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A MULTISECTORAL ANALYSIS OF THE BUSINESS CYCLE

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Lily, because of her unselfish sacrifices and dedication during a total period of two years and a half when he left his family to study in the United States.

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CHAPTER I

INTRODUCTION

The business cycle is the recurring alternate expansion and contraction of general economic activities as reflected in aggregate output, national income, employment, the general price level, costs, profits, and other major aggregate economic indicators. It has existed in such free enterprise industrial economies as Great Britain, the United States, France, and Germany for more than two hundred years, ever since their "activities of production, distribution, and consumption have become closely interwoven through division of labor, the making and spending of money incomes, a system of banking and credit, a mode of production relying extensively on fixed capital, and some ease in communication and transportation."[1]

The general pattern of the business cycle is a continuous rise in aggregate economic activity followed by a continuous, but usually smaller and shorter, decline. The activity at the peak of a business cycle is usually higher than at the preceding peak, and the activity at

[1] Arthur F. Burns, The Business Cycle in a Changing World (New York: Columbia University Press, 1969), p. 7.

the trough of a cycle higher than at the preceding trough, revealing a clear trend of growth in a longer period, or, in other words, the alternations of expansion and contraction are around a rising trend.

The business cycle is a historical phenomenon.[2] In spite of its repetitiveness, each cycle differs from others in duration, intensity, and the forces which govern the course of fluctuations. However, this by no means indicates that a general theory of the business cycle which would account for the essential relationship between strategic factors of the cycle is impossible. In effect, it is exactly the task of a theory, or model, that while it explains adequately the regularities and similarities of the behavior of the object under study, it allows for, at the same time, its irregularities and dissimilarities.[3]

Numerous theories have been constructed to explain the business cycle, especially during the 1930's when business cycle theories dominated the main current of economic literature, and stimulated and laid down the foundations of modern macroeconomics. The focus of study in macroeconomics has gradually been shifted from business

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[2] G. Haberler, Prosperity and Depression (New York: Atheneum, Publishers, 4th ed., paper back, 1963; 1st ed. by Harvard University Press, 1937), p. 275.

[3] Haberler, op. cit., pp. 274-276; J. R. Hicks, A Contribution to the Theory of the Trade Cycle (Oxford, Oxford University Press, 1950), pp. 2-3. Cf. R. A. Gordon, Business Fluctuations (New York: Harper & Brothers, Publishers, 2nd ed., 1961), p. 259.

cycles to economic growth and development since World War II. This does not mean that business cycles which have characterized advanced market economies no longer exist, nor does it imply that controversies over various cycle theories have been settled.

The common feature of most business cycle theories is their macroscopic approach, i.e., to use concepts of broad averages and aggregates of a collective nature, such as total output, national income, total employment, money supply, and the general price level. This seems inevitable if a theory which aims at representing the economic process as a whole is to be manageable. However, relations among aggregates are the result of many decisions by individual units of the economy. It is natural, therefore, for an economist to wish to go behind the macro-relations, to see how individual decisions lead to stable relations in aggregates--if they do so at all.[4] The present study is one in this direction.

The next chapter of the study is a presentation of the acceleration principle in conventional terms and the business cycle theory of J. R. Hicks in which the acceleration principle forms a corner stone. The acceleration principle will be criticized as lacking of a sound microeconomic foundation. Some weak points in

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[4] R. G. D. Allen, Mathematical Economics (London: Macmillan Company, 1956), p. 694; see also Haberler, *op. cit.*, pp. 248-249.

Hicks' business cycle theory will be pointed out in this chapter.

Chapter III re-examines the acceleration principle in terms of price-cost relationship. The acceleration principle will be modified in that the concept of the normal capital-output ratio will be restated in terms of profitability rather than technical necessity. It will be shown in this chapter that a rigid relationship between increases in demand for a product and increases in capital which is used for its production, upon which the acceleration principle is based, exists when the production function is homogeneous of degree one.

Discussion of the acceleration principle in terms of price-cost relationship has been confined to an individual firm in Chapter III. In Chapter IV, it will be extended to the industry and the economy as a whole. A distributed lag investment function will be formulated. It will be demonstrated that interactions between the multiplier and the distributed lag accelerator will result in cumulative processes of the business cycle. The effect of technical progress which gives a rising trend to successive business cycles will also be discussed in this chapter.

Chapter V of the thesis will be devoted to a study of the upper and lower turning point of the business cycle. The concepts of "ceiling" and "floor" which were used in Hicks' theory to account for the upper and lower turning point will be discarded in this chapter, and relative changes in prices and costs which change profit margins to different extent in different industries will be substituted.

Each industry is connected with others through input-output relations. Inter-industrial analysis will be used in Chapter VI to demonstrate how change in output of one industry will affect output of others. The net effect of all changes will determine the overall course of the whole economy. An outline of the operation of the theory thus far developed will be contained in this chapter.

Although empirical matters are not of primary concern, Chapter VII will test the validity of the model by reference to historical data.

CHAPTER II

FROM THE ACCELERATION PRINCIPLE TO HICKS' BUSINESS CYCLE THEORY

A. The Acceleration Principle and Determination of Investment

The basic idea underlying the acceleration principle in its original form is that there is a certain rigid relationship between output and the capital stock employed in its production. The relationship is assumed to be determined by technical considerations. Changes in the demand for, and production of, a certain product will give rise to proportional changes in the demand for, and production of, those capital goods which are used for their production. Let a be the accelerator, indicating the amount of capital goods required for the production of one unit of output. If O_t and O_{t-1} represent output of the product in the current and the previous periods t and t-1, and K_t and K_{t-1} represent the stock of capital at the end of those periods respectively, then

$$K_t = aO_t \tag{II-1}$$

$$K_{t-1} = aO_{t-1} \tag{II-2}$$

Since investment is the addition to capital stock, net investment during period t, I_t, can be derived from the above equations:

$$I_t = K_t - K_{t-1} = a(O_t - O_{t-1})^{1} \qquad \text{(II-3)}$$

According to the acceleration principle, therefore, investment is a function of the rate of change in output, and change in investment, a function of the rate of change

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[1]But if there is excess capacity at the end of period t-1 as compared with that required for producing the output in period t-1, I_t and a would be smaller than the case when there is no excess capacity. In the meantime, since O_t is the output of the current period which can only be guessed at the beginning of the period, the investment function should be

$$I_t = a(\text{ex } O_t - O_{t-1})$$

where ex O_t is expected output in period t. The problem is further complicated by the fact that capital at the end of period t cannot be all used to produce output during period t. The investment function would have to be

$$I_t = a(\text{ex } O_{t+1} - \text{ex } O_t)$$

if the entrepreneur is not constantly lagging in his adjustment to new levels of output. Here everything is clearly dependent on future output expectations. The acceleration principle can also be put in a lagged form:

$$K_t = a\ O_{t-1}$$

$$K_{t-1} = a\ O_{t-2}$$

$$I_t = K_t - K_{t-1} = a(O_{t-1} - O_{t-2})$$

In this case, net investment is a function of the difference between two observed, instead of expected, levels of output. It can be seen, therefore, the acceleration principle is by no means a simple concept. For references see S. Bober, The Economics of Cycles and Growth (New York: John Wiley & Sons, Inc., 1968), pp. 142-166; and T. F. Dernburg and D. M. McDougall, Macroeconomics (New York: McGraw-Hill Book Company, 1968), pp. 332-334.

of the rate of change in output. Investment increases as the rate of increase in output increases; and it decreases as the rate of increase decreases. Investment remains constant when the rate of increase in output is constant; and it becomes zero when the level of output remains constant.

Many economists assume, contrary to the acceleration principle, that investment is a function of the level of income or output.[2] Support for this relationship, like that used to justify the acceleration principle, is attributed in part to technological factors. A high level of output requires a large stock of capital to produce it. It is concluded that investment must be high when the level of output is high. But this is a non sequitur for although it is true that more output requires more capital stock, the level of capital stock has nothing to do with the rate of net investment. Net investment is the addition to capital stock. When the stock of capital is constant, whatever level it may be, there is simply no net investment.

It may be argued that when output has increased to a higher level than before, investment will be required in order to bring the stock of capital to its appropriate new level. But here the investment is induced by the change in output, and the amount of the investment will

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[2]For references see Gardner Ackley, Macroeconomic Theory (New York: Macmillan Company, 1961), pp. 330-336, 501.

be determined by the rate of change in output, not the level of output.[3]

Another reason proposed to support the connection of the level of output or income to the rate of investment concerns profits. It argues that current profits rise and fall with production and affect both expected returns from investment and internal supply of funds.[4] It may be true that investment is dependent on profits, but profits are obviously not solely dependent on the level of income. The appearance of profit is a signal of change. Profits increase and decrease as production increases and decreases. When income first increases to a higher level, both the rate of profit and the amount of profit may be raised. There may be new opportunities for investment and additional internal funds available for use. But after a certain period of time when the opportunities have been exhausted and the additional funds have been used, investment will fall to zero unless other changes take place.[5]

It is perhaps relevant at this point to remark on the concept of the marginal efficiency of investment

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[3] Ibid., pp. 336-337.

[4] B. G. Hickman, "Diffusion, Acceleration, and Business Cycles," American Economic Review, XLIX (September, 1959), 5-36.

[5] Ibid., 338-339.

in Keynesian economics.[6] The marginal efficiency of investment is a schedule relating the rate of investment to that of interest at a given stock of capital. At every rate of interest there is a corresponding rate of investment. And the lower is the rate of interest, the greater is the rate of investment.[7] But investment at any rate above zero will increase the stock of capital, which, in turn, will shift the marginal efficiency of investment schedule downward. Therefore, unless the rate of interest is continuously decreasing, or there are other changes which shift the marginal efficiency of capital schedule, and hence the marginal efficiency of investment surface, upward, net investment will eventually fall to zero.[8] The marginal efficiency of capital is a schedule which relates the optimum stock of capital to the rate of interest, given expected yields of capital and its cost of production when net investment is zero.

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[6]The concept was popularized by Keynes. However, instead of the marginal efficiency of investment, Keynes himself used the marginal efficiency of capital, which many economists considered as confusing. The distinction between the two terms was first made by Lerner. See Abba P. Lerner, The Economics of Control (New York: Macmillan Co., 1944), chap. 25, esp. pp. 334-337; and Gardner Ackley, op. cit., pp. 481-485.

[7]See Lerner, op. cit., pp. 336-337, esp. fig. 5; Ackley, op. cit., pp. 483-484, esp. figs. 17-5 and 17-6; and R. G. D. Allen, Macroeconomic Theory (New York: St. Martin Press, 1967), pp. 108-112.

[8]Lerner, loc. cit.; Ackley, loc. cit.; and Dale W. Jorgenson, "The Theory of Investment Behavior," in

The changes which would shift the MEC and the MEI upward could be either technological improvements, which reduced the cost of capital goods, or increase in income, which raised the expected yields of the capital asset. Increase of factors other than capital which causes their prices to fall relative to the price of capital might through its effect on the marginal physical product of capital either shift the MEC and the MEI upward or downward, according to whether these factors and capital are complements or substitutes.[9] Given a constant technology and relative factor prices, therefore, an increase in income will cause new investment to take place at given rate of interest. The rate of investment will depend on the rate of change in income. And income has to be increasing continuously in order to prevent investment from falling to zero. Under these circumstances, the marginal efficiency of investment thesis is analogous to the acceleration principle.

