Kondratieff, Schumpeter, and Kuznets: Trend Periods Revisited
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I

THE analysis of fluctuations longer than the nine-year business cycle has been somewhat confused by a failure to distinguish sharply and to relate three distinct phenomena: *the forces set in motion by a leading sector in growth,* stemming from the introduction and progressive diffusion of a new technology, and its deceleration; *the forces set in motion by changes in the profitability of producing foodstuffs and raw materials,* whether from the side of prices or technology, including their effects on investment in new territories and mines, on capital movements, interest rates, terms of trade, and domestic and international income distribution; and *the forces set in motion* (notably, in housing and urban infrastructure) *by large waves of international or domestic migration or other forces changing the rate of family formation, housing demand, and the size of the working force.* As the world economy unfolded after 1783, these three phenomena operated concurrently and related to each other in complex ways not easy to disentangle. Nevertheless, the substantial literature on long waves can be usefully clarified by distinguishing these phenomena more sharply than is sometimes done and then relating them to each other at particular times and places. The exercise of doing so has, I believe, some general implications for economic theory, for they are all aspects of the process of adjustment towards a moving equilibrium, never attained—a process for which we lack an adequate dynamic theory.

II

Although he acknowledged two predecessors, N. D. Kondratieff is properly regarded as the father of the notion that capitalist economies are subject to cycles some fifty years in length.[1] He

[1] N. D. Kondratieff, "The Long Waves in Economic Life," *The Review of Economic Statistics,* XVII (Nov. 1935). See also George Garvy, "Kondratieff's Theory of Long Cycles," *Review of Economic Statistics,* XXV (Nov. 1943), and the discus-

established an empirical case by finding two and a half cycles in a number of price, wage, interest rate, and other value-affected series, with troughs around 1790, 1844-1851, and 1890-1896; peaks at 1810-1817, 1870-1875, and 1914-1920. Production data were both sparse and recalcitrant when set into this cyclical mold. Nevertheless, Kondratieff believed long-run cycles in output accompanied his cycles in prices and other value data.

He did not attempt directly to provide a theory of the long cycle; but he counterattacked critics who asserted that the phenomena he was examining reflected exogenous forces: changes in technology, wars and revolutions, the bringing of new countries into the world economy, and fluctuations in gold production. His counterattack asserted that none of these phenomena could be properly regarded as exogenous to the working of a world capitalist system;[2] but he did not render them endogenous. He implied that a coherent explanation must exist; but, in his own phrase, he never developed "an appropriate theory of long waves."

Starting essentially from Kondratieff's long price cycles, Schumpeter tried to provide such a theory by linking price movements to the grand sequence of technological leading sectors, grouped in three batches: cotton textiles and iron; railroads, steam, and steel; electricity, industrial chemistry, and the internal combustion engine. The price link was achieved by assuming that the early, experimental phase of innovation involved an inflationary expansion of credit-financed investment not matched promptly by the cost-reducing results the innovation would ultimately yield. The maturing and diffusion of the innovation in sectors with significant weight in the economy brought cost reductions sufficiently powerful to bring down the aggregate price index.

This theory did not conform well to the available data on upswings. The early experimental phase of cotton textile and iron innovation did not require credit expansion on a scale capable of inflating the British price level; and price reductions came promptly —even in the inherently inflationary setting of the Napoleonic Wars. Nor did the early days of the electricity-chemicals-automobile revolution provide a persuasive explanation for the price in-

sion of Kondratieff's views in Simon Kuznets, *Secular Movements in Production and Prices* (Boston, 1930), pp. 263-265.

[2] N. D. Kondratieff, "Long Waves," pp. 112-115. Subsequent troughs in relative prices in the 1930's and in 1972, and the peak about 1951 impart a special contemporary interest to Kondratieff's hypothesis.

crease between the mid-1890's and 1914. The railroads and the price increase of the 1850's, in the upswing of the second Kondratieff, looked like the best case. As Schumpeter was aware, however, by the 1850's railroads were well beyond an inflationary infancy, and major railroad expansion in the 1840's, in Britain and the American northeast, was accompanied by relatively stagnant or falling prices. Railroads by themselves do not explain the price increase of the 1850's and the maintenance of a high range of prices down to 1873.

While Schumpeter's link between innovations and long price cycles was unpersuasive, he did succeed in pushing towards the center of the stage the notion of leading sectors in economic growth. This concept had emerged during the 1930's out of the work of Simon Kuznets and others.[3] Schumpeter's analysis of the Kondratieff downswing correctly caught the way in which the fruition of a major technological innovation brought with it pressures for price decline, a narrowing of profit margins, and rising real wages. In general, however, Schumpeter's effort to use the dynamics of innovation to explain Kondratieff's long cycles was only partially successful.

Simon Kuznets appears twice in the story of long cycles, first as the young theorist of *Secular Movements in Production and Prices*, seeking to use the tools of the statistician to open the way to a general dynamic theory of production and prices.[4] Kuznets was determined to proceed from a more solid statistical base than Kondratieff. Whereas Kondratieff examined 36 series (finding long cycles in 25), Kuznets subjected some 65 production and 35 price series (drawn from five countries) to trend analysis. He found that primary trends in production and prices reflected systematically the life cycle of a given technical innovation (or opening up of a new territory or natural resource); that is, a phase of rapid, then decelerating, increase in output; of rapid, then decelerating, decrease in price. Here, in Kuznets' phrase, was the path followed by the industries which "lead in development."[5]

[3] Schumpeter evidently knew and was respectful of Kuznets' *Secular Movements in Production and Prices* and A. F. Burns' *Production Trends in the United States Since 1870* (New York 1934). Significant work on sectoral patterns was also done in the late 1930's by Walther Hoffmann, *Stadien und Typen der Industrialisierung* (Kiel, 1931).

[4] Note, in particular, his peroration, Kuznets, *Secular Movements*, p. 329.

[5] Ibid., pp. 3-5.

The first thing Kuznets' analysis of primary trends demonstrated was that the cost-reducing effect of innovation was generally translated promptly into price reductions—a proposition Schumpeter failed to take into account. In fact, with the passage of time price reductions were subject to retardation, just as were increases in output; and, in the post-1865 period, a number of sectors saw marked deceleration in primary production trends accompanied, after the mid-1890's, by price increases. Kuznets demonstrated that over time a version of diminishing returns operated with respect to a given innovative breakthrough. He found similar paths in certain key agricultural and raw material sectors,[6] such as wheat, cotton, bituminous coal, and copper in the United States. In this pattern, Kuznets had the materials in hand to proceed to an explanation for Kondratieff's long cycles in over-all price indexes, for Kuznets was dealing with commodities of heavy weight in those indexes. But he did not take that route. He stayed with the sectors.

Kuznets exhibited a similar reserve with respect to over-all production. He did not link his insights into sectoral retardation to statistical data on the course of national output. He was satisfied to contrast in general terms the "fairly continuous march of economic progress" with the decelerating paths of the sectors; and he noted that the relatively steady over-all rate of growth was sustained by a succession of leading sectors.[7]

Only in dealing with secondary movements in production and prices—those taking place around the primary trend—did Kuznets come seriously to grips in general terms with the relations among aggregate output, prices, labor productivity, and real wages. He first demonstrated that secondary expansion and contraction in production were systematically preceded by price increases and decreases, suggesting clearly the role of price movements as a mechanism for shifting the direction of investment. In a sustained theoretical passage of some fifty pages, Kuznets then posed the question of why a period of rising prices should be, at once, a period of rapidly expanding output and of constrained real wages.[8] His answer was, essentially, that the downward relative shift in (urban) consumers' income, due to rising prices, is compensated for by reduced savings and by enlarged opportunities for employment

[6] Ibid., pp. 71, 74, 83, 90, 91, 103.
[7] Ibid., pp. 4-5.
[8] Ibid., pp. 206-59.

in the production of capital goods, whose financing is rendered easier by the shift in income distribution from wages to profits. Kuznets then explored why an expansion phase of this kind should come to an end. He adduced a decline in labor productivity, as the working force in the rapidly expanding sectors was increased, combined with monetary restraints, as rising prices reduced the incentive to mine gold under a gold standard regime. I would not wholly agree with this model; but, as shall emerge, it is relevant to phenomena confronted in the U.S. and in other advanced industrial economies in the period from the mid-1890's to 1914.

Kuznets then raised the question of whether these secondary movements in prices and production are to be regarded as cycles. He concluded that they are not: they are to be viewed as "specific, historical occurrences."[9] Finally, he explored how the rate of growth of a primary trend affects the amplitude of both secondary fluctuations and conventional cyclical movements. He found and sought to explain the expected positive correlation.

Kuznets did not, then, try to relate his important, limited findings to the wide-ranging phenomena which Kondratieff asserted were capable of being embraced in a general theory of long waves. He regarded his book as a preliminary reconnaissance of the issues that had to be faced in building a general dynamic theory. Nevertheless, in its analysis of primary trends in a succession of leading sectors and in the lagged linkage he established between secondary trend movements in prices and production, this germinal study had a grip on two of the three key mechanisms I would regard as basic to an understanding of secular trends.

Kuznets then abandoned the world of refined sectoral analysis of production and prices for the highly aggregated field of comparative national income analysis. But he returned briefly to long waves in his *National Product Since 1869,* his essay on "Levels of Variability of Rates of Growth," and at length in his celebrated paper of 1958, "Long Swings in the Growth of Population and in Related Economic Variables."[10] Here he elaborated suggestively a hypoth-

[9] Ibid., p. 258.

