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THE TAKE-OFF INTO SELF-SUSTAINED GROWTH[1]

I

THE purpose of this article is to explore the following hypothesis: that the process of economic growth can usefully be regarded as centering on a relatively brief time interval of two or three decades when the economy and the society of which it is a part transform themselves in such ways that economic growth is, subsequently, more or less automatic. This decisive transformation is here called the take-off.[2]

The take-off is defined as the interval during which the rate of investment increases in such a way that real output *per capita* rises and this initial increase carries with it radical changes in production techniques and the disposition of income flows which perpetuate the new scale of investment and perpetuate thereby the rising trend in *per capita* output. Initial changes in method require that some group in the society have the will and the authority to install and diffuse new production techniques; [3] and a perpetuation of the growth process requires that such a leading group expand in authority and that the society as a whole respond to the impulses set up by the initial changes, including the potentialities for external economies. Initial changes in the scale and direction of finance flows are likely to imply a command over income flows by new groups or institutions; and a perpetuation of growth requires that a high proportion of the increment to real income during the take-off period be returned to productive investment. The take-off requires, therefore, a society prepared to respond actively to new possibilities for productive enterprise; and it is likely to require political, social and institutional changes which will both perpetuate an initial increase in the scale of investment and result in the regular acceptance and absorption of innovations.

In short, this article is an effort to clarify the economics of industrial revolution when an industrial revolution is conceived of narrowly with respect to time and broadly with respect to changes in production functions.

[1] I wish to acknowledge with thanks the helpful criticisms of an earlier draft by G. Baldwin, F. Bator, K. Berrill, A. Enthoven, E. E. Hagen, C. P. Kindleberger, L. Lefeber, W. Malenbaum, E. S. Mason and M. F. Millikan.

[2] This argument is a development from the line of thought presented in *The Process of Economic Growth* (New York, 1952), Chapter 4, especially pp. 102–5. The concept of three stages in the growth process centering on the take-off is defined and used for prescriptive purposes in *An American Policy in Asia* (New York, 1955), Chapter 7.

[3] We shall set aside in this article the question of how new production techniques are generated from pure science and invention, a procedure which is legitimate, since we are examining the growth process in national (or regional) economies over relatively short periods. We shall largely set aside also the question of population pressure and the size and quality of the working force, again because of the short period under examination; although, evidently, even over short periods, the rate of population increase will help determine the level of investment required to yield rising output *per capita* (see below, p. 28, note 2). By and large, this article is concerned with capital formation at a particular stage of economic growth; and of the array of propensities defined in *The Process of Economic Growth* it deals only with the propensity to accept innovations and the propensity to seek material advance, the latter in relation to the supply of finance only.

II. Three Stages in the Growth Process

The historian examining the story of a particular national economy is inevitably impressed by the long-period continuity of events. Like other forms of history, economic history is a seamless web. The cotton-textile developments in Britain of the 1780s and 1790s have a history stretching back for a half century at least; the United States of the 1840s and 1850s had been preparing itself for industrialisation since the 1790s, at the latest; Russia's remarkable development during the two pre-1914 decades goes back to 1861 for its foundations, if not to the Napoleonic Wars or to Peter the Great; the remarkable economic spurt of Meiji Japan is incomprehensible outside the context of economic developments in the latter half of the Tokugawa era; and so on. It is wholly legitimate that the historian's influence should be to extend the story of the British industrial revolution back into the seventeenth century and forward far into the nineteenth century; and that Heckscher should embrace Sweden's transition in a chapter entitled, "The Great Transformation (1815–1914)."[1] From the perspective of the economic historian the isolation of a take-off period is, then, a distinctly arbitrary process. It is to be judged, like such other arbitrary exercises as the isolation of business cycles and secular trends, on whether it illuminates more of the economic process than it conceals; and it should be used, if accepted, as a way of giving a rough framework of order to the inordinately complicated biological problem of growth rather than as an exact model of reality.

There is difficulty in this set of conceptions for the statistical analyst of economic development as well as for the historian. At first sight the data mobilised, for example, by Clark, Kuznets, Buchanan and Ellis exhibit a continuum of degrees of development both within countries over time and as among countries at a given period of time, with no *prima facie* case for a clearly marked watershed in the growth process.[2] In part this statistical result arises from the fact that historical data on national product and its components are only rarely available for an economy until after it has passed into a stage of more or less regular growth; that is, after the take-off. In part it arises from the fact that, by and large, these authors are more concerned with different levels of *per capita* output (or welfare)—and the structural characteristics that accompany them—than with the growth process itself. The data they mobilise do not come to grips with the inner determinants of growth. The question raised here is not how or why levels of output *per capita* have differed but rather how it has come about that particular economies have moved from stagnation—to slow, piece-meal advance—to

[1] E. F. Heckscher, *An Economic History of Sweden*, Tr. G. Ohlin, (Cambridge, Massachusetts, 1954), Chapter 6.

[2] Colin Clark, *The Conditions of Economic Progress* (London, 1951, second edition); Simon Kuznets, "International Differences in Capital Formation and Financing" (mimeographed; Conference on Capital Formation and Economic Growth, November 1953) (National Bureau of Economic Research, New York, 1953); Norman Buchanan and Howard Ellis, *Approaches to Economic Development* (Twentieth Century Fund, New York, 1955). See also the United Nations data presented as a frontispiece to H. F. Williamson and John A. Buttrick, *Economic Development* (New York, 1954).

a situation where growth was the normal economic condition. Our criterion here is not the absolute level of output *per capita* but its rate of change.

In this argument the sequence of economic development is taken to consist of three periods: a long period (up to a century or, conceivably, more) when the preconditions for take-off are established; the take-off itself, defined within two or three decades; and a long period when growth becomes normal and relatively automatic. These three divisions would, of course, not exclude the possibility of growth giving way to secular stagnation or decline in the long term. It would exclude from the concept of a growing economy, however, one which experiences a brief spurt of expansion which is not subsequently sustained; for example, the United States industrial boom of the War of 1812 or the ill-fated spurts of certain Latin American economies in the early stages of their modern history.

Take-offs have occurred in two quite different types of societies; and, therefore, the process of establishing preconditions for take-off has varied. In the first and most general case the achievement of preconditions for take-off required major change in political and social structure and, even, in effective cultural values. In the vocabulary of *The Process of Economic Growth*, important changes in the propensities preceded the take-off. In the second case take-off was delayed not by political, social and cultural obstacles but by the high (and even expanding) levels of welfare that could be achieved by exploiting land and natural resources. In this second case take-off was initiated by a more narrowly economic process, as, for example, in the northern United States, Australia and, perhaps, Sweden. In the vocabulary of *The Process of Economic Growth*, the take-off was initiated primarily by a change in the yields; although subsequent growth brought with it changes in the propensities as well. As one would expect in the essentially biological field of economic growth, history offers mixed as well as pure cases.

In the first case the process of establishing preconditions for take-off might be generalised in impressionistic terms as follows:

We start with a reasonably stable and traditional society containing an economy mainly agricultural, using more or less unchanging production methods, saving and investing productively little more than is required to meet depreciation. Usually from outside the society, but sometimes out of its own dynamics, comes the idea that economic progress is possible; and this idea spreads within the established *élite* or, more usually, in some disadvantaged group whose lack of status does not prevent the exercise of some economic initiative. More often than not the economic motives for seeking economic progress converge with some non-economic motive, such as the desire for increased social power and prestige, national pride, political ambition and so on. Education, for some at least, broadens and changes to suit the needs of modern economic activity. New enterprising men come forward willing to mobilise savings and to take risks in pursuit of profit, notably in commerce. The commercial markets for agricultural products, domestic handicrafts and consumption-goods imports widen. Institutions for mobilising capital appear; or they expand from primitive levels in the

scale, surety and time horizon for loans. Basic capital is expanded, notably in transport and communications, often to bring to market raw materials in which other nations have an economic interest, often financed by foreign capital. And, here and there, modern manufacturing enterprise appears, usually in substitution for imports.