B. Development of the Acceleration Principle

Although economists have long recognized the importance of the acceleration effect, J. M. Clark was

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National Bureau of Economic Research, Determinants of Investment Behavior, ed. by Robert Ferber (New York: Columbia University Press, 1967), p. 155.

[9] J. E. Hibdon, Price and Welfare Theory (New York: McGraw-Hill Book Company, 1969), pp. 350-353, 396-399; A. J. Braff, Microeconomic Analysis (New York: John Wiley & Sons, Inc., 1969), p. 217n.

perhaps the first one who gave it a systematic and almost exhaustive analysis.[10] In a paper published in 1917, he used the acceleration principle to explain two fundamental features of the business cycle: (1) investment tends to fluctuate in a much greater amplitude than total output during the process of the cycle,[11] and (2) investment may start to decline while total output is still growing, and it may start to rise while the latter is still declining. Twenty years later in 1936, R. F. Harrod combined the acceleration principle with the multiplier theory to form his trade cycle theory.[12] And again in 1939, he used the same tool in constructing a dynamic model, which has become a cornerstone of modern growth economics, although the primary concern of Harrod by that

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[10] J. M. Clark, "Business Acceleration and the Law of Demand: A Technical Factor in Economic Cycles," Journal of Political Economy, XXV (March, 1917), 217-235; reprinted in G. Haberler (ed.), Readings in the Business Cycle Theory (Homewood, Ill.: Richard D. Irwin, Inc., 1951), pp. 235-254. For a detailed statement of the acceleration principle, see Haberler, Prosperity and Depression (New York: Atheneum Publishers, 4th ed., 1963, paperback, originally published by Harvard University Press, 4th ed., 1958), pp. 85-105; and A. H. Hansen, Business Cycles and National Income (New York: W. W. Norton Company, Inc., 1951), pp. 179-190.

[11] Cf., W. J. Baumol, "Acceleration without Magnification," American Economic Review, XLVI (June, 1956), 409-12. Baumol points out that it is not true that since $I=k(ds/dt)$ therefore

$$dI/dt > ds/dt, \text{ or } \frac{dI}{dt}/I > \frac{ds}{dt}/s,$$

where k refers to the accelerator, and s, sales.

[12] R. F. Harrod, The Trade Cycle (Oxford: Oxford University Press, 1936).

time was short run fluctuations of the business cycle.[13]

Shortly after the first appearance of Harrold's dynamic model, Paul A. Samuelson published his celebrated paper "Interactions between the Multiplier Analysis and the Principle of Acceleration," in which he used difference equations to analyze the possible patterns of change in national income.[14] He assumed

$$Y_t = g_t + C_t + I_t \tag{II-4}$$

$$C_t = cY_{t-1} \tag{II-5}$$

$$I_t = a(C_t - C_{t-1}) \tag{II-6}$$

where Y represents the increase of national income beyond its fundamental level, g, deficit government spending, C, consumption, I, investment, all measured by their difference from their respective fundamental level. c is the marginal propensity to consume, and subscripts t and t-1 denote time periods. Substituting equations (II-5) and (II-6) into equation (II-4) to get

$$Y_t = g_t + c(1 + a)Y_{t-1} - caY_{t-2} \tag{II-7}$$

This is a non-homogeneous difference equation of the second order with constant coefficients. Given initial conditions Y_{t-1} and Y_{t-2}, the pattern of the time path of national income depends on the relative magnitudes of the marginal propensity to consume, c, and the accelerator,

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[13] R. F. Harrod, "An Essay in Dynamic Theory," _Economic Journal_, XLIX (March, 1939), 14-33.

[14] _Review of Economic Statistics_, XXI (May, 1939), pp. 75-78.

a. In fact, there are five general types of possible result:[15]

(1) Income may converge steadily to an equilibrium level.

(2) Income may fluctuate in cycles of diminishing amplitude which converge upon the same equilibrium level as in case (1).

(3) Income may fluctuate in cycles of constant amplitude around the equilibrium level.

(4) Income may fluctuate in cycles of increasing amplitude around the equilibrium level.

(5) Income may move away from equilibrium level at an ever increasing rate without fluctuation.

Samuelson had no intention of providing a business cycle theory in this paper, but his approach suggested that a model which treats cyclical fluctuations of economic activities as a self-reenforced and self-perpetuating process of the system could be constructed on the basis of interactions between the multiplier and the accelerator. This has been successfully done by Hicks.[16]

Hicks' business cycle theory is essentially based on: (1) the assumption of interactions between the

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[15]For the solution of the difference equation, read W. J. Baumol, Economic Dynamics (New York: Macmillan Co., 1957), pp. 165-195.

[16]J. R. Hicks, A Contribution to the Theory of the Trade Cycle (Oxford: Oxford University Press, 1950).

multiplier and the accelerator, (2) the concept of a moving or dynamic equilibrium, and (3) the concepts of the "ceiling" and the "floor." According to Hicks:

$$Y_t = C_t + I_t \tag{II-8}$$

$$C_t = cY_{t-1} \tag{II-9}$$

$$I_t = A_t + a(Y_{t-1} - Y_{t-2}) \tag{II-10}$$

$$Y_t = A_t + (c + a)Y_{t-1} - aY_{t-2} \tag{II-11}$$

where Y stands for output, and A for autonomous investment. Autonomous is distinguished from induced investment in the sense that while the latter occurs in response to change in output, the former occurs in response to factors outside the system. Here, Hicks assumes that autonomous investment is increasing at a constant rate.[17]

Hicks superimposes the actual output thus derived upon the equilibrium output the equation of which is

$$E_t = A_t + (c + a)E_{t-1} - aE_{t-2} \tag{II-12}$$

where E represents the equilibrium output, and

$$\begin{aligned} E_t &= E_{t-1}(1 + g) = E_{t-2}(1 + g)^2 \\ &= \ldots E_o(1 + g)^t \end{aligned} \tag{II-12a}$$

g is the equilibrium rate of growth. Subtract equation (II-12) from equation (II-11), and substitute y for Y - E

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[17] Ibid., p. 84. Concerning Hicks' assumption with regard to autonomous investment it seems to the writer that Maurice W. Lee made a mistake by assuming that Hicks' autonomous investment was a function of total output in the current period. Lee, Macroeconomics: Fluctuations, Growth, and Stability (Homewood, Ill.: Richard D. Irwin, Inc., 4th ed., 1967), pp. 432-433.

to get

$$y_t = (c + a)y_{t-1} - ay_{t-2} \tag{II-13}$$

This is a second order homogeneous difference equation. One of the aforementioned five types of possibility will result, given some initial disturbance. But instead of a static level of equilibrium, the actual output will converge to, fluctuate around, or deviate explosively from, a dynamic course of equilibrium depending on the relative value of the coefficients of the equation.

It should be noted, however, that y represents the absolute deviation of actual output from equilibrium output. In the course of oscillations, the absolute deviation may be increasing, yet, when the growth of the dynamic equilibrium course is taken into account, the relative deviation, i.e., the ratio of the absolute deviation to the equilibrium output, may be diminishing. Let r be the relative deviation, then

$$y_t = r_t E_t = r_t E_o (1 + g)^t \tag{II-14}$$

Substitute this value for y_t in equation (II-13) to get

$$r_t = \frac{c + a}{1 + g} r_{t-1} - \frac{a}{(1 + g)^2} r_{t-2} \tag{II-15}$$

This is again a second order homogeneous difference equation. The conclusions obtained from equation (II-13), concerning the time path of actual output when deviating from its equilibrium level, hold equally true here, except for a change of the critical values of c and a which distinguish one type of possibility from another.

Hicks believes that in the real economy an upward deviation from the equilibrium course of growth will result either explosive oscillations around the equilibrium or a direct movement away from the equilibrium.[18] But the availability of resources at any period of time always constitutes a "ceiling" to total production. When the economy reaches the ceiling, the growth rate of output will be reduced which will cause investment to decline because of the acceleration effect. When investment decreases, total output decreases, through the multiplier. This explains the upper turning point of the cycle.

The lower turning point of the cycle can be explained by the nature of disinvestment and Hicks' special assumption with regard to autonomous investment. Gross investment in fixed capital cannot be negative, and the absolute value of net investment cannot be greater than the depreciation of fixed capital. After these limits have been reached, further declines in output can no longer induce further reductions in either gross or net investment, if investment consists of only fixed capital. His conclusion is only slightly, but not substantially, modified when the disinvestment in inventory

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[18]Hicks, op. cit., pp. 91-92.

is taken into consideration.[19] Since Hicks assumes that autonomous investment increases at a constant rate throughout all the time, total investment at this point will equal autonomous investment minus a constant, i.e., depreciation on the part of the capital stock which is subject to the acceleration effect. Through the multiplier, this forms a "floor" to total production, below which output cannot decline. Because this minimum or floor increases as autonomous investment increases, it will ultimately bring the accelerator back into operation. The economy will then recover.

C. Criticisms of Hicks' Business Cycle Theory

Incorporating many of the contributions made by other earlier writers, notably, the interaction between the multiplier and the accelerator, the equilibrium path of growth, and the full employment ceiling, Hicks' theory neatly accounts for the regular fluctuations of trade and industry around a secular trend in industrialized advanced market economies. However, despite of the strictness and consistency of the theory, Hicks has been criticized by many economists for basing his theory on

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[19] Ibid., pp. 103-104. Besides, when output is decreasing, very often inventory will be increasing, not decreasing.

the acceleration principle.[20] Kaldor points out:[21]

> The real weakness of Hicks' model consists in his use of the acceleration principle, which is a crude and highly unsuitable tool for analysis--and also an obsolete one, that an economist of Hicks' subtlety should have long ago discarded.

Tsiang also points out:[22]

> The assumption frequently made by macro-economic theorists of a constant accelerator . . . is one which is obviously not based carefully upon the fundamental analysis of the rational behavior of individual firms.

An increase in demand may be met largely by an increase in price with little increase in output. Additional output in response to an increase in demand can be produced by more intensive utilization of existing capital equipments. The increase in capital stock expected in accordance with the acceleration principle will not be required. There are well established economic principles underlying the price and output decisions of a profit-seeking firm and adjustment of production to a given level of output.

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[20]See among others, J. S. Duesenberry, Business Cycles and Economic Growth (New York: McGraw-Hill Book Company, 1958); A. F. Burns, "Hicks and the Real Cycle," Journal of Political Economy, LX (February, 1952), 1-24. As for the accomplishments of Hicks' Business cycle theory, see, among others, R. M. Goodwin, "A Non-linear Theory of the Cycle," Review of Economics and Statistics, XXXII (November, 1950), 316-320.

[21]N. Kaldor, "Hicks on the Trade Cycle Theory," Economic Journal, LXI (December, 1951), 833-47; reprinted in Essays on Economic Stability and Growth (London: Gerald Duckworth & Co., 1960), 198.