[10] S. Kuznets, *National Product Since 1869* (New York, 1946), especially pp. 87-90; *Quantitative Aspects of the Economic Growth of Nations,* I; "Levels and Variability of Rates of Growth," *Economic Development and Cultural Change,* V (Oct. 1956), 44-51; and "Long Swings in the Growth of Population and in Related Economic Variables," *Proceedings of the American Philosophical Society,* CII:1 (1958), 25-52. Between Kuznets' "Secular Movements" and his *National Product Since 1869,*

esis which would link U.S. immigration to the pattern of investment—a hypothesis formulated by Brinley Thomas and A. K. Cairncross.[11] Kuznets asserted that the rhythm of American growth between the 1870's and the 1920's both attracted and was subsequently shaped by flows of immigration from abroad. As the most dynamic element in the rate of growth of U.S. population, the scale of immigration substantially determined fluctuations in non-farm residential construction and roughly coincided with fluctuations in capital expenditures for railroads. Trend fluctuations in other forms of investment were inverse to outlays on housing and railroads before the 1920's, reflecting a competition for scarce investment resources similar to the tension in Britain between domestic investment and capital exports. Trend fluctuations in the per capita flow of goods to consumers tended to follow fluctuations in other forms of investment rather than outlays for non-farm housing and railroads before the 1920's. Using overlapping ten-year averages, the peaks in population-increase, non-farm residential construction, and capital expenditure on railroads before 1914 come in the periods 1880-1890 and 1900-1910. For GNP (and GNP per capita) the peaks are 1875-1885 and 1900-1910. There is the familiar trough of the 1890's and evidence of some falling away in the pre-1914 decade. If one chooses to extend the analysis beyond 1914, peaks emerge in 1920-1930 and 1940-1950 for population increase and GNP per capita. This set of measurements is the proximate origin of a substantial part of the large literature on the "Kuznets cycle" of the past fifteen years.

Kuznets treated American railroads as a "population-sensitive" form of investment.[12] As the leading sector in American growth from the 1840's to the 1880's, closely linked to the emergence of

Arthur F. Burns (1954) had moved the analysis of trend cycles in growth in the U.S. from a sectoral to an aggregate basis (see, especially, ch. vi in his *Production Trends in the United States Since 1870*).

[11] Brinley Thomas, *Migration and Economic Growth* (Cambridge, 1954), especially pp. 102-113; A. K. Cairncross, *Home and Foreign Investment, 1870-1913* (Cambridge, 1953), especially pp. 187-221. It should be noted that, still earlier, Walter Isard and Norman J. Silberling had demonstrated an association between migration and construction in the United States, as well as with transport cycles; Walter Isard, "A Neglected Cycle: The Transport-Building Cycle," *Review of Economic Statistics* (Nov. 1942), pp. 149-158; Norman J. Silberling, *The Dynamics of Business* (New York and London, 1943) especially pp. 175-238. See also Brinley Thomas' recent challenge to what he regards as excessively "American-centered" views of the long cycle, *Migration and Urban Development* (London, 1972), especially chs. i-iv.

[12] S. Kuznets, "Long Swings," p. 33.

the steel industry after the Civil War, the railroads were surely connected in one way or another with immigration, with population increase, internal population movement, and almost everything else that mattered in the American economy.[13] And the waning of railroads as a leading sector in the 1890's is a significant factor in the protracted cyclical depression of that decade. But to designate the railroads as merely "population-sensitive" is to evade a good many basic analytic issues. Take, for example, the quite different economic motives for the railway booms of the 1840's and the 1850's. The former linked industrial and commercial centers in the American Northeast, a direction of investment that commended itself (as in England) after the agricultural boom and bust of the 1830's in the American South and West. On the contrary, the railroad boom of the 1850's was positively related to the rise in the world wheat price and the attraction of opening up new wheat acreage in the mid-West. The motivation for the transcontinental lines built after the Civil War was, economically, still more complex, since it was not tied so closely to the exploitation of a single natural resource. Then there is a lion in the path: the problem of the decline of the railroads as a leading sector before 1914, at a time when immigration moved up to peak levels.[14] While, evidently, the sequence of great transport innovations, from turnpikes and canals to the automobile, should have a major place in any analysis of the course of modern economic growth, we lose more than we gain by treating them as "population-sensitive."

Kuznets' analysis was further narrowed by the virtual disappearance of prices from his long cycle mechanism.[15] What one might call the orthodox Kuznets cycle school has focused primarily on

[13] For reasons set out in Appendix B (pp. 223-230) of the second (1971) edition of *The Stages of Economic Growth*, I do not regard the well-known works of Robert Fogel and Albert Fishlow as altering the judgment that railroadization, in all its multiple consequences, was the leading sector in American economic growth from the 1840's through the 1880's.

[14] S. Kuznets, *Secular Trends*, p. 191; and Melville J. Ulmer, *Capital in Transportation, Communication and Public Utilities: Its Formation and Financing* (Princeton, 1960), p. 112.

[15] S. Kuznets, "Long Swings," p. 36: "One could also probably find long swings in price structures, that is, in the relations of prices of various factors of production or of various groups of goods." In his various expositions of the Kuznets long cycle Moses Abramovitz has sometimes listed price movements as related to them; but he did not establish a firm and lucid linkage. See, for example, Abramovitz' colloquy on this subject before the Joint Economic Committee, *Employment, Growth, and Price Levels*, 86th Congress, 1st Session, Part II (Washington, 1959), pp. 458-59.

establishing twenty-year cycles in a wide range of production and investment data.[16] But the exploration of long period fluctuations over the past two decades has not been wholly dominated by this perspective. It has taken three directions which I shall illustrate rather than annotate thoroughly.

First, there are those who have pursued and refined the demographic element which was at the heart of Kuznets' 1958 paper. Allen C. Kelley, for example, explored in Australia and elsewhere how a major change in the age-structure of a population, brought about by migration (or war), could set in motion waves in the rate of labor-force participation, the formation of families (and housing construction), and in the savings rate.[17] Richard A. Easterlin, for example, using U.S. data, sought to clarify how an increased demand for labor could induce demographic change (including fertility rates), and how this demographic change could then play back on the demand for housing and urban infrastructure, carrying this dimension of the Kuznets cycle analysis forward to the rise and collapse of the post-1945 U.S. baby boom.[18]

A second group of analysts looked for Kuznets cycles in a quite different direction: in flows of capital and trade balances rather than in flows of migrants. This raised questions about the motivation for international capital movements posed in the work of Thomas and Cairncross, but with a still older lineage reaching back at least to C. K. Hobson, to Frank Taussig, his distinguished pupils, and others who explored what used to be called the transfer mechanism. Arthur I. Bloomfield used a long cycle framework in reviewing fluctuations in international investment before 1914.[19]

[16] In addition to Abramovitz' 1959 statement before the Joint Economic Committee, see also his "The Nature and Significance of Kuznets' Cycles," *Economic Development and Cultural Change*, IX (April 1961), 225-48; and "The Passing of the Kuznets Cycle," *Economica* (Nov. 1968), pp. 349-67.

[17] Kelley's widest ranging paper in this field is "Demographic Cycles and Economic Growth: The Long Swing Reconsidered," JOURNAL OF ECONOMIC HISTORY, XXIX (Dec. 1969), pp. 633-56.

[18] Richard A. Easterlin, *Population, Labor Force, and Long Swings in Economic Growth* (New York, 1968).

[19] Arthur I. Bloomfield, *Patterns of Fluctuation in International Investment before 1914*, Princeton Studies in International Finance No. 21 (Princeton, 1968), p. 5. Conversely, P. J. O'Leary and W. Arthur Lewis conclude that British capital movements were perverse: motivated merely by dissatisfaction with low rates of return in domestic capital markets and supplying excessive capital to agricultural regions at a time when their export prices were falling, in the period 1883-1896; "Secular Swings in Production and Trade, 1870-1913," *The Manchester School*, XXIII (May 1955), 145-46. This judgment is based, I believe, on a somewhat superficial view

Country studies were done by Jeffrey G. Williamson and A. G. Ford, among others.[20] In the present narrow context, the point to be made is that these studies inevitably raised an issue posed by Kondratieff, explored by the early Kuznets (in his work on secondary movements in prices and production), but pretty well washed out by Schumpeter, the latter-day Kuznets, and their followers: that is, the relative abundance or scarcity of supplies of foodstuffs and raw materials. As Bloomfield noted: "A large but indeterminable part of the long-term capital that flowed to the 'newer' overseas countries before 1914 was undoubtedly stimulated directly or indirectly by the actual and prospective expansion of demand in the industrial centers for the primary products of those countries."[21] Bloomfield goes on to point out, quite correctly, that railroads and other foreign-financed infrastructure in these areas were often built for economic reasons that transcended a desire to expand exports, and sometimes, even, for non-economic reasons. But the flows of capital to Argentina and Australia, Canada, New Zealand, and (I would add) pre-1860 United States cannot be understood outside the context of the changing profitability of foodstuff and raw material production as decreed, on the one hand, by price movements of their export products, on the other, by major developments in transport and other technology related to agriculture.