Since public-health measures are enormously productive in their early stages of application and, as innovations go, meet relatively low resistance in most cultures, the death rate may fall and the population begin to rise, putting pressure on the food supply and the institutional structure of agriculture, creating thereby an economic depressant or stimulus (or both in turn), depending on the society's response.[1]

The rate of productive investment may rise up to 5% of national income;[2] but this is unlikely to do much more than keep ahead of the population increase. And, in general, all this activity proceeds on a limited basis, within an economy and a society still mainly characterised by traditional low-productivity techniques and by old values and institutions which developed in conjunction with them. The rural proportion of the population is likely to stand at 75% or over.

In the second case, of naturally wealthy nations, with a highly favorable balance between population and natural resources and with a population deriving by emigration from reasonably acquisitive cultures, the story of establishing the preconditions differs mainly in that there is no major problem of overcoming traditional values inappropriate to economic growth and the inert or resistant institutions which incorporate them; there is less difficulty in developing an *élite* effective in the investment process; and there is no population problem.[3] Technically, much the same slow-moving process of change occurs at high (and, perhaps, even expanding) levels of *per capita* output, and with an extensive growth of population and output still based on rich land and other natural resources. Take-off fails to occur mainly because the comparative advantage of exploiting productive land and other natural resources delays the time when self-reinforcing industrial growth can profitably get under way.[4]

[1] Historically, disruptive population pressure has been generated in pretake-off societies not only by the easy spread of highly productive measures of public health but also by the easy acceptance of high-yield new crops, permitting a fragmentation of land-holdings, earlier marriage and a rise in the birth rate; *e.g.*, Ireland and China.

[2] The relation of the investment rate to growth depends, of course, on the rate of population rise. With stagnant population or slow rise a 5% investment rate could yield substantial growth in real output *per capita*, as indeed it did in pre-1914 France. On the other hand, as noted below (p. 36) investment rates much higher than 5% can persist in primitive economies which lack the preconditions for growth, based on capital imports, without initiating sustained growth. For some useful arithmetic on the scale and composition of capital requirements in a growing economy with a 1% population increase see A. K. Cairncross, *Home and Foreign Investment* (Cambridge, 1953), Chapter 1.

[3] Even in these cases there have often been significant political and social restraints which had to be reduced or eliminated before take-off could occur; for example, in Canada, the Argentine and the American South.

[4] Theoretically, such fortunate societies could continue to grow in *per capita* output until diminishing returns damped down their progress. Theoretically, they might even go on as growing non-industrial societies, absorbing agricultural innovations which successfully countered diminishing

The beginning of take-off can usually be traced to a particular sharp stimulus. The stimulus may take the form of a political revolution which affects directly the balance of social power and effective values, the character of economic institutions, the distribution of income, the pattern of investment outlays and the proportion of potential innovations actually applied; that is, it operates through the propensities. It may come about through a technological (including transport) innovation, which sets in motion a chain of secondary expansion in modern sectors and has powerful potential external economy effects which the society exploits. It may take the form of a newly favorable international environment, such as the opening of British and French markets to Swedish timber in the 1860s or a sharp relative rise in export prices and/or large new capital imports, as in the case of the United States from the late 1840s, Canada and Russia from the mid-1890s; but it may also come as a challenge posed by an unfavorable shift in the international environment, such as a sharp fall in terms of trade (or a wartime blockage of foreign trade) requiring the rapid development of manufactured import substitutes, as in the case of the Argentine and Australia in the 1930s and during the Second World War.[1] All these latter cases raise sharply the profitability of certain lines of enterprise and can be regarded as changes in the yields.

What is essential here, however, is not the form of stimulus but the fact that the prior development of the society and its economy result in a positive sustained, and self-reinforcing, response to it: the result is not a once-over change in production functions or in the volume of investment, but a higher proportion of potential innovations accepted in a more or less regular flow, and a higher rate of investment.

In short, the forces which have yielded marginal bursts of activity now expand and become quantitatively significant as rapid-moving trends. New industries expand at high rates, yielding profits which are substantially reinvested in new capacity; and their expansion induces a more general expansion of the modern sectors of the economy where a high rate of plough-back prevails. The institutions for mobilising savings (including the fiscal and sometimes the capital-levy activities of government) increase in scope and efficiency. New techniques spread in agriculture as well as in industry, as increasing numbers of persons are prepared to accept them and the deep

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returns. Something like this process might describe, for example, the rich agricultural regions of the United States. But, in general, it seems to be the case that the conditions required to sustain a progressive increase in agricultural productivity will also lead on to self-reinforcing industrial growth. This result emerges not merely from the fact that many agricultural improvements are labor-saving, and that industrial employment can be stimulated by the availability of surplus labor and is required to draw it off; it also derives from the fact that the production and use of materials and devices which raise agricultural productivity in themselves stimulate the growth of a self-sustaining industrial sector.

[1] Historically, the imposition of tariffs has played an important role in take-offs, *e.g.*, the American Tariffs of 1828 (cotton textiles) and 1841–42 (rail iron); the Russian tariffs of the 1890s, etc. Although these actions undoubtedly served to assist take-off in leading sectors, they usually reflected an energy and purpose among key entrepreneurial groups which would, in any case, probably have done the trick.

changes they bring to ways of life. A new class of business-men (usually private, sometimes public servants) emerges and acquires control over the key decisions determining the use of savings. New possibilities for export develop and are exploited; new import requirements emerge. The economy exploits hitherto unused backlogs in technique and natural resources. Although there are a few notable exceptions, all this momentum historically attracted substantial foreign capital.

The use of aggregative national-income terms evidently reveals little of the process which is occurring. It is nevertheless useful to regard as a necessary but not sufficient condition for the take-off the fact that the proportion of net investment to national income (or net national product) rises from (say) 5% to over 10%, definitely outstripping the likely population pressure (since under the assumed take-off circumstances the capital–output ratio is low),[1] and yielding a distinct rise in real output *per capita*. Whether real consumption *per capita* rises depends on the pattern of income distribution and population pressure, as well as on the magnitude, character and productivity of investment itself.

As indicated in the accompanying table (see p. 31), I believe it possible to identify at least tentatively such take-off periods for a number of countries which have passed into the stage of growth.

The third stage is, of course, the long, fluctuating story of sustained economic progress. Overall capital per head increases as the economy matures. The structure of the economy changes increasingly. The initial key industries, which sparked the take-off, decelerate as diminishing returns operate on the original set of industrial tricks and the original band of pioneering entrepreneurs give way to less single-minded industrial leaders in those sectors; but the average rate of growth is maintained by a succession of new, rapidly growing sectors, with a new set of pioneering leaders. The proportion of the population in rural pursuits declines. The economy finds its (changing) place in the international economy. The society makes such terms as it will with the requirements for maximising modern and efficient production, balancing off, as it will, the new values against those retarding values which persist with deeper roots, or adapting the latter in such ways as to support rather than retard the growth process. This sociological

[1] The author is aware of the substantial ambiguities which overhang the concept of the capital–output ratio and, especially, of the dangers of applying an overall aggregate measure. But since the arithmetic of economic growth requires some such concept, implicitly or explicitly, we had better refine the tool rather than abandon it. In the early stages of economic development two contrary forces operate on the capital–output ratio. On the one hand there is a vast requirement of basic overhead capital in transport, power, education, etc. Here, due mainly to the long period over which such investment yields its return, the apparent (short-run) capital–output ratio is high. On the other hand, there are generally large unexploited backlogs of known techniques and available natural resources to be put to work; and these backlogs make for a low capital–output ratio. We can assume formally a low capital–output ratio for the take-off period because we are assuming that the preconditions have been created, including a good deal of social overhead capital. In fact, the aggregate marginal capital–output ratio is likely to be kept up during the take-off by the requirement of continuing large outlays for overhead items which yield their return only over long periods. Nevertheless, a ratio of 3–1 or 3·5–1 on average seems realistic as a rough bench-mark until we have learned more about capital–output ratios on a sectoral basis.

calculus interweaves with basic resource endowments to determine the pace of deceleration.

It is with the problems and vicissitudes of such growing economies of the third stage (and especially with cyclical fluctuations and the threat of

Some Tentative, Approximate Take-off Dates

Country.	Take-off.	Country.	Take-off.
Great Britain	1783–1802	Russia	1890–1914
France	1830–1860	Canada	1896–1914
Belgium	1833–1860	Argentine [3]	1935–
United States [1]	1843–1860	Turkey [4]	1937–
Germany	1850–1873	India [5]	1952–
Sweden	1868–1890	China [5]	1952–
Japan [2]	1878–1900		

[1] The American take-off is here viewed as the upshot of two different periods of expansion: the first, that of the 1840s, marked by railway and manufacturing development, mainly confined to the East—this occurred while the West and South digested the extensive agricultural expansion of the previous decade; the second the great railway push into the Middle West during the 1850s marked by a heavy inflow of foreign capital. By the opening of the Civil War the American economy of North and West, with real momentum in its heavy-industry sector, is judged to have taken off.

[2] Lacking adequate data, there is some question about the timing of the Japanese take-off. Some part of the post-1868 period was certainly, by the present set of definitions, devoted to firming up the preconditions for take-off. By 1914 the Japanese economy had certainly taken off. The question is whether the period from about 1878 to the Sino-Japanese War in the mid-1890s is to be regarded as the completion of the preconditions or as take-off. On present evidence, I incline to the latter view.

[3] In one sense the Argentine economy began its take-off during the First World War. But by and large, down to the pit of the post-1929 depression, the growth of its modern sector, stimulated during the war, tended to slacken; and, like a good part of the Western World, the Argentine sought during the 1920s to return to a pre-1914 normalcy. It was not until the mid-1930s that a sustained take-off was inaugurated, which by and large can now be judged to have been successful despite the structural vicissitudes of that economy.

[4] Against the background of industrialisation measures inaugurated in the mid-1930s the Turkish economy has exhibited remarkable momentum in the past five years founded in the increase in agricultural income and productivity. It still remains to be seen whether these two surges, conducted under quite different national policies, will constitute a transition to self-sustaining growth, and whether Turkey can overcome its current structural problems.

[5] As noted in the text it is still too soon (for quite different reasons) to judge either the Indian or Chinese Communist take-off efforts successful.

chronic unemployment) that the bulk of modern theoretical economics is concerned, including much recent work on the formal properties of growth models. The student of history and of contemporary underdeveloped areas [1]

[1] A number of so-called underdeveloped areas may have, in fact, either passed through the take-off process or are in the midst of it, *e.g.*, Mexico, Brazil, Turkey, the Argentine and India. I would commend for consideration—certainly no more until the concept of take-off is disproved or verified—the dropping of the concept of "underdeveloped areas" and the substitution for it of a quadripartite distinction among economies: traditional; pretake-off; take-off; and growing. Against the background of this set of distinctions we might then consider systematically two separable questions now often confused. First, the stage of growth, as among growing economies. It is legitimate to regard Mexico and the United States, Great Britain and Australia, France and Japan, as growing economies, although they stand at very different points along their national growth curves, where the degree of progress might be measured by some kind of index of output (or capital) per head. Second, the foreseeable long-run potential of growing economies. Over the long pull, even after they are "fully developed," the *per capita* output levels that different economies are likely to achieve will undoubtedly vary greatly, depending notably on resource endowments in relation to population. The arraying of levels of output *per capita* for different economies, now conventional, fails to distinguish these three elements; that is, the current rate of growth; the stage of growth; and the foreseeable horizon for growth.

is more likely to be concerned with the economics of the first two stages; that is, the economics of the preconditions and the take-off. If we are to have a serious theory of economic growth or (more likely) some useful theories about economic growth, they must obviously seek to embrace these two early stages—and notably the economics of the take-off. The balance of this article is designed to mobilise tentatively and in a preliminary way what an economic historian can contribute to the economics of take-off.

III. The Take-off Defined and Isolated

There are several problems of choice involved in defining the take-off with precision. We might begin with one arbitrary definition and consider briefly the two major alternatives.

For the present purposes the take-off is defined as requiring all three of the following related conditions:

(*a*) a rise in the rate of productive investment from (say) 5% or less to over 10% of national income (or net national product);

(*b*) the development of one or more substantial manufacturing[1] sectors, with a high rate of growth;

(*c*) the existence or quick emergence of a political, social and institutional framework which exploits the impulses to expansion in the modern sector and the potential external economy effects of the take-off and gives to growth an on-going character.

The third condition implies a considerable capability to mobilise capital from domestic sources. Some take-offs have occurred with virtually no capital imports; *e.g.*, Britain and Japan. Some take-offs have had a high component of foreign capital; *e.g.*, the United States, Russia and Canada. But some countries have imported large quantities of foreign capital for long periods, which undoubtedly contributed to creating the preconditions for take-off, without actually initiating take-off; *e.g.*, the Argentine before 1914, Venezuela down to recent years, the Belgian Congo currently. In short, whatever the role of capital imports, the preconditions for take-off include an initial ability to mobilise domestic savings productively, as well as a structure which subsequently permits a high marginal rate of savings.

This definition is designed to isolate the early stage when industrialisation takes hold rather than the later stage when industrialisation becomes a more massive and statistically more impressive phenomenon. In Britain, for example, there is no doubt that it was between 1815 and 1850 that industrialisation fully took hold. If the criterion chosen for take-off was the period of most rapid overall industrial growth, or the period when large-scale industry matured, all our take-off dates would have to be set forward; Britain, for example, to 1819–48; the United States to 1868–93; Sweden

[1] In this context "manufacturing" is taken to include the processing of agricultural products or raw materials by modern methods; *e.g.*, timber in Sweden; meat in Australia; dairy products in Denmark. The dual requirement of a "manufacturing" sector is that its processes set in motion a chain of further modern sector requirements and that its expansion provides the potentiality of external economy effects.

to 1890–1920; Japan to 1900–20; Russia to 1928–40. The earlier dating is chosen here because it is believed, on present (often inadequate) evidence, that the decisive transformations (including a decisive shift in the investment rate) occur in the first industrial phases; and later industrial maturity can be directly traced back to foundations laid in these first phases.

This definition is also designed to rule out from the take-off the quite substantial economic progress which can occur in an economy before a truly self-reinforcing growth process gets under way. British economic expansion between (say) 1750 and 1783, Russian economic expansion between (say) 1861 and 1890, Canadian economic expansion between 1867 and the mid-1890s—such periods—for which there is an equivalent in the economic history of almost every growing economy—were marked by extremely important, even decisive, developments. The transport network expanded, and with it both internal and external commerce; new institutions for mobilising savings were developed; a class of commercial and even industrial entrepreneurs began to emerge; industrial enterprise on a limited scale (or in limited sectors) grew. And yet, however essential these pretake-off periods were for later development, their scale and momentum were insufficient to transform the economy radically or, in some cases, to outstrip population growth and to yield an increase in *per capita* output.

With a sense of the considerable violence done to economic history, I am here seeking to isolate a period when the scale of productive economic activity reaches a critical level and produces changes which lead to a massive and progressive structural transformation in economies and the societies of which they are a part, better viewed as changes in kind than merely in degree.

IV. Evidence on Investment Rates in the Take-off

The case for the concept of take-off hinges, in part, on quantitative evidence on the scale and productivity of investment in relation to population growth. Here, as noted earlier, we face a difficult problem; investment data are not now available historically for early stages in economic history. Following is such case as there is for regarding the shift from a productive investment rate of about 5% of NNP to 10% or more as central to the process.[1]

[1] In his important article, "Economic Development with Unlimited Supplies of Labour," *Manchester School*, May 1954, W. Arthur Lewis indicates a similar spread as defining the transition to economic growth:

> "The central problem in the theory of economic development is to understand the process by which a community which was previously saving and investing 4 or 5% of its national income or less, converts itself into an economy where voluntary saving is running at about 12–15% of national income or more. This is the central problem because the central fact of economic development is rapid capital accumulation (including knowledge and skills with capital). We cannot explain any 'industrial' revolution (as the economic historians pretend to do) until we can explain why saving increased relatively to national income."

Presumably Mr. Lewis based this range on empirical observation of contemporary "underdeveloped" areas on which some data are presented below. As in note 2, p. 28, above, it should be emphasised that the choice of investment proportions to symbolise the transition to growth hinges on the assumptions made about the rate of population increase.

1. *A* Prima Facie *Case*

If we take the aggregate marginal capital–output ratio for an economy in its early stage of economic development at 3·5–1 and if we assume, as is not abnormal, a population rise of 1–1·5% per annum it is clear that something between 3·5 and 5·25% of NNP must be regularly invested if NNP *per capita* is to be sustained. An increase of 2% per annum in NNP *per capita* requires, under these assumptions, that something between 10·5 and 12·5% of NNP be regularly invested. By definition and assumption, then, a transition from relatively stagnant to substantial, regular rise in NNP *per capita*, under typical population conditions, requires that the proportion of national product productively invested move from somewhere in the vicinity of 5% to something in the vicinity of 10%.

2. *The Swedish Case*

In the appendix to his paper on international differences in capital formation, cited above, Kuznets gives gross and net capital formation figures in relation to gross and net national product for a substantial group of countries where reasonably good statistical data exist. Excepting Sweden, these data do not go back clearly to pretake-off stages.[1] The Swedish data begin in the decade 1861–70; and the Swedish take-off is to be dated from the latter years of the decade.

Kuznets' table of calculations for Sweden follows:

Decade.	Domestic GCF GNP (%).	Domestic NCF NNP (%).	Depreciation to DGCF (%).
1. 1861–70	5·8	3·5–	(42)
2. 1871–80	8·8	5·3	(42)
3. 1881–90	10·8	6·6	(42)
4. 1891–1900 . . .	13·7	8·1	43·9
5. 1901–10	18·0	11·6	40·0
6. 1911–20	20·2	13·5	38·3
7. 1921–30	19·0	11·4	45·2

Note (Kuznets): Based on estimates in Eric Lindahl, Einan Dahlgren and Karin Kock, *National Income of Sweden, 1861–1930* (London: P. J. Kingston, 1937), Parts One and Two, particularly the details in Part Two.

These underlying totals of capital formation exclude changes in inventories.

While gross totals are directly from the volumes referred to above, depreciation for the first three decades was not given. We assumed that it formed 42% of gross domestic capital formation.

[1] The Danish data are on the margin. They begin with the decade 1870–79, probably the first decade of take-off itself. They show net and gross domestic capital formation rates well over 10%. In view of the sketch of the Danish economy presented in Kjeld Bjerke's " Preliminary Estimates of the Danish National Product from 1870–1950 " (Preliminary paper mimeographed for 1953 Conference of the International Association for Research on Income and Wealth), pp. 32–4, it seems likely that further research would identify the years 1830–70 as a period when the preconditions were actively established, 1870–1900 as a period of take-off. This view is supported by scattered and

3. *The Canadian Case*

The data developed by O. J. Firestone [1] for Canada indicates a similar transition for net capital formation in its take-off (say, 1896–1914); but the gross investment proportion in the period from Confederation to the mid-nineties was higher than appears to have marked other periods when the preconditions were established, possibly due to investment in the railway net, abnormally large for a nation of Canada's population, and to relatively heavy foreign investment, even before the great capital import boom of the pre-1914 decade:

Canada: Gross and Net Investment in Durable Physical Assets as Percentage of Gross and Net National Expenditure (for Selected Years).

	$\frac{GCF}{GNP}$.	$\frac{NCF}{NNP}$.	Capital consumption as percentage of gross investment.
1870	15·0	7·1	56·2
1900	13·1	4·0	72·5
1920	16·6	10·6	41·3
1929	23·0	12·1	53·3
1952	16·8	9·3	49·7

4. *The Pattern of Contemporary Evidence in General* [2]

In the years after 1945 the number of countries for which reasonably respectable national income (or product) data exist has grown; and with such data there have developed some tolerable savings and investment

highly approximate estimates of Danish National Wealth which exhibit a remarkable surge in capital formation between 1864 and 1884.

Estimates of National Wealth in Denmark

	1,000 millions of kroner.	Source.
1864	3·5	Falbe-Hansen, *Danmarks statistik*, 1885.
1884	6·5	Falbe-Hansen, *Danmarks statistik*, 1885.
1899	7·2	Tax-commission of 1903.
1909	10·0	Jens Warming, *Danmarks statistik*, 1913.
1927	24·0	Jens Warming, *Danmarks erhvervs- or samfundsliv*, 1930.
1939	28·8	Economic expert committee of 1943, *Økonomiske efterkrigsproblemer*, 1945.
1950	54·5	N. Banke, N. P. Jacobsen og Vedel-Petersen, *Danske erhvervsliv*, 1951.

(Furnished in correspondence by Einar Cohn and Kjeld Bjerke.) It should again be emphasised, however, that we are dealing with a hypothesis whose empirical foundations are still fragmentary.

[1] O. J. Firestone, *Canada's Economic Development, 1867–1952, with Special Reference to Changes in the Country's National Product and National Wealth*, paper prepared for the International Association for Research in Income and Wealth, 1953, to which Mr. Firestone has kindly furnished me certain revisions, shortly to be published. By 1900 Canada already had about 18,000 miles of railway line; but the territory served had been developed to a limited degree only. By 1900 Canada already had a net balance of foreign indebtedness over $1 billion. Although this figure was almost quadrupled in the next two decades, capital imports represented an important increment to domestic capital sources from the period of Confederation down to the pre-1914 Canadian boom, which begins in the mid-1890s.

[2] I am indebted to Mr. Everett Hagen for mobilising the statistical data in this section, except where otherwise indicated.

estimates for countries at different stages of the growth process. Within the category of nations usually grouped as "underdeveloped" one can distinguish four types.[1]

(*a*) *Pretake-off economies*, where the apparent savings and investment rates, including limited net capital imports, probably come to under 5% of net national product. In general, data for such countries are not satisfactory, and one's judgment that capital formation is low must rest on fragmentary data and partially subjective judgment. Examples are Ethiopia, Kenya, Thailand, Cambodia, Afghanistan and perhaps Indonesia.[2]

(*b*) *Economies attempting take-off*, where the apparent savings and investment rates, including limited net capital imports, have risen over 5% of net national product.[3] For example, Mexico (1950) NCF/NDP 7·2%; Chile (1950) NCF/NDP 9·5%; Panama (1950) NCF/NDP 7·5%; Philippines (1952) NCF/NDP 6·4%; Puerto Rico (1952) NCF (Private)/NDP 7·6%; India (1953) NCF/NDP, perhaps about 7%. Whether the take-off period will, in fact, be successful remains in most of these cases still to be seen.

(*c*) *Growing economies*, where the apparent savings and investment rates, including limited net capital imports, have reached 10% or over; for example, Colombia (1950) NCF/NDP, 16·3%.

(*d*) *Enclave economies* (1) cases where the apparent savings and investment rates, including substantial net capital imports, have reached 10% or over, but the domestic preconditions for sustained growth have not been achieved. These economies, associated with major export industries, lack the third condition for take-off suggested above (p. 32). They include the Belgian Congo (1951) NCF/NDP 21·7%; Southern

[1] The percentages given are of net capital formation to net domestic product. The latter is the product net of depreciation of the geographic area. It includes the value of output produced in the area, regardless of whether the income flows abroad. Since indirect business taxes are not deducted, it tends to be larger than national income; hence the percentages are lower than if national income was used as the denominator in computing them.

[2] The Office of Intelligence Research of the Department of State, Washington, D.C., gives the following estimated ratios of investment (presumably gross) to GNP in its Report No. 6672 of August 25, 1954, p. 3, based on latest data available to that point, for countries which would probaly fall in the pretake-off category:

	%		%
Afghanistan	5	Pakistan	6
Ceylon	5	Indonesia	5

[3] The Department of State estimates (*ibid.*) for economies which are either attempting take-off or which have, perhaps, passed into a stage of regular growth include:

	%		%
The Argentine	13	Colombia	14
Brazil	14	Philippines	8
Chile	11	Venezuela	23

Venezuela has been for some time an "enclave economy," with a high investment rate concentrated in a modern export sector whose growth did not generate general economic momentum in the Venezuelan economy; but in the past few years Venezuela may have moved over into the category of economies experiencing an authentic take-off.

Rhodesia (1950) GCF/GDP 45·5%, (1952) GCF/GDP 45·4%. (2) Cases where net capital exports are large. For example, Burma (1938) NCF/NDP, 7·1%; net capital exports/NDP, 11·5%; Nigeria (1950–51) NCF/NDP 5·1%; net capital exports/NDP, 5·6%.

5. *The Cases of India and Communist China*

The two outstanding contemporary cases of economies attempting purposefully to take-off are India and Communist China, both operating under national plans. The Indian First Five Year Plan projects the growth process envisaged under assumptions similar to those in paragraph 1, p. 34, above. The Indian Planning Commission estimated investment as 5% of NNP in the initial year of the plan, 1950–51.[1] Using a 3/1 marginal capital–output ratio, they envisaged a marginal savings rate of 20% for the First Five Year Plan, a 50% rate thereafter, down to 1968–69, when the average proportion of income invested would level off at 20% of NNP. As one would expect, the sectoral composition of this process is not fully worked out in the initial plan; but the Indian effort may well be remembered in economic history as the first take-off defined *ex ante* in national product terms.

We know less of the Chinese Communist First Five Year Plan than we do of the concurrent Indian effort, despite the recent publication of production goals for some of the major sectors of the Chinese economy.[2] Roundly, it would appear that, from a (probably) negative investment rate in 1949, the Chinese Communist regime had succeeded by 1952 in achieving a gross rate of about 12%; a net rate of about 7%.

On arbitrary assumptions, which have a distinct upward bias, these figures can be projected forward for a decade yielding rates of about 20% gross, 17% net by 1962.

So far as the aggregates are concerned, what we can say is that the Indian planned figures fall well within the range of *prima facie* hypothesis and historical experience, if India in fact fulfils the full requirements for take-off, notably the achievement of industrial momentum. The Chinese Communist figures reflect accurately an attempt to force the pace of history, evident throughout Peking's domestic policy, whose viability is still to be demonstrated. In particular, Peking's agricultural policy may fail to produce the minimum structural balance required for a successful take-off, requiring radical revision of investment allocations and policy objectives at a later stage.

We have, evidently, much still to learn about the quantitative aspects of this problem; and, especially, much further quantitative research and imaginative manipulation of historical evidence will be required before the hypothesis tentatively advanced here can be regarded as proved or disproved.

[1] Government of India, Planning Commission, *The First Five Year Plan*, 1952, Vol. I, Chapter 1.

[2] These comments are based on the work of Alexander Eckstein and the author in *The Prospects for Communist China* (New York and London, 1954), Part 5, pp. 222 ff. The statistical calculations are the work of Mr. Eckstein.

What we can say is that *prima facie* thought and a scattering of historical and contemporary evidence suggests that it is not unreasonable to consider the take-off as including as a necessary but not sufficient condition a quantitative transition in the proportion of income productively invested of the kind indicated here.

V. The Inner Structure of the Take-off

Whatever the importance and virtue of viewing the take-off in aggregative terms—embracing national output, the proportion of output invested, and an aggregate marginal capital–output ratio—that approach tells us relatively little of what actually happens and of the causal processes at work in a take-off; nor is the investment-rate criterion conclusive.

Following the definition of take-off (pp. 32–33 above), we must consider not merely how a rise in the investment rate is brought about, from both supply and demand perspectives, but how rapidly growing manufacturing sectors emerged and imparted their primary and secondary growth impulses to the economy.

Perhaps the most important thing to be said about the behavior of these variables in historical cases of take-off is that they have assumed many different forms. There is no single pattern. The rate and productivity of investment can rise, and the consequences of this rise can be diffused into a self-reinforcing general growth process by many different technical and economic routes, under the ægis of many different political, social and cultural settings, driven along by a wide variety of human motivations.

The purpose of the following paragraphs is to suggest briefly, and by way of illustration only, certain elements of both uniformity and variety in the variables whose movement has determined the inner structure of the take-off.

1. *The Supply of Loanable Funds*

By and large, the loanable funds required to finance the take-off have come from two types of sources: from shifts in the control over income flows, including income-distribution changes and capital imports; [1] and from the plough-back of profits in rapidly expanding particular sectors.

The notion of economic development occurring as the result of income shifts from those who will spend (hoard [2] or lend) less productively to those who will spend (or lend) more productively is one of the oldest and most

[1] Mr. Everett Hagen has pointed out that the increase in savings may well arise from a shift in the propensity to save, as new and exciting horizons open up, rather than merely from a shift of income to groups with a higher (but static) propensity to save. He may well be right. This is, evidently, a matter for further investigation.

[2] Hoarding can, of course, be helpful to the growth process by depressing consumption and freeing resources for investment if, in fact, non-hoarding persons or institutions acquire the resources and possess the will to expand productive investment. A direct transfer of income is, evidently, not required.

fundamental notions in economics. It is basic to the *Wealth of Nations*,[1] and it is applied by W. Arthur Lewis in his recent elaboration of the classical model.[2] Lewis builds his model in part on an expansion of the capitalist sector, with the bulk of additional savings arising from an enlarging pool of capitalist profits.

Historically, income shifts conducive to economic development have assumed many forms. In Meiji Japan and also in Czarist Russia the substitution of government bonds for the great landholders' claim on the flow of rent payments lead to a highly Smithian redistribution of income into the hands of those with higher propensities to seek material advance and to accept innovations. In both cases the real value of the government bonds exchanged for land depreciated; and, in general, the feudal landlords emerged with a less attractive arrangement than had first appeared to be offered. Aside from the confiscation effect, two positive impulses arose from land reform: the state itself used the flow of payments from peasants, now diverted from landlords' hands, for activity which encouraged economic development; and a certain number of the more enterprising former landlords directly invested in commerce and industry. In contemporary India and China we can observe quite different degrees of income transfer by this route. India is relying to only a very limited extent on the elimination of large incomes unproductively spent by large landlords; although this element figures in a small way in its program. Communist China has systematically transferred all non-governmental pools of capital into the hands of the State, in a series of undisguised or barely disguised capital levies; and it is drawing heavily for capital resources on the mass of middle and poor peasants who remain.[3]

In addition to confiscatory and taxation devices, which can operate effectively when the State is spending more productively than the taxed individuals, inflation has been important to several take-offs. In Britain of the late 1790s, the United States of the 1850s, Japan of the 1870s there is no doubt that capital formation was aided by price inflation, which shifted resources away from consumption to profits.

The shift of income flows into more productive hands has, of course, been aided historically not only by government fiscal measures but also by banks and capital markets. Virtually without exception, the take-off periods have been marked by the extension of banking institutions which expanded the supply of working capital; and in most cases also by an expansion in the range of long-range financing done by a central, formally organised, capital market.

Although these familiar capital-supply functions of the State and private institutions have been important to the take-off, it is likely to prove the case,

[1] See, especially, Smith's observations on the "perversion" of wealth by "prodigality"—that is, unproductive consumption expenditures—and on the virtues of "parsimony" which transfers income to those who will increase "the fund which is destined for the maintenance of productive hands." Routledge edition, London, 1890, pp. 259–60.

[2] *Op. cit.*, especially pp. 156–9.

[3] *Prospects for Communist China*, Part 4.

on close examination, that a necessary condition for take-off was the existence of one or more rapidly growing sectors whose entrepreneurs (private or public) ploughed back into new capacity a very high proportion of profits. Put another way, the demand side of the investment process, rather than the supply of loanable funds, may be the decisive element in the take-off, as opposed to the period of creating the preconditions, or of sustaining growth once it is under way. The distinction is, historically, sometimes difficult to make, notably when the State simultaneously acts both to mobilise supplies of finance and to undertake major entrepreneurial acts. There are, nevertheless, periods in economic history when quite substantial improvements in the machinery of capital supply do not, in themselves, initiate a take-off, but fall within the period when the preconditions are created: *e.g.*, British banking developments in the century before 1783; Russian banking developments before 1890, etc.

One extremely important version of the plough-back process has taken place through foreign trade. Developing economies have created from their natural resources major export industries; and the rapid expansion in exports has been used to finance the import of capital equipment and to service the foreign debt during the take-off. United States, Russian and Canadian grain fulfilled this function, Swedish timber and pulp, Japanese silk, etc. Currently Chinese exports to the Communist Bloc, wrung at great administrative and human cost from the agricultural sector, play this decisive role. It should be noted that the development of such export sectors has not in itself guaranteed accelerated capital formation. Enlarged foreign-exchange proceeds have been used in many familiar cases to finance hoards (as in the famous case of Indian bullion imports) or unproductive consumption outlays.

It should be noted that one possible mechanism for inducing a high rate of plough-back into productive investment is a rapid expansion in the effective demand for domestically manufactured consumers' goods, which would direct into the hands of vigorous entrepreneurs an increasing proportion of income flows under circumstances which would lead them to expand their own capacity and to increase their requirements for industrial raw materials, semi-manufactured products and manufactured components.

A final element in the supply of loanable funds is, of course, capital imports. Foreign capital has played a major role in the take-off stage of many economies: *e.g.*, the United States, Russia, Sweden, Canada. The cases of Britain and Japan indicate, however, that it cannot be regarded as an essential condition. Foreign capital was notably useful when the construction of railways or other large overhead capital items with a long period of gestation, played an important role in the take-off. After all, whatever its strategic role, the proportion of investment required for growth which goes into industry is relatively small compared to that required for utilities, transport and the housing of enlarged urban populations. And foreign capital can be mightily useful in helping carry the burden of these overhead items either directly or indirectly.

What can we say, in general, then, about the supply of finance during the take-off period? First, as a precondition, it appears necessary that the community's surplus above the mass-consumption level does not flow into the hands of those who will sterilise it by hoarding, luxury consumption or low-productivity investment outlays. Second, as a precondition, it appears necessary that institutions be developed which provide cheap and adequate working capital. Third, as a necessary condition, it appears that one or more sectors of the economy must grow rapidly, inducing a more general industrialisation process; and that the entrepreneurs in such sectors plough back a substantial proportion of their profits in further productive investment, one possible and recurrent version of the plough-back process being the investment of proceeds from a rapidly growing export sector.

The devices, confiscatory and fiscal, for ensuring the first and second preconditions have been historically various. And, as indicated below, the types of leading manufacturing sectors which have served to initiate the take-off have varied greatly. Finally, foreign capital flows have, in significant cases, proved extremely important to the take-off, notably when lumpy overhead capital construction of long gestation period was required; but take-offs have also occurred based almost wholly on domestic sources of finance.

2. *The Sources of Entrepreneurship*

It is evident that the take-off requires the existence and the successful activity of some group in the society which accepts borrowers' risk, when such risk is so defined as to include the propensity to accept innovations. As noted above, the problem of entrepreneurship in the take-off has not been profound in a limited group of wealthy agricultural nations whose populations derived by emigration mainly from north-western Europe. There the problem of take-off was primarily economic; and when economic incentives for industrialisation emerged commercial and banking groups moved over easily into industrial entrepreneurship. In many other countries, however, the development of adequate entrepreneurship was a more searching social process.

Under some human motivation or other, a group must come to perceive it to be both possible and good to undertake acts of capital investment; and, for their efforts to be tolerably successful, they must act with approximate rationality in selecting the directions toward which their enterprise is directed. They must not only produce growth but tolerably balanced growth. We cannot quite say that it is necessary for them to act as if they were trying to maximise profit; for the criteria for private profit maximisation do not necessarily converge with the criteria for an optimum rate and pattern of growth in various sectors.[1] But in a growing economy, over

[1] For a brief discussion of this point see the author's " Trends in the Allocation of Resources in Secular Growth," Chapter 15, *Economic Progress*, ed. Leon H. Dupriez, with the assistance of Douglas C. Hague (Louvain, 1955), pp. 378–9. For a more complete discussion see W. Fellner, " Individual Investment Projects in Growing Economies " (mimeographed), paper presented to the Center for International Studies Social Science Research Council Conference on Economic Growth, October 1954, Cambridge, Massachusetts.

periods longer than the business cycle, economic history is reasonably tolerant of deviations from rationality, in the sense that excess capacity is finally put to productive use. Leaving aside the question of ultimate human motivation, and assuming that the major overhead items are generated, if necessary, by some form of state initiative (including subsidy), we can say as a first approximation that some group must successfully emerge which behaves as if it were moved by the profit motive, in a dynamic economy with changing production functions; although risk being the slippery variable, it is under such assumptions Keynes' dictum should be borne in mind: "If human nature felt no temptation to take a chance, no satisfaction (profit apart) in constructing a factory, a railway, a mine or a farm, there might not be much investment merely as a result of cold calculation." [1]

In this connection it is increasingly conventional for economists to pay their respects to the Protestant ethic.[2] The historian should not be ungrateful for this light on the grey horizon of formal growth models. But the known cases of economic growth which theory must seek to explain take us beyond the orbit of Protestantism. In a world where Samurai, Parsees, Jews, North Italians, Turkish, Russian, and Chinese Civil Servants (as well as Huguenots, Scotsmen and British North-countrymen) have played the role of a leading *élite* in economic growth John Calvin should not be made to bear quite this weight. More fundamentally, allusion to a positive scale of religious or other values conducive to profit-maximising activities is an insufficient sociological basis for this important phenomenon. What appears to be required for the emergence of such *élites* is not merely an appropriate value system but two further conditions: first, the new *élite* must feel itself denied the conventional routes to prestige and power by the traditional less acquisitive society of which it is a part; second, the traditional society must be sufficiently flexible (or weak) to permit its members to seek material advance (or political power) as a route upwards alternative to conformity.

Although an *élite* entrepreneurial class appears to be required for take-off, with significant power over aggregate income flows and industrial investment decisions, most take-offs have been preceded or accompanied by radical change in agricultural techniques and market organisation. By and large the agricultural entrepreneur has been the individual land-owning farmer. A requirement for take-off is, therefore, a class of farmers willing and able to respond to the possibilities opened up for them by new techniques, land-holding arrangements, transport facilities, and forms of market and credit organisation. A small purposeful *élite* can go a long way in initiating economic growth; but, especially in agriculture (and to some extent in the industrial working force), a wider-based revolution in outlook must come about.[3]

[1] *General Theory*, p. 150.

[2] See, for example, N. Kaldor, "Economic Growth and Cyclical Fluctuations," ECONOMIC JOURNAL, March 1954, p. 67.

[3] Like the population question, agriculture is mainly excluded from this analysis, which considers the take-off rather than the whole development process. Nevertheless, it should be noted that, as

Whatever further empirical research may reveal about the motives which have led men to undertake the constructive entrepreneurial acts of the take-off period, this much appears sure: these motives have varied greatly, from one society to another; and they have rarely, if ever, been motives of an unmixed material character.

3. *Leading Sectors in the Take-off*

The author has presented elsewhere the notion that the overall rate of growth of an economy must be regarded in the first instance as the consequence of differing growth rates in particular sectors of the economy, such sectoral growth rates being in part derived from certain overall demand parameters (*e.g.*, population, consumers' income, tastes, etc.), in part from the primary and secondary effects of changing supply factors, when these are effectively exploited.[1]

On this view the sectors of an economy may be grouped in three categories:

(*a*) *Primary growth sectors*, where possibilities for innovation or for the exploitation of newly profitable or hitherto unexplored resources yield a high growth rate and set in motion expansionary forces elsewhere in the economy.

(*b*) *Supplementary growth sectors*, where rapid advance occurs in direct response to—or as a requirement of—advance in the primary growth sectors; *e.g.*, coal, iron and engineering in relation to railroads. These sectors may have to be tracked many stages back into the economy, as the Leontief input–output models would suggest.

(*c*) *Derived growth sectors*, where advance occurs in some fairly steady relation to the growth of total real income, population, industrial production or some other overall, modestly increasing parameter. Food output in relation to population, housing in relation to family formation are classic derived relations of this order.

Very roughly speaking, primary and supplementary growth sectors derive their high momentum essentially from the introduction and diffusion of changes in the cost–supply environment (in turn, of course, partially influenced by demand changes); while the derived-growth sectors are

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a matter of history, agricultural revolutions have generally preceded or accompanied the take-off. In theory we can envisage a take-off which did not require a radical improvement in agricultural productivity: if, for example, the growth and productivity of the industrial sector permitted a withering away of traditional agriculture and a substitution for it of imports. In fact, agricultural revolutions have been required to permit rapidly growing (and urbanising) populations to be fed without exhausting foreign exchange resources in food imports or creating excessive hunger in the rural sector; and as noted at several points in this argument, agricultural revolutions have in fact played an essential and positive role, not merely by both releasing workers to the cities, and feeding them, but also by earning foreign exchange for general capital-formation purposes.

[1] *Process of Economic Growth*, Chapter 4, especially pp. 97–102; and, in greater detail, "Trends in the Allocation of Resources in Secular Growth," see above, p. 41, n. 1.

linked essentially to changes in demand (while subject also to continuing changes in production functions of a less dramatic character).

At any period of time it appears to be true even in a mature and growing economy that forward momentum is maintained as the result of rapid expansion in a limited number of primary sectors, whose expansion has significant external economy and other secondary effects. From this perspective the behaviour of sectors during the take-off is merely a special version of the growth process in general; or, put another way, growth proceeds by repeating endlessly, in different patterns, with different leadings sectors, the experience of the take-off. Like the take-off, long-term growth requires that the society not only generate vast quantities of capital for depreciation and maintenance, for housing and for a balanced complement of utilities and other overheads, but also a sequence of highly productive primary sectors, growing rapidly, based on new production functions. Only thus has the aggregate marginal capital–output ratio been kept low.

Once again history is full of variety: a considerable array of sectors appears to have played this key role in the take-off process.

The development of a cotton-textile industry sufficient to meet domestic requirements has not generally imparted a sufficient impulse in itself to launch a self-sustaining growth process. The development of modern cotton-textile industries in substitution for imports has, more typically, marked the pretake-off period, as for example in India, China and Mexico.

There is, however, the famous exception of Britain's industrial revolution. Baines' table on raw-cotton imports and his comment on it are worth quoting, covering as they do the original leading sector in the first take-off: [1]

Rate of Increase in the Import of Cotton-wool, in Periods of Ten Years From 1741–1831.

	%.		%.
1741–1751	81	1791–1801	67½
1751–1761	21½	1801–1811	39½
1761–1771	25½	1811–1821	93
1771–1781	75¾	1821–1831	85
1781–1791	319½		

From 1697 to 1741, the increase was trifling: between 1741 and 1751 the manufacture, though still insignificant in extent, made a considerable spring: during the next twenty years, the increase was moderate: from 1771 to 1781, owing to the invention of the jenny and the water-frame, a rapid increase took place: in the ten years from 1781 to 1791, being those which immediately followed the invention of the mule and the expiration of Arkwrights's patent, the rate of advancement was prodigiously accelerated, being nearly 320%: and from that time to the present, and especially since the close of the war, the increase, though considerably moderated, has been rapid and steady far beyond all precedent in any other manufacture.

Why did the development of a modern factory system in cotton textiles lead on in Britain to a self-sustaining growth process, whereas it failed to do so in other cases? Part of the answer lies in the fact that, by the late eighteenth century, the preconditions for take-off in Britain were very fully developed. Progress in textiles, coal, iron and even steam power had been

[1] E. Baines, *History of the Cotton Manufacture* (London, 1835), p. 348.

considerable through the eighteenth century; and the social and institutional environment was propitious. But two further technical elements helped determine the upshot. First, the British cotton-textile industry was large in relation to the total size of the economy. From its modern beginnings, but notably from the 1780s forward, a very high proportion of total cotton-textile output was directed abroad, reaching 60% by the 1820s.[1] The evolution of this industry was a more massive fact, with wider secondary repercussions, than if it were simply supplying the domestic market. Industrial enterprise on this scale had secondary reactions on the development of urban areas, the demand for coal, iron and machinery, the demand for working capital and ultimately the demand for cheap transport, which powerfully stimulated industrial development in other directions.[2]

Second, a source of effective demand for rapid expansion in British cotton textiles was supplied, in the first instance, by the sharp reduction in real costs and prices which accompanied the technological developments in manufacture and the cheapening real cost of raw cotton induced by the cotton gin. In this Britain had an advantage not enjoyed by those who came later; for they merely substituted domestic for foreign-manufactured cotton textiles. The substitution undoubtedly had important secondary effects by introducing a modern industrial sector and releasing in net a pool of foreign exchange for other purposes; but there was no sharp fall in the real cost of acquiring cotton textiles and no equivalent lift in real income.

The introduction of the railroad has been historically the most powerful single initiator of take-offs.[3] It was decisive in the United States, Germany and Russia; it has played an extremely important part in the Swedish, Japanese and other cases. The railroad has had three major kinds of impact on economic growth during the take-off period. First, it has lowered internal transport costs, brought new areas and products into commercial markets and, in general, performed the Smithian function of widening the market. Second, it has been a prerequisite in many cases to the development of a major new and rapidly enlarging export sector which, in turn, has served to generate capital for internal development; as, for example, the American railroads of the 1850s, the Russian and Canadian railways before 1914. Third, and perhaps most important for the take-off itself, the development of railways has led on to the development of modern coal, iron and engineering industries. In many countries the growth of modern basic industrial sectors can be traced in the most direct way to the requirements for building

[1] The volume (official value) of British cotton goods exports rose from £355,060 in 1780 to £7,624,505 in 1802 (Baines, *op. cit.*, p. 350). See also the calculation of R. C. O. Matthews, *A Study in Trade Cycle History* (Cambridge, 1954), pp. 127–9.

[2] If we are prepared to treat New England of the first half of the nineteenth century as a separable economy, its take-off into sustained growth can be allocated to the period, roughly, 1820–50 and, again, a disproportionately large cotton-textile industry based substantially on exports (that is, from New England to the rest of the United States) is the regional foundation for sustained growth.

[3] For a detailed analysis of the routes of impact of the railroad on economic development see Paul H. Cootner, *Transport Innovation and Economic Development : The Case of the U.S. Steam Railroads*, 1953, unpublished doctoral thesis, M.I.T.

and, especially, for maintaining substantial railway systems. When a society has developed deeper institutional, social and political prerequisites for take-off, the rapid growth of a railway system with these powerful triple effects has often served to lift it into self-sustaining growth. Where the prerequisities have not existed, however, very substantial railway building has failed to initiate a take-off, as, for example, in India, China, pre-1895 Canada, pre-1914 Argentine, etc.

It is clear that an enlargement and modernisation of Armed Forces could play the role of a leading sector in take-off. It was a factor in the Russian, Japanese and German take-offs; and it figures heavily in current Chinese Communist plans. But historically the role of modern armaments has been ancillary rather than central to the take-off.

Quite aside from their role in supplying foreign exchange for general capital-formation purposes, raw materials and foodstuffs can play the role of leading sectors in the take-off if they involve the application of modern processing techniques. The timber industry, built on the steam saw, fulfilled this function in the first phase of Sweden's take-off, to be followed shortly by the pulp industry. Similarly, the shift of Denmark to meat and dairy products, after 1873, appears to have reinforced the development of a manufacturing sector in the economy, as well as providing a major source of foreign exchange. And as Lockwood notes, even the export of Japanese silk thread had important secondary effects which developed modern production techniques.[1]

> "To satisfy the demands of American weaving and hosiery mills for uniform, high-grade yarn, however, it was necessary to improve the quality of the product, from the silkworm egg on through to the bale of silk. In sericulture this meant the introduction of scientific methods of breeding and disease control; in reeling it stimulated the shift to large filatures equipped with machinery; in marketing it led to large-scale organization in the collection and sale of cocoons and raw silk . . . it exerted steady pressure in favor of the application of science, machinery, and modern business enterprise."

The role of leading sector has been assumed, finally, by the accelerated development of domestic manufacture of consumption goods over a wide range in substitution for imports, as, for example, in Australia, the Argentine and perhaps in contemporary Turkey.

What can we say, then, in general about these leading sectors? Historically, they have ranged from cotton textiles, through heavy-industry complexes based on railroads and military end products, to timber, pulp, dairy products and finally a wide variety of consumers' goods. There is, clearly, no one sectoral sequence for take-off, no single sector which constitutes the magic key. There is no need for a growing society to recapitulate the structural sequence and pattern of Britain, the United States or Russia. Four basic factors must be present:

1. There must be enlarged effective demand for the product or products of sectors which yield a foundation for a rapid rate of growth

[1] W. W. Lockwood, *The Economic Development of Japan* (Princeton, 1954), pp. 338–9.

in output. Historically this has been brought about initially by the transfer of income from consumption or hoarding to productive investment; by capital imports; by a sharp increase in the productivity of current investment inputs, yielding an increase in consumers' real income expended on domestic manufactures; or by a combination of these routes.

2. There must be an introduction into these sectors of new production functions as well as an expansion of capacity.

3. The society must be capable of generating capital initially required to detonate the take-off in these key sectors; and especially, there must be a high rate of plough-back by the (private or state) entrepreneurs controlling capacity and technique in these sectors and in the supplementary growth sectors they stimulated to expand.

4. Finally, the leading sector or sectors must be such that their expansion and technical transformation induce a chain of Leontief input–output requirements for increased capacity and the potentiality for new production functions in other sectors, to which the society, in fact, progressively responds.

VI. Conclusion

This hypothesis is, then, a return to a rather old-fashioned way of looking at economic development. The take-off is defined as an industrial revolution, tied directly to radical changes in methods of production, having their decisive consequence over a relatively short period of time.

This view would not deny the role of longer, slower changes in the whole process of economic growth. On the contrary, take-off requires a massive set of preconditions going to the heart of a society's economic organisation and its effective scale of values. Moreover, for the take-off to be successful, it must lead on progressively to sustained growth; and this implies further deep and often slow-moving changes in the economy and the society as a whole.

What this argument does assert is that the rapid growth of one or more new manufacturing sectors is a powerful and essential engine of economic transformation. Its power derives from the multiplicity of its forms of impact, when a society is prepared to respond positively to this impact. Growth in such sectors, with new production functions of high productivity, in itself tends to raise output per head; it places incomes in the hands of men who will not merely save a high proportion of an expanding income but who will plough it into highly productive investment; it sets up a chain of effective demand for other manufactured products; it sets up a requirement for enlarged urban areas, whose capital costs may be high, but whose population and market organisation help to make industrialisation an on-going process; and, finally, it opens up a range of external economy effects which, in the end, help to produce new leading sectors when the initial impulse of the take-off's leading sectors begins to wane.

We can observe in history and in the contemporary world important changes in production functions in non-manufacturing sectors which have powerful effects on whole societies. If natural resources are rich enough or the new agricultural tricks are productive enough such changes can even outstrip population growth and yield a rise in real output per head. Moreover, they may be a necessary prior condition for take-off or a necessary concomitant for take-off. Nothing in this analysis should be read as deprecating the importance of productivity changes in agriculture to the whole process of economic growth. But in the end take-off requires that a society find a way to apply effectively to its own peculiar resources what D. H. Robertson once called the tricks of manufacture; and continued growth requires that it so organise itself as to continue to apply them in an unending flow, of changing composition. Only thus, as we have all been correctly taught, can that old demon, diminishing returns, be held at bay.

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