[22]S. C. Tsiang, "Accelerator, Theory of the Firm and the Business Cycle," Quarterly Journal of Economics, LXV (August, 1951), 327.

But it seems that these basic economic principles are ignored when the acceleration principle is employed and dependence on assumed technical considerations becomes paramount.

Economists agree that the profit-maximizing firm will produce that output at which marginal revenue is equal to the marginal cost of production. Moreover, it will use that method of production, or that combination of production factors, for which the marginal rate of technical substitution between two factors is equal to the ratio of the prices of the two factors. If it were concluded that there was no functional relationship between changes in output on the one hand, and investment on the other, for economic reasons, then the acceleration principle would be without support, and those who continued to employ the latter would be implicitly rejecting the traditional theory of the firm as incorrect, or, at least, as irrelevant. If both were correct, then there should be certain relationship between them which could be properly formulated.[23]

Hicks has also been criticized for using the concept of the ceiling. So far as human resource is concerned,

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[23]Cf. J. G. Witte, Jr., "The Microfoundation of the Social Investment Function," Journal of Political Economy, LXXI (October, 1963), 441-56. Witte's thesis is concerned with the use of assumptions in Keynes' theory as to the continuous function relating the rate of investment and the rate of interest.

the size of labor force is not fixed and has sufficient flexibility through immigration, increased employment of women, overtime, and transfer of workers from low-productivity employments such as agriculture and domestic services.[24] In the real world, a full employment ceiling in the sense that all resources are fully utilized has never been reached. Keynes once said:[25]

> Except during the war, I doubt if we have any recent experience of a boom so strong that it led to full employment. In the United States employment was very satisfactory in 1928-29 on normal standard; but I have seen no evidence of a shortage of labour, except, perhaps, in the case of a few groups of highly specialized workers. Some "bottle-necks" were reached, but output as a whole was still capable of further expansion.

Keynes' statement correctly suggests the possible existence of more than one ceiling. Instead of a single ceiling of the overall capacity, or total resources, there may be ceilings of various types of resources. A single ceiling would have existed only if (1) there were technical substitutability among all resources, and (2) there were complete mobility of resources. In the real world, however, neither of these is necessarily true.

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[24] R. C. O. Matthews, The Trade Cycle (Welwyn, Herts., England: James Nisbet & Co., Ltd., 1959), p. 157.

[25] J. M. Keynes, The General Theory of Employment, Interest and Money (London: Macmillan Co., 1936), p. 322. J. S. Duesenberry also points out that in the United States there is never an effective ceiling on the level of output. See Duesenberry, "Hicks on the Trade Cycle," Quarterly Journal of Economics, LXIV (August, 1950), 472.

Different types of resources are not always mutually substitutable, especially in a relatively short period of time. Even if they are, lack of mobility may prevent them from actually being substituted. At an early stage of the upswing, when there is substantial unemployment almost all over the economy, industries may find no difficulty in getting suitable resources. As the upswing continues, however, it becomes more and more difficult to find additional units of a particular resource which are of equal efficiency. This eventually will create bottlenecks to further development.[26]

As a matter of fact, the concept of the ceiling is not necessary for the explanation of the upper turning point of the business cycle. Complete lack of substitutability among, and immobility of, resources may exist in the real world. But the factor which effectively brings the boom to an end very probably may be an increase in costs in relation to product prices as caused by increasing resource immobility. An unfavorable change in demand which cuases prices to fall relative to costs provides another possibility. These will be analyzed in

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[26] R. F. Harrod, "Notes on Trade Cycle Theory," Economic Journal, LXI (June, 1951), 261-275; "Domar and Dynamic Economics," Economic Journal, LXIX (September, 1959), 451-464; reprinted in M. G. Mueller, ed., Readings in Macroeconomics (New York: Holt, Rinehart and Winston, Inc., 1955), 294-305; J. S. Duesenberry, op. cit.; and S. S. Alexander, "Issues of Business Cycle Theory Raised by Mr. Hicks," American Economic Review, XLI (December, 1951), 861-878.

a later chapter.

As for the lower turning point of the business cycle, it seems quite doubtful that autonomous investment will be increasing at a constant rate, regardless of either the level of output or the rate of change in it. Harrod has compared the distinction between induced investment and autonomous investment with that between the concepts of short-period and long-period costs. He says:[27]

> . . . a firm may well experience a decrease of sales one day or during a whole week without decreasing its orders or changing its plans in any way; . . . On the other hand, it is hard to think of any investment in an economy which will not be made subject to reconsideration if depression is sufficiently prolonged and intense.

It is doubtful whether the distinction makes any sense, especially when it is applied to the long run. As Duesenberry has pointed out, the classification into autonomous investment and induced investment is poorly related to the underlying micro-theory of investment.[28]

Autonomous investment should be a considerable proportion of total investment, since it is a major factor responsible for the recovery of the economy. Therefore, a separate theory concerning its behavior ought to

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[27]Harrod, "Notes on Trade Cycle Theory," Economic Journal, LXI (June, 1951), 267.

[28]Duesenberry, "Hicks on the Trade Cycle," op. cit., 473.

be developed, even if the distinction between autonomous investment and induced investment is acceptable. It is simply not enough to say that autonomous investment increases at a constant rate.[29]

Finally, economic history does not repeat itself. Every cycle is different from the others in one way or another. Hicks is successful in explaining the similarities among business cycles, but is less successful in explaining their dissimilarities.[30] This seems to be a weak point common to all aggregate models. In fact, all the difficulties in Hicks' theory discussed above have something to do with the use of the conventional acceleration principle. If the concept is reformulated in terms of price-cost relationship, many of the weak points in Hicks will be avoided, and business cycle theory will rest on a more solid microeconomic foundation.

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[29]Incidentally, there are some similarities between Hicks and Keynes with respect to the explanation of the duration of the depression and the recovery of the economy. See Keynes, The General Theory, p. 317.

[30]W. W. Rostow, "Some Notes on Mr. Hicks and History," American Economic Review, XLI (June, 1951), 317.

CHAPTER III

A REEXAMINATION OF THE ACCELERATION PRINCIPLE IN TERMS OF PRICE-COST RELATIONSHIP

A. Changes in Production in Response to Changes in Demand

This chapter will investigate the relationship between changes in demand for a particular commodity produced by a firm and changes in demand for the capital goods which are used in its production. The influence of profitability rather than technical necessity will be examined in order to find out the extent to which the acceleration principle holds. The accelerator will be considered as the normal capital-output ratio in the Marshallian long-run equilibrium. Conclusions thus derived will be extended to the industry, and then, in the next chapter, to the economy as a whole.

Figure III-1 shows the short-run and the long-run cost conditions of an individual firm, under imperfect competition, at constant returns to scale. The vertical axis of the diagram measures costs and revenue, and the horizontal axis measures quantity of production, which indicates also the capacity of the firm. The long-run marginal cost curve (LMC), which is parallel to the horizontal axis, coinciding with the long-run average cost curve (LAC), denotes constant returns to scale. Assume that neither demand nor cost curves will be affected by changes in production and capacity of the firm so that the effects of secondary repercussions can be ignored for the time being.

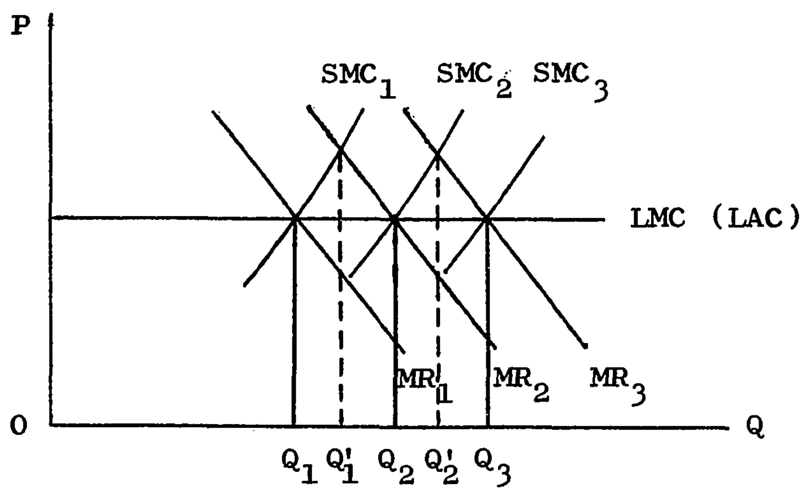

Figure III-1

Starting from the original long-run equilibrium position at which $MR_1 = SMC_1 = LMC$ (LAC), an increase in demand which shifts the marginal revenue curve from MR_1 to MR_2 will, in the short-run, cause output to increase from OQ_1 to OQ_1'. The additional output will be produced by a more intensive utilization of the existing capacity. However, since the long-run marginal cost is below the short-run marginal cost when output is OQ_1', the firm will expand its capacity in the long-run until the new long-run equilibrium position is reached at OQ_2 where $MR_2 = SMC_2 = LMC$ (LAC). Similarly, an increase in demand which shifts the marginal revenue curve from MR_2 to MR_3 will cause the long-run equilibrium output to increase from OQ_2 to OQ_3. As can be seen from Figure III-1, if the increases in demand are equal at the relevant level of price, and therefore the marginal revenue curve shifts by equal horizontal distances, the increase in production in response to the increase in demand will also be equal. This is to say that $Q_1Q_2 = Q_2Q_3$.

It should be noted, however, that MR = SMC = LMC is not a sufficient condition for the long-run equilibrium in the case of imperfect competition. The sufficient conditions, according to the conventional price theory, are (1) MR = SMC = LMC, and (2) AR = SAC = LAC, where AR refers to the average revenue and SAC refers to the short-run average cost. If the long-run marginal cost is constant and equal to the long-run average cost, the two conditions can never be fulfilled at the same time under imperfect competition when MR $<$ AR. Since the short-run marginal cost curve cuts the short-run average cost curve at the latter's lowest point, the average revenue must be higher than the short-run as well as the long-run average cost when MR = SMC = LMC.

Economists are apt, especially when dealing with long-run equilibrium problems, to assume that the LAC curve is like a scalloped line, while realizing that, in the real world, very probably it assumes a U shape which has a long horizontal section.[1] Under perfect competition, if the LAC curve of a firm is parallel to the horizontal axis, the long-run equilibrium point will be indeterminate. In the case of imperfect competition, if the LAC curve is horizontal, the firm will realize an excess profit when MR = SMC = LMC. If there is no barrier to entry, new firms will be attracted to enter the industry, and the demand curve faced by the existing firm will become more and more elastic until the firm becomes eventually a competitive firm. If there are absolute barriers to entry, the profit will tend to be maintained.

Neither of these extremes is true for most of the cases. In the present paper it will be assumed that there are certain barriers to entry which take the form of additional costs such as the economies of being already established that the existing firm possesses over newcomers. Therefore, potential firms will seek to enter only when the rate of excess profit is above a certain level.[2] For the purpose of simplification, entry and withdrawal of firms will not be taken into consideration

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[1]For example, C. E. Ferguson, Microeconomic Theory (Homewood, Ill.: Richard D. Irwin, Inc., revised ed., 1969), pp. 213, 239, 243, 274, 292, and 294. One exception is perhaps Kelvin Lancaster, Introduction to Modern Microeconomics (Chicago: Rand McNally & Co., 1969).