Behind the question of capital movements and price fluctuations in foodstuffs and raw materials lay a deeper question: What were the equilibrium levels of world output for foodstuffs and the various raw materials; what determined these levels; and what determined departures from them? What was the meaning and consequences of the lagged price-output corrective mechanisms caught by the early Kuznets in his measurement of secondary trends in foodstuff and raw materials such as wheat, cotton, bituminous coal, and copper?[22] International capital movements did not generally launch

of the motives for pre-1896 capital exports (see below, pp. 735-742). The opening of highly fertile areas could be profitable even in a general environment of falling prices. But, on the face of it, the build-up of Argentine, Canadian, and Australian infrastructure in the 1880's was a fortunate preparation for the period of rising prices and production that followed, roughly, 1896. Neverthless, the O'Leary-Lewis analysis must be accounted a major effort to take into account price and international capital movements in assessing long cycles.

[20] Jeffrey G. Williamson, *American Growth and the Balance of Payments, 1820-1913* (Chapel Hill, 1964); A. G. Ford, "British Investment in Argentina and Long Swings, 1880-1914," JOURNAL OF ECONOMIC HISTORY, XXXI (Sept. 1971), 650-663.

[21] A. I. Bloomfield, *Patterns of Fluctuation*, p. 5.

[22] S. Kuznets, *Secular Movements*, pp. 74, 84, 91, and 104.

periods of expansion in foodstuff and raw material producing areas. They moved in to exploit and support waves of prosperity already under way, triggered by the increased profitability of expanding output of particular foodstuffs and raw materials.[23] But they were palpably part of the process of balancing population expansion, urbanization, and the pace of industrialization with requisite increases in inputs. We can conclude that a part of the latter-day long wave discussion has approached again the issue of successive periods of agricultural depression and expansion into new territories, without by any means settling the matter.

A third strand in latter-day Kuznets long cycle analysis would link fluctuations in the rate of increase in output not with railroads and immigration, not with international capital movements to new areas but to the uneven sequence of major industrial innovations and consequent fluctuations in the capital-output (or capital-income) ratio. Here we return to the world of leading sectors—to Kuznets' primary secular movements, to A. F. Burns' study of sectoral retardation, and to Schumpeter's heroic innovations—linked, this time, to trend movements in production growth rates and productivity rather than to prices. E. H. Phelps Brown, S. J. Handfield-Jones, and Bernard Weber have led the way in this mode of analysis.[24]

There are two final points to be noted about the intellectual history of Kuznets' cycle analysis. First, there emerges a growing awareness that what one is talking about in a latter-day Kuznets cycle may be, simply, variation in the character of conventional business cycles (Juglars)—especially phases of "severe and protracted depression"—rather than an authentic cycle whose rhythm

[23] The lag of capital imports behind series reflecting domestic expansion can be traced out in the economic history of particular foodstuff and raw material producing regions, but it is caught statistically in general terms by A. I. Bloomfield, *Patterns of Fluctuation*, p. 34.

[24] E. H. Phelps Brown with Sheila V. Hopkins, "The Course of Wage-Rates in Five Countries, 1860-1939," *Oxford Economic Papers*, II (June 1950), especially pp. 238-39; E. H. Phelps Brown with S. J. Handfield-Jones, "The Climacteric of the 1890's: A Study in the Expanding Economy," *Oxford Economic Papers*, IV (Oct. 1952); E. H. Phelps Brown and B. Weber, "Accumulation, Productivity, and Distribution in the British Economy, 1870-1938," *Economic Journal*, LXIII (June 1953); Bernard Weber and S. J. Handfield-Jones, "Variations in the Rate of Economic Growth in the U.S.A., 1869-1939," *Oxford Economic Papers*, VI (June 1954). For earlier speculation on retardation in older sectors incorporating new technology, see A. F. Burns, *Production Trends*, especially pp. 276-81; also, G. T. Jones, *Increasing Return* (Cambridge, 1933).

and structure should supplant the concept of a Juglar.[25] A second modification, suggested by Abramovitz in "The Passing of the Kuznets Cycle," is that one ought to regard twenty-year waves in output as a phenomenon confined to the period "from about the 1840's to 1914." Certainly, if one builds the Kuznets cycle on migration, housing construction, and the railroads, it cannot be logically extended beyond 1914 in the United States. Indeed, as suggested earlier, the railways, although still a massive outlet for investment, ceased to be a leading sector before 1914. Over the period 1840-1914, there are two ambiguous and two clear cases of "severe and protracted depression": the ambiguous case of the late 1850's, merging as it did into the Civil War; the long and deep depressions of the 1870's and the 1890's; the ambiguous case of the period 1909-1913, when the economy decelerated, unemployment was somewhat above the average of the period 1900-1907, but there was no "severe and protracted depression" in the same sense as in the 1870's and 1890's. Clearly, two cases do not justify a category of cycles.

I conclude, then, that the phenomena identified but not explained by Kondratieff have still not been brought within the framework of "an appropriate theory of long waves." Schumpeter tried but failed to link leading growth sectors to the upswings in long-term price cycles. The early Kuznets exposed some of the critical relationships between technology, prices, and production in the sectors but moved on to highly aggregated growth analysis before he achieved a synthesis responsive to Kondratieff's challenge. The later Kuznets dramatized long cycles in the United States related to migration, housing construction, and railways; and he set others to work looking for long cycles elsewhere. But, under close examination, the phenomenon turned out to be more restricted in time and limited in meaning than some first thought. Meanwhile, others looked to

[25] Compare, in particular, Moses Abramovitz in "The Nature and Significance of Kuznets Cycles," p. 226, with "The Passing of the Kuznets Cycle," p. 351. On this point, see also P. J. O'Leary and W. Arthur Lewis, "Secular Swings," pp. 116-18: "One may be tempted to deny that there is fundamentally a Kuznets cycle, and may prefer to say that all that happens is that once every twenty years one of the Juglar depressions gets out of hand, and lasts for 6 to 8 years, instead of lasting 1 and 2 years only." This point relates to Arthur F. Burns' emphasis on the "sharp divergence of production trends" and "the strain and loss of industrial balance" during the upward phase of a trend-cycle movement, yielding a protracted downward phase of a re-adjustment and recovery of balance; Burns, *Production Trends*, pp. 248-49. It is also connected to Kuznets' finding, cited above, p. 723, that the amplitude of secondary cycles is associated positively with the momentum of a sector, as measured by its primary trend.

long term capital movements and changing rates of increase in industrial production, related to the sequence of leading sectors, for partial insight into trends longer than conventional business cycles.

I propose, therefore, to set aside the twenty-year Kuznets cycle, and to examine the trends in economic history by using the three concepts that have been cumulatively generated from Kondratieff forward, along with conventional business cycle analysis; the three concepts to which I refer are: the sequence of leading growth sectors; changes in the demand for and supply of foodstuff and raw materials and the changing pattern of investment they induced; and the now well-studied relations between fluctuations in population, family formation, housing construction, and the size of the working force.

III

We begin with the period 1865-1914 because data permit the interplay of these three concepts to be illustrated with reasonable clarity. A part of the story of trends (as well as growth) in these years is, surely, the shift in leading sectors in the more advanced economies of the time: from railroads and steel, in all their manifestations, to electricity, the new chemicals, and the early phase of the internal combustion engine.[26] The shift was not uniform in its timing

[26] It is impossible to chart the transition in leading sectors with precision for two reasons. First, conceptually, what we need are data embracing the whole leading sector complex; that is, the sector incorporating the new technology plus its backward and lateral linkages to the rest of the economy. Such data are not available. Second, there are narrower data problems. The traditional industrial classifications derive from institutional rather than technological history, embracing sub-sectors with neither uniform price nor income elasticities of demand nor with uniform technological influences, nor, even, uniform short-run elasticities of supply. Without further disaggregation, these categories leave us often in the position of having no analytic grip on the statistical movements they describe. Thus, Kuznets' despairing conclusion: "Since the high and accelerated rate of technological change is a major source of the high rates of growth of per capita product and productivity in modern times and is also responsible for striking shifts in production structure, it is frustrating that the available sectoral classifications fail to separate new industries from old, and distinguish those affected by technological innovations"; S. Kuznets, *Economic Growth of Nations: Total Output and Production Structure* (Cambridge, 1971), p. 315. Nevertheless, some useful propositions about leading sectors are possible short of satisfactory measurement. And, as I have argued on other occasions, I believe it wiser to get at leading sectors with such data as we can muster than to confine our study to over-aggregated data which conceal from view variables critical to growth, trend, and cyclical analysis; see, for example, W. W. Rostow, *Stages of Economic Growth*, 2d ed. (Cambridge, 1971), especially pp. 183-89.

and character; nor did all the major economies move away from the old and on to the new leading sectors at the same pace. Nevertheless, one can observe around about 1900 in Britain, Germany, and the United States a deceleration in the older sectors not wholly compensated by the higher rates of output increase in the newer sectors. In general, the sectoral trends in output were accompanied by productivity movements in the same direction. The over-all result was a deceleration of national income per occupied person in the U.K. and Germany, and (to a lesser degree) in the U.S.[27] To some extent this deceleration is the cause of the deceleration or decline in real wage rates over this period, long noted in the United States, Britain, and Germany, with France a somewhat special case, enjoying as it did one of its "belles époques" in the pre-1914 period.[28]

The fact that Phelps Brown and Hopkins included the case of Sweden is useful in the present context. Sweden was at an earlier

[27] E. H. Phelps Brown with Sheila V. Hopkins, "The Course of Wage Rates," p. 291. It is useful to compare their data with Kuznets' calculations of deviations of per capita product from straight line trends in growth rates, arrayed in overlapping averages. The American cyclical depression of the 1890's was longer and deeper than elsewhere. The average level of unemployment in the U.S. for the years 1893-1898 was 14.2 percent; in Britain it was 3.7 percent. Britain moved rapidly out of its trough of 1893; the U.S. wallowed in a trough from 1893 to 1898. This differential experience affected, of course, the contours of the subsequent expansions which, in the British case, were affected also by the Boer War, a more substantial affair economically than the Spanish-American War. Nevertheless, after its rebound from the disproportionately severe depression of the 1890's, retardation emerges in the U.S. as in the British and German data.

