA, the Japanese stock of machinery and equipment per worker increased 207-fold and its stsock of non-residential structures 62-fold from 1890 to 1992. By the latter year the Japanese capital stock per worker was bigger than in the USA.

There seems no doubt that high rates of capital accumulation, and high and increasing levels of capital per worker were a necessary condition for the productivity increases achieved in the capitalist epoch.

It is clear from Figure 1 that the US accession to productivity leadership involved a much bigger effort of domestic investment and creation of a much higher level of capital per worker than the UK had ever achieved[2]. Since 1950, in the effort to catch up with US productivity levels, European countries and the dynamic economies of Asia have also had to increase the capital intensity of their economic activity very substantially.

Improvements in "Human Capital"

Another striking feature, which has characterised the period since 1820, is the enormous increase in the average level of education. In 1820, the majority of the population in all countries was illiterate. In the advanced capitalist countries universal enrolment in primary education became obligatory in the nineteenth century and the proportion receiving secondary and higher education has risen steadily in the twentieth. The total stock of education in the age group 15-64 is illustrated in Table 3, with primary education given a weight of 1, secondary 1.4 and higher education 2, to provide a rough correction for the remuneration which these different levels attract. In Japan and the USA the average person's "human capital" by this yardstick, increased ten-fold from 1820 to 1992. The expansion of education took place for a diversity of reasons, cultural and recreational, as well as economic, but the economic impact has been very substantial. It was first stressed by Schultz (1961), incorporated in the growth accounts of Denison (1962) and has been rediscovered more recently by the "new" growth theorists. The increase in educational levels helped to "embody" technical progress, because the content of education changed over time to accommodate to the growing stock of knowledge. There has been a proliferation of specialised intellectual disciplines to facilitate the absorption of knowledge and to promote its development through research.

The education stock is, of course, only a rough measure of changes in human capital. It is better than enrolment ratios which are often used as a crude proxy in the new growth

literature, but it should be adjusted for differences of efficiency of education systems in transmitting cognitive skills, and supplemented with information on less formal types of skill acquisition.

Interaction Between Economies

The degree of integration of different parts of the world has grown dramatically since 1820 and the increased openness has had an important impact on growth potential. In 1820 exports were only 1 per cent of world product. By 1913, the ratio had risen to 8.7 per cent. By then it was meaningful to speak of an interactive "world" economy, rather than an aggregate of countries, many of which had little knowledge or contact with foreign technology. There was a very bad patch from 1913 to 1950, a period of neo-mercantilism, when the trade ratio declined, but after 1950, it moved sharply upward. By 1992, it had risen to 13.5 per cent (see Table 4).

This growth in international trade has been important in enabling countries to specialise in types of production in which they are most efficient. It has also eliminated the handicap of countries with limited natural resources. The attractiveness of international exchange has been greatly facilitated by improvements of technology in transport which have reduced costs and made distance less relevant. Trade has also been important in diffusing new products and new technologies. Its role in this respect has been strengthened by international investment flows which have done even more to diffuse technology and organisational improvements.

The proportionate importance of foreign trade depends on the size of an economy. It is very much bigger in the Netherlands than in the United States, and has enabled the Netherlands to specialise on what it does best and raise its productivity to the same level as the USA. Small countries can therefore get proportionately bigger benefits from international trade than large countries. It is also clear that the opening of economies has been strongly associated with rapid economic growth. This has been the case with the accelerated post-war growth of the most dynamic European and Asian countries, whereas the inward-looking Latin American economies performed much worse.

Economies of Scale

There is a very wide range (440:1) in the size of GDP in the 56 country sample in

Maddison (1995*c*) but there is no significant relationship between size and productivity performance. Some small economies like Norway and Ireland have much higher per capita incomes than very large economies like India, China or Russia.

The average size of productive establishments in advanced capitalist countries is much smaller than is often imagined. In the private sector of the US economy there are about 6 million establishments, and on average they employ 14 people. Manufacturing has the largest establishments, with an average employment of 51 people in 1990 (down from an average of 66 in 1980). The median US manufacturing establishment is five times as big as the average, but it is no bigger than the median in the Netherlands (see Maddison (1994)). Thus there is little evidence that big countries have much of a scale advantage, and small countries can get most of the benefits of specialisation through international trade.

However, it seems likely that in the six decades between 1913 and 1973, when US labour and total factor productivity accelerated, economies of scale did play a significant role in augmenting American performance. It also seems likely that, since 1950, West European and some Asian economies benefited similarly when they replicated patterns of consumption in standardised items which the USA had earlier pioneered.

Structural Change

Over time, economic growth has brought major changes in the structure of employment and output, in response to changes in demand, technology and international specialisation. These structural changes are illustrated, in terms of employment, for eight countries in Table 5.

Structural changes are usually considered to be an important independent source of growth, and politicians often tend to assume that some sectors are more noble or better for growth than others. Thus in the eighteenth century, French economists thought of' agriculture as the font of prosperity, and this antiquated idea has still some resonance in the highly protectionist stance of the European Union's policy for this sector. Other analysts, e.g. Kaldor, Mahalanobis, and many contemporary governments who provide industrial subsidies, consider industry to be the noble sector. More recently, governments have targeted parts of the service sector for such favoured treatment, particularly national-flag airlines.

In the short term, structural shifts can be important for growth. Thus the post-war acceleration of growth in continental Europe and Japan started with large resources of underemployed labour in agriculture, and there were significant possibilities for quickening

growth by moving this labour into more productive activity. However, shifts from low to high productivity sectors are nearly always accompanied by increases in the physical capital stock; improvements in skill, education, or organisation; or greater openness to international trade. One must therefore be careful to avoid double counting in measuring the impact of structural shifts.

Natural Resources

A factor of production which once figured prominently in economic theory, is natural resources, for which land is the most convenient proxy. There are very large differences among countries in the ratio of natural resources to population. The United States had 48 hectares per head of population in 1820, and 3.7 hectares in 1992, whereas Japan had only 1.2 hectares in 1820 and 0.3 hectares in 1992. The difference in resource endowment made it easier for the USA to grow, and was a handicap for Japan. It also affected the pattern of American and Japanese technology in agriculture (see Hayami and Ruttan, 1985). But in the long run, the inevitable decline in per capita natural resource availability, and the handicap of countries with low resource endowment has been more than made good by advances in technology, and possibilities for international trade. Early pessimists like Malthus and Ricardo were wrong about the role of scarce natural resources as a retardant of growth. In spite of the huge increase in world population, and unchanged human biological needs for food, the proportion of employment in agriculture has dropped enormously. In the advanced capitalist countries, agriculture now accounts for less than 5 per cent of employment. In agriculture and mining, technological development and geological prospection have increased the yield from an essentially fixed stock of resources in a way which Malthus would never have thought feasible.

Productivity and Growth Accounts

Over the past sixty years, economists have developed methods for assembling quantitative evidence to measure the impact on growth of labour input and most of the other causal influences mentioned above. These techniques help considerably to illuminate the dynamic forces in capitalist development, though technical progress, the most elusive, is not measured directly, but generally left as a residual.

Table 6 sets out successive steps in the effort to "explain" growth in the six advanced countries which are best documented. We are trying to explain differences in intercountry and intertemporal rates of performance. In the first panel of Table 6, GDP, like all the other items, is shown in terms of compound growth rates. Appendix B of Maddison (1995*c*) shows in detail how the estimates of GDP were constructed, and Appendix C shows how they can be converted into a common numeraire

(1990 Geary-Khamis dollars).

The next step is to estimate labour input and labour productivity. Great importance was attached to this measure when it was developed in the USA in the 1930s by the Works Project Administration, the Bureau of Labor Statistics and the National Bureau of Economic Research. At that time, when there was massive unemployment, such measures were needed to analyse what potential the economy might have if unemployment were reduced to more normal levels. Clark (1940) made extensive use of sectoral labour productivity measures in his pioneering comparative study of "economic progress", and Rostas (1948) used them in his pathbreaking comparison of British and American performance levels, which was the most conclusive documentary evidence of the extent of the lead which the USA had developed over the UK. It is still a very useful device for measuring performance, because it is feasible to push the measure further back in time than some of the other items in the accounts. It is clear from Table 6 that labour input has grown unevenly over time and between countries. It has been very different from the movement of population. Over the long term, working hours of the average person fell by half; labour input increased less than population; and labour productivity rose a good deal faster than GDP per capita. From 1820 to 1992, Japanese labour productivity rose 46-fold compared with a 28-fold increase in per capita GDP.

The measure of labour input is subject to a significant margin of error the further back one goes in time, and there is still room for improvement in the measurement of working hours in the advanced countries, even for recent years. For lower income countries, measurement of labour input is necessarily rough, partly because of the smaller statistical effort they have been able to mount, and also because it is inherently more difficult to define employment when a large proportion of the population is engaged in activities where the production unit is the family. Appendix J of Maddison (1995c) provides estimates of labour input and productivity for 40 of our sample countries. Maddison (1980) provides a more elaborate analysis of the possibilities for refining labour market accounts.