[2]Cf. M. Blaug, Economic Theory in Retrospect (Homewood, Ill.: Richard D. Irwin, Inc., 1962), pp. 359-360; T. Scitovsky, Welfare and Competition (Homewood, Ill.: Richard D. Irwin, Inc., 1951), p. 333.

until Chapter V.

Figure III-2 shows changes in output in response to changes in demand of a firm operating at increasing returns to scale. At the original equilibrium position, where $MR_1 = SMC_1 = LMC$, the equilibrium output is OQ_1. When demand shifts to the right such that the marginal revenue curve shifts from MR_1 to MR_2, the long-run equilibrium output will increase from OQ_1 to OQ_2. When the marginal revenue curve is MR_3, the long-run equilibrium output will be OQ_3. Once again, if the increases in demand are equal, the increases in output caused by them will also be equal. That is, $Q_1Q_2 = Q_2Q_3$. However, this is a special case where the LMC, the LAC, and the MR curves are linear. For other cases of increasing returns to scale Q_1Q_2 and Q_2Q_3 need not be equal.

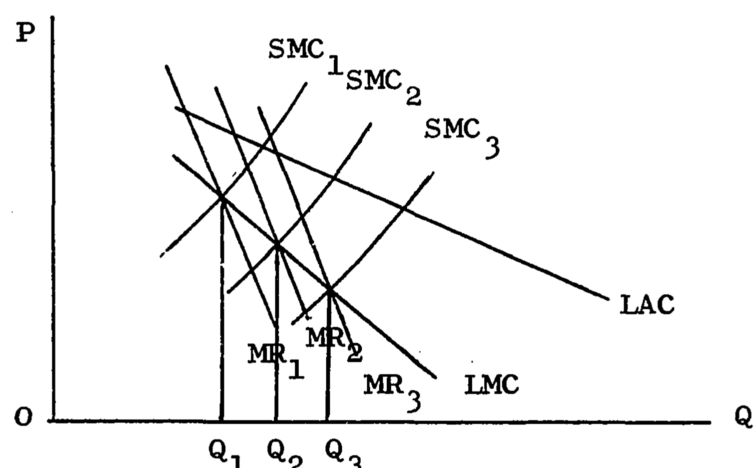

Figure III-2

When the firm is operating at decreasing returns to scale, equal changes in demand will cause equal changes in output in the special case where the LMC, the LAC, and the MR curves are linear too. Otherwise, Q_1Q_2 and Q_2Q_3 need not be equal. The case is shown in Figure III-3.

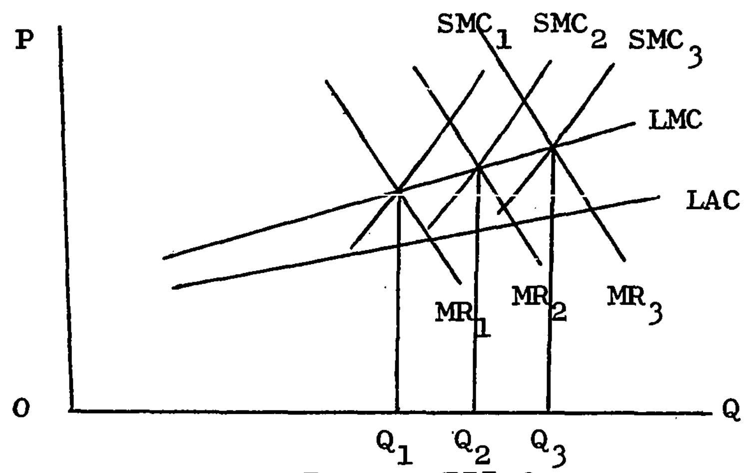

Figure III-3

B. <u>Conditions for a Constant Accelerator</u>

If the production function is homogeneous of degree one, then the long-run average cost curve will be parallel to the horizontal axis, representing constant returns to scale, while a production function which is homogeneous of degree greater or less than one corresponds to a monotonically decreasing or increasing curve (representing increasing or decreasing returns to scale) respectively.[3] These can be demonstrated diagramatically

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[3] C. E. Ferguson, <u>Microeconomic Theory</u> (Homewood, Ill.: Richard D. Irwin, Inc., 1966), p. 181n. See also Cliff Lloyd, <u>Microeconomic Analysis</u> (Homewood, Ill.: Richard D. Irwin, Inc., 1967), pp. 114-117, 128-129. A production function $f(X_1, \ldots, X_n)$ is said to be homogeneous of degree K if $f(\lambda X_1, \ldots, \lambda X_n) = \lambda^K f(X_1, \ldots, X_n)$, where $X_1, \ldots, X_n$ are the quantities of different inputs.

as following. In Figure III-4, OQ measures the output of a particular product, OC and OL measure the amounts of capital and labor respectively. $C_1Q_1Q_2$ and $C_2Q_3Q_4$ represent the total product curves at different scales of production from which the short-run cost curves are derived. OQ_1Q_4 is a scale line moving out along a ray from the origin into the input space.

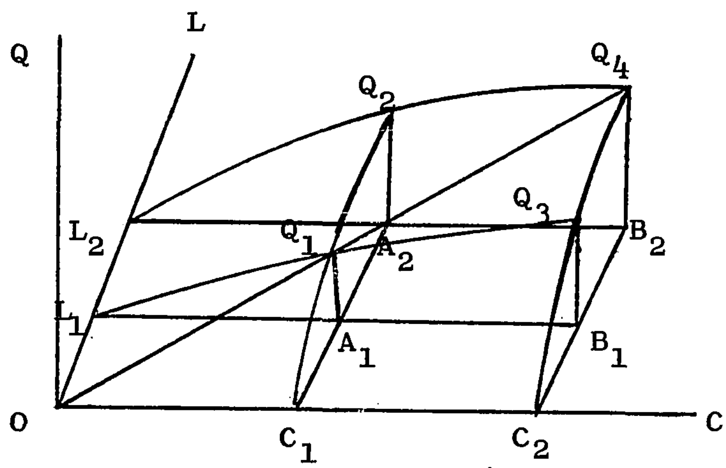

Figure III-4

If the production function represented by the production surface is homogeneous of degree one, OQ_1Q_4 will be a straight line, which implies that changes in output will entail proportional changes in demand for capital equipment. To be more specific, suppose A_1Q_1 is the amount of output produced by the combination of OC_1 units of capital and OL_1 units of labor, and B_2Q_4 is the

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Thus if each of the independent variables is multiplied by λ, the value of the function is increased by λ^K. If $K > 1$, there will be increasing returns to scale at all levels of output; if $K = 1$, constant returns to scale; and $K < 1$, decreasing returns to scale.

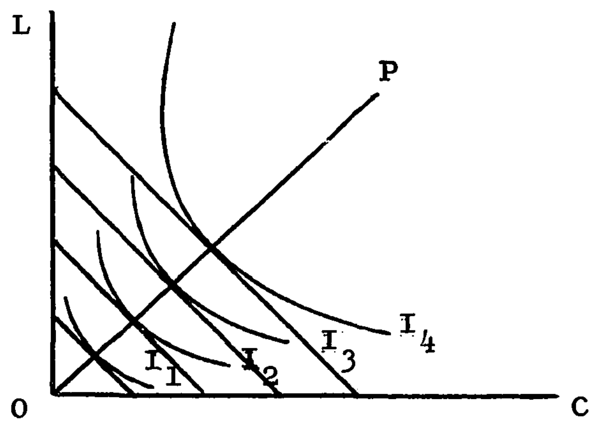
amount of output produced by the combination of OC_2 units of capital and OL_2 units of labor. Assume that OC_2 is equal to $2(OC_1)$, and that OL_2 if equal to $2(OL_1)$, then B_2Q_4 must be equal to $2A_1Q_1$, if the production function is homogeneous of degree one.

Under the condition of increasing returns to scale, the slope of the OQ_1Q_4 curve will increase, and the increases in inputs will be less than proportionate to the increases in output. If there are decreasing returns to scale, the slope of OQ_1Q_4 curve will diminish, and the increases in inputs will be more than proportionate to the increases in output.

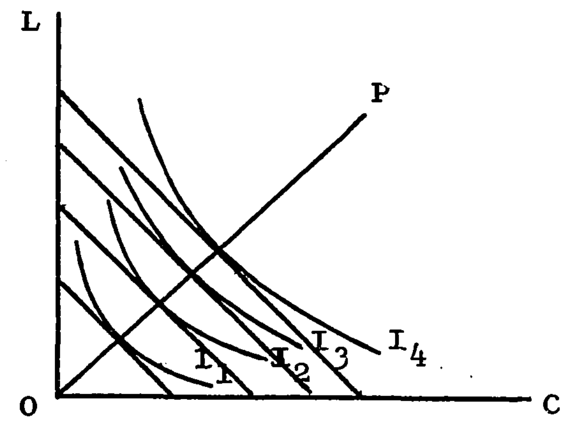
However, the expansion path of a firm which connects the points of tangency of various isocost lines to the corresponding isoquants, showing the least cost combinations for various levels of output, may not coincide with a scale line. Given relative factor prices, the expansion path of a firm is a scale line for all homogeneous production functions and some other types of production function where the expansion path happens to be linear. The production function may be such that the expansion path slopes upward to the labor axis, or downward to the capital axis, hence less or more than proportionate changes in capital will be entailed by changes in output, if the tendency is not offset or more than offset by decreasing or increasing returns to scale. Thus we have at least five different basic patterns of production function as shown by the diagrams on the following page.

The horizontal axis, C, measures the input of capital, and the vertical axis, L, measures the input of labor, C_1, C_2, ... are various quantities of capital input, and L_1, L_2, ... are various quantities of labor input. I_1, I_2 ... are the isoquants derived from a production function with $I_2 = 2I_1$, $I_3 = 3I_1$, $I_4 = 4I_1$ ... etc. It is only in Figure III-5(a) that changes in production will entail proportional changes in capital; while in Figure III-5(b) and Figure III-5(d) changes in production will entail less than proportional changes in capital; and in Figures III-5(c) and III-5(e) changes in capital in response to changes in production will be more than proportional.

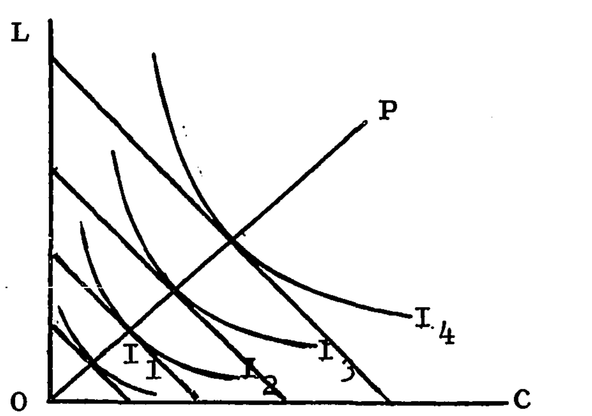
In general, given relative factor prices, net investment is a linear function of changes in output when (1) the production function is linear homogeneous, and (2) non-linear expansion path compensated by increasing or decreasing returns to scale so that changes in output entail proportional changes in capital requirement. In other cases net investment may be an increasing or decreasing function of changes in output depending on the nature of the particular production function, which is a matter of empirical investigation and cannot be settled by a priori considerations.