Years	*U. K. excluding Ireland 1860-1914*	*Germany 1850-1913*	*Sweden 1861-1914*	*United States 1870-1914*
1870-79 to 1880-89	−2.3	−7.6	−7.6	+11.7
1875-84 to 1885-94	+4.2	+0.1	−5.8	−4.0
1880-89 to 1890-99	+7.5	+5.8	−0.8	−6.8
1885-94 to 1895-1904	+3.6	+2.5	+1.8	+1.1
1890-99 to 1900-09	−4.5	−3.7	0	+4.6
1895-1904 to 1905-14	−6.0	−4.3	−0.9	−5.4
1900-09 to 1905-14	−3.9	−2.3	−0.5	−13.4

Source: Simon Kuznets, *Economic Growth of Nations*, p. 45.

[28] Ibid., p. 287. The sharp decline in French real wages late in the period derives from a particularly rapid increase in the cost of living. In a chart of product wage rates, E. H. Phelps Brown with S. J. Handfield-Jones shows Belgium sharing the relative stagnation of real wages after 1900; Phelps Brown and Handfield-Jones, "The Climacteric of the 1890's," p. 268. Paul Douglas' classic study of real wages in the United States showed, of course, no increase in real full time earnings between the period 1890/99 and 1914; Paul Douglas, *Real Wages in the United States, 1890-1926* (Boston, 1930), p. 582. The data chosen by Phelps Brown and Hopkins are hourly wage rates.

stage of growth than the other four countries charted. It had moved in the 1890's from take-off into a more diversified stage of growth, and was, over the years down to 1914, rapidly absorbing more sophisticated technology, notably in the pulp and paper and engineering sectors.[29] It shared deceleration to a degree; but the fact that its national income per occupied person and real wage rate moved at a quite different pace than that of the older industrial states is *prima facie* confirmation of the role of the leading sector transition in the latter case. Something of the same is true of Japan.[30]

The role of the leading sector transition is further reinforced if one looks more closely at the four older industrial economies. France, as we know, aided by the emergence of electric power, experienced a sharp acceleration of growth from about the mid-1890's to 1914, a surge notable in the final years of the period. This surge was rooted in what Marczewski and Crouzet designated as the "new" industries. This group rises in weight from 4.1 percent to 11.0 percent of industrial production between 1885-1894 to 1905-1913. The category includes rubber, gas, electricity, cement, and automobiles. France also moved briskly into aluminum production.[31]

Next to France, the waning of the older sectors is best compensated for in the United States. The over-all retardation in U.S. industrial growth after 1900 has been documented in detail, but in America the older sectors still had great momentum.[32] Steel, for example, was supported by rich U.S. ores, the scale of the market,

[29] See, for example, Lennart Jörberg, *Growth and Fluctuations of Swedish Industry* (Stockholm, 1961).

[30] The trend rate of growth of Japanese GNP apparently rises from a trough in 1902 to a peak in 1916; see Kazushi Ohkawa and Henry Rosovsky, ch. i in Lawrence Klein and Kazushi Ohkawa, editors, *Economic Growth, The Japanese Experience Since the Meiji Era* (Homewood, Ill., 1968), p. 8. On the diversification of Japanese industry in this period, based, as in Sweden, on the absorption of more sophisticated technologies, see Yuichi Shinoya, ch. iii, Ibid., especially pp. 74-77. On the sharp rise of real consumption expenditure per capita, after a brief setback during the period 1904-1909 (embracing the Russo-Japanese War), see Simon Kuznets, ch. vii, Ibid., especially p. 198.

[31] Jan Marczewski, "Some Aspects of the Economic Growth of France, 1660-1958," *Economic Development and Cultural Change*, IX (April 1961), especially pp. 382 and 386, as well as Tables 5, 7, and 9. François Crouzet "Essai de construction d'un indice annuel de la production industrielle française au XIX^{e} siècle," *Annales, Economies, Sociétés, Civilisations*, XXV (Jan.-Feb. 1970), especially pp. 71-73, 78-81, and Tables 6, 10b, 11a, and 11b in the statistical annex.

[32] Arthur Burns, *Production Trends*, especially ch. v. For retardation in productivity after 1899, see John Kendrick, *Productivity Trends in the United States* (Princeton, 1961), ch. iii, especially the five-year moving average chart of total factor productivity, p. 67.

and the efficiency of the industry's organization. Meanwhile, new technology spurred the emergence of new sectors in U.S. manufacturing industries.[33]

The new sectors of high momentum for the United States in the period 1899-1914 were the automobile sectoral complex (embracing automobiles, petroleum, rubber products, and so on); canned foods and ice; cigarettes; chemicals (including, notably, fertilizers, paints and varnishes); phonographs; electrical machinery. Net production of electricity in central stations rose from 6 to 25 billion KWH between 1902 and 1912. In 1899 non-electric prime movers generated 9.8 million horsepower; in 1919, 20.0 million. Comparable figures for electric motors are 0.5 and 16.3.[34] The scale of the rise in the automobile sectoral complex is suggested by the fact that the percentage of value added by automobile, petroleum and rubber industries rose from .99 percent of total value added in manufactures in 1899, to 2.63 percent in 1909, to 8.6 percent in 1919.[35] The great surge comes, of course, relatively late in the period with the emergence of Ford's mass-produced Model T, but growth accelerates from as early as 1904.

The over-all deceleration in the first decade of the twentieth century of German industrial production (as well as in income per capita) emerges in both Wagenführ's and Hoffmann's indexes.[36] Running against this trend were developments in the metals and

[33] Solomon Fabricant with the assistance of Julius Shiskin, *The Output of Manufacturing Industries, 1899-1937* (New York: National Bureau of Economic Research, 1940). William H. Shaw, *Value of Commodity Output Since 1869* (New York: National Bureau of Economic Research, 1947), also supplies highly disaggregated data permitting isolation of rapidly growing new sectors.

[34] S. Fabricant p. 296.

[35] Ibid., p. 102. This is a significant underestimate, since the impact of the automobile on steel, glass, battery, and other component production is not included.

[36] R. Wagenfuhr, "Die Industriewirtschaft Entwicklungstendenzen der deutschen und internationalen Industrieproduktion 1860-1932," *Sonderheft 31 Vierteljahreschafte zur Konjunktorforschung* (Berlin, 1933), p. 18; Walther G. Hoffmann, *Des Wachstum der Deutschen Wirtschaft sert der Mitte des 19. Jahrhunderts* (Berlin, 1965), pp. 451-52. The two indexes of industrial production move as follows, by decades (1913=100):

Years	*Wagenführ*	*Average Annual Rate of Growth*	*Hoffmann*	*Average Annual Rate of Growth*
1860	14.1		12.7	
1870	17.4	2.13%	18.8	4.00%
1880	24.8	3.61	26.1	3.34
1890	40.5	5.03	38.9	4.07
1900	64.5	4.76	61.4	4.67
1910	88.4	3.20	85.5	3.37

metal-working sectors, chemicals, paper and printing, gas and electricity.[37] As in the United States, steel production maintains a high momentum. In chemicals, the continued rapid expansion of sulphuric acid and rubber, joined by oil refining and coal derivatives, counters the slower growth in the soda and soap sub-sectors.[38] The rise of the German electrical manufacturing industry in the pre-1914 years (as well as the rapid exploitation of electric power) is, of course, a famous story in economic history.[39] Between 1900 and 1913 Hoffmann's index of German electricity production rises from 12 to 100.[40] Only the fledgling automobile industry exhibits a more rapid rate of growth: from 2.5 in 1901 to 100 in 1913.[41]

Examining the much-studied deceleration of British industry and real income per capita in the period 1900-1914, Phelps Brown and Handfield-Jones conclude as follows: ". . . the previous rise had been carried forward by the massive application of Steam and Steel, which now had not much scope for extension; while the new techniques, especially of electricity, the internal combustion engine, and the new chemical processes, did not attain massive application until during and after the First World War."[42] In general, the British absorption of the new technologies, including new methods of aluminum production, was not unimpressive; although Britain fell behind Germany and the U.S. in industrial chemistry and electrical equipment manufacture.[43] Its industrial pattern of these years

[37] W. G. Hoffmann, *Das Wachstum der Deutschen Wirtschaft*, pp. 392-93.
[38] Ibid., pp. 361-62.
[39] See, for example, David Landes, *The Unbound Prometheus* (Cambridge, 1969), especially pp. 287-90.
[40] W. G. Hoffmann, *Das Wachstum der Deutschen Wirtschaft*, pp. 388.
[41] Ibid., p. 358.
[42] Phelps Brown and Handfield-Jones, "The Climateric of the 1890's," p. 283.
[43] In sulphuric acid, for example, the British loss of leadership is suggested by the following table exhibiting sulphuric acid production:

WORLD PRODUCTION OF SULPHURIC ACID, 1867 TO 1913
(Thousands of tons of 100 percent acid)

Country	*1867*	*1878*	*1900*	*1913*
United Kingdom	155	600	1,000	1,082
Germany	75	112	950	1,686
France	125	200	500	900
Italy	—	—	200	600
Belgium	20	30	165	420
United States	40	180	940	2,250
Rest of World	(85)	(165)	(475)	(1,362)
TOTAL WORLD	(500)	(1,300)	(4,200)	(8,300)

Source: Ingvar Svennilson, *Growth and Stagnation in the European Economy* (Geneva, 1954), p. 286.

was marked, however, by two more basic characteristics as compared with its European competitors. First, a greater deceleration in the older industries, symbolized by these figures for consumption of steel and wrought iron:[44]

TABLE 1
CONSUMPTION OF STEEL AND WROUGHT IRON
(Crude steel equivalent in million tons)

Year	*United Kingdom (Including Ireland)*	*Germany (Including Luxembourg)*	*France*
1900	4.6	6.7	2.5
1913	7.2	13.7	4.7

Source: Ingvar Svennilson, *Growth and Stagnation in the European Economy* (Geneva, 1954), p. 274.

The extent to which the relatively greater British slackening in the older sectors was a matter of resource limitations (or other inescapable constraints) as opposed to less aggressive entrepreneurship is still a matter for lively debate.[45] But as a number of analysts have perceived, the distinction is not as sharp as might first appear: rational maximizing behavior may be quite different in a slow-growing industry with a high proportion of old, inherited capital stock than in the rapidly growing sector of a nation newer to industrialization. There was, however, another factor at work, that is, the extraordinary rise of capital exports, after the London capital market had worked off the burden of the Boer War, and the consequently dampened level of domestic investment. This brings us to the second of our three trend mechanisms: the changing pattern of investment in the world economy as decreed by the relative scarcity (and price movements) of foodstuffs and raw materials.

IV

In general, three factors can set in motion an expansion of foodstuff or raw material production: the pressure of a demand curve

[44] The increases in steel production were: U.K., 45 percent; Germany, 142 percent; France, 108 percent; Ibid., p. 261. Those for coal production were: U.K. 28 percent; Germany, 74 percent; France, 25 percent; Ibid., p. 252.

[45] David Landes marshals the case for a substantial entrepreneurial role in Britain's pre-1914 falling behind the German (and American) pace; D. Landes, *The Unbound Prometheus*, pp. 326-58. Six papers deal with facets of this question in Donald N. McCloskey, editor, *Essays on a Mature Economy: Britain after 1840* (Princeton, 1971). Five of the papers argue the rationality of British industrial practice. For a general defense of the British entrepreneurs as efficient maximizers in the Victorian era, see Donald N. McCloskey, "Did Victorian Britain Fail?," *Economic History Review* XXIII (Dec. 1970). McCloskey's argument, however, is not germane to the present discussion, since he does not extend his defense to the Edwardian period.

shifting to the right against a fixed or slower shifting supply curve, yielding an increase in price which is sustained for a sufficient period to attract increased investment; the availability of a new technology in transport, refrigeration, and so on, which renders profitable the exploitation of a hitherto known but unexploited (or less vigorously exploited) resource, at existing or even falling prices; the discovery of a new source of raw materials capable of profitable exploitation with existing prices. The latter two types of development may not be wholly independent, and they may be induced by price movements. All of these elements play their part in the story of foodstuff and raw material prices and output between the end of the American Civil War and 1914. The reversal in the trend of price movements toward the end of the century is not confined to foodstuffs; but for our present narrow illustrative purposes it may be useful to focus on wheat.

First, of course, there is the extraordinary expansion of American wheat acreage and output after the Civil War, closely linked to the laying of the transcontinental railway net; its rapid deceleration, as prices move down, especially between 1881 and the trough of 1894, and the limits of the American frontier are reached; the relatively limited response of American wheat acreage and output down to 1914 despite the higher range of prices. Meanwhile, rapidly expanding domestic demand attenuates the American role as a wheat exporter. The data on yield per acre suggest an initial surge in productivity, with a slackening in the 1880's; a second phase of increasing productivity in the course of the 1890's, and severe retardation in the years before the First World War.[46]

This was, of course, the general setting in which the opening up of new wheat areas in Australia, Argentina, and Canada became attractive; Russia, too, experienced a remarkable surge in wheat production and exports. The result is set out in Table 2.[47] Broadly speaking, world wheat production appeared to have responded to the recovery from the low range of prices which prevailed in the

[46] For successive five-year periods starting with 1885-1889, W. Malenbaum's data show wheat yield per acre moving as follows: 13 percent, 3 percent, −2 percent, 9 percent, −2 percent; W. Malenbaum, *The World Wheat Economy, 1885-1939* (Cambridge, Mass., 1953), pp. 236-39. See also Malenbaum's discussion of U.S. regional wheat yield trends, pp. 97-99. For trend cycles in U.S. production and yields for individual agricultural commodities, see Arthur Burns, *Production Trends*, pp. 207-15, 323, for stagnation of output per unit of labor input and decline per unit of capital input in the U.S.

[47] W. Malenbaum, *The World Wheat Economy*, pp. 238-39.

TABLE 2
WORLD WHEAT PRODUCTION, 1885-1914
(5-year averages in millions of bushels)

	1885-89	*1889-94*	*1894-99*	*1899-1904*	*1904-09*	*1909-14*	*Percent of Total World Increase 1885-90 to 1909-14*
Argentina	19.9	47.3	59.6	93.3	158.1	147.1	9.5%
Australia	25.9	31.3	27.3	42.7	59.3	90.5	4.8
Canada	38.3	40.9	51.8	76.6	104.0	197.1	11.8
U.S.A.	515.6	628.3	686.5	713.8	671.8	694.4	13.3
Overseas Exporters: Total	599.7	747.8	825.2	926.4	993.2	1129.1	39.4
Bulgaria, Hungary, Rumania, Yugoslavia, Poland	224.1	259.7	258.8	281.2	305.2	335.2	8.3
Russia	357.5	360.4	452.2	545.1	620.3	791.7	32.4
European Exporters: Total	581.6	620.1	711.0	826.3	925.5	1126.9	40.7
Algeria, Fr. Morocco, Tunis, Chile, Uruguay	56.9	62.0	63.0	64.4	70.0	82.0	1.9
Indian Peninsula	265.8	247.2	240.6	249.0	301.7	351.8	6.4
Ex-European Exporters: Total	322.7	309.2	303.6	315.4	371.7	433.8	8.3

TABLE 2 (*continued*)
WORLD WHEAT PRODUCTION, 1885-1914
(5-year averages in millions of bushels)

	1885-89	*1889-94*	*1894-99*	*1899-1904*	*1904-09*	*1909-14*	*Percent of Total World Increase 1885-90 to 1909-14*
European Importers: Total	823.7	802.1	853.2	903.0	914.0	926.7	10.4
Ex-European Importers: (Egypt, So. Africa, Japan Korea, New Zealand): Total	63.5	65.4	68.9	70.0	71.2	78.2	1.1
World: Total	2391.2	2544.6	2761.9	3041.1	3275.6	3730.7	99.9
Percentage Increase over Pevious Period		6.4%	8.5%	10.1%	7.7%	13.9%	

Source: W. Malenbaum, *The World Wheat Economy, 1885-1939*, pp. 238-239.

mid-1890's; the slackening of the price increase from, say, 1899 to 1906; and the resumed rise from then to 1913.[48]

How did international capital movements relate to this process? The general answer is that they helped prepare the way for and, in some cases, mightily reinforced but did not cause the process to take place. The scale of capital exports did, of course, have consequences for the character and pace of evolution in the capital-exporting nations.

The great surges of external investment relative to grain production (aside from the pre-1873 flows to the U.S.) were to Australia in 1883-1886; to Argentina, in 1886-1890; and to Canada in 1905-1913. The massive build-up of foreign investment in Russia proceeds less erratically, but expansion was particularly marked in the 1890's and in the period 1904-1909.

In Australia, railroad mileage more than doubled in the 1880's, a period when net capital inflow was about half of gross domestic capital formation.[49] This occurred at a time when wool dominated Australian exports, as gold production tapered off. In the 1880's Australia turned to domestic development and found the London capital market in a mood to finance its enterprises. There was no immediate expansion of Australian exports. But from 1884 Australian land policy changed in ways that encouraged agricultural production rather than pastoral activity. When wheat prices moved up in the mid-1890's, the combination of prior land policy and railroadization had set the stage for the expansion in output registered in Table 2.[50] The expansion of immigration comes later, accompanied by some revival of capital imports in the years before 1914. But Australian capital imports never reached again the peak level of the mid-1880's.[51]

The Argentine case bears a family resemblance to that of Australia: there is an initial phase of capital imports and railroadization in the 1880's related to domestic developments in Argentina; a subsequent surge in exports, including wheat exports, starting in the

[48] For various wheat price movements over these years, see, for example, Ibid., p. 118.

[49] N. G. Butlin, *Investment in Australian Economic Development, 1861-1900* (Cambridge, 1964), pp. 320-22, 29.

[50] See the contemporary comment quoted in W. Malenbaum, *The World Wheat Economy*, p. 141.

[51] See, especially, A. R. Hall, *The London Capital Market and Australia, 1870-1914* (Canberra, 1963), page opposite 88, and Appendixes II and IV.

1890's, substantially dependent on prior railroadization; a second wave of capital imports accompanied by large net immigration in the years before 1914. Although Argentine capital imports never quite regained the peak levels of 1888-1889, the expansion of 1905-1914 was stronger than in the Australian case.[52] The initiating impulse in this process was political: the consolidation of a firm central government by Roca in 1880. At the time, Argentina was, like Australia, primarily an exporter of wool. The pampas were, however, obviously an area capable of profitable grain exploitation even at low world prices, if immigrants could be attracted and efficient transport provided. Unlike the case of Australia, immigrants came to Argentina in large numbers in the 1880's. As the railways moved out over the pampas and barbed wire permitted the segregation of pastoral areas, the immigrants put increased acreage into production. There was a spectacular surge of output and exports in the early 1890's, helping stabilize the Argentine economy after the Baring Crisis in the face of falling export prices which otherwise would have had disastrous consequences;[53] and then the price increase, from the mid-1890's, induced the tripling in output to be observed in Table 2, accompanied by a quadrupling in wheat acreage (3.47 million acres in 1889-1894, to 16.05 in 1909-1914), and a memorable period of general prosperity.

The role of the turn-around in wheat prices in the mid-1890's is most dramatic in the Canadian case.[54] Since the Land Act of 1868 and the Homestead Act of 1872, the Dominion government had been trying to bring western acreage, with its palpable potential for low-cost wheat, effectively into production. But railroads had to be built, the population expanded by substantial net immigration, the competition of American extension of the frontier overcome, and dry farming techniques absorbed. There were surges of immigration and capital imports (in support of railway building) in the early 1870's and 1880's; and some expansion of new homesteads, responding to transient wheat price increases in the early 1880's and

[52] See A. G. Ford, *The Gold Standard, 1880-1914, Britain and Argentina* (Oxford, 1962). For general economic background and data, see pp. 81-89. For capital import statistics, in the form of annual U.K. issue for Argentina, p. 195. See, also, John H. Williams, *Argentine International Trade Under Inconvertible Paper Money, 1880-1900* (Cambridge, Mass., 1920); and H. S. Ferns, *Britain and Argentina in the Nineteenth Century* (Oxford, 1960).

[53] See, especially, John H. Williams, *Argentine International Trade*, pp. 223-26.

[54] W. T. Easterbrook and Hugh G. J. Aitken, *Canadian Economic History* (Toronto, 1956), p. 483.

a decade later.[55] Only from the mid-1890's, however, does the great expansion in western Canada take hold and net immigration rapidly increase. Later, there was a majestic pre-1914 expansion in capital imports, notably from 1905 to 1914. Capital inflows were at the astonishing level of 9.2 percent of GNP in 1906-1910, and 12.4 percent in 1911-1915.[56]

The Russian case cannot be traced out in quite the same way, and the element of immigration is, of course, lacking. Nevertheless, massive capital imports play a critical role in railroadization of the country—a phenomenon that prepared the way for and then lifted it into its take-off of the 1890's.[57] Along with Stolypin's agricultural policy, these two related developments also made possible the remarkable increase in wheat production in the eight years before 1914. Almost 40 percent of the increase in Russian production over this quarter-century took place in the final quinquennium.

I have briefly surveyed these episodes in the history of wheat to suggest the process Kondratieff referred to as "the bringing of new countries into the world economy," and to underline the reality and power of the mechanism the early Kuznets captured in his treatment of the lagged relation between price and output movements in foodstuffs and raw materials. In a rough-and-ready way the world economy was responding in these years to profit possibilities created by price movements and technological developments: a dynamic stock adjustment principle was at work on a grand scale.

This balancing process, however, including the capital flows it induced, reinforced the effect of industrial deceleration on real wages in the more advanced industrial nations of the Western world. The expansions in the new countries were much bigger affairs than, merely, increases in acreage, production, and exports of foodstuffs and raw materials. The railroads had their usual diffuse and powerful effects, including an increase in urbanization. In Australia, Argentina and Canada there were large flows of immigrants to absorb and house, and those moving internally had to be grub-staked.

[55] Kenneth Buckley, *Capital Formation in Canada, 1896-1930* (Toronto, 1955), p. 14.

[56] Ibid., p. 64.

[57] Herbert Feis, *Europe: The World's Banker, 1870-1914* (New Haven, 1930), pp. 210-11. Also, Rondo Cameron, *France and the Economic Development of Europe, 1800-1914* (2d ed., Chicago, 1961), pp. 300-1.

There was, thus, a double effect. First, there was the underlying global supply-demand balance that caused the price turn-around in 1896; then there was the inflationary expansion in the new countries. The high export prices in those countries and the capital imports available permitted inflationary expansion to proceed, and high levels of imports, without discipline from the balance of payments. The upshot was a relative increase in prices and wages in the new country, a tendency to draw labor away from as well as towards the export industries, and a second shift in terms of trade against the capital-exporting nation. These booms slowed the expansion of export products below the level they might otherwise have attained. Cairncross' price and wage data on Canada from 1900 to 1913 illustrate the process quite well.[58]

A phase of unfavorable terms of trade for food-importing nations and of capital exports was a kind of tax that had to be paid by the world economy as a whole for maintaining a balance between the demand for and supply of grain. The incidence of that tax, however, did not fall evenly. The expanding food producing areas gained; the food importers as a whole enjoyed the long-run benefits of the expansion in food supplies but in the short-run faced rising costs of living. Britain, the major capital exporter, paid a significant additional short-run price for which its rapid increase in export (and export-related) profits was an inadequate compensation.[59]

V

It is into this setting of movements in leading sectors, in prices, the development of new areas, and capital flows that the key phenomena of the latter day Kuznets cycle must be fitted; for the movements all relate to the immigration and population movements that Kuznets placed at the center of the stage.

[58] A. K. Cairncross, "Investment in Canada, 1900-1913," reprinted in A. R. Hall, editor, *The Export of Capital from Britain, 1870-1914* (London, 1968), p. 157, from Cairncross' *Home and Foreign Investment, 1870-1913* (Cambridge, 1953). Also see, Roland Wilson, *Capital Imports and the Terms of Trade* (Melbourne, 1931); and for the U.S. in the 1830's and 1850's, W. B. Smith and A. H. Cole, *Fluctuations in American Business, 1790-1860* (Cambridge, Mass., 1935), pp. 66 and 100, and discussion on pp. 66-69 and 93-101.

[59] For a fuller exposition of the balance sheet for Britain, see the author's *British Economy of the Nineteenth Century* (Oxford, 1948), pp. 26-28. For similarities and differences in European net barter terms of trade movements over this period, see, especially, C. P. Kindleberger, *The Terms of Trade, A European Case Study* (New York, 1956), pp. 26-27.

In the case of the "new countries," the story is relatively straightforward. The combination of railroad technology, the lowering of shipping freight rates, and price movements made profitable the opening of new fertile, hitherto unexploited acreage; immigrants flowed to these regions; the whole process, erratically reinforced by international capital movements, set in motion a rapid generalized expansion transcending agriculture, permitting the large-scale flow of immigrants to be productively absorbed in the new economies. The process was extremely sensitive to short-run as well as trend phenomena. The net balance of immigration to Canada fluctuated closely with conventional business cycles.[60] This was also true of Argentina[61] and Australia.[62] The flows of immigration not only set up immediate demands for housing and social overhead capital, as we have seen, but also altered demographic trends and patterns.

The United States over the period 1865-1914 presents a somewhat more complex case. There is still, even after the frontier is formally closed in 1890, a strong element of the "new country" dynamics. As Kuznets noted, receipts from sales of public lands follow his long cycle pattern;[63] but they also followed the course of agricultural prices, lifting from a figure of about $1 million per annum in the trough of the mid-1890's to almost $10 million in 1908, the highest post-1865 figure except 1888.[64] In fact, the first two post-Civil War surges of American railway construction, focused as they were on the opening up and then filling out of the trans-Mississippi network, belong substantially with the cases of the "new countries." The laying out of the western network and then the building of feeder lines dominated this quarter-century's effort. But the pull of America on the European immigrant was more than a question of good land made accessible by railroads. Vast new mineral resources were opened up by the railroads, as

[60] See, for example, A. K. Cairncross, *Home and Foreign Investment, 1870-1913*, p. 41.

[61] See, for example, John H. Williams, *Argentine International Trade*, p. 207.

[62] See, for example, the annual data in Imre Ferenczi and W. F. Willcox, *International Migrations*, I (New York: National Bureau of Economic Research, 1929), p. 947.

[63] S. Kuznets, "Long Swings in the Growth of Population and in Related Economic Variables," pp. 35 and 51. In the population-association mood of this paper, Kuznets states, ". . . quickening of population growth would involve similar movements in the rate of expansion to new lands."

[64] *Historical Statistics of the United States*, p. 12.

was also true in Canada.[65] Above all, of course, the United States was moving rapidly forward to industrial primacy; and from the depression of the 1890's, at least, the momentum, scale and fluctuations in industrial expansion must be accounted the predominant factor drawing some 14 million immigrants between 1896 and 1914.

Three characteristics of the American economy help account for the power of its attraction: the still high if decelerating momentum in the old leading sectors, and the relative promptness with which the new leading sectors were exploited; the economic stimulus provided by the expansion in the working force and the demand for housing and overhead capital caused by immigration itself; and the fact that the United States was only a modest capital exporter.[66] The prosperity of American agriculture contributed to the vitality of the economy in multiple ways after the mid-1890's, even if the feeding of an immigrant-swollen population and rapid urbanization attenuated the export of American foodstuffs.

After the 1890's the shift from agriculture towards industry, from rural towards urban life, accelerated. The Gallman and Howle decadal estimates (Table 3) exhibit vividly how current price and real output trends moved in different directions in the early years of the twentieth century.[67] Between 1900 and 1910 the labor force in agriculture increased by less than 1 percent; in non-agricultural tasks, by 48 percent.[68] It is primarily the higher pace of industrial expansion which draws the immigrants in the great pre-1914 influx.

Looked at in this way, the latter-day Kuznets cycle is less of a

[65] Cairncross underlines this point: ". . . it would be a mistake to lay stress exclusively on agricultural development. The rise in export prices was not the sole factor at work. Between 1900 and 1913 rich deposits of mineral ores were found and developed in the Cobalt, Porcupine and other districts. Canada became the leading nickel producer in the world, and copper, silver and gold were exported in large quantities. These minerals sold at low prices, but mining costs were also low and production was highly profitable." Cairncross, *Home and Foreign Investment, 1870-1913*, p. 42.

[66] The period 1897-1905 was a phase of modest but regular net capital export for the United States; but from 1906 to 1914 (excepting 1908 and 1913) the United States was once again a net capital importer. These were the years of highest immigration. Over the whole span 1897-1914, the U.S. exported net $1.2 billion. See, for example, J. G. Williamson, *American Growth*, p. 151.

[67] Robert S. Gallman and Edward S. Howle, "Trends in the Structure of the American Economy since 1840," ch. iii in Robert W. Fogel and Stanley L. Engerman, editors, *The Reinterpretation of American Economic History* (New York, 1971), p. 26.

[68] Stanley Lebergott, *Manpower in Economic Growth: The American Record since 1800* (New York, 1964), p. 510.

TABLE 3
SHARES OF AGRICULTURE AND INDUSTRY IN VALUE ADDED, U.S. ECONOMY, 1879-1909
(percent)

	Current Prices		*Constant Prices*	
Year	*Agriculture*	*Industry*	*Agriculture*	*Industry*
1879	53	47	53	47
1889	39	61	41	59
1899	37	63	35	65
1909	38	62	26	74

Source: Robert S. Gallman and Edward S. Howle, "Trends in the Structure of the American Economy Since 1840," ch. iii in R. W. Fogel and S. L. Engerman, editors, *The Reinterpretation of American Economic History* (New York, 1971).

uniform cycle than ever. There are three waves of immigration (and internal migration) associated primarily (but not exclusively) with the extension of railways and the opening of new lands: 1865-1873 (with declines in 1868 and 1871); 1878-1882; 1886-1892. The 1892 peak is then not exceeded until 1902 when the massive pre-1914 influx is under way.[69] The setbacks in the 1870's and 1890's were more severe than that of the 1880's and those that occurred in the first decade of the century. Lebergott estimates average decadal levels of unemployment of 10 percent for the 1870's and 1890's, 4 percent for the 1880's and 1900-1909.[70]

On the other hand, the hard core of Kuznet's proposition (and that of his predecessors in this field) stands: large flows of immigration did set in motion (as also in Australia, Argentina, and Canada) demands for housing and infrastructure which yielded powerful business expansions which transcended in their scope the sectors whose expansion made immigration attractive in the first place. And as Kuznets noted, there is evidence in the U.S. data of competition between the capital requirements of infrastructure expansion and other forms of investment, just as in Britain there is tension between capital exports and domestic investment. There is thus a significant place in the mechanism of growth and cyclical analysis for migration and all its secondary and tertiary consequences, so long as they are linked to the dynamics of leading sector analysis and the underlying forces that made attractive the opening of new areas.

[69] For unemployment and immigration data, 1890-1914, see Ibid., p. 43.
[70] Ibid., p. 189.

VI

We can apply this tripartite mechanism to other times. The pattern of American development from 1815 to 1860 was characterized by an interweaving of impulses imparted by new leading sectors, "new country" commodity dynamics, and immigration. There was a brief postwar surge into new lands, notably in Mississippi, Alabama, Missouri, Illinois and Indiana, as wheat and cotton prices rose from their 1814 troughs. This boom gave way in 1818-19. The cotton textile and other industries nurtured during the years of embargo and war briefly floundered; but for most of the 1820's the leadership in American growth is taken over by the successful take-off of New England, based on cotton textiles. Agricultural prices trend downward. The opening of new land is at a rate far below the 1818 peak. Towards the end of the 1820's commodity prices level off or, even, begin to rise a little. British cotton stocks run down and the price of American slaves begins to rise. Land sales expand sharply in 1829 and the boom of the 1830's is on. Although the railways make their first substantial appearance and the momentum in New England cotton textiles is maintained, the American expansion of the 1830's is a classic "new country" boom, reinforced in its latter stages by large capital imports. There is a sharp increase in immigration and in such indicators of building as we have available. The cotton lands are, of course, the central focus of the expansion, but land sales expand dramatically in Ohio, Indiana, Illinois, Michigan and Wisconsin as well.

Then the pattern shifts. Cotton and wheat prices fall away from their peaks of 1836 and 1838, and never during the 1840's do land sales come close to their pre-1860 peak (1836). But a powerful railroad and industrial boom developed in the northeast, more than tripling railroad mileage between 1840 and 1850. All this was done at a time when the United States was a net capital exporter, so high were its repayments of interest and principal, so low its repute in the London capital market after the excesses of the 1830's. Immigration, from the business cycle trough in 1843, moves up strongly during the decade. But here, surely, we have a significant element of push from Ireland and Germany as well as the pull of the American economy. The surge of immigration towards the end of the decade, overriding the cyclical downturn, is reflected, as we would

expect, in the failure of building to show any significant contraction, as it did after the peak in 1836.

The 1850's, like the 1830's, provided another example of "new country" expansion, with wheat and cotton prices relatively high, until the depression of 1858-59. Land sales peaked in 1854-55. Again, this is a decade when railway mileage tripled; but this time the railway expansion is not a reaction to a previous agricultural boom-and-bust. A railway net is thrown out over the Middle West, permitting a great increase of acreage and the emergence of the United States as a substantial wheat as well as cotton exporter. The industrial leading sector complex also moves foward. The American iron and engineering industries refine their techniques in this decade, diminishing dependence on British rail imports; and, by 1860, the take-off of the American north is (in my view) completed. As in the 1830's this broad-based expansion was sustained by large net capital imports. These not only helped finance the building of the railroads, but, as in other "new country" booms, permitted the absorption and housing of a large flow of immigrants, as well as a general surge in urbanization, without discipline from the balance of payments (at least until the crisis and downturn came decisively in 1857). The United States absorbed 2.8 million immigrants in the 1850's, twice the level of the 1840's. Their year-to-year flow appears sensitive to both land sales and business fluctuations; peaking in 1854, but not declining sharply until the unambiguous years of depression, 1858-59. Like a good many other series, building shows a protracted plateau, sustained down to the last two years of the decade.

What does this way of looking at things suggest if one looks at the period since the end of the First World War? The United States of the 1920's, like New England a century earlier, was dominated by the rapid expansion of a new leading sector complex—that is, the automobile and all its works. Like electricity and the new chemicals, the automobile complex achieved massive scale after the First World War as the United States moved into a stage of growth I have called "high mass-consumption." Again, as in the 1820's, agriculture was slack; but, after falling from 1899 to 1919, agricultural productivity increased. There was an immediate post-war increase in prices; but in 1920 (as in 1818) agricultural prices broke sharply downward. Immigration rose after 1919; but,

responding to the new legislation, it fell promptly, averaging only 284,000 from 1925 to 1930, after which it fell away rapidly in response to the depression. Nevertheless, there was a strong housing boom in the 1920's, due in part to the migration to the suburbs which the automobile made possible.

In Western Europe, the maturing of the new leading sectors was also the central economic phenomenon in the interwar years. But they did not move ahead with the same momentum as in the United States. Postwar vicissitudes of various kinds, including inflation in France and Germany, helped yield this result, as well as terms of trade so favorable to Britain that its export markets, in areas producing foodstuffs and raw materials, were relatively impoverished and its export-related industries marked by high chronic unemployment. More basically, however, levels of income per capita in Western Europe were sufficiently below those of the U.S. that the diffusion of the automobile, durable consumers goods, and the migration to suburbia were bound to proceed more slowly, unless the process was strongly stimulated by public policy.

The link between the new leading sectors and the level and rate of expansion of consumers income (as opposed to the quite different motivation for, say, railroad investment) also helped account for the length and intractability of the post-1929 depression. Only massive public efforts to expand the level of effective demand—like those undertaken in post-1933 Germany and, to a lesser degree (via housing and devaluation) in post-1931 Britain—could bring the level of unemployment down to what might be called normal pre-1914 levels. It required full scale rearmament to achieve this result in the United States.

Cutbacks in acreage and the expansion of incomes in the second half of the 1930's yielded a reversal of foodstuff and raw material price trends in the pre-1939 years. The upward price trend persisted to about 1951—a longer period than after the First World War or after the Napoleonic Wars. In these years there were new oil and mineral discoveries, but no great new agricultural regions to open. Increases in productivity (which accelerate in the U.S. after 1937) and acreage expansion in familiar agricultural areas kept the world's population fed.

Down to 1951, Britain felt the cutting edge of unfavorable terms of trade, but overseas export markets were thereby strengthened.

Then began a twenty-year phase in which prices of foodstuffs and raw materials on the world scene were relatively weak. The result, this time, was quite different than during the interwar years. In the 1950's and 1960's Western Europe (and, from the mid-1950's, Japan) at last fully exploited the potentialities of high mass-consumption, absorbing efficiently the technologies the United States had pioneered since, say, Henry Ford's moving assembly line. As this process gathered strength abroad in the 1950's, the United States moved off in another direction. A shift began towards a new set of leading sectors, as high mass-consumption no longer had the capacity to drive the economy forward. The peak for the automobile sectoral complex can be dated in the mid-1950's; the automobile never again led the economy in growth. Operating through political as well as economic markets, the income elasticity of demand asserted itself towards the end of the 1950's in the form of rapid increases in outlays for education, health services, travel, recreation, and welfare. To these might be added the aerospace complex, in the post-Sputnik period. While Western Europe and Japan enjoyed a last decade's fling at high mass-consumption in the 1960's, the United States was experimenting with the complexities of what I have called the search for quality. From the end of the Korean War to 1972 this process occurred in a setting of relatively cheap supplies of foodstuffs, energy, and raw materials. As for immigration, there were extraordinary North-South manpower movements from the Mediterranean to Central and Western Europe and from Puerto Rico and Mexico to the United States; there was, furthermore, a somewhat new tendency for industrial production to shift to areas of cheap and ample labor supply; for example, South Korea, Hong Kong, Taiwan, Singapore, Mexico.

In 1972-73, the world economy experienced a turning point in foodstuff and raw material prices, a break as sharp as those of the 1790's, 1840's, 1890's, and 1930's. As on earlier occasions, one can attribute the turn to *ad hoc* events: in this case, a convergence of bad harvests and a new consciousness of their oligopolistic power among the members of OPEC. But the central fact is that the immediately available American agricultural and energy reserves were running down. These had helped to keep world prices relatively low. When U.S. oil production began its absolute decline in 1970, OPEC began to perceive its opportunity. When U.S. food reserves

(including idled cropland) disappeared in 1972, the market produced a result in agriculture differing only in degree from that imposed by OPEC in petroleum.

Certainly, as in earlier trend period upswings, the rate of increase in prices of 1972-1974 will not be regularly sustained. In fact, it has softened in recent months in response to the endemic recession in the OECD world. But the global pace of population increase and industrialization suggest that the pressure of demand on the supply of foodstuffs and raw materials will not prove to be a short-term phenomenon. I am inclined to believe that the fifth Kondratieff upswing is upon us. In different ways each of the previous Kondratieff upswings generated anxieties about the long-run balance between population, land, and natural resources—from Malthus to the Paley Commission report. This time the challenge is more severe, given the extraordinary pace of population increase and the heroic innovations that will be required to supply food, energy, raw materials, and to tame pollution in a world now committed to virtually universal industrialization.

Whatever the limits of growth prove to be over, say, the next seventy-five years, in the nearer term the nations of the world, as on previous occasions in the past, must press forward their leading sector complexes in a setting where the relative prices of foodstuffs and raw materials are high. We can already observe the familiar consequences of that situation for rates of inflation, interest rates, urban real wages, income distribution (within societies and on the world scene), and patterns of investment. Much is, of course, unique about the world economy of the 1970's. But the counterpoint between leading sector complexes and the constraining forces set in motion by relative shortages of foodstuffs and raw materials—and the investment requirements for their correction—is an old story in economic history, as old, in fact, as the British take-off of 1783-1802.

VII

This way of looking at things moves us closer, I believe, to the "appropriate theory of long waves" which Kondratieff called for, but which his successors never achieved. Long waves or trends can only be explained in terms of a general, highly disaggregated dynamic theory of production and prices which would embrace the major trend phenomena and relate them to each other. I cannot

elaborate fully here the terms of such a theory;[71] but I can suggest its character as it bears on the three major phenomena examined in this essay. For our limited purposes in exploring secular trends, we can, at some risk of oversimplification, limit our disaggregation to four kinds of sectors:

The leading sector complexes; that is, those centered on factory-manufactured textiles, the steam engine, modern iron technology, the railroads; steel; electricity; the major branches of the modern chemical industry; the automobile; the service sectors now expanding rapidly in real terms. Historically, these unfolded in a sequence generated by a mixture of consumers demand and the progressive requirements of industry and of transport. In the contemporary world they are drawn from the pool of existing technologies and productively absorbed in a sequence related to private and public demands and the technical absorptive capacity of particular economies.[72] At any period of time the industrial structure of an economy which has moved beyond take-off will consist, in part, of old leading sector complexes as well as the new ones, with the latter moving forward at high rates while the former decelerate, level off, or even absolutely decline.

The agricultural sector; excluding agricultural inputs to industry. Here the link is to population increase, the rate of increase of private income per capita, and the income elasticity of demand for food in general and for specific types of food.

Inputs to the industrial system; that is, energy, raw materials, products of agriculture, and so on. Here the link is to the rate of increase of industrial output, whose composition, in turn, is determined by the stage of growth of the system, its leading sectors, and so on.

Housing and infrastructure; in this case the link is to the rate of family formation as decreed by population increase, domestic and international migration, and the factors determining the rate of

[71] I deal with these matters in *The Process of Economic Growth*, and more currently in "Technology and the Price System," a chapter in a volume in tribute to Clarence Ayres, edited by William Breit and W. P. Culbertson, Jr., to be published in 1976 by the University of Texas Press.

[72] Hollis Chenery and Lance Taylor have associated the coming in of different leading sector complexes with the rise of GNP per capita (in effect, with stages of growth) in the contemporary world in "Development Patterns: Among Countries and over Time," *The Review of Economics and Statistics*, L (Nov. 1968), especially pp. 405 ff.

urbanization—since social overhead capital outlays tend to be greater per capita in urban than rural areas.

To convert a disaggregated sector model of this kind into one which yields an approximation of secular movements in production and prices, one must make four assumptions:

The proportion of income invested within a national post-take-off economy, if not absolutely fixed, varies within relatively narrow limits. As Kuznets wrote of the United States, there seemed to be "some limits to *total* capital formation in the country, perhaps largely on the savings side. . . ."[73]

The dynamic system does not adjust instantaneously. There are lags between the appearance of a profit possibility (due to price movements, discoveries, or new technology) and an effective flow of new investment; between the initiation of investment and its completion; between its completion and its full contribution to the flow of goods and services to the economy. These lags may vary significantly with different types of investment.

Current investment decisions tend to be made on a microbasis, responding to current indicators of future profitability, and there is a follow-the-leader tendency in capital markets. This fact, plus inherent lags in the investment process, produces a systematic tendency to overshoot the sectorial optima once evidence of profitability in a major line of investment is recognized and acted upon.

The system is international, in the specific sense that flows of migration and of capital are possible, and that a wide range of prices are determined by demand and supply situations throughout the world economy.

What Kondratieff, Schumpeter, and the early and late Kuznets were getting at were the forces set in motion by the imperfect effort of the world economy to approximate, under these four conditions, an optimum pattern of investment and output in these four kinds of sectors. Thus, we are not examining different theories of secular movements in prices and production but aspects of the dynamic adjustment process in particular national economies within a more or less inter-connected world economic system. The interweaving of the leading sector complexes and the agricultural sector, setting

[73] S. Kuznets, "Long Swings in the Growth of Population," p. 33. This proposition does not, of course, exclude capital imports, the typical rise in the investment proportion during the early phase of modern growth, or the possibilities of changes in the proportion, as during the railway age or in post-1945 Western Europe and Japan.

in motion between them the major flows of capital and migrants, with significant influence on the demand for housing, thus explain most of the phenomena isolated for study in the literature of sectoral trends. If looked at in this way, it is a literature highly relevant to the 1970's and beyond.[74]

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[74] If we remain loyal to Kondratieff's challenge, we are left with gold and wars. As has often been noted, gold discoveries cannot be regarded as wholly exogenous events. A falling price trend in an international regime dominated by a gold standard increased progressively the incentive to find and mine gold as well as to develop more efficient mining technologies. The two major periods of gold discovery in the century after 1815 come after protracted periods of falling prices. Once found, the exploitation of gold yielded in the mining areas a version of the "new country" dynamics; that is, flows of internal and international migration, capital flows, broad-based booms transcending mining itself, and local wage and price increases greater than those elsewhere. See, for example, Donald Wood Gilbert, "The Economic Effects of the Gold Discoveries Upon South Africa: 1886-1910," *Quarterly Journal of Economics*, XLVII (Aug. 1933), pp. 553-97.

As for war, it strongly reinforced, if, indeed, it did not largely create, the first Kondratieff upswing in prices and the abnormal expansion in British agriculture. In the second, we have the Crimean and American Civil Wars as well as Bismarck's three ventures. In the third, the Spanish-American and Boer Wars, the Russo-Japanese and Balkan Wars, climaxed by that of 1914-1918. In the fourth, the Second World War and the Korean War occur. All these conflicts reinforce the inflationary tendency at work in the Kondratieff upswings; but the price increases of the early 1850's, 1890's, and late 1930's, preceded the relevant wars.

Kondratieff implied not that wars caused or contributed to long-cycle price increases, but that, somehow, long-cycle upswings led to wars. Only the American Civil War can be linked in any coherent way to the expansion process decreed by the rising prices and increasing demands for food which are the mark of the Kondratieff upswing. These asserted themselves in the 1850's and are linked to the railroad expansion of that decade. The westward march of the railroad in the 1850's and the foreseeable absorption into the Union of all that lay between the Mississippi and California did, indeed, force on to the agenda the constitutional issues that led to war, although those issues were rooted, of course, in slavery. That is all one can rationally make of the causal linkage Kondratieff implied between long-cycle upswings and wars. But the tensions that exist or might develop over scarce or prospectively scarce resources in the period which began in 1972 suggest that we might take Kondratieff's observation as a warning against the dangerous potentialities of the neo-mercantilism which is one possible outcome of the fifth Kondratieff upswing.