Economists who developed labour productivity measures were aware of the need to use more complex concepts which would take account of capital inputs as well as labour. Early post-war analysts laid great stress on the role of capital in economic growth, though for lack of accurate information, some of them assumed that the capital-output ratio was stable. In the 1950s and early 1960s, others, in lieu of capital measures, used incremental investment output ratios (ICORs), e.g., Maddison (1964) and ECE (1964). The new growth theorists have now reverted to using investment as a proxy for capital stock estimates for the large number of

countries for which the latter are not available.

A major breakthrough in capital stock measurement came when Goldsmith (1951) pioneered the "perpetual inventory" method in which stock estimates were derived from long-term investment series at constant prices. Kendrick (1961) used such measures in a major study of US economic growth from 1869 to 1953 which took account of both capital and labour inputs. In the course of the 1970s and 1980s, several OECD countries developed official capital stock estimates on a perpetual inventory basis, as they had a long enough run of investment data to permit their construction. Academic researchers such as Feinstein and Gallmann pushed these capital stock estimates much further back in time.

The different national capital estimates are similar conceptually but are not easily comparable because of substantially different assumptions about asset lives, differences in coverage, and the difficulty of deriving suitable purchasing power parity coefficients to convert them into a common currency. Standardised estimates adjusted to deal with these problems for France, Germany, Japan, the Netherlands, UK and USA from Maddison (1991 and 1995*a*) are used in panels 4 and 5 of Table 6. These capital stock estimates are also broken down into non-residential structures, and machinery. This is a very pertinent distinction, as the rate of growth of the latter component has been much faster than the former (see Figure 1 and Tables 1 and 2), and technical progress is probably more rapidly embodied in machinery investment than in structures.

>From the fourth and fifth panels of Table 6 one can readily see that capital input did not move in parallel with output as had often been assumed. Table 6 shows that US capital inputs rose much faster than output from 1820 to 1913, and slowed in 1913-73. Capital productivity was negative in the first period, and positive in the latter. The US capital-output ratios first rose and then fell (see Table 2).

Once measures of capital stock were available, the next step was to develop measures of joint factor productivity, i.e. the ratio of output to combined inputs of capital and labour. Tinbergen (1942) made the first international comparisons of this kind with very rough measures of capital. Kendrick (1961) was a much more sophisticated exercise by sector of the economy, but covered only one country.

Schultz (1961) suggested that inputs of "human capital" should also be regarded as a factor of production. The main component he had in mind was the increase in the educational levels, but improvements in skill through working with sophisticated equipment, and improvements in health were also relevant. The idea proved attractive and measures of joint

factor productivity were soon constructed in which education was treated as part of factor input. In growth accounts, the normal procedure is to treat increases in education as an improvement in labour quality, rather than as an independent factor of production analogous with physical capital. In the sixth panel of Table 6, total factor productivity was calculated by relating changes in output to the combined input of quality adjusted labour, non-residential physical capital and land (which is taken as a proxy for natural resources).

A climate propitious for the development of even more ambitious growth accounts was created by the ferment of discussion on US growth performance in the 1950s and early 1960s. This was partly due to the political situation of competitive coexistence in which Krushchev was threatening to overtake the United States, but the theorists were also encouraged by the likelihood that their ideas could probably be tested empirically. The key writings in this first wave of modern growth theory were by Abramovitz (1956) and Solow (1956, 1960, 1962 and 1963).

Abramovitz produced a brilliant recapitulation of what was then known about the quantifiable causes of US growth. He stressed the degree of ignorance in these matters and put forward the idea of including education and research in the growth accounts. Solow's 1956 article was of major importance and by far the most influential. He broke with the Harrod-Domar models which had dominated the post-war literature, and had included the notion of constant capital-output ratios. He constructed a model with two inputs, labour and the productive services derived from the capital stock. He assumed constant returns to scale, diminishing returns to each input, and exogenous technical progress. In his 1960 and 1962 articles and his 1963 book Solow stressed the likelihood that a substantial part of technical progress was embodied in successive vintages of the capital stock and he put forward some tentative guesses as to how big this impact might have been. Salter (1960) stressed the same point. Unfortunately this important idea has so far been subject to much less empirical testing than what is generally considered to be his "standard" model.

Denison (1962) adopted the key ideas of Solow (1956) and Schultz (1961) in creating "growth accounts" to explain twentieth-century American economic performance. In 1967 he applied the technique to explain differences in growth rates and levels of achievement in eight West European countries and the USA for 1950-64. Denison and Chung (1976) incorporated Japan into the sample. Denison used an augmented version of joint factor productivity similar to that in Table 6. He adopted the basic neo-classical features one finds in the 1956 Solow model, i.e. the use of income shares as factor weights, and the assumption of exogenous

technical progress, but his procedures were eclectic and he also allowed for economies of scale. He rejected Solow's (1960, 1962 and 1963) suggestions for embodying technical progress in successive vintages of the capital stock. He wanted it to be the major item in his final performance measure, the "residual". This, as he acknowledged, was not confined to measuring technical progress but also reflected the effect of unmeasured influences and possible mismeasurement.

In addition to the augmented factor inputs, Denison (1962, 1967) included other, supplementary, elements of explanation. These included foreign trade effects, the impact of structural change, economies of scale in domestic markets, as well as some other influences, such as government regulation and crime, changes in capacity use, labour hoarding, etc.

Panels 7, 8 and 9 of Table 6 show the impact of four major supplementary influences on economic growth. Panel 7 shows the foreign trade effect. I assumed that growth of foreign trade (exports plus imports) produced 10 per cent economies of scale in 1913-50 and 1973-92 and 20 per cent in 1950-73. This scale effect was weighted by the share of exports plus imports in GDP in the initial year of the period. The trade effect was biggest in the golden age (1950-73), small or negative in 1913-50, and fairly modest in 1973-92. The reason for giving trade a bigger bonus effect in 1950-73 is that this was a period of massive reduction of tariffs, elimination of most non-agricultural quantitative restrictions on goods and removal of the most important exchange controls. The impact of this liberalisation in improving resource allocation and facilitating transfers of technology was bigger than in 1913-50 when there were increases in tariffs, quantitative restrictions and exchange controls, and in 1973-92 when progress in tariff reduction was (by 1950-73 standards) relatively modest.

Panel 8 shows the combined effect of structural change and labour hoarding (dishoarding). The latter is related to the structural change effect and only applies to Germany and Japan, where the proportion of self-employed people and family workers was higher than in the other economies. The structural effect was measured as the difference between actual output growth in each of three sectors (agriculture, industry and services) and the change in output which would have occurred if the structure of employment had not changed (whilst assuming the labour productivity growth within each of the three sectors had remained as actually experienced). The impact of this augmented structural effect is significant in size and there can be substantial changes in direction. These economies now have the bulk of their activity in services where productivity grows most slowly, and the average level of service productivity is now lower than in industry. Thus there is now a significant structural drag in

some economies, whereas in the golden age, when growth was very vigorous, structural change had a large positive impact by propelling labour rapidly into more productive employment. The changes between different phases were most marked in the case of Japan.

Panel 9 shows the impact of economies of scale at the national level. These are not included in strict neo-classical analysis like that of Jorgenson, but Denison always included a significant scale bonus as national economies increased in size. I have always assumed a smaller scale bonus than Denison, equivalent to 3 per cent of the GDP change, as I think it is likely to have been less important than analogous gains arising from the increased openness of the economies via foreign trade.

The tenth panel shows the residual in the growth accounts, i.e. the unexplained residue after taking account of total factor productivity and the supplementary influences on growth. I have not been able to measure the supplementary influences and the residual for the whole period covered by the accounts, but the difference between the residual and total factor poductivity is likely to have been far more important in the golden age than in earlier periods.

In this growth accounting exercise, no attempt is made to measure the effect of technical progress directly. The residual in the lead country can be taken as a provisional measure of technical progress. For the follower countries, the residual was bigger than in the USA from 1950 to 1992, and smaller in 1913-50. For the followers, the residual includes the impact of technological catch-up (or falling behind) as well as technical progress.

Denison always presented the derivation of his estimates transparently, so that readers could reproduce or modify them in case of disagreement. He also was careful to point out possible errors, and to distinguish harder evidence from softer conjectures. He could do this all the more readily because the accounting approach is a very flexible device for organising evidence on causal influences affecting the growth process. It is possible to modify the accounts by changing the weights of different items, by adding new items or dropping old ones. I have myself used a Denisonian framework with very substantial modifications, dropping his assumption that work intensity increases as hours decline, using a different concept of output, bigger weights for capital and foreign trade effects, lower weights for domestic economies of scale, and embodying part of technical progress in successive vintages of capital[3]. The growth accounting approach can also be used to test the findings of econometricians who use the regression approach for causal analysis. They experiment with new ideas about what is important in the growth process, and may come up with exciting results. Often the most exciting ones come from simple regressions. If some elements are left

out, those which remain may take over a large part of their "explanatory" power, because of the close interactions of most elements in the growth process. It is therefore useful to cross-check the explanatory items discovered by econometricians in the stodgier but more transparent framework of growth accounts. When a new or more heavily weighted item is added to the accounts, one may find that growth is overexplained, and then there is reason to rework the regression.

There have now been a large number of studies in the growth accounting tradition. I covered 34 countries in various studies for the post-war period (Maddison 1970, 1972, 1989; Maddison and Associates, 1992). For six advanced capitalist countries I have made more ambitious and systematic attempts to improve the quality of the measures and push the analysis further back in time (Maddison 1987, 1991, 1995*b* and Appendix K of Maddison (1995*c*). Kendrick (1976 and 1994) has developed very ambitious estimates to measure the "total" stock of capital in the United States, adding the stock of R and D to that of physical capital, human capital, and inventories. He has also made several successive attempts to provide international comparisons of growth accounts for the business sector of the economy using the OECD's database. Abramovitz has always played a very creative role as a consumer, interpreter, and critical commentator on international growth accounts. He and Paul David have atoned for the non-publication of their splendid 1965 manuscript by publishing a large number of articles over the past 30 years interpreting the causal factors in US growth. There have been individual country studies in the growth accounting tradition for Brazil, Canada, France, India, Japan, Korea, Mexico, the UK and the USA, as well as regional comparisons for different parts of the world[4].

Parallel with the growth accounting literature there was a steady flow of' articles after 1966 by Dale Jorgenson and his associates. These were mainly on the US economy but also covered several other advanced capitalist countries. Jorgenson's approach was more rigorously neo-classic than Denison's in excluding economies of scale. He defined output and capital somewhat differently, included immediate inputs in the analysis, concentrated on the private sector of the economy and disaggregated in much finer detail by branch and sector. He was more ambitious in trying to squeeze the residual in the growth accounts to zero, whereas Denison was willing to live with the fact that his growth accounts left a substantial part of growth unexplained. There was a useful interaction between the two approaches in the *Survey of Current Business* 1969-72 with three articles by Jorgenson and Griliches, and two lengthy comments by Denison, which led Jorgenson and Griliches to concede that they had

exaggerated their initial degree of explanation. The great virtue of Jorgenson's approach is that it helps to identify the locus of technical progress by showing in detail how productivity has changed in different sectors and branches of the economy.

After a hiatus of almost 25 years, there was a revival of interest by economic theorists and econometricians in the characteristics and causes of economic growth in the late 1980s. To some extent this new interest was stirred by the availability of new comparative evidence of growth rates and levels in advanced capitalist countries in Maddison (1982 and 1991) and the comprehensive data set on income levels, growth rates and associated information for 130 countries for 1960 onwards in the Penn World Tables (PWT) of Summers and Heston (1988 and 1991).

The three seminal articles in this new wave were Baumol (1986), Romer (1986) and Lucas (1988). Baumol was concerned more with the characteristics of long-term growth experience than with causes. He focused on convergence in productivity and per capita income levels. For sixteen advanced capitalist countries, he concentrated on movements between two points; the initial year, 1870, and the end year, 1979. He suggested that post-war convergence within this group was a reinforcement of an earlier tendency which had existed since 1870. In support of this view, he cited Abramovitz (1986) who had shown a long-term reduction in the coefficients of variation of labour productivity levels within the 16 country sample at successive benchmarks from 1870 to 1979. Baumol concluded that the sixteen countries formed a convergence club, and found further evidence in the Summers and Heston Penn World Tables of post-war intraregional convergence in centrally planned economies and middle income countries.

Baumol's emphasis on convergence and his use of the Summers Heston database to test hypotheses by regression had a very powerful influence on the research agenda of the new growth literature.

There are two weaknesses in Baumol's analysis:

a) his sample was limited mainly to high income countries and biased in favour of the convergence hypothesis. The new growth theorists seized on this weakness and tried to remedy it by maximalist coverage. In the Summers and Heston

database they had access to information for 130 countries and could test the hypothesis on a global basis. These data were available for only 25 of the 172 years we have covered, but it was sufficient for them to conclude that Baumol's convergence thesis applied only to a limited group of countries.

b) by concentrating on convergence Baumol fudged the leader-follower dichotomy and obscured a very important aspect of the historical performance of nations. There was in fact a big difference between comparative growth performance before and after 1950. From 1870 to 1950, 13 of the advanced capitalist countries which Baumol examined were falling behind US productivity levels, whereas 15 of them were catching up on the USA after 1950 (see Tables 7, 8 and Figure 2).This phenomenon of falling behind and then catching up can also be seen for GDP per capita for a longer period and a wider range of countries. The contrast between this long-run feature and the post-war situation has not been sufficiently recognised in the new growth literature, and hence it tends to exaggerate the generality of findings which are valid only for a truncated time period.

Romer (1986) and Lucas (1988) were more interested than Baumol (1986) in theoretical issues and in modifying the analysis of growth causality which Solow (1956) had developed. Romer stressed the interrelation between technical progress and the growth of physical capital, whereas Lucas gave greater stress to the interaction of technical progress and human capital. Solow's (1956) approach implied that diminishing returns would set in if investments were pushed hard, whereas Romer stressed the likelihood of spillovers or externalities which would produce constant or increasing returns. Thus Romer spoke of growth being "unbounded". He did not test his hypothesis, but illustrated its plausibility by citing long-term evidence of accelerating labour productivity growth from the nineteenth century to the 1970s (from Maddison 1982). He did not consider evidence of the long-run relation between capital stock and output growth, and he might have felt less sure of the empirical support for his position if he had been able to see the evidence of Table 6. This shows a sharp fall in labour productivity, capital productivity and total factor productivity after 1973.

Romer (1986) was interested in developing an approach which would explain why all countries had not converged to the same level of income. In doing this, he did not pay much attention to interactions between countries nor did he acknowledge the leader-follower dichotomy, which is so important in my analysis. For him technical progress and economic growth are mainly endogenous processes, without much possibility for follower countries to

borrow from the technological leader. He did not acknowledge the specificity of the *nation-state* as the basic unit of analysis, and assimilated the problem of explaining differential country performance to that of explaining the behaviour of individuals or firms within a single economy. It is quite plausible that technical progress has been to a large degree endogenous in the Romer sense for the United States, but this is unlikely to have been the general situation. Large and fairly advanced follower countries, such as France, Germany, the UK or Japan, have had elements of endogeneity in their technological development, but for the rest of the world technological progress is likely to have been exogenous.

Lucas (1988) was interested in modifying what he considered to be the "standard neoclassical" model in a way which would give better explanations of why the income levels of' different nations had not converged. He did this by adding human capital which he assumed to interact with technical progress and to produce spillovers or externalities. He talks of the "Solow-Denison framework" in referring to the "standard neoclassical" model, but Denison (1962) had already augmented the Solow (1956) model. Lucas (1988) was not an innovator in adding human capital, but he attached greater importance to human capital as an engine of growth, and his linkage between human capital and technical progress was not present in the growth accounting approach. The new growth theorists who have followed Lucas in incorporating human capital have a different approach from growth accountants who treat education as an augmentation of labour quality, using relative earnings of people with a given level of education as weights. Disciples of Lucas treat human capital as a separate factor of production, analogous to physical capital. Using this approach one might expect them to use costs of education at different levels as weights, rather than earnings. In fact they generally use school enrolment rates as crude proxy measures for human capital.

Romer (1986) and Lucas (1988) were mainly concerned with theoretical issues, but there have been a great many attempts to test their ideas and Baumol's hypothesis by applying econometric techniques to the different versions of the database of Summers and Heston. It is worth considering three influential contributions to this literature.

Barro (1991) reached rather circumspect conclusions in applying the new approaches. He found human capital to be an important contributor to growth, but his regression analysis left a good deal of the weak performance of sub-Saharan Africa and Latin America unexplained. Barro and Sala-i-Martin (1992) found convergence of levels of income between US states for the period since 1840, and suggested that the convergence implications of the augmented Solow model were likely to be fulfilled when the institutional, political and policy settings of

countries were similar. This they characterised as "conditional" convergence.

Mankiw, Romer and Weil (1992) considered that the new growth theory had been too cavalier in dismissing the Solow (1956) model. They augmented it to include human capital and tested it with the Summers and Heston material. They used it selectively, dropping oil-producing countries from their first sample of 98 countries, then using a 75-country sample from which they had dropped countries where the data were shaky or idiosyncratic. Finally, they concentrated on 22 OECD countries for which they did find convergence. They concluded that their augmented Solow model was robust if one allowed for the institutional and policy differences between countries, which prevent convergence from occurring.

The new growth theory has been useful in re-emphasising a number of fundamental issues concerning the interrelation of technical progress, economies of scale and formation of physical and human capital. The distinction between the "conditional" convergence of countries where the institutional policy mix is similar and repudiation of the idea of "unconditional" convergence (on a global scale) is useful and is one way of bringing attention to the interaction of "proximate" and "ultimate" causal influence. It is a fundamental point which has been strongly emphasised by Abramovitz (1989) and is central to North's (1990) attempt to develop a broader view of growth causality.

The concern of the new growth school to build models where greater explanatory power is allocated to technical progress is a topic of fundamental importance, touched upon by many other analysts, and not tackled very seriously by the growth accountants. Non-neoclassic authors, such as Kaldor (1957) or Scott (1989), have also stressed the strength of the link between investment and technical progress. The evolutionary school (Verspagen 1992 and Fagerberg 1994) has hopes of finding better explanations of technical progress by improvement and closer scrutiny of R and D statistics.

In my view, the most promising route towards better explanations of technical progress is to develop and test the ideas of Solow (1960, 1962 and 1963) and Salter (1960) who emphasised the impact of technical progress in raising the quality of successive vintages of capital. With the perpetual inventory technique it is relatively easy to see the age-structure of the capital stock, and, as better capital estimates become available for more countries, longer periods, and disaggregated by type of asset and industry, these relationships can be explored more seriously. Such work would reinforce the analysis already done by Jorgenson and his associates in locating the parts of the economy where progress in labour and total factor productivity has been most rapid. If countries could be persuaded to provide the type of

census information on interfirm spreads of productivity performance which have in the past been available for the USA, our depth of vision would be significantly improved (see Klotz, Madoo and Hansen, l980).

The new wave has succeeded in reviving causal analysis of economic growth as a central field of concern in economic theory. It has also done a great service in globalising the perspectives of empirical research. It is clearly useful to improve the quality of the database, and to extend it much further back in time. Maddison (1995*c*) seeks to do this by assessing the quality of the information we already have, and enlarging the intertemporal and interspatial field of vision.

The Institutional Context

Thus far we have discussed proximate elements of growth causality which are more or less measurable and can be embedded in a growth accounting framework or fitted into an econometric model. It is not too difficult to deploy this evidence to explain why the West European countries, which are institutionally similar to the USA, were able to mount such a successful catch-up effort in the past half century, or indeed, to explain why Japan, after a deep institutional transformation around 1867, was able to catch up with the West. The real puzzle is not so much the success of the West, but the backwardness of the rest.

If we are to explain why the economic growth experience of nations has been so diverse, and why income spreads are now so wide, it is necessary to go beyond proximate and measurable elements of causality and consider institutional, social or policy influences which may retard or encourage economic development. Economic "backwardness" is a topic which has concerned economic historians for decades. Gerschenkron (1962) drew attention to this problem and correctly stressed the need for historical perspective, but his spatial perspective was concentrated on European countries. North and Thomas (1973), North (1981 and 1990) and Abramovitz (1986) are other influential analysts who stress the importance of institutions or differential social capability, but they also deal with a limited range of backwardness, i.e. varieties of European experience.

As individual country situations are so varied, it is difficult to reach general conclusions about the influence of deeper layers of causality. For this we really need individual country studies. However, I do have some tentative judgements about the way institutional situations have helped condition the performance of the seven different groups of nations which are

considered below.

Western Europe

The West European countries already had high levels of income by world standards in 1820, and historical evidence suggests that they gradually pulled ahead of the rest of the world from 1500 to the beginning of the nineteenth century. In this protocapitalist period, their growth was much slower than it has been since, because technical progress then moved at a slower pace. Nevertheless their socio-institutional development prepared them to exploit the possibilities for faster growth and rapid technical progress which emerged in the nineteenth century. Thus the West European group provided leadership in productivity and technology for several centuries. Northern Italy and Flanders played this role from 1400 to 1600, the Netherlands from then until the end of the eighteenth century, and the UK in the nineteenth.

The main characteristics of Western Europe which have favoured its development are as follows:

The most fundamental was the recognition of human capacity to transform the forces of nature through rational investigation and experiment. Thanks to the Renaissance and the Enlightenment, Western elites gradually abandoned superstition, magic, and submission to religious authority. The Western scientific tradition that underlies the modern approach to technical change and innovation had clearly emerged by the seventeenth century and began to impregnate the educational system. Circumscribed horizons were abandoned, and the quest for change and improvement was unleashed.

The ending of feudal constraints on the free purchase and sale of property was followed by a whole series of developments which gave scope for successful entrepreneurship. Nondiscretionary legal systems protected property rights. The development of accountancy helped further in making contracts enforceable. State fiscal levies became more predictable and less arbitrary. The growth of trustworthy financial institutions and instruments provided access to credit and insurance, which made it easier to assess risk and to organise business rationally on a large scale over a wide area. Techniques of organisation, management and labour discipline were also improved.

A third distinctive feature of Western Europe was the emergence of a system of nation-states in close propinquity, which had significant trading relations and relatively easy

intellectual interchange in spite of their linguistic and cultural differences. This stimulated competition and innovation. Migration to or refuge in a different culture and environment were options open to adventurous minds; printing and universities added to the ease of interchange.

The Western family system was different from that in other parts of the world. It involved controls over fertility and limited obligations to more distant kin. This reinforced the possibilities for accumulation. It also had a lasting impact on western demography. European population growth was much more modest than the subsequent experience of Africa, Asia and Latin America.

Since 1820, the institutional arrangements of Western Europe have not stood still. The degree of democratic participation and the socioeconomic role of government have changed a good deal in ways that have generally been positive for growth. The welfare state has made capitalist property relations and the operation of market forces more legitimate by removing most of the grievances which motivated proponents of a socialist alternative.

In the post-war period, interrelations between these countries have involved articulate co-operation and some rudiments of a managed international order. This, too, has been favourable to economic growth.

Western Offshoots

The four Western Offshoots (Australia, Canada, New Zealand and the USA) inherited and adapted institutional arrangements, societal habits and language from the most economically advanced of the Western European nations. They sloughed off some badges of status and inherited privilege and thus enhanced the modernity of their capitalist institutions. This modernity was most marked in the USA, whose institutions were created in a revolutionary break from the old world inspired partly by ideas of the French enlightenment. However, the United States condoned slavery as an institution for nearly the first century of its history, which slowed its growth and marred the quality of life. It also had fragile financial institutions which plunged it into economic collapse in the 1930s. The circumstances of the Western Offshoots differed importantly from those of Western Europe. They had huge natural resources and were distant from European wars. Their population grew much faster because of higher fertility and large-scale immigration. Over the long run, Canada's propinquity to the USA helped to give it the most rapid per capita growth of the group. Remoteness from the most dynamic parts of the world economy was a significant handicap for Australia and New Zealand which were the worst performers in the group.

Southern Europe

This is a miscellany of medium-income countries whose institutional heritage has been different from Western Europe but they have been closely integrated with the West since 1948 as members of OEEC, OECD and the European Union. Most of them benefited from US Marshall Plan aid and latterly from very substantial EU transfers. Large parts of Greece were still part of the Ottoman Empire until 1913, and many of the most dynamic Greek entrepreneurs have operated in the diaspora rather than within the country itself. Ireland was in effect a British colony until 1920 and domestic conditions were depressing enough to create massive emigration. Spain and Portugal were once the most important colonial powers of Europe. Their brand of conquest imperialism brought substantial fiscal tribute from colonies, but led to irresponsible domestic fiscal policy and sapped the rigour of the forces for growth. They were less influenced than Western Europe by the Renaissance and Enlightenment, the content of their education system was adversely affected by clerical power, and large sections of the population were illiterate for much longer than in Western

Europe. Turkish institutions were clearly very different from Western Europe's in the nineteenth century, but the Kemalist reforms of the 1920s were very significant and intended to assimilate it to European norms. However, Turkey is clearly the outlier in terms of demography and income level, and it might well have been included in the Asian group.

Eastern Europe

The institutional background of these countries is quite varied. What gives them homogeneity is not geography but the fact that they switched from capitalist institutions to those of a dirigiste command economy for a substantial period. Tsarist Russia's economic, social and political institutions were different from those in the West, and the country was further differentiated from 1917 onwards by the advent of communism. Czechoslovakia and Hungary were fairly prosperous members of the Habsburg Empire until 1918, and were more advanced than Poland, most of which was a Russian colony until 1918, or than Bulgaria, Romania and Yugoslavia, which were parts of the Ottoman Empire for a good part of the nineteenth century.

Latin America

Although most of Latin America became politically independent in the 1820s, and like North America has very large natural resources, it is very different in its institutional background. In the Western Offshoots, the indigenous populations were marginalised: in Latin America they were assimilated, but became an underclass. Peonage and slavery led to very wide disparities in income, wealth, education and economic opportunity (see Table 9). There has been continuing neglect of popular education, heavy-handed regulatory tendencies in government, a long history of debt default and fiscal irresponsibility. The last characteristic has led to chronic inflation, and long-standing political instability. These characteristics were important in keeping Latin American growth and levels of income well below those in North America [see Maddison (1992) for an analysis of twentieth century constraints on performance in Brazil and Mexico, and Maddison (1995*a*) for a much longer-term assessment of Mexico's institutional heritage].

Asia

The Asian countries were the biggest part of the world economy in 1820 with 69 per cent of world population and 57 per cent of world GDP. By 1992, they had regained a good deal of their old predominance, with 58 per cent of world population and 37 per cent of world GDP. In 1820 they were a rather homogeneous group in terms of per capita income, but by 1992 they had the widest intra-regional income spread, 27:1, between Japan and Bangladesh. This is huge compared with the spreads within the five regions previously discussed and one must therefore be circumspect in generalising about Asian countries, though their extreme heterogeneity is a phenomenon that developed only after 1950.

Three countries - China, India and Japan - accounted for 84 per cent of Asian population and 82 per cent of GDP in 1820. It is useful to examine their institutional characteristics in some detail to see in what way they might have hindered economic growth.

By Western standards, the most comprehensible case is Japan[5]. When challenged by the West, it reformed its institutions drastically, did what was necessary to promote growth, and eventually caught up. The other two countries were held back by indigenous institutions or attitudes, and not helped by their experience of Western colonialism.

Traditional Japan was very isolated. Travel and study abroad were prohibited. Japanese were not permitted to build ships with a carrying capacity above 75 tons. The only trade contact was with the Dutch, whose East India Company had established a small depot in Nagasaki to which they could send a ship once a year from Indonesia.

In 1853, the American navy forced a gunboat entry to Tokyo Bay and extorted extraterritorial, legal and commercial privileges. These concessions were extended to France, the Netherlands, Russia and the UK. The treaties restricted Japanese commercial and fiscal autonomy, opened the economy to foreign trade, and required tariffs to be no more then 5 per cent. This experience was not too different from that of China in the 1840s, but the intrusion was more sudden, and the Japanese reaction was very different.

In China, the foreigners appeared on the fringe of a huge country which the ruling elite regarded as the locus of civilisation. They considered the "barbarian" intruders as an irritating nuisance. In Japan, the foreigners struck in the biggest city, humiliated the Shogun and destroyed his legitimacy as a ruler. The Japanese had already borrowed important elements of Chinese civilisation and saw no shame in copying a Western model which had demonstrated its superior technology so dramatically.

In 1867, the Tokugawa shogunate was overthrown, and the new Meiji regime carried out

sweeping reforms. These provided Japan with an up-to-date version of Western capitalist institutions. The Emperor became the head of a centralised state with 46 prefectures. These replaced the previous territorial division between 270 feudal lords (the *daimyo*). Legal inequalities were abolished, and old distinctions in the dress and rights of *samurai* (the military), peasants, artisans and merchants disappeared. People obtained freedom to choose their trade or occupation, free of guild restrictions, and could produce any crop or commodity. Land could be bought and sold freely. Feudal property rights and rice stipends of the *daimyo* and *samurai* were commuted into state pensions and government bonds. State taxes replaced old feudal levies in kind, and their incidence was equalised throughout the realm. Primary education became compulsory. New textbooks were written with a Western content. Large numbers of students were sent abroad for technical and higher education. A national monetary and banking system was created. Agricultural research and industrial development were promoted by government. The armed forces were reorganised and rearmed on Western lines.

The government set out on a programme of economic development and military aggrandizement which had no parallel in other Asian countries. The old Tokugawa society had operated with an unusually large elite group - a fossil emperor and his court in Kyoto, the Shogun and his government in Edo, 270 *daimyo* in their castle towns, and 420 000 *samurai.* Together with their households these people had been nearly 6 per cent of the population (about three times the proportion of the Chinese elite). There was an economic "surplus" which was redirected to more productive uses as these people were transformed into a modernising military-bureaucratic and business elite.

Finally, one must note that Japanese reproductive and family planning habits were such that demographic expansion was very modest by Asian standards.

The Chinese experience is more enigmatic[6]. Two thousand years ago, its level of economic performance was probably similar to that of the Roman Empire, and above European levels from around 500 to 1400 AD. But Chinese per capita income stagnated from 1400 to 1950 whilst the West forged ahead. For a century after the 1840s China was a quasi-colony of the West, ceding extra-territorial rights in treaty ports to 20 foreign countries, its customs revenue controlled by foreigners, surrendering territory to Russian, French, British and Japanese colonialists.

Several aspects of Chinese society and culture make this increasing economic backwardness difficult to explain. The mainstream Chinese religion, Confucianism, was concerned with pragmatic prescriptions for behaviour in this world, rather than with problems

of immortality, the soul, the after-life, or God. China tackled the challenges of nature with an engineering approach. A third of the cultivated land was irrigated. Famines were mitigated by a public granary system. In Moghul India, the proportion of irrigated land was one-tenth of that in China, and the incidence of famine depended on vagaries of the monsoon.

In the last (Ch'ing) dynasty, China had remarkably modern property relations. There was no serfdom, about 30 per cent of farmers were tenants paying rent in money or kind, and the rest were small peasant proprietors, with a low proportion of landless labourers. Moneylenders were active and land changed hands freely. Commercial activity was not subject to usury restrictions and merchants could move freely. Paper money existed from the early ninth century and merchants could use bills of exchange for payments.

China showed precocity in major inventions compared with the West. Water mills, efficient harnesses for horses, paper and porcelain were in use in the Han dynasty (200 BC to 200 AD), i.e. 1 000 to 1 500 years before they arrived in the West. Printing, the crossbow, iron, gunpowder and paper money were introduced during the Tang dynasty (600-900 AD), and the abacus in the Sung dynasty (1000-1271 AD). Chinese farming was more like horticulture than agriculture, with advanced techniques of irrigation, drainage, double cropping, seed selection, transplanting and use of manuals of best practice. New crops like maize and potatoes were imported from the new world. From 1400 to 1950, by increasingly intensive use of land and labour, it managed to support a more than seven-fold increase in population with no noticeable fall in living standards.

All of these characteristics suggest that China should have been able to develop its technology and productivity as fast as the West. It is not clear what prevented this from happening, but it seems likely that Chinese success in forging the world's biggest and most enduring political unit may have been incompatible with successful capitalist development. Two important characteristics which made for continuity and consolidated the central power may have been inimical to economic progress.

China had a non-phonetic ideographic script, which was intelligible to people who spoke very different regional variants of Chinese. This had a tremendous consolidating power in facilitating centralised control over a vast area. It was attractive to invaders from the border areas (Mongols and Manchus) who saw it as a ready-made vehicle to enforce their rule. In the process of using the language, these barbarians assimilated Chinese cultural values. Mastery of written Chinese gave the literati and the bureaucracy a sophisticated and cultivated world view, but learning 40 000 characters was a long and exhausting process which strengthened

Chinese ethnocentrism, encouraged self-satisfaction, inhibited intellectual deviance and curiosity. The difficulty of the language was a barrier to widespread literacy compared with Japan, which supplemented a much smaller number of characters with alphabetic scripts. The content of Chinese education was concentrated on calligraphy, ancient classics and conventional wisdom. It acted as an instrument of thought control, serving to inhibit unorthodox thinking and to preserve political stability. The Chinese were pragmatic inventors but did not develop the experimental scientific approach which emerged in the West.

Another important Chinese characteristic was the strength and continuity of the bureaucracy, which emerged about 200 BC as an instrument of central power, an alternative to the previous elite of hereditary feudal lords. It was used in all later dynasties, even by the Yuan (Mongol) and Ch'ing (Manchu) who were initially warlords. Throughout most of subsequent Chinese history, military expenditure was modest by European, Indian or Japanese standards, because the civilian bureaucracy was usually a very effective instrument of imperial control.

Bureaucrats achieved their status by passing competitive written examinations which tested their knowledge of Chinese classics. They were, in principle, a meritoc-racy, but the cost of prolonged education was a social barrier, and in the nineteenth century about a third of the licentiates obtained degree status by purchase rather than examination.

The bureaucracy was responsible for tax collection, policing, maintenance of order and arbitration of disputes. Confucian tradition and strong family discipline encouraged obedience to their decisions. These were not challengeable by lawyers, and they often imposed collective punishments for crimes and misdemeanours. Bureaucrats had large discretionary powers, and their judgement was influenced by the fact that their salaries were low. They augmented them by bribes and by siphoning off part of the tax revenue.

The top bureaucratic levels were closely enmeshed with the "gentry" class. The latter were usually landlords with rental incomes. They had legal privileges and lower tax burdens, and like the bureaucracy, were differentiated from the masses by sartorial and other marks of distinction and deference. The content of gentry education was similar to that of the bureaucracy.

The bureaucracy supplied control functions which might otherwise have been provided by an aristocracy, priesthood or military. Their influence in promoting orthodox thinking and social stability helped keep the country together, but discouraged economic and social change.

Indian institutional arrangements were more complex and exploitative than those of China and Japan, and their inhibiting impact on economic development seems much clearer[7].

There were three main layers in the traditional Indian society when the British started to take over in the eighteenth century. The top fifth of the population were Mus1ims. Hindu village society was about 70 per cent of the population, and pagan tribal groups about a tenth.

The Moghul emperor's main instrument of social control was the warlord aristocracy. Its members provided military and administrative services and in return had a claim (*jagir*) on revenue from a given part of the village sector. Nobles were rotated from one *jagir* to another, and these estates were liable to royal forfeit on death. The *jagirdar* had an incentive to squeeze village society to minimal levels of subsistence, to spend as much as possible on consumption and to die in debt to the state. There was no motive to improve landed property. This elite, their families and those who provided for their needs were Muslims and mainly urban dwellers. There was also a smaller Hindu elite of nobles and princes who had thrown in their lot with the Moghuls. They had hereditary rights to village tax revenue in the areas they controlled.

Village society was ethnically and linguistically heterogeneous, but kept docile and exploitable by the sanctions of a hierarchical caste system. This segregated the rural population into mutually exclusive groups whose economic and social functions were rigidly hereditary. The requirements of ritual purity prevented social mobility and inter-marriage, dictated food habits, and prevented most imaginable forms of social homogenisation.

The hereditary division of labour prevented people from raising their productivity by changing their economic activity. There was no allowance for aptitude, intelligence or new ideas in allocating jobs and little possibility of firing someone for inefficiency. At the top of village society were brahmins, and at the bottom were untouchables. In between the caste hierarchy varied in different parts of the country. In each village the dominant caste controlled the land, though their property rights were circumscribed. In general, land could not be transferred or sold to people outside the village, and tenants of the dominant caste could not be evicted. Artisan families within the village did not sell their products for money but had a hereditary patron-client relationship to a group of cultivating families who paid in kind.

Another characteristic of Indian society was the joint family system. All generations of the family lived together and pooled their income with little distinction between brothers or cousins. Women were completely subordinate to men, adult men were expected to do what their fathers told them.

These village arrangements were the base of economic life for more than two millenia. Villages were defensive self-contained units designed for survival in periods of war and alien domination. They paid taxes to whoever held state power, and were relatively indifferent to the passage of foreign invaders and rulers. Conquerors of India found a ready-made source of income, so they had no incentive to destroy the system. Instead they installed themselves as a new and separate caste. This was the choice of the Muslim conquerors and later of the British. Newcomers were not absorbed into a homogeneous culture as in China. They simply added another layer to a complex system of social segregation.

In addition to village society, India had a large number of tribal communities. Aboriginal tribes led an independent pagan existence as hunters and forest dwellers, completely outside Hindu society and paying no taxes to the Moghuls. In the Moghul period they probably accounted for 10 per cent of the population.

The top layer of this traditional structure was transformed by British rule, and the Muslims were the big losers. The warlord aristocracy was replaced by a new military-bureaucratic elite. The greater efficiency of government permitted a substantial reduction in the fiscal burden. The tax squeeze on village society was reduced. The incomes of the dominant castes in rural society were increased. Property rights became better defined in the village sector, to the detriment of the traditional rights of tenants and labourers. The British built 56 000 kilometres of railways, and irrigation was extended eight-fold during their rule. Consumption patterns changed to the detriment of urban artisans and village weavers. Some of the new elite's income and savings was siphoned out of India as remittances to the UK. There was little growth in per capita income during British rule, the caste system was not modified, the top official jobs were occupied by foreigners, the *de facto* privileges of British commercial interests were detrimental to Indian entrepreneurship. When the British left, 88 per cent of the population were illiterate.

Africa

In 1820, North Africa was part of the Ottoman Empire; Spain had toeholds in Morocco; Portugal in Angola and Mozambique; and the British had just taken over the Dutch settlement at the Cape. The rest of the continent was unknown and unexplored, occupied by hunter-gatherers, pastoralists or practitioners of subsistence agriculture. Levels of technology were primitive. The only territorial units which resembled those of today were Egypt, Ethiopia and

Morocco. Slaves were the main export. Fifteen million of them left Africa between 1450 and 1870.

The European powers became seriously interested in grabbing Africa in the 1880s. France and Britain were the most successful. Twenty-two countries eventually emerged from French colonisation, twenty-one from British, five from Portuguese, three from Belgian, two from Spanish. Germany lost its colonies after the First World War, Italy after the Second.

The rush for Africa was a safety valve for European political rivalries. Territorial conquest was relatively cheap. None of the indigenous peoples (except Ethiopians) managed to repel European firepower for very long, and the risky face-offs between European powers were settled without serious conflict. The only cases where colonisation was motivated primarily by economic considerations were the Belgian Congo and Rhodesia, where Leopold II and Cecil Rhodes established personal fiefs.

The postwar situation in Western Europe was one of rapid economic growth. It became clear that possession of colonies was not a means to economic prosperity, and all the European colonies were abandoned. The British colonial bond was broken in Egypt in 1956, in Ghana in 1957, Nigeria in 1960, Tanzania in 1961, and Kenya in 1963. White settler interests retarded the process in Zimbabwe and Namibia, and in South Africa the indigenous population did not get political rights until 1994. French decolonisation started with Morocco in 1956 and was more or less completed with the exodus from Algeria in 1962. Belgium abandoned Zaire in 1960. Portugal and Spain made their exit in 1975. In these years the cold war was at its height, and the continent again became the focus of international rivalry. China, the USSR, Cuba and East European countries supplied economic and military aid to countries viewed as proxies in a world-wide conflict of interest. Western countries were strongly influenced by this competitive situation. They were less fastidious in allocating aid than they might otherwise have been. As a result Africa accumulated large foreign debts which had a meagre development pay-off.

Independence brought many serious challenges. One was the newness of the nation states. Their political leadership had to create elements of national solidarity and stability from scratch. Thirteen of the francophone countries had belonged to two large federations whose administrative and transport network had been centred on Dakar and Brazzaville. These networks had to be revamped. Zaire started independence with a civil war, Nigeria had one seven years later and Ethiopia suffered even more from this problem under its military dictatorship. In several cases, the new political elites sought to achieve political stability and

reinforce their legitimacy by creating one-party states with the incumbent president keeping this position for life. This generally made matters worse by facilitating corruption and greatly reducing pressures to change mistaken policy. In some cases, this form of despotism was fairly enlightened, in others, well intentioned utopians led their countries into disastrous experiments, and in a few, venal and repressive rulers produced even worse results.

There was a great scarcity of people with education or administrative experience. Suddenly, these countries had to create a political elite, staff a national bureaucracy, establish a judiciary, create a police force and armed forces, send out dozens of diplomats, find school teachers and build up health services. The first big wave of job opportunities strengthened the role of patronage and rent-seeking, and reduced the attractions of entrepreneurship. The existing stock of graduates was too thin to meet the new demand and there was heavy dependence on foreign personnel.

Many countries overburdened their weak state apparatus with new economic tasks. "Planning" was *a la mode*. It was encouraged by many foreign advisers and appealed to the social engineering aspirations of some of the new leaders. The late colonial practice of rigging prices and exchange rates was reinforced rather than weakened. Dependence on foreign aid was taken to be axiomatic.

In fact, African countries achieved quite respectable rates of GDP growth, but their welfare impact was eaten away by explosive population increases. Demographic expansion was faster than in other regions, and shows little sign of deceleration. African governments were slow to recognise the need for birth control and many aid donors were reluctant to help in this field.

Concluding Comments

In this paper, we first surveyed the "proximate" and measurable causes of growth. In this domain it is rather clear what the driving forces of successful capitalist development have been, but over the long haul, proximate analysis does not explain why the communist experiment failed, why Latin American performance has been worse than North American, why the ancient civilisations of Asia were so tardy in exploiting possibilities for growth, or why Africa is stuck at the income level that Western Europe had in 1820. We have offered some provisional explanations at the "institutional" level, but they are less precise and more difficult to test than proximate explanations. It is also difficult to generalise or prescribe, as

"institutional" barriers vary a good deal between different countries and regions.

Another level at which one can attempt to explain differences in performance is to look at the impact of alternative economic policies. It is difficult to draw a fine line between institutions and policy. It is often assumed that countries with very different income levels, income distribution, social structure, institutional and political heritage, can implement similar domestic fiscal or monetary policy options, privatise state enterprise, open up their economies to foreign trade, and provide successful incentives for foreign investors. This is the current operating assumption of the IMF and World Bank, which prescribe a similar policy mix for Russia, Latin America and Africa. It is the assumption of the E.U. which tries to homogenise economic policy instruments within its member countries in the approach to monetary union. In fact, however, differences in social, political and institutional heritage are an important constraint on policy options and their modes of implementation.

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Table 1. **Stock of Machinery and Equipment and Non-Residential Structures per Person Employed, Six Countries, 1820-1992**
(1990 international dollars)

	USA	France	Germany	Netherlands	UK	Japan
			Machinery and Equipment			
1820	281	n.a.	n.a.	n.a.	238	n.a.
1870	1 367	n.a.	n.a.	n.a.	857	n.a.
1890	4 115	n.a.	n.a.	n.a.	1 114	194
1913	6 932	n.a.	n.a.	n.a.	2 021	695
1950	15 150	2 325	3 948	3 878	4 699	3 234
1973	26 259	15 778	18 513	20 394	13 893	13 287
1992	39 636	33 930	31 736	30 044	23 095	40 243
			Non-residential Structures			
1820	3 503	n.a.	n.a.	n.a.	2 973	n.a.
1870	10 294	n.a.	n.a.	n.a.	6 254	n.a.
1890	23 270	n.a.	n.a.	n.a.	7 014	1 171
1913	37 905	n.a.	n.a.	n.a.	7 404	1 709
1950	42 673	15 795	14 364	25 686	7 556	4 518
1973	59 461	33 037	39 697	45 393	21 464	26 402
1992	72 625	69 232	70 119	57 918	41 797	73 135

Source: Maddison (1995*b*) and Appendix J of Maddison (1995*c*). "International" dollars is used here to denote estimates made by converting national currencies by a multilateral Geary-Khamis purchasing power parity rather than the exchange rate. Thus they represent dollars of comparable purchasing power (see Appendix C of Maddison (1995*c*) for a detailed explanation).

Table 2. **Ratio of Gross Non-Residential Capital Stock to GDP, 1820-1992**

	USA	France	Germany	Netherlands	UK	Japan
			Machinery and Equipment			
1820	.07	n.a.	n.a.	n.a.	.05	n.a.
1890	.46	n.a.	n.a.	n.a.	.11	.10
1913	.52	n.a.	n.a.	n.a.	.18	.25
1950	.64	.21	.39	.27	.31	.74
1973	.65	.50	.62	.61	.52	.58
1992	.86	.74	.70	.78	.65	1.07
			Non-residential Structures			
1820	.88	n.a.	n.a.	n.a.	.63	n.a.
1890	2.59	n.a.	n.a.	n.a.	.72	.61
1913	2.78	n.a.	n.a.	n.a.	.66	.64
1950	1.81	1.42	1.42	1.79	.50	1.03
1973	1.47	1.05	1.32	1.36	.80	1.16
1992	1.57	1.52	1.63	1.53	1.17	1.95

Source: Maddison (1995*a*) and Appendix K of Maddison (1995*c*).

Table 3. **Years of Education Per Person Aged 15-64, Six Countries, 1820-1992**
(average for both sexes)

	USA	France	Germany	Netherlands	UK	Japan
1820	1.75	n.a.	n.a.	n.a.	2.00	1.50
1870	3.92	n.a.	n.a.	n.a.	4.44	1.50
1913	7.86	6.99	8.37	6.42	8.82	5.36
1950	11.27	9.58	10.40	8.12	10.60	9.11
1973	14.58	11.69	11.55	10.27	11.66	12.09
1992	18.04	15.96	12.17	13.34	14.09	14.87

Source: Appendix K of Maddison (1995*c*) and Maddison (1991), p.64, updated. Primary education was given a weight of 1, secondary 1.4 and higher 2 in line with evidence on the relative earnings associated with different levels of education in these countries in Psacharopoulos (1975), p.165.

Table 4. **Merchandise Exports as Per Cent of GDP in Sample Countries**
(exports and GDP at 1990 prices)

	1820	1870	1913	1929	1950	1973	1992
France	1.3	4.9	8.2	8.6	7.7	15.4	22.9
Germany	n.a.	9.5	15.6	12.8	6.2	23.8	32.6
Netherlands	n.a.	17.5	17.8	17.2	12.5	41.7	55.3
UK	3.1	12.0	17.7	13.3	11.4	14.0	21.4
Total Western Europe	n.a.	10.0	16.3	13.3	9.4	20.9	29.7
Spain	1.1	3.8	8.1	5.0	1.6	5.0	13.4
USSR/Russia	n.a.	n.a.	2.9	1.6	1.3	3.8	5.1
Australia	n.a.	7.4	12.8	11.2	9.1	11.2	16.9
Canada	n.a.	12.0	12.2	15.8	13.0	19.9	27.2
USA	2.0	2.5	3.7	3.6	3.0	5.0	8.2
Argentina	n.a.	9.4	6.8	6.1	2.4	2.1	4.3
Brazil	n.a.	11.8	9.5	7.1	4.0	2.6	4.7
Mexico	n.a.	3.7	10.8	14.8	3.5	2.2	6.4
Total Latin America	n.a.	9.0	9.5	9.7	6.2	4.6	6.2
China	n.a.	0.7	1.4	1.7	1.9	1.1	2.3
India	n.a.	2.5	4.7	3.7	2.6	2.0	1.7
Indonesia	n.a.	0.9	2.2	3.6	3.3	5.0	7.4
Japan	n.a.	0.2	2.4	3.5	2.3	7.9	12.4
Korea	0.0	0.0	1.0	4.5	1.0	8.2	17.8
Taiwan	-	-	2.5	5.2	2.5	10.2	34.4
Thailand	n.a.	2.1	6.7	6.6	7.0	4.5	11.4
Total Asia	n.a.	1.3	2.6	2.8	2.3	4.4	7.2
World	1.0	5.0	8.7	9.0	7.0	11.2	13.5

Source: Appendices C, E and I of Maddison (1995*c*). As the export figures refer to the customs territory of the year cited, the GDP denominator refers to the same area and is taken from Appendix H; in the case of Korea in 1913 and 1929 the denominator was adjusted to include the whole country.

Table 5. **Proportion of Employment by Major Economic Sector, 1820-1992**

	USA	France	Germany	Netherlands	UK	Japan	China	Russia
	Agriculture, Forestry and Fisheries							
1820	70.0	n.a.	n.a.	n.a.	37.6	n.a.	n.a.	n.a.
1870	50.0	49.2	49.5	37.0	22.7	70.1	n.a.	n.a.
1913	27.5	41.1	34.6	26.5	11.7	60.1	n.a.	70.0
1950	12.9	28.3	22.2	13.9	5.1	48.3	77.0	46.0
1992	2.8	5.1	3.1	3.9	2.2	6.4	58.6	17.0
	Mining, Manufacturing, Construction & Utilities							
1820	15.0	n.a.	n.a.	n.a.	32.9	n.a.	n.a.	n.a.
1870	24.4	27.8	28.7	29.0	42.3	n.a.	n.a.	n.a.
1913	29.7	32.3	41.1	33.8	44.1	17.5	n.a.	n.a.
1950	33.6	34.9	43.0	40.2	44.9	22.6	7.0	29.0
1992	23.3	28.1	37.8	24.3	26.2	34.6	22.0	36.0
	Services							
1820	15.0	n.a.	n.a.	n.a.	29.5	n.a.	n.a.	n.a.
1870	25.6	23.0	21.8	34.0	35.0	n.a.	n.a.	n.a.
1913	42.8	26.6	24.3	39.7	44.2	22.4	n.a.	n.a.
1950	53.5	36.8	34.8	45.9	50.0	29.1	16.0	25.0
1992	74.0	66.8	59.1	71.8	71.6	59.0	20.0	47.0

Source: Appendix K of Maddison (1995*c*), Maddison (1991), Bairoch and Associates (1968), OECD (1994) and national sources.

Table 6. **Successive Steps in Growth Accounting, 1820-1992**
(annual average compound growth rates)

	USA	France	Germany	Netherlands	UK	Japan
			GDP			
1820-70	4.22	1.27	2.00	1.93	2.04	.31
1870-1913	3.94	1.63	2.81	2.20	1.90	2.34
1913-50	2.84	1.15	1.06	2.43	1.19	2.24
1950-73	3.92	5.02	5.99	4.74	2.96	9.25
1973-92	2.39	2.26	2.30	2.14	1.59	3.76
			Total Hours Worked			
1820-70	3.09	n.a.	n.a.	n.a.	.86	.21
1870-1913	2.02	-.10	.92	.92	.76	.45
1913-50	.35	-.75	.45	1.10	-.46	.40
1950-73	1.15	.01	.00	-.04	-.15	1.44
1973-92	1.27	-.46	-.38	-.07	-.57	.61
			Labour Productivity (GDP per hour worked)			
1820-70	1.10	n.a.	n.a.	n.a.	1.16	.09
1870-1913	1.88	1.74	1.87	1.27	1.13	1.89
1913-50	2.48	1.87	.60	1.31	1.66	1.85
1950-73	2.74	5.11	5.99	4.78	3.12	7.69
1973-92	1.11	2.73	2.69	2.21	2.18	3.13
			Total Non-Residential Capital Stock			
1820-70	5.46	n.a.	n.a.	n.a.	2.61	n.a.
1870-1913	5.53	n.a.	n.a.	n.a.	1.73	3.49*
1913-50	2.01	n.a.	n.a.	n.a.	1.09	4.17
1950-73	3.27	4.80	5.93	4.55	5.17	9.18
1973-92	3.13	4.30	3.37	3.07	3.32	6.81
			Capital Productivity (GDP per unit of non-residential capital)			
1820-70	-1.18	n.a.	n.a.	n.a.	-.55	n.a.
1870-1913	-1.51	n.a.	n.a.	n.a.	.16	-.95*
1913-50	.81	n.a.	n.a.	n.a.	.10	-1.85
1950-73	.63	.22	.05	.18	-2.10	.06
1973-92	-.72	-1.96	-1.04	-.90	-1.67	-2.85
			Total Factor Productivity			
1820-70	-.15	n.a.	n.a.	n.a.	.15	n.a.
1870-1913	.33	n.a.	n.a.	n.a.	.31	-.31
1913-50	1.60	n.a.	n.a.	n.a.	.81	.36
1950-73	1.72	3.22	4.05	2.71	1.48	5.08
1973-92	.18	.73	1.54	.77	.69	1.04
			Foreign Trade Effect			
1913-50	.03	.02	-.09	.10	.01	.03
1950-73	.11	.37	.48	1.32	.32	.53
1973-92	.05	.12	.15	.32	.15	.09
			Structural and Labour Hoarding (Dishoarding) Effects			
1913-50	.29	.04	.00	n.a.	-.04	-.15
1950-73	.10	.36	.68	-.07	.10	2.10
1973-92	-.17	.15	.17	-.12	-.09	.09
			Scale Effect			
1913-50	.09	.03	.04	.07	.04	.07
1950-73	.12	.15	.18	.14	.09	.28
1973-92	.07	.07	.07	.06	.05	.11
			Unexplained Residual			
1913-50	1.09	n.a.	n.a.	n.a.	.80	.39
1950-73	1.39	2.34	2.71	1.32	.97	2.17
1973-92	.23	.39	1.15	.51	.58	.75

* 1890-1913.

Source: Panels 1 to 6 from Appendix K of Maddison (1995*c*) for Japan, UK and USA, and French, German and Dutch labour inputs and labour productivity from Appendix J. Capital inputs from Maddison (1996). Other elements from Maddison (1995*b*). Total factor productivity is the ratio of GDP growth to the weighted average of associated inputs (labour, human capital, non-residential gross fixed capital, and land); with weights for all six countries as in Appendix K of Maddison (1995*c*).

Table 7(a). **Labour Productivity Levels (GDP per Hour Worked) in Advanced Capitalist Countries, 1870-1992**
(US level = 100)

	1870	1913	1929	1938	1950	1973	1992
Austria	62	57	44	39	32	65	83
Belgium	94	70	64	61	48	70	98
Denmark	67	66	68	61	46	68	75
Finland	37	35	34	36	32	57	70
France	60	56	55	62	45	76	102
Germany	70	68	58	56	35	71	95[a]
Italy	46	41	38	44	34	66	85
Netherlands	103	78	84	72	51	81	99
Norway	48	43	45	50	43	60	88
Sweden	54	50	44	49	56	77	79
Switzerland	77	63	72	68	69	78	87
UK	115	86	74	69	62	68	82
Arithmetic Average	69	59	57	56	46	70	87
Australia	147	103	86	83	69	72	78
Canada	71	82	69	61	77	81	87
USA	100	100	100	100	100	100	100
Japan	20	20	24	25	16	48	69

[a] Figure refers to West Germany; including East Germany it would be 85.

Source: Table J-4 of Maddison (1995*c*).

Table 7(b). **Labour Productivity Levels (GDP Per Hour Worked) in Medium and Low Income Countries, 1950-92**
(US level = 100)

	1950	1973	1992		1950	1973	1992
Greece	20	46	59[a]	Argentina	49	47	41
Ireland	30	43	71[a]	Brazil	19	24	23
Portugal	20	42	48	Chile	37	38	37
Spain	21	46	69	Colombia	22	25	27
				Mexico	24	33	29
Arithmetic Average	23	44	62	Peru	23	27	15
				Venezuela	71	82	58
Czechoslovakia	29	34	28				
Hungary	21	28	25	Arithmetic Average	35	39	33
Poland	19	24	21				
USSR	24	28	19	Bangladesh	6	3	4
				China	7	6	10
Arithmetic Average	23	29	23	India	5	4	5
				Indonesia	8	8	12
				Pakistan	6	6	9
				Philippines	11	11	10
				South Korea	10	14	29
				Taiwan	9	18	38
				Thailand	6	7	15
				Arithmetic Average	8	9	15

[a] 1991.

Source: Table J-4 of Maddison (1995*c*).

Table 8. **Falling Behind and Catching-up: Rates of Divergence from or Convergence Towards the US Labour Productivity Levels (GDP Per Hour Worked), 1870-1992**
(annual average compound growth rates)

	1870-1950	1950-73	1973-92
Austria	-0.81	3.12	1.30
Belgium	-0.84	1.70	1.76
Denmark	-0.46	1.69	0.52
Finland	-0.20	2.62	1.09
France	-0.37	2.33	1.57
Germany	-0.88	3.18	1.53
Italy	-0.37	2.98	1.27
Netherlands	-0.87	2.01	1.05
Norway	-0.15	1.48	2.04
Sweden	0.04	1.39	0.17
Switzerland	-0.14	0.52	0.59
UK	-0.77	0.39	1.03
Arithmetic Average	-0.49	1.96	1.16
Australia	-0.95	0.21	0.39
Canada	0.10	0.23	0.35
Japan	-0.30	4.84	1.96
Greece		3.60	1.29[a]
Ireland		1.56	2.87[a]
Portugal		3.20	0.73
Spain		3.60	2.16
Arithmetic Average		2.99	1.76
Czechoslovakia		0.68	-1.06
Hungary		1.12	-0.49
Poland		1.03	-0.78
USSR		0.64	-1.92
Arithmetic Average		0.87	-1.06
Argentina		-0.19	-0.70
Brazil		1.02	-0.25
Chile		0.14	-0.20
Colombia		0.56	0.35
Mexico		1.25	-0.62
Peru		0.69	-2.87
Venezuela		0.63	-1.87
Arithmetic Average		0.59	-0.88
Bangladesh		-2.33	0.77
China		-0.65	2.88
India		-0.59	1.46
Indonesia		-0.11	2.00
Pakistan		0.08	1.77
Philippines		0.00	-0.56
South Korea		1.33	4.04
Taiwan		2.84	4.13
Thailand		0.94	3.90
Arithmetic Average		0.17	2.27

[a] 1973-91.

Source: Derived from Table J-5 of Maddison (1995*c*).

Table 9. **Inequality of Pre-Tax Income of Households, 19 Countries**
(top decile per capita income as a multiple of that in bottom two deciles)

France (1970)	14.4	Argentina (1961)	11.2
Germany (1973)	10.5	Brazil (1970)	20.0
Netherlands (1967)	10.5	Chile (1968)	21.2
Sweden (1972)	8.1	Colombia (1974)	21.8
UK (1973)	9.1	Mexico (1969)	25.5
		Venezuela (1962)	25.0
Australia (1966-67)	7.2	India (1964-65)	12.4
Canada (1969)	12.6	Japan (1969)	7.5
USA (1972)	14.9	Korea (1970)	7.6
		South Africa (1965)	41.5
		Tanzania (1968)	16.4

Sources: Sawyer (1976) p.14 for OECD countries; Lecaillon, Paukert, Morrisson and Germidis (1984), pp.26-27 for other countries. Figures for South Africa refer to individual and not household income.

Endnotes

[1] In defining productivity leadership, I have ignored the special case of Australia, whose impressive achievements in the nineteenth century were due largely to its natural resource advantages rather than to its technical achievements and stock of man-made capital.

[2] There seems to be a widely held view that the United States had a lower capital intensity than the UK in the nineteenth century. This flatly contradicts the evidence of my standardised estimates. Field (1983) has been influential in spreading the erroneous perception. He asserts that the US ratio of tangible assets (excluding land) to output was one third of that of the UK in the mid-nineteenth century. He compares an early (1952) Goldsmith estimate of the net stock of US tangible assets in 1850 derived from survey data, with the gross stock of wealth in Great Britain in 1860 (at 1851-60 prices), which Feinstein derived by the perpetual inventory method using very long asset lives. Field adds an unexplained 400 million pounds to Feinstein's estimate and converts it into dollars by the exchange rate. This shaky assemblage was later described by James and Skinner (1985) as "strong historical evidence". Broadberry (1993) seems to have been convinced by Field. Engerman (in Gallman and Wallis 1992) also suggests that "the United States had a considerably lower capital-output ratio than did Great Britain (and the rest of the world) in the nineteenth century". He cites Goldsmith's balance sheets (including land, tangible and financial assets held at home and abroad) as evidence. However, Goldsmith valued British land at 60 times the US price.

[3] See Maddison (1972) for a detailed review of Denison's methodology, and a confrontation of his results for nine countries with mine, using alternative assumptions within the same analytical framework. Maddison (1987) is a survey of the growth accounting literature, and presents my own detailed growth accounts for six advanced capitalist countries for 1913 to 1984.

[4] See Denison (1993) for a survey of most of this literature.

[5] See Maddison (1969) for a discussion of Japan's Tokugawa background and the Meiji reaction to the West.

[6] There are several major studies of China which are relevant to the topics I raise. Perkins (1969) analyses China's quantitative economic performance from 1368 to 1968; Elvin (1973) deals with China's early technical precocity and its failure to keep pace with the West after 1400; Chang (1962) deals with the bureaucracy and gentry and their sources of income; Weber (1964) deals with Chinese religion and its socio-economic impact.

[7] See Maddison (1971) and Lal (1988) for an extensive analysis of India's institutional heritage.