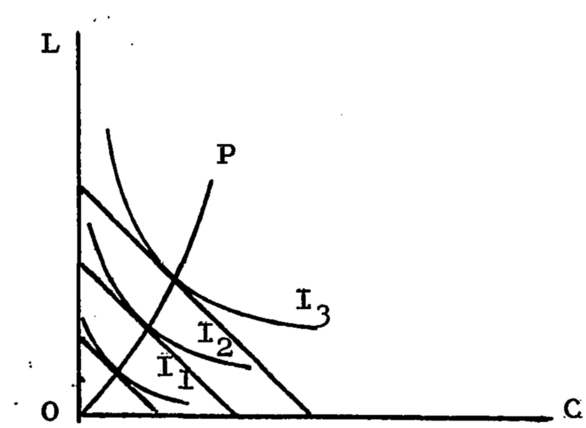
(a) Homogeneous of degree one.



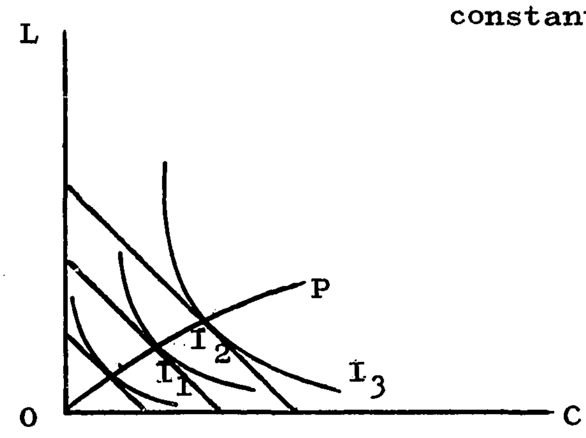
(b) Homogeneous of degree more than one.



(c) Homogeneous of degree less than one.



(d) Non-homogeneous with the expansion path bending toward the labor axis; constant returns to scale.



(e) Non-homogeneous with the expansion path bending toward the capital axis; constant returns to scale.

Figure III-5

C. Relative Prices and the Choice among Techniques

So far the effect of changes in relative prices on the choice among various methods of production has not been considered. That this is important is indicated by Hayek, who based his trade cycle theory on the "Ricardo effect." The Ricardo effect says that the entrepreneur tends to substitute labor for capital when the real wage rate decreases relative to the rate of interest, and vice versa.[4] Although Kaldor rigorously attacked Hayek's versions in both Prices and Production and Profits, Interest, and Investment, he did recognize the danger that "too little ... attention is being paid to the question of variation in methods of production during the trade cycle and what significance is to be attached to them."[5]

If the production function is such that factors of production must be used in a fixed proportion, and hence the isoquant assumes an L shape, changes in relative prices will cause no change in the combination of factors of production. But in the real world this is scarcely the case. Technologically, several basic methods

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[4] F. A. Hayek, Profits, Interest, and Investment (London: George Routledge & Sons, Ltd., 1939), Chap. 1.

[5] N. Kaldor, "Capital Intensity and the Trade Cycle," Economica, New Series, VI (February, 1939), 78-92, 359-82; reprinted in Essays on Economic Stability and Growth (London: Gerald Duckworth & Co., 1960), 121. See also "Professor Hayek and the Concertina Effect," Economica, New Series, IX (November, 1942); reprinted in Essays, 148-176.

of production represented by different combinations of factors of production may exist; part, or several parts, of the process of production within a particular method of production may be taken care of with capital intensive or labor intensive devices. Overtime can be worked, and new hands can be employed. Figure III-6 shows the effect of changes in relative prices on the combinations of capital and labor in producing the same amount of output. When the relative prices are such that A_1B_1 is the budget line, the combination of factors will be determined at P_1, where OC_1 units of capital and OL_1 units of labor will be employed. If the relative prices change in such a way that A_2B_2 becomes the budget line, then the combination of factors will be determined at P_2, where OC_2 units of capital and OL_2 units of labor will be employed.

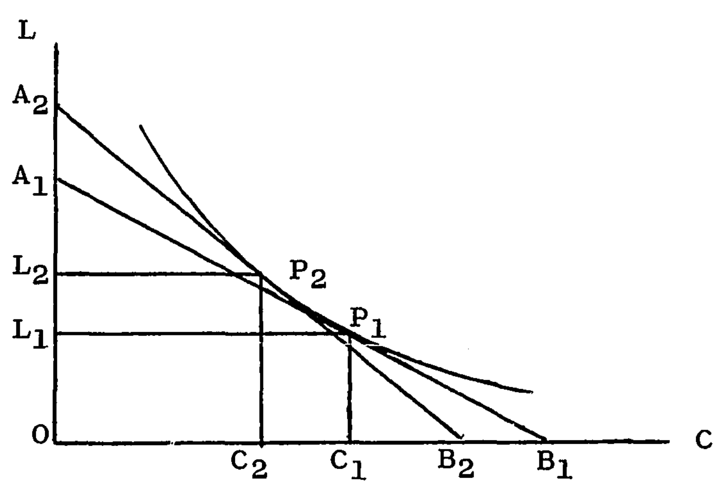

Figure III-6

However, it seems not very likely that the entrepreneur would base his choice of basic methods of production on short-run fluctuations of relative prices. He would be more interested in their long-run tendency to change. If the wage rate is increasing relative to the rate of interest, he will adopt more capital intensive techniques. But he will adopt more labor intensive methods of production if the wage rate is decreasing relative to the price of capital. The long-run tendency of the wage rate in industrially advanced countries has been to increase relative to the price of capital in the last century. This is one of the major factors which have been encouraging the development of capital-using methods of production.

However, this involves changes in production functions. In a relatively short period of time, such as that comprising the business cycle, the problem is rather one that involves a shift from one production process to another with a given production function.[6] In this case, it does not seem very likely that changes in relative prices during the cycle would affect the expansion path. Mainly because of the indivisibility of production factors, the isoquant is never a continuous curve in the real world. Any deviation from a specific combination of production factors previously used in production would involve additional cost and would not

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[6] R. G. D. Allen, Mathematical Economics (London: Macmillan Company, 1956), pp. 336-341.

pay unless the changes in relative prices were considerably drastic. Thus, for the purpose of analysis, the assumption of a linearly homogeneous production function seems justified. This implies a constant accelerator, which will be defined in this paper as the normal capital-output ratio in the Marshallian long-run equilibrium. However, it is by no means necessary to assume that the firm is always in its long-run equilibrium. As demand increases, the first response of the firm is almost always to increase output with existing capacity. The result will be increases in the SMC along a given SMC curve. Investment will occur so long as the long-run marginal cost is smaller than the short-run marginal cost.

The above argument has been based on the assumption that changes in output entail no change in resource prices. This assumption is not always true of course. An increase in resource prices shifts the long-run cost curves upward. Therefore, it pushes the equilibrium point to the left and reduces equilibrium output, as shown in the following diagram, where LMC' represents the new long-run marginal cost curve after resource prices having increased, and E' is the new equilibrium point. The same conclusion is also applicable to the situations of increasing and decreasing returns to scale.

At an early stage of the upswing of the business cycle, when there are unemployed resources of various

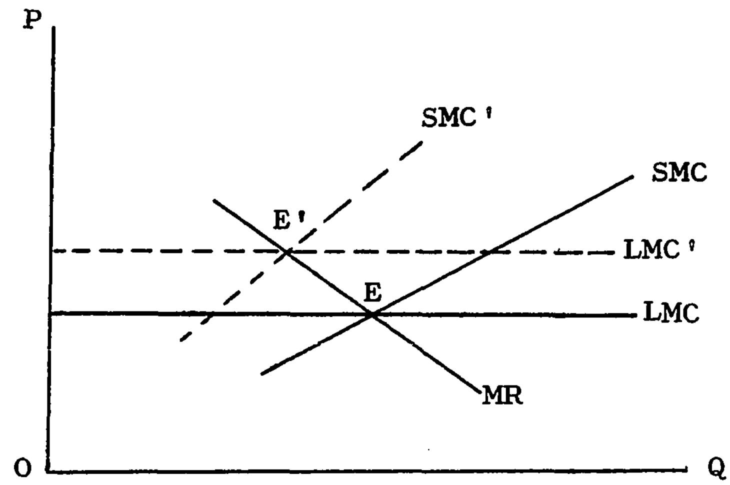

Figure III-7

kinds, increases in production, generally speaking, will not cause resource prices, and therefore costs, to increase. As the economy becomes more and more prosperous, resource prices will increase, and inferior units of production factors will be employed; both will cause costs to increase. It is true that given total resources and the state of technology, there is a ceiling to the economy beyond which output can no longer be increased.[7] The effective check which prevents output from growing at a desirable rate is normally not the physical limits of total resources available for employment, but rather

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[7] J. R. Hicks, A Contribution to the Theory of the Trade Cycle (Oxford: Oxford University Press, 1950), chaps. VIII and X. For criticisms of Hicks' concept of the ceiling, see, among others, W. W. Rostow, "Some Notes on Mr. Hicks and History," American Economic Review, XLI (June, 1951), 316-24; S. S. Alexander, "Issues of Business Cycle Theory Raised by Mr. Hicks," American Economic Review, XLI (December, 1951), 861-78; R. F. Harrod, "Domar and Dynamic Economics," Economic Journal, LXIX (September, 1959), 451-64.

increases in costs, which makes production less profitable.

The prices of all resources are not likely to increase proportionally because their demand-supply conditions are different. Firms in certain industries may face a rapid increase in the prices of some specific resources required for production, forcing costs of production up accordingly. Other industries may continue to be able to maintain a relatively constant cost of production. This partly explains the uniqueness of each cycle. The business cycle is an historical phenomenon. In spite of certain similarities, it does not repeat itself in the course of history, i.e., each cycle follows a course which is more or less different from those followed by others. A business cycle theory cannot be considered satisfactory if it fails to account for the dissimilarities of the cycles.

D. Concluding Remarks

From the above analysis the following conclusions concerning the acceleration principle can be drawn:

(1) Given relative prices, a rigid relationship between changes in demand for a particular product and changes in capital goods required for its production, upon which the acceleration principle is based, does exist if the production function is homogeneous of degree one. If the production function is homogeneous of degree greater than one, less than proportional changes in

capital will be required as demand for, and production of, the product changes. The required increase in capital will be more than proportional if the production function is homogeneous of degree less than one. A nonhomogeneous production function may imply increases in capital that are either more or less than proportional to output changes, depending on individual cases.

(2) Short-run fluctuations of relative prices of factors of production will not affect production methods unless the changes in relative prices are quite large.

(3) Increases in resource prices at a later stage of the upswing of the business cycle tend to reduce output and, therefore, the demand for additional capital.

CHAPTER IV

CUMULATIVE PROCESS OF THE BUSINESS CYCLE

A. Formulation of a Distributed Lag Investment Function

Discussion of the acceleration principle so far has been on the basis of the effect of price-cost relationship on the firm's production. Now the industry and the economy as a whole will be considered. Assume that I^i is the net investment of a particular industry i, I_j^f is the net investment of firm j in the industry which is composed of n firms. Assume further that O_j^f is the output of the j^{th} firm and equals the quantity demanded for the product of the firm. The accelerator for the firm is d_j^f. Then the investment function of the industry may be written:

$$I^i = \sum_{j=1}^{n} I_j^f = \sum_{j=1}^{n} d_j^f \Delta O_j^f \qquad \text{(IV-1)}$$

This implies that net investment of the industry is a weighted sum of the change in output of all firms in the industry, provided that their production functions are all linearly homogeneous. If all firms of the industry are using basically the same method of production, then we may assume that all d's are equal, and rewrite the above equation as the following:

$$I^i = d^i \Delta O^i \qquad \text{(IV-2)}$$

where ΔO^i is the change in output of the industry and d^i is the overall accelerator of the industry, indicating the additional units of capital required for the production of one more unit of output if production capacity is to be expanded to its long-run equilibrium point, i.e., the optimal point where the marginal revenue is equal to the long-run marginal cost.

A further question concerns the time period involved in the above two equations. While a change in demand relates primarily to a change in income, and involves, therefore, the income period, a change in capital, i.e., investment, involves the investment period. The income period is the average interval between the income receipts by those who receive income from another group's purchases. The investment period is the interval during which fixed capital of the firm is completely adjusted to the change in demand and production. It is usually called the long run. Consistent with the preceding analysis, the accelerator is the capital-output ratio when the firm reaches its long-run equilibrium, that is, a sort of "normal" capital-output ratio.

The length of the investment period varies from firm to firm, and from industry to industry. Some firms may require only a month or two to adapt their productive capacity to a change in demand, while others, such as those in heavy industries, may require several years. Generally speaking, the investment period will be much longer than the income period and may cover several income periods.

Suppose that the investment period of the i[th] industry is as long as m income periods, then

$$I_t^{i,t-1} + I_{t+1}^{i,t-1} + \dots + I_{t+m-1}^{i,t-1} = d^i \Delta O_{t-1}^i \qquad \text{(IV-3)}$$

where the subscripts refer to the income period in which the investment occurs, and the superscript t-1 refers to the period in which the change in output, to which the investment is ascribable, occurs. Then the change in the capital stock of the industry in any period, I_t^i, will equal the sum of the increments of the capital stock ascribable to the changes in output in a number of past periods, or

$$I_t^i = I_t^{i,t-1} + I_t^{i,t-2} + \dots + I_t^{i,t-m} \qquad \text{(IV-4)}$$

where $I_t^{i,t-1}$ represents the investment of the industry in period t caused by the change in output in period t-1, and $I_t^{i,t-m}$, the investment in period t caused by the change in output in period t-m.

If the adjustment of the capital stock of the industry to a certain change in the demand for and production of the product of the industry is spread evenly over time, then equation IV-4 can be rewritten as:

$$I_t^i = \frac{d^i}{m}(\Delta O_{t-1}^i + \Delta O_{t-2}^i + \Delta O_{t-3}^i + \cdots + \Delta O_{t-m}^i) \qquad \text{(IV-5)}$$

$$\text{or} \quad I_t^i = \frac{d^i}{m}(O_{t-1}^i - O_{t-m-1}^i) \qquad \text{(IV-6)}$$

in which $\frac{d^i}{m}$ may be designated, following S. S. Alexander, as the current accelerator.[1]

Equation IV-6 is the investment function of a particular industry. It is obvious that the net investment of the economy as a whole is the sum of the investments of all industries in the economy, i.e.,

$$I_t = \Sigma I_t^i = \Sigma \frac{d^i}{m} (O_{t-1}^i - O_{t-m-1}^i) \qquad \text{(IV-7)}$$

$$\text{or} \quad I_t = \frac{d}{m} (O_{t-1} - O_{t-m-1}) \qquad \text{(IV-8)}$$

where I_t is the net investment of the economy in period t, O_t and O_{t-m-1} are the total outputs of the economy in periods t and t-m-1 respectively, and $\frac{d}{m}$ is the current accelerator for the economy as a whole which is a weighted sum of the current accelerator for individual industries of the economy, assuming that there is no structural change in the economy, or that the changes are such that they offset each other and therefore exert no effect on the overall current accelerator.

However, the total output as represented by O_t

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[1] S. S. Alexander, "The Accelerator as a Generator of Steady Growth," Quarterly Journal of Economics, LXIII (May, 1949), 74-97.

or O_{t-m-1} consists of both final and intermediate goods and services. To convert total output into national output or national income, including only final goods and services, multiply $(O_{t-1} - O_{t-m-1})$, and divide d by the ratio between national output and total output, to obtain

$$I_t = \frac{a}{m}(Y_{t-1} - Y_{t-m-1}) \qquad \text{(IV-9)}$$

This is an ordinary distributed lag acceleration principle, where Y stands for real national output or income, and $\frac{a}{m}$, the current accelerator, which is the quotient of the full or ultimate accelerator, a, divided by the number of the income period in the investment period, m. Since national output is only a part of total output, it is expected that a will be much greater than d.

B. An Aggregate Model and Two Types of Possibility

Assume that consumption is a certain proportion of the income in the previous period. Thus,

$$C_t = cY_{t-1} \qquad \text{(IV-10)}$$

$$\text{or} \quad C_t = (1-s)Y_{t-1} \qquad \text{(IV-10a)}$$

where c and s represent the marginal propensity to consume and the marginal propensity to save respectively. Current income equals current consumption plus current investment:

$$Y_t = C_t + I_t \qquad \text{(IV-11)}$$

Substitute equations (IV-9) and (IV-10a) into equation (IV-11) to get

$$Y_t = (1-s)Y_{t-1} + \frac{a}{m}(Y_{t-1} - Y_{t-m-1}) \qquad \text{(IV-12)}$$

This is an homogeneous difference equation of the $(m+1)^{th}$ order with constant coefficients whose general solution is

$$Y_t = A_1X_1^t + A_2X_2^t + \ldots + A_{m+1}X_{m+1}^t$$

where the 'A's are constants determined by the initial conditions, and the 'X's are the m+1 roots of the auxiliary equation of equation (IV-12). The auxiliary equation is

$$f(X) = X^{m+1} - (1-s+\frac{a}{m})X^m + \frac{a}{m} = 0 \qquad \text{(IV-13)}$$

A high order equation such as this is not easy to solve at all, especially when m becomes large. However, Hicks' analysis in the appendix to The Trade Cycle may give a general idea about the solution.[2]

Hicks started with the assumption that the marginal propensity to save, s, was equal to zero. He discovered that equations like (IV-13) would have two major real roots if s = 0.[3]

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[2] J. R. Hicks, A Contribution to the Theory of the Trade Cycle (London: Oxford University Press, 1950), pp. 187-189, 195-197. Cf. S. S. Alexander, op. cit., Appendix.

[3] $f(X) = X^{m+1} - (1-s+\frac{a}{m})X^m + \frac{a}{m} = 0$

If $a < 1$, the largest root is unity; Y_t must therefore converge to a constant, the value of which depends on the initial conditions.

If $a = 1$, two roots are equal to unity, and they are the largest roots. Y_t will converge to form $A_1 + tA_2$.[4] The system is therefore explosive.

If $a > 1$, the largest root is greater than unity, and the process is therefore explosive.

Now allow s to be greater than zero. The two roots will draw together, becoming first equal and then

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$(X-1)\left[X^m - \frac{a}{m}(X^{m-1} + X^{m-2} + \ldots + X + 1)\right] = 0$; if $s = 0$

One root is therefore $X = 1$. The others are given by the equation

$X^m - \frac{a}{m}(X^{m-1} + X^{m-2} + \ldots + X + 1) = 0$.

$f(1) = 1 - \frac{a}{m}(1 + 1 + \ldots + 1 + 1) = 1 - a$, which is negative so long as $a > 1$.

$f(a) = a^m - \frac{a}{m}(a^{m-1} + a^{m-2} + \ldots + 1) > 0$, so long as $a > 1$.

By Descartes' rule of signs, therefore, there is one real root between 1 and a. The conclusion holds when $a \nless 1$. Because if $a < 1$, then

$f(1) = 1-a > 0$

$f(a) = a^m - \frac{a}{m}(a^{m-1} + a^{m-2} + \ldots + 1) < 0$.

[4] The general solution in this case is

$$X_t = (A_1 + tA_2)X_1^t + A_3X_3^t + \ldots + A_{m+1}X_{m+1}^t$$

Since $X_1 = X_2 = 1$ are the largest roots, the other roots will become insignificant as t increases. And the whole system will converge to the form $A_1 + tA_2$, which is an arithmetical progression.

complex, as s increases.[5] The value of s for which the major roots become equal is[6]

$$s_0 = 1 - \left(\frac{m+1}{m}\right)a^{\frac{1}{m+1}} + \frac{a}{m} \qquad \text{(IV-14)}$$

If $0 < s < s_0$, the major roots are real; if $s > s_0$, the major roots are complex, yielding therefore cyclical solutions.

Although equation (IV-12) has not been solved in terms of the marginal propensity to save, s, the accelerator, a, and the number of the income period included in the investment period, m, some general idea about the system does reveal itself from the above analysis. The accelerator, a, gives a rough means of distinguishing between damped and explosive cases. And the marginal propensity to save, s, has a damping effect, by reducing

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[5] If $s > 0$, then the auxiliary equation

$$f(X) = X^{m+1} - (1-s+\tfrac{a}{m})X^m + \frac{a}{m}$$
$$= (X-1)\left[X^m - \tfrac{a}{m}(X^{m-1} + X^{m-2} + \dots + 1)\right] + sX^m = 0$$

The introduction of the extra term sX^m into the equation, as compared with the one in footnote 4, has the effect of reducing the larger root and drawing the two roots together. After a certain point the two roots will become complex.

[6] Reproduce from Hicks: If $f(X) = 0$ has two equal roots, it must have a common root with $f'(X) = 0$.

$$f'(X) = (m+1)X^m - m(1-s+\tfrac{a}{m})X^{m-1} = 0,$$

then $X = \frac{m}{m+1}(1-s+\frac{a}{m})$. Substituting this value in $f(X) = 0$, we get $\left[\frac{m}{m+1}(1-s+\frac{a}{m})\right]^{m+1} = a$.

Therefore, $s = 1 - \left(\frac{m+1}{m}\right)a^{\frac{1}{m+1}} + \frac{a}{m}$. Hicks, <u>op. cit.</u>, p. 196.

the larger one of the two real roots. Corresponding to any given s, there are two critical values of a: the upper point, above which the system will be divergent or explosive, and the lower point, below which the system will be convergent, even if $s = 0$; this will be all the more certain if $s > 0$. Between the two points the system will oscillate at either an increasing or a decreasing amplitude, depending on whether the modulus is greater or smaller than unity.[7] Unfortunately, the "middle point" where the modulus equals unit is not easy to calculate in the present case.

Corresponding to any given a, there is a critical value of s, s_0, as was designated in equation (IV-14), at which the two major roots become equal; and thereafter, complex. When a is given, s_0 steadily diminishes as m increases.

Based on the various possibilities of the time pattern of the aggregate model outlined above, two different types of business cycle theory can be constructed. For relatively high values of the accelerator, there will be an explosive process either expanding (or contracting)

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[7]Any complex number, x+iy, can be expressed in terms of periodic trigonometric functions, and write as $\sqrt{x^2 + y^2}$ (cosR + isinR), and its complex conjugate, x-iy, as $\sqrt{x^2 + y^2}$ (cosR - isinR).
$\sqrt{x^2 + y^2}$ is called the modulus of the complex number.

at an increasing pace, or fluctuating at an increasing amplitude. For relatively low values of the accelerator, multiplier-accelerator interactions will produce damping fluctuations. The former requires "buffers" of one kind or another to form a complete model of the business cycle, just like that the latter requires "erratic shocks" to restrengthen fluctuations.[8] As Goodwin has pointed out, however,[9]

> Random shocks will work both with and against the cycle, the net effect is too small to be relied on to keep the cycle going with any appreciable amplitude.

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[8]R. C. O. Matthews, The Trade Cycle (Welwyn, Herts., England: James Nisbet & Co., Ltd., 1959), pp. 16-30). See also J. S. Duesenberry, Business Cycles and Economic Growth (New York: McGraw-Hill Book Co., 1958), pp. 35-36. It seems to the writer, however, that some of the writers that he refers to are in effect not the appropriate representatives of the types of the cycle theory. Take Harrod for example. For Harrod fluctuations are caused by the basic "antinomy," i.e., over-production relative to the equilibrium or warranted level of output will stimulate producers to expand, and under-production will lead them to contract, their production. For Hicks, according to Harrod, it is the existence of certain lags combined with the assumptions that the multiplier and the accelerator have certain values that cause the system to fluctuate. (Harrod, "Notes on Trade Cycle Theory," Economic Journal, LXI (June, 1951), 263-265; and S. S. Alexander, "Mr. Harrod's Dynamic Model," Economic Journal, LX (December, 1950), 722-729.) N. Kaldor completely rejected the acceleration principle. His theory is based on the non-linearity of both the saving and the investment function. (Kaldor, "A Model of the Trade Cycle," Economic Journal, L (March, 1940), 78-92; reprinted in Essays on Economic Stability and Growth (London: Gerald Duckworth & Co., 1960.)

[9]R. M. Goodwin, "A Non-linear Theory of the Cycle," Review of Economics and Statistics, XXXII (November, 1950), 316-320.

Even if the effect is indeed appreciable, a theory that relies heavily on random disturbances leaves the cause of the cycle virtually unexplained.[10] Therefore, following hicks, the proposition will be accepted that the accelerator, the marginal propensity to save, and the lags are of such magnitudes that explosive processes are produced, at least as a rule.[11]

C. The Effect of Technical Progress

So far, the effect of technical progress has not been taken into consideration. This is too important a factor to be ignored. Technical progress exists when given output can be produced with less input, or, what amounts to the same thing, more output can be produced with given input. Several efforts have been made since the second half of the 1950's to measure the relative contribution of technical progress and investment to income growth.[12] These researches found that most of growth is the result of technical progress. According to Solow, 87.5 percent of the increase in real GNP per man-hour that occurred between 1909 and 1949 was

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[10]It must be admitted, though, shortcomings of a theory do not rule out the possibility of the existence of the phenomena that it is trying to explain.

[11]J. R. Hicks, op. cit., pp. 91 and 107.

[12]For reference, see Donald Dewey, Modern Capital Theory (New York: Columbia University Press, 1965), p. 144.

attributable to technical progress, and only 12.5 percent was attributable to increased capital per man-hour.[13]

However, there are other economists who question the logical possibility of isolating the contributions of investment and technical progress to income growths. Dewey remarks:[14]

> . . . economic progress occurs with the creation of new machines and labor skills, and it would seem to be an impossible task to divide how much of any given increase in income should be credited to technical progress as against increases in capital stock and labor supply. A quantum of knowledge usually has little or no economic payoff until it is 'incorporated' or 'embodied' in a set of specialized men and machines.

It may be difficult, statistically as well as conceptually, to separate technology from capital and labor. But even Dewey agrees that there is no objection to assuming that technology is something different from capital and labor.[15]

The effect of technical progress on economic activities can be in different ways. Technical progress in the form of new methods of production lowers the long-run cost curves, therefore, raising the equilibrium level of output. The new methods may be capital-saving but labor-using, labor-saving but capital-using, or neutral.

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[13] Robert M. Solow, "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, XXXIX (August, 1957), 312-20; reprinted in M. G. Mueller (ed.), Readings in Macroeconomics (New York: Holt, Rinehart and Winston, Inc., 1966), 323-333.

[14] Dewey, op. cit., 143.

[15] Ibid., 142-143.

A new method is said to be capital-using if technical change increases the marginal product of capital more than the marginal product of labor at a given capital-labor ratio, encouraging the entrepreneur to use more capital relative to labor. It is labor-using if the opposite is true. Technical progress is neutral if at a constant capital-labor ratio, the rate of the marginal product of capital to the marginal product of labor, i.e., the marginal rate of technical substitution between capital and labor, remains unchanged.[16]

Historically, most innovations, the application of new methods of production, are more capital intensive than those they have displaced. Even if an invention is capital saving in nature, its rapid introduction is almost sure to stimulate investment by making existing capital obsolete.[17]

According to a study by Kuznets, both the gross and net incremental capital-output ratios in most industrially advanced countries under study--the United Kingdom, Germany, Sweden, the United States, Canada, Australia, and Japan--rose between the early periods and recent

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[16] C. E. Ferguson, Microeconomic Theory (Homewood, Ill.: Richard D. Irwin, Inc., 1966), pp. 150-152.

[17] Gardner Ackley, Macroeconomic Theory (New York: Macmillan Company, 1961), p. 552.

periods.[18] These imply that in a relatively short period of time, technical progress stimulates additional investment at given rate of change in demand and production, while in a longer period of time, it increases the magnitude of the accelerator.

Technical progress may also take the form of creation of new commodities. And in this case it tends to raise the marginal propensity to consume, and reduce, therefore, the marginal propensity to save, s, in equation (IV-12). Because a person's demand for almost any commodity is saturable, the marginal propensity to consume is apt to decline as income increases, unless new commodities are available to create new demand, or to meet hitherto unsatisfied old demand. Thus it can be expected that technical progress either in the form of the application of new methods of production, or in the form of the creation of new commodities, will have the effect of exaggerating economic activities when the economy is moving upward, and alleviating contractions when it is on the decline.

Finally, technical progress improves productivities of various factors of production, either pushing the production possibilities curve outward, or the potential production capacity (the ceiling) upward.

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[18] Simon Kuznets, Modern Growth Theory (New Haven: Yale University Press, 1966), p. 260.

Business cycles may be conceived of as periodic fluctuations underneath and along the increasing ceiling.

CHAPTER V

THE DOWNTURN AND THE UPTURN

A. LAC and Its Changes during the Upswing

Three types of the long-run average cost functions were distinguished in Chapter IV: a perfectly horizontal LAC curve, representing constant returns to scale; an upward sloping LAC curve, representing decreasing returns to scale; and a downward sloping LAC curve, representing increasing returns to scale. In the real world, however, a firm's LAC curve may exhibit all three shapes over various possible sizes.

Ferguson has demonstrated three different shapes of LAC curve.[1]

Panel a, Figure V-1 shows a long-run average cost curve for a firm when economies of scale are negligible, and diseconomies soon come into play, causing the LAC curve to turn up at a relatively small volume of output. The LAC curve illustrated in panel b, Figure V-1, is at the opposite, where economies of scale play an important and long lasting role, and diseconomies become

[1] C. E. Ferguson, Microeconomic Theory (Homewood, Ill.: Richard D. Irwin, Inc., Rev. Ed., 1969), p. 213.

effective only at a very large volume of output.

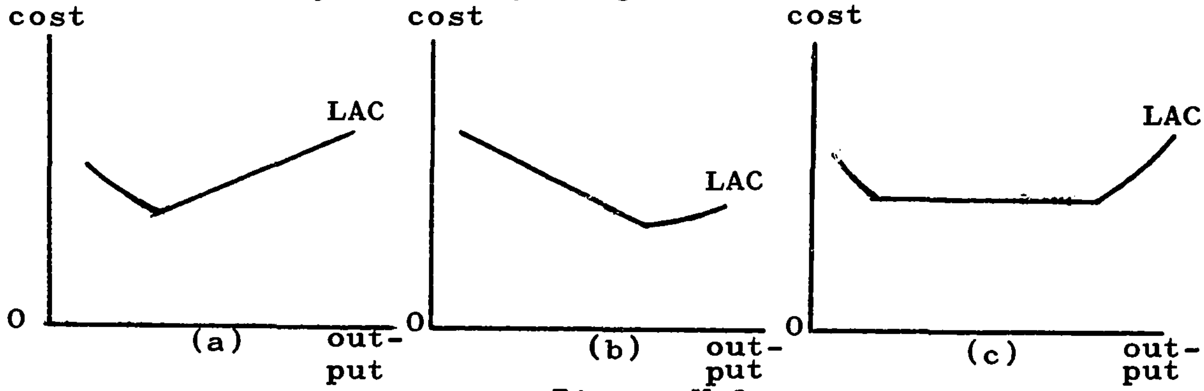

Figure V-1

However, many economists and businessmen feel that neither of these extremes generally describes the behavior of LAC in the American economy. The typical long-run average cost curve is thought to assume the shape in panel C, where the curve has a long horizontal section. This implies that a very modest scale of operation may enable a firm to capiture all of the economies of scale, and that diseconomies may not be incurred until the volume of output is very large.[2]

The shapes of the LAC curve are important to the understanding of an industry's long-run response to an increase in demand. It can be expected that, as demand increases, there will be an expansion of the industry's capacity. The expansion could take place either by expansion of existing firms or by entrance of new firms.

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[2]Ferguson, op. cit., p. 213; D. S. Watson, Price Theory and Its Uses (New York: Houghton Mifflin Co., 2nd ed., 1968), p. 201; K. Lancaster, Introduction to Modern Microeconomics (Chicago: Rand McNally & Co., 1969), p. 125.

If the LAC is of the shape in panel a, figure V-1, existing firms would remain about the same size, and expansion would take place by new optimum-sized firms entering the industry. If the LAC curve is of the shape in panel b, which is typified by the so-called natural monopolies, expansion by existing firms would occur. This would have the effect of reducing the overall accelerator of the economy.

If LAC is horizontal over a wide range of output, as shown in panel c, the expansion would take place by expansion of existing firms before the rate of excess profit reaches a certain level as assumed in Chapter IV, and new firms would come in when the rate of excess profit exceeds that level, so long as the marginal revenue curve cuts the LMC curve on the horizontal portion of the latter.[3] In both cases, increases in the demand for a product would cause proportional increases in demand for the capital goods which are used for its production. This is another way of saying that the acceleration principle holds when firms are operating on the horizontal section of their LAC curve.

If the horizontal portion of the LAC curve is relatively short, so that an increase in demand causes

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[3]Cf. G. Malanos, Intermediate Price Theory (Chicago: J. B. Lippincott Co., 1962), pp. 249-250; G. J. Braff, Microeconomic Analysis (New York: John Wiley & Sons, Inc., 1969), pp. 114-115.

the new marginal revenue curve to intersect the LMC curve on its rising portion, the increase in production in response to the increase in demand would be less than proportional, and the increase in the demand for capital in response to the increase in production would be more than proportional. New firms would be attracted to enter the industry earlier than it would be in the case when the LMC curve remains horizontal. This can be illustrated by the following diagram.

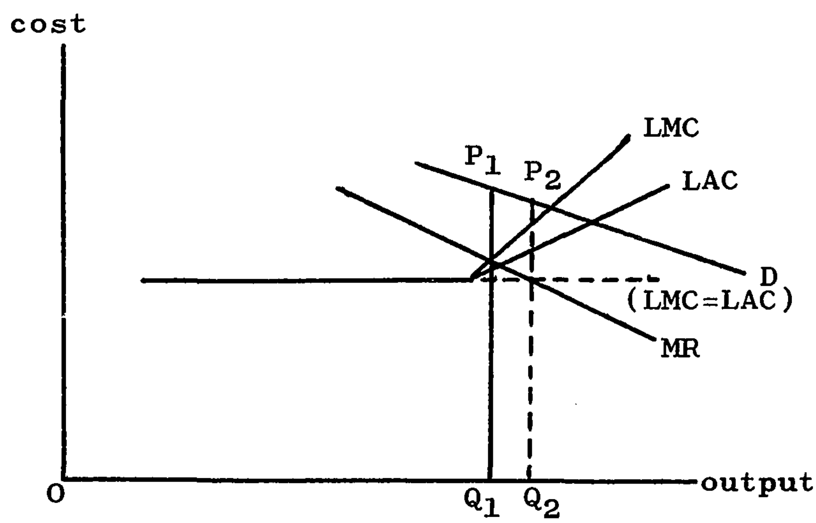

Figure V-2

At an increasing LMC, and therefore LAC, as shown in figure V-2, the output is OQ_1, which is less than OQ_2, and the price is Q_1P_1, which is higher than Q_2P_2. OQ_2 and Q_2P_2 are respectively the output and the price when the LAC remains constant (and therefore is equal to the LMC).

The effect on an industry's overall accelerator of the intersection of the marginal revenue curve on the rising portion of the LMC curve is difficult to generalize. However, as demand increases continuously during the upswing of the business cycle, the price would sooner or later be raised to a level at which new firms start to enter. This would shift the demand curve of existing firms to the left, and push them back to the horizontal portion of the LAC curve for operation. Therefore, it will be both convenient and justifiable to assume that all firms operate in the range of constant returns, and that the rising part of the LAC curve never becomes effective.[4]

As the upswing gets beyond a certain point, the supplies of some, and eventually all, inputs become more and more inelastic, and the firm has to pay even higher prices to get additional units of inputs. This is especially true for certain type or types of resources, human as well as nonhuman, which are more or less specific to the industry in question, such as skilled workers highly specialized in a certain field. Their supply does not always increase as fast as their demand increases. An individual firm in an industry can bid away additional units of this type of resource from other firms in the industry practically without limit. But the price that it has to pay might be prohibitive. Substitution may be

[4]Cf. K. Lancaster, op. cit., pp. 106-107.

possible, but only with successively more inferior units which have lower physical productivities. All of these will have the effect of shifting the LAC curve upward, and therefore reducing the equilibrium level of output, so long as the elasticity of the demand curve is greater than zero.[5] This was illustrated by Figure III-7 in Chapter III.

The increase in the firm's cost of production caused by an expansion of the output of other firms inside and outside the industry is apparently pecuniary external diseconomies. Scarcity is the fundamental source.[6] Along with pecuniary diseconomies, there are pecuniary economies and technological economies and diseconomies that might occur as a result of an increase in aggregate output. As Hibdon has pointed out, there are no pecuniary external economies independent of technological economies somewhere in the economy, although pecuniary diseconomies may have no technological counterpart.[7] The types of technological economies frequently referred to by economists are the development of labor

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[5]Imperfect competition has been assumed throughout the present paper. For the effect of increased factor prices on the level of output of the firm under perfect competition, see J. M. Henderson and R. E. Quandt, Microeconomic Theory (New York: McGraw-Hill Book Company, 1958), pp. 93-94.

[6]J. E. Hibdon, Price and Welfare Theory (McGraw-Hill Book Company, 1969), p. 442.

[7]*Ibid.*, p. 444.

market and that of information services. However, it does not seem very likely for either a labor market or any information services to be fully developed in a relatively short period of time. During the period of the upward-moving stage of the business cycle, pecuniary external diseconomies caused by the increasing scarcity of resources as the economy approaches its full employment level will outrun all external economies. Costs of production will increase. And the firm will produce less than what it would tend to produce if there were no such increase in costs of production.

B. Demand Elasticity and the Downturn of the Cycle

The increase in costs causes further increase in money income, assuming that monetary authorities allow the supply of money to grow. This in turn may shift the demand curve, and so the marginal revenue, to the right. This may offset, or even more than offset, the reduction in output resulting from the increase in costs. The following diagram illustrates this situation. LMC is the original long-run marginal cost curve. LMC' represents the long-run marginal cost curve after increase in resource prices. Originally, the firm produces OQ_1. As demand increases, its marginal revenue curve shifts to MR_2. In the long-run, the firm would produce OQ_4, if there were no change in resource prices. However, as the aggregate output of the economy increases, prices of various

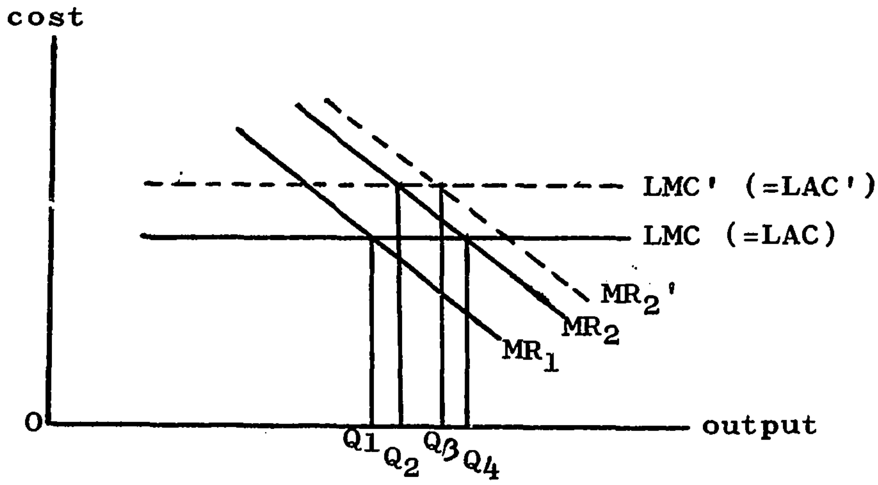

Figure V-3

resources increase. This shifts the long-run marginal cost curve to LMC'. The new equilibrium level of output will be OQ_2, which is smaller than OQ_4. But the increase in costs of production raises the level of money income, which moves the marginal revenue curve further to MR_2' determining the new equilibrium level of output which the firm is in the long-run going to produce. The new equilibrium level may be smaller than, equal to, or larger than OQ_4. Figure V-3 shows a particular case in which OQ_3 is smaller than OQ_4, representing that further increase in demand resulting from the increase in production costs is not large enough to offset the effect on output of the latter.

As mentioned before, a person's demand for almost any product is saturable. Income elasticity of demand for a product for both the individual and the economy as a whole first increases then decreases, as income grows.[8] Given population, tastes and technology, it may be postulated that the total demand for any product with respect to national income assumes the form of a Gompertz curve, as shown in the following diagram, where the Y axis measures national income and the X axis measures the quantity of the product demanded at a given price.

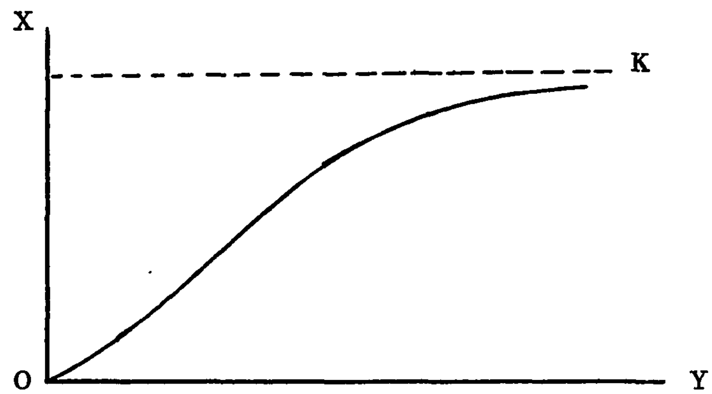

Figure V-4

The equation for the Gompertz curve is

$$X = Ka^{b^{Y}}$$

which may be put in logarithmic form

$$\log X = \log K + b^{Y} \log a$$

The particular form employed here is the one when log a is negative and b is less than one.[9] An increase in

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[8]For a diagrammatic demonstration, see G. Malanos, op. cit., pp. 99-100.

[9]F. E. Croxton and D. J. Cowden, Applied General Statistics (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 2nd ed., 1955), p. 303.

population shifts K, the asymptote, upward. Unfavorable change in taste against the product in question causes the curve to turn downward. Technological advance in the form of substitutive new product will have the same effect as unfavorable change in taste.

The coefficient of income elasticity of demand is different for different products according to their nature and the position that they have currently reached on their respective Gompertz curves. For the products for which the income elasticity of demand is relatively low, the increase in demand caused by income growth may not be sufficient to offset the effect of the increase in costs on output. Therefore, output will be reduced, and so will be investment. For other products whose demand elasticity with respect to income is relatively high, the effect of the increase in demand may more than offset that of the increase in costs, so that output, and investment, will continue growing.

Contraction starts first from those industries whose outputs either decline or stop or slow-down growing due to the fact that either the income elasticities of demand for their products are low, or that the supply of resources required for the production of their products is inelastic as compared with other industries, or both. It then spreads to more and more industries for the same reason and the diffusion effect of the contracted industries through input-output relations, which will be discussed in the next chapter.

The decline of the marginal propensities to consume (MPC) for certain products, measured by the slopes of the Gompertz curves of the products at relevant points, may be offset by the increase in the MPC for others, so that the aggregate MPC does not fall as income increases. This is dependent roughly on the structure of the various products and their positions on respective Gompertz curves. The situation is more complicated when taking into consideration changes in income distribution, consumer expectations about future income, and consumer income of the immediate past during the business cycle. However, since new consumer products constitute only a small proportion of total consumer products even in a most progressive economy, it seems reasonable to assume that the aggregate MPC tends to fall as income increases, if technical progress in the form of creation of new consumer products is not rapid enough. The aggregate MPC may fall or not depending on the rate of technical progress in the form of creation of new consumer products. An increase in the aggregate MPC as income increases, although unusual, is not impossible. Therefore, a decline in the aggregate MