BRITISH ECONOMIC GROWTH 1760-1913: A CHALLENGE FOR NEW GROWTH THEORY

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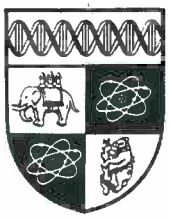

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BRITISH ECONOMIC GROWTH 1760-1913: A CHALLENGE FOR NEW GROWTH THEORY

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British Economic Growth 1760-1913: A Challenge for New Growth Theory

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I. Introduction

Most empirical investigation of the new growth theory has been undertaken looking at cross-sections of countries for the period since 1960 leading to well-known papers such as those of Barro (1991), De Long and Summers (1991), Levine and Renelt (1992) and Mankiw, Romer and Weil (1992) which are reasonably successful in accounting for observed growth patterns. Equally interesting, but so far much less thoroughly studied, is how successful new growth theory is in explaining changes in growth rates over time in a given country. A recent paper which opens up this issue looking at recent decades raises significant doubts on this score and concludes that the explanatory variables highlighted by new growth theory show much greater persistence than does growth performance (Easterly et al., 1993).

The existence of estimates of economic growth rates for Britain dating back to 1700 provides an opportunity to examine further the ability of new growth theory to explain acceleration and deceleration in growth while at the same time considering its hypotheses in a different era of economic progress, where growth rates and income levels might be particularly likely to show persistent differences for the reasons highlighted by Nelson and Wright (1992). Indeed recent writers have informally appealed to Britain's experience during the Industrial Revolution as supporting their models (De Long and Summers, 1991; Murphy, Shleifer and Vishny, 1991).

A substantial research effort in the past twenty years has produced a substantially revised picture of Britain's growth in the eighteenth and nineteenth century which is summarized in Table 1. Both the measurement and the interpretation of this experience have been carried out in a traditional Solovian framework embodied in the assumptions of the traditional growth accounting approach of Table 1. Noteworthy controversies have been conducted in this way over growth during the Napoleonic Wars (Crafts, 1987; Mokyr, 1987; Williamson, 1987) and the so-called climacteric at the end of the Victorian period (Crafts, 1985, ch.8; McCloskey, 1981).

TABLE 1

Sources of Growth, 1760-1913 (% per annum)

	Real GDP Growth	Due to Capital	Due to Labor	Total Factor Productivity
1760-1801	1.0	0.5	0.4	0.1
1801-31	1.9	0.8	0.7	0.4
1831-60	2.5	1.2	0.7	0.6
1856-73	2.2	0.9	0.5	0.8
1873-99	2.1	0.9	0.5	0.7
1899	1.4	0.9	0.5	0.0

Sources: Derived from a standard growth accounting identity using Crafts and Harley (1992) for the first two rows and Feinstein et al. (1983) for the last three rows; 1831-60 is amended from Feinstein (1981) to allow for his revised (1988) capital stock estimates.

In this paper the following three questions will be addressed:

i) Are the predictions of New Growth Theory consistent with the evolution of growth over time in pre-World War I Britain?

ii) Does New Growth Theory call for a re-appraisal of the controversies surrounding growth at the beginning and end of the nineteenth century?

iii) Has New Growth Theory anything to learn from nineteenth century British economic history?

II. Key Ideas from Endogenous Growth Theory

At the heart of New Growth Theory is the proposition that investment in a broad sense, including human as well as physical capital, drives the growth process and that broad capital does not experience diminishing returns. Long-run growth in per capita incomes

occurs without the need to invoke exogenous technological progress. In addition, positive externalities to investment especially through the spillover effects of learning are stressed. An implication is that policy changes, changes in savings propensities or shocks to the output to capital ratio can have effects on the long-term (steady-state) growth rate unlike the case of the traditional Solow model. Both traditional growth accounting and trend growth estimates derived using the assumption of trend stationary processes are potentially seriously misleading. A basic overview of one-sector endogenous growth theory is contained in De Klundert and Smulders (1992).

Recognizing the importance in production of human capital, externalities and learning effects can, of course, be consistent with a Solow type world in which there are still ultimately diminishing returns to broad capital and where economies have different steady-state levels of income - such in essence is the claim of Mankiw, Romer and Weil (1992). Moreover, there seems to be strong evidence of tendencies to convergence among the post-1945 OECD economies and it may be that the key insight of new growth theory turns out to be the existence of locally increasing returns together with multiple equilibria in the form of a number of convergence clubs of different groups of countries (Durlauf and Johnson, 1992).

Two hypotheses from the one-sector endogenous growth literature are of particular interest in looking at nineteenth century British growth. First, De Long and Summers (1991) stress that the key type of physical investment expenditure to promote growth is that in machinery and equipment which they argue is characterized by unusually high social returns. Second, as set out by, for example, Easterly and Rebelo (1993), investment and therefore long-run growth rates are reduced by increases in direct (but not indirect) tax rates working through households' intertemporal utility maximization decisions.

Two-sector models in the New Growth Theory tradition offer further hypotheses for consideration in the context of British industrialization and again two are worth close attention. Murphy, Shleifer and Vishny (1991) present a simple model in which rent-seeking

reduces the rate of growth rather than just the level of real income notably through drawing talent away from entrepreneurship in goods production. The implications of the model are that, seeking the highest quasi-rents, the ablest run firms in the sector (rent-seeking or production) whose output is most elastic with respect to human capital unless differences in the compensation contract or barriers to persons of a certain gender or ethnicity intervene.

Lucas (1988) examines possible consequences of specialization along the lines of comparative advantage in international trade in a world in which human capital is accumulated through work experience which reduces the unit labour requirement over time but at rates which differ between sectors. If specialization is in the sector with greater learning effects, then living standards improve relatively rapidly - (provided the terms of trade do not deteriorate too quickly) - while at the same time learning tends to reinforce the original pattern of comparative advantage.

Interestingly, in a British context at least, both these last two models may, prima facie, be more insightful for the period of the Industrial Revolution than for recent decades and they certainly have echoes in the historical literature. Jones (1988) bases his interpretation of the world's failure to achieve modern economic growth on the suffocating impact of rent-seeking. Nelson and Wright (1992) argue that in the nineteenth century productivity increases depended largely on trial and error methods with much tacit rather than codified knowledge which tended to preclude international spillovers in a world with much less intra-industry trade. The British stranglehold on exports of cotton textiles is especially significant in this respect (Sandberg, 1974). Crouzet (1985) stresses that France and other European countries were cut-off from benefiting from British experience for a crucial period during the Napoleonic Wars.

III. A Preliminary Empirical Investigation

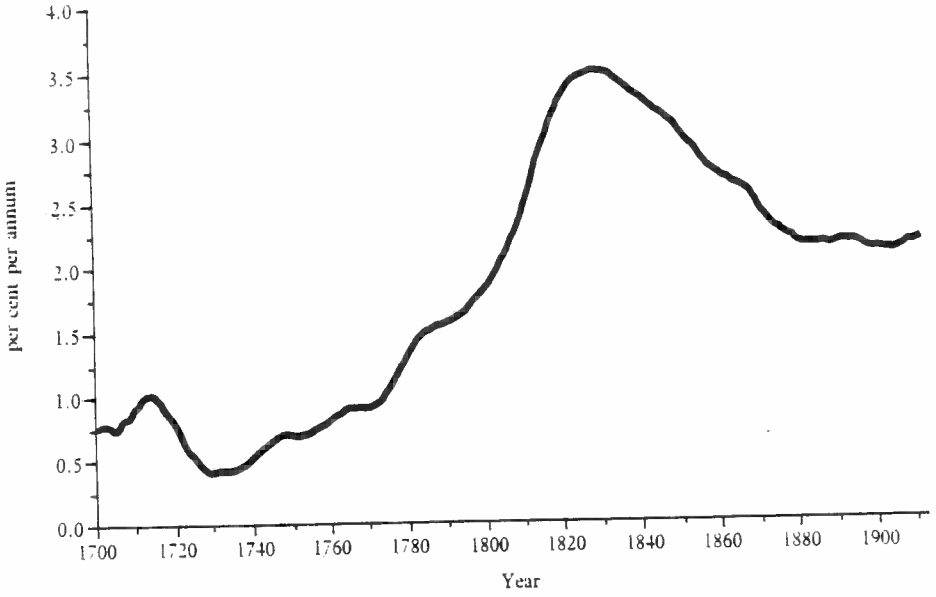
This section contains two elements of a new look at trends in British growth making use of the data underlying Table 1 but approaching the interpretation of the experience using recent developments in economic and econometric analysis.

Figures 1 and 2 reflect estimates of the trend rate of growth based on time series analysis rather than arithmetic calculation of growth rates between endpoints which is the basis of Table 1. Annual data are only available for part of the period for GDP; the only possibility of annual data on output growth for the eighteenth century lies in estimates of industrial production which are themselves imperfect, although not necessarily unreliable (Crafts and Harley, 1992).

The estimates for industrial output in Figure 1 obtained with a structural time series model using a Kalman filter technique show a steadily rising trend rate of growth during the years 1760-1830, as might be expected given Table 1, although the subsequent pattern of deceleration is rather different from what one might guess. Importantly, trend growth is stochastic, is much higher in the fifty years before World War I than in the late eighteenth century, and the unit root hypothesis cannot be rejected for this sample (Crafts, Leybourne and Mills, 1991).

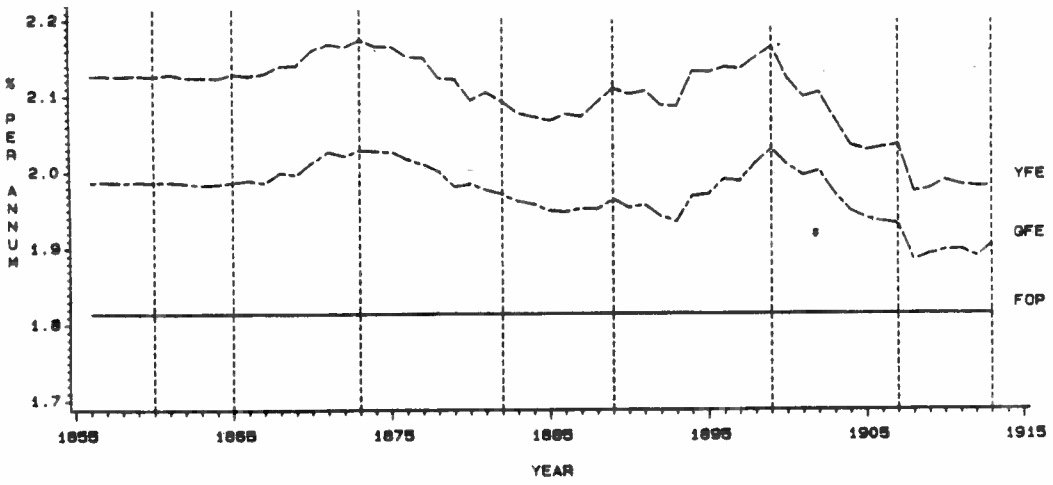
The estimates for trend GDP growth shown in Figure 2 also cast doubt on the notion of a late nineteenth/early twentieth century growth climacteric - any decline in the estimated trend is obviously very small. In this case, however, the unit root hypothesis was rejected by the test reported in Table 2 and subsequent analysis in Mills (1991) of four separate tests concluded decisively against persistence in innovations to output for pre-World War I UK.

Figure 1 : Estimated Trend Rate of Growth of Industrial Output



Source: Crafts, Leybourne and Mills (1992).

Figure 2 : Estimated Trend Rate of Growth of GDP



Source: Crafts, Leybourne and Mills (1989); estimates are for alternative series where YFE is based on income, FOP is based on output and YFE is the usually quoted series based on an average of output, income and expenditure estimates.

TABLE 2

Unit Root Test on 19th Century UK GDP

Dickey-Fuller test based on the equation (1855-1913):

$$y_t = \underset{(0.245)}{1.032} + \underset{(0.101)}{0.580}y_{t-1} + \underset{(0.002)}{0.081}_t + \underset{(0.131)}{0.374}(y_{t-1} - y_{t-2})$$

$T = -4.16$

rejects the unit root null hypothesis that the coefficient on $y_{t-1} = 1$, where y is the logarithm of GDP.

The estimated trend stationary equation for GDP is:

$$y_t = 6.12 + 0.0193t \quad (s = 0.0355).$$

Sources: Crafts, Leybourne and Mills (1989) and Crafts and Mills (1992).

The second approach used here is to consider British growth in the light of Levine and Renelt's (1992) regression analysis of recent growth experience which attempts to identify robust findings from tests of hypotheses spawned by New Growth Theory. Before turning to this explicitly, Table 3 reports on what is known about the behaviour over time of variables highlighted in recent growth economics.

Two features of Table 3 stand out by comparison with data-sets for the recent past. First, it is notable how low was the share of expenditure devoted to equipment investment in Britain in these years. This is ironic given that De Long and Summers motivate their well-known paper by explicit reference to mechanization as the central feature of the Industrial Revolution (1991, p. 445) but perhaps not so surprising given the calculations by Field (1985, p. 387) that manufacturing machinery comprised less than 4% of the British and less than 1.5% of the American net capital stock in 1860. Second, outside of wartime, it is striking how low was the share of government consumption and direct taxes as a share of GDP and yet both investment in broad capital and the rate of economic growth appear to have been at distinctly modest rates.

TABLE 3

New Growth Theory Variables, 1760-1913

	Investment/ GDP	Equipment Investment/ GDP	Primary School Enrolment	Direct Tax Rate (%)	Government Consumption/ GDP
1760-80	0.057	0.011	0.36	2.4	0.103
1780-1801	0.063	0.013	0.36	2.7	0.124
1801-31	0.083	0.016	0.36	3.9	0.144
1831-60	0.094	0.019	0.62	1.5	0.060
1856-73	0.077	0.018	0.76	1.3	0.053
1873-99	0.083	0.020	1.00	1.0	0.056
1899-1913	0.087	0.022	1.00	1.7	0.088

Sources: Investment data are from Feinstein (1988, pp. 431-2), school enrolment data based on Matthews et al. (1982, p. 573 extended back to eighteenth century using literacy estimates from Cressy (1980, p.177), tax and government expenditure from Mitchell (1988, pp. 576-87).

Table 4 reports the results of an attempt to predict changes in British growth rates for the standard periodization adopted in the historical literature using a standard equation estimated for the recent past. It can be regarded as a severe out of sample test!

It appears from the table that the model does quite well at explaining the move to higher growth in the mid-nineteenth century compared with the mid eighteenth century which would result from higher rates of investment in both physical and human capital together with lower government spending (cf. Table 3). On the other hand, it fails to predict either the acceleration in growth during the Industrial Revolution years 1780-1830 or the alleged climacteric of 1899-1913.

TABLE 4

Predicted Differences from 1760-80 Base in Growth Rate of Income/Person

	Predicted	Actual
1780-1801	-0.07	+0.4
1801-31	-0.02	+0.5
1831-60	+1.11	+1.3
1856-73	+1.23	+1.4
1873-99	+1.69	+1.2
1899-1913	+1.53	+0.6

Sources: Predicted income growth based on the following equation from Levine and Renelt (1992) (with irrelevant dummies suppressed):

%Y/Pgrowth = 2.01 - 0.69RGDP60* + 0.08Popgr + 1.21SEC + 1.79PRIM* + 9.41INV* - 6.37 GOV*

where * indicates a statistically significant coefficient, RGDP60 is real income per person in 1960 in PPP adjusted dollars, SEC is the secondary school enrollment rate, PRIM is the primary school enrollment rate, INV is the ratio of investment to GDP and GOV is the ratio of government consumption spending to GDP. To predict changes in income growth only the statistically significant coefficients were used and RGDP60 was ignored. This last variable can be thought of as a proxy for catch-up potential from income levels lagging behind the leading country - the UK is regarded as the leader throughout the period.

Is it possible that the failure of the Levine and Renelt equation to forecast the changes in growth rates at either end of the nineteenth century reflects measurement error? If so, the problem would surely lie with the proxy for human capital accumulation which may be less suitable for this bygone age (and may well be less than satisfactory in modern times).

This explanation seems extremely unlikely for the 1899-1913 period where the main distortions, which relate to education above the primary level and migration, would surely lead a better specified equation to predict increasing rather falling rates of growth. First, at this point, Britain was substantially raising its commitment to formal education at the secondary and higher levels; indeed Pollard (1989, p.181) describes the expansion of technical and scientific education as 'breathtaking'. Second, this was a period of increased migration which was disproportionately made up of the unskilled (Hatton, 1993); for

example, Erickson (1972, p. 363) found 29.5% of male emigrants from England and Scotland arriving on ships in New York in the 1880s were labourers compared with 8.2% in the 1881 Census. It seems clear that migration during the so-called climacteric was tending to raise the rate of growth of human capital per member of the home labor force.

For the Industrial Revolution era it is more difficult to be sure but an explanation of accelerating growth through a significant expansion of human capital accumulation seems unlikely. In particular, it would be desirable to know what may have happened to the acquisition of skills through on the job training. However, the most detailed study of workforce literacy based on analysis of convicts transported to Australia suggests that illiteracy was increasing, especially among skilled categories, and concludes that there was a deskilling of the labour force (Nicholas and Nicholas, 1992).

Prima facie, the variables highlighted by New Growth Theory do not seem to be successful in explaining the variation in British growth over time. Perhaps it will be necessary therefore to conclude, as do Easterly et al. (1993), that shocks may be an important influence on changing growth rates. There are certainly good candidates for this role in the historical literature.

Mokyr (1990, p.13) provides an explanation for the Industrial Revolution period based on his concept of 'macroinventions', which are unrelated to the volume of investment in broad capital and essentially unpredictable. Important examples occurred in the late eighteenth century in cotton and iron which gave rise subsequently to a renewed capability to grow through 'microinventions', the small incremental improvements obtained through learning. This would, of course, amount to suggesting that it would be wise to retain the possibility that exogenous technological progress can sometimes play a part in growth, at least at the technological frontier.

While this hypothesis envisages a rise in the trend rate of growth during the Industrial Revolution, as was suggested by the econometric results, for the era immediately before World War I the time series evidence indicated that it may be better to look for shocks which temporarily pushed the economy below trend. Crafts and Mills (1992) provide a possible solution. They find that investment fluctuated far more than would be expected in a neoclassical model with growth and real business cycles while at the same time they find that share prices exhibited massive excess volatility. This suggests that the economy may have experienced fluctuations arising from expectations formed along Keynesian lines in a world of imperfect information.

IV. A Further Look

Before accepting the conclusions of the last section, it is desirable to consider the two-sector models reviewed in section II, whose insights are not really captured by Table 4. These models will also be helpful in pursuing the second of the questions posed in the introduction concerning the need for re-appraisal of controversies surrounding the episodes which were the focus of attention in section III.

Murphy, Shleifer and Vishny (1991, p. 505) see Britain as a case where the allocation of talent favoured entrepreneurship during the Industrial Revolution and contrast this with eighteenth century France where the best and the brightest became rent-seekers. So perhaps the reallocation of talent explains the acceleration in British economic growth after 1780?

It is surely correct to argue that political circumstances in Britain were less conducive to rent-seeking than those in France (Root, 1991) and to note that the balance of power between Parliament and the Monarchy after 1688 precluded capricious behaviour by myopic rulers (North and Weingast, 1989). It is also right to suppose that by the mid-nineteenth century there had occurred a shift from pre-industrial times towards fortunes being made from industrial entrepreneurship.

TABLE 5

Some Aspects of the Allocation of Talent

a) Lawyers/Occupied Population(%)

1688: 2.9	1841: 2.3	1861: 1.6	1881: 1.6
1801: 2.5	1851: 1.9	1871: 1.5	1891: 1.6

Sources: Derived from Lindert and Williamson (1982) and Armstrong (1972), assuming that prior to 1841 the proportion of clerks to lawyers was as in 1841.

b) UK Non-Landed Estates of 500K plus by Sector

	Manufacturing & Minerals	Professions/ Public Admin	Commerce/ Finance
1809-39	8 [111]	4 [158]	19 [344]
1840-79	60 (15)	9 (0)	88 (19)
1880-1919	290 (83)	11 (0)	273 (77)

Source: Derived from Rubinstein (1981) (1992) adding food, drink & tobacco to his manufacturing category. Figures in parentheses are those leaving £1 mn. plus and in square brackets those leaving £100K plus.

c) American Multimillionaires

	Manufacturing	Minerals	Commerce/ Finance
Born pre-1865	34	26	39

Source: Derived from Jaher (1980).

Nevertheless, Table 5 suggests that during the classic Industrial Revolution years British fortunes were overwhelmingly to be made in commerce/finance rather than in the industrial activities in which productivity growth so famously accelerated. Also very striking in the early nineteenth century is the relative importance of the professional and public administrative category. Rubinstein sums up the data as showing "the importance of the British state in its various facets - the East India Company, the military, government

contracting, office-holding in State and Church and 'Old Corruption' - as a source of wealth far more important than marketplace-determined manufacturing capitalism or the free professions" (1992, p.88). Indeed the use of the most educated continued to be skewed towards the rent-seeking sectors of the church and the law (as Table 5 also suggests); of Cambridge University students between 1752 and 1849 61% went into the church and none into banking or business proportions which changed to 38% and 7% respectively during 1850-99 (Jenkins and Caradog-Jones, 1950, p.99).

Rather than accounting for acceleration in growth after 1780, an allocation of talent approach may be better deployed to explain why growth was held back in this period. More generally, New Growth Theory tends to add weight to the controversial claims of Williamson (1985) (1987) that growth was seriously retarded by the Napoleonic Wars.

Williamson based his argument on the one-for-one crowding out effects of government borrowing in the context of a traditional neoclassical growth model and argued that in the absence of war in the years 1791-1820 the capital stock would have grown 2.42% and output 0.85% per year faster (1985, p.179). Subsequent research has been sceptical, notably because it is not clear that real interest rates rose (Heim and Mirowski, 1987). The extent of crowding out effects is extremely hard to ascertain particularly because we do not have good evidence either on price expectations or on the extent of Ricardian Equivalence (Black and Gilmore, 1990).

These issues cannot be resolved here but the New Growth Theory does suggest three points which tend to strengthen Williamson's argument. First, and most obviously, whereas Williamson used profits share of income to estimate the elasticity of output with respect to capital, this might now generally be thought to be an underestimate which ignores externalities. Second, the disincentive to investment may come through higher direct taxes - income tax was introduced in 1799 - as well as interest rates. Third, the war in raising the size of the government sector and government contracting may have induced a switch of

talent to rent-seeking, whose rewards are reflected in Table 5. Even so, Williamson's argument still seems distinctly overstated since his counterfactual investment rate in the absence of war is one which the UK did not actually achieve at any time before the 1950s.

The Lucas (1988) model appears quite attractive as a way of thinking about the acceleration in British growth in the early nineteenth century and the associated British lead over European rivals. The key exportables in which Britain established a technological lead and an industry much bigger than elsewhere were cotton textiles and iron. By 1850, the UK had 21 mn. cotton spindles compared with 4.5 mn in France and sold 60% of cotton output abroad - (at one point cotton goods were half of all exports) - while it produced 2.25 mn tonnes of pig-iron compared with 0.4 mn. in France and sold 40% as exports (Mitchell, 1992).

Moreover, the economic history literature has always argued that the first half of the nineteenth century was a period when much of the productivity advance in both industries came through learning by doing, which, particularly in the case of iron, had few spillovers abroad (Allen, 1983; David, 1975; Hyde, 1977). The downward revisions to estimates both of growth and total factor productivity growth confirmed by Crafts and Harley (1992) give the clear implication that a high proportion of the productivity improvement accrued in a relatively few dynamic sectors including notably cotton and iron (Crafts, 1985; Harley, 1991).

Clearly then, the Lucas model is helpful in thinking about British growth during the Industrial Revolution and, under these nineteenth century conditions, provides a hypothesis to explain the 'mysterious' acceleration in British growth not accounted for by the standard regression approach. Even so, its contribution needs to be put into a proper perspective and two important points should be borne in mind. First, eliminating the gains from trade related learning by doing would only remove part of the acceleration in growth. For illustration, assume in the counterfactual case that Britain in the 1850s had French levels of productivity

in cotton (O'Brien and Keyder, 1978) and German levels in iron (Allen, 1979) and in both cases catered only for home demand, then rework Harley's (1992) decomposition of total factor productivity growth by sector. The result would be a reduction of overall TFP growth of about a quarter (= 0.12% per year for 1780-1860).

Second, recall that these impressive gains from 'microinvention' required the preceding (exogenous) 'macroinventions' of the eighteenth century to bring about a re-orientation of British trade. Davis (1979, pp.64-5) puts the point very clearly, as follows. "Export trade had little to do, directly or indirectly, with the beginnings of the Industrial Revolution. The immense expansion of cotton manufacture from the 1770s... was associated not with small improvements but with a fundamental transformation in techniques and organization... the cotton industry grew to a large scale before its export trade became very significant." Indeed, in the middle of the eighteenth century, relatively rapid agricultural productivity improvement seemed to be pushing Britain to a position of comparative advantage in agriculture (Crafts, 1993). A simulation with a CGE model of a counterfactual in which this agricultural improvement continued at its historical rate but with no technological progress in industry confirms that Britain would indeed have become a substantial agricultural exporter but for the shift in direction promoted by the shock of macro-inventions (Harley, 1992).

How do these models fare when asked to confront the growth slowdown of the late nineteenth century? The Allocation of Talent model based on rent-seeking versus productive sector entrepreneurship is not helpful in this instance. Britain from the mid-nineteenth century to World War I remained committed to free trade and a balanced budget, was a minimalist state with regard to industrial policy and, as Table 3 showed, maintained a low ratio of government expenditure to GDP. Table 5 underlines the demise of wealth made from public sector patronage after the end of 'Old Corruption'.

The Lucas model, however, offers some important insights both regarding slowdown and the failure of the UK to match the performance of the USA. By the 1880s the productivity gains from learning by doing with the classic industrial revolution technology had been largely exhausted and total factor productivity growth in both pig-iron and cottons dried up (Lazonick and Mass, 1984; McCloskey, 1973). This can account for at least a modest slowdown in the trend rate of growth. Moreover, as Table 6 reports, the UK failed to establish a revealed comparative advantage in the hi-tech sectors of the early twentieth century where learning effects could now be expected to be strong. Kennedy (1987) in particular has stressed that the share of value-added accruing in these sectors was distinctly lower than in the USA.

TABLE 6

Revealed Comparative Advantage Rankings

	UK		USA	
	1913	1937	1913	1937
Agricultural Equipment	10	16	2	1
Cars & Aircraft	12	11	4	2
Industrial Equipment	5	7	3	3
Electricals	8	5	5	4
Iron & Steel	3	9	9	5
Non-Ferrous Metals	16	15	1	6
Book & Film	13	8	10	7
Chemicals	11	12	12	8
Metal Manufactures	7	13	6	9
Brick & Glass	14	10	11	10
Wood & Leather	15	14	7	11
Rail & Ship	1	3	8	12
Fancy Goods	9	4	13	13
Apparel	6	6	14	14
Alcohol & Tobacco	4	1	15	15
Textiles	2	2	16	16

Source: Derived from Crafts (1989, Table 1); at this time hi-tech sectors might be thought of as cars & aircraft, chemicals, electricals and industrial equipment.

Lucas (1993) reviewing his earlier model accepts that in any particular sector learning by doing does become exhausted and that the model requires modification if it is to offer a

plausible explanation of persistent growth differences in the very long-run. In particular, it needs a mechanism whereby the human capital accumulated through experience in one-sector spills over into new goods in which further learning effects accrue. The history of the late nineteenth century suggests that such a mechanism did not operate strongly in Britain and certainly did not promote the acceleration in TFP growth to the hitherto unprecedented rate of 1.5% per year achieved by the USA from the early twentieth century (Abramovitz and David, 1973).

Nelson and Wright (1992) give a highly plausible explanation of this transition which is suggestive of the value of Lucas (1993) as a vision of America at this time. They argue that the basis of American leadership was the special conditions of cheap resources, high wage rates and large markets which promoted the corporate capitalism much praised by Chandler (1990). American success was in particular based on "the confluence of two technological streams: the ongoing advance of mechanical and metal-working skills and performance, focused on high-volume production of standardized commodities; and the process of exploring developing and utilizing the mineral resource base (1992, p. 1938). Wright (1990, Table 4) demonstrates that comparative advantage in American manufacturing exports in the early twentieth century was very different from that of the UK and based on relative natural resource intensity. Table 5 reflects the implications of American compared with British conditions for the allocation of talent between manufacturing & minerals and commerce & finance.

Of course, the precise contribution of America's natural resource endowments, compared with high volumes of invisible earnings from pre-existing foreign investment or capital market imperfections as argued by Crafts (1985) and Kennedy (1987), in promoting this favorable combination of comparative advantage and growth remains to be established. Nevertheless, a key contribution of New Growth Theory is to undermine McCloskey's (1981) position that there could not have been any British growth failure and that observed

productivity performance was the maximum permitted by an exogenous natural rate of growth.

V. Conclusions and Implications for New Growth Theory

By now the answers to the first two questions posed in the introduction should be fairly clear. First, approaches based on New Growth Theory do not appear able readily to explain changes over time in the rate of economic growth in Britain during 1760-1913. In particular, both the acceleration in growth during the Industrial Revolution and the apparent climacteric of the late nineteenth century go against what one would expect given trends in factor accumulation, government activity and opportunities for rent-seeking. In this respect my findings are similar to those of Easterly et al. (1993) for twentieth century growth.

Second, nevertheless, in each of these episodes insights from New Growth Theory are helpful in understanding the growth process and are likely to give rise to a significant re-appraisal of existing debates. New Growth Theory provides additional support for the role of the Napoleonic Wars in reducing early nineteenth century growth and also offers renewed scope for those wishing to argue that late Victorian Britain did experience a growth failure. In general, the two-sector models considered in Lucas (1993) seem potentially more insightful than one-sector models in the British case.

What then might New Growth Theory learn from nineteenth century British economic history? Four points may be useful.

i) It is doubtful that growth theorists should aspire to the complete eradication of exogenous technological change from the explanation of growth. The Industrial Revolution underlines the role of 'macroinventions' in promoting faster growth even when the wartime economic environment was inauspicious. At the same time, it must be recognized that both

history and recent growth models lead us to anticipate that such exogenous shocks matter a good deal because of the subsequent learning-based growth to which they give rise.

ii) It is by no means clear that the UK pre-World war I should be modelled at the macro-level as a case of endogenous growth, particularly given the evidence in favour of trend stationarity in GDP. There is good support for the idea of learning effects but it remains to be established that there were not diminishing returns to broad capital. Perhaps the nineteenth and twentieth centuries were different epochs, as Nelson and Wright's (1992) review of the basis of technological leadership suggests.

iii) Similarly, it seems probable that nineteenth century Britain and America became members of different convergence clubs given the important roles of natural resources and localized learning effects in technology and comparative advantage. Broadberry (1992) argues that the long-run path of manufacturing productivity differentials supports this hypothesis. This would indicate the need for caution in interpreting estimates of the apparent impact of productivity gap measures of catch-up, as Durlauf and Johnson (1992) emphasize.

iv) Finally, the British experience points to the importance of the research agenda of investigating the idea of learning spillovers, set out in Lucas (1993), while also suggesting an example of an economy where relatively fast learning was not sustained. Perhaps this was, at least partly, a consequence of natural resource endowments but more research into such instances as well as Korean style 'miracles' would seem highly desirable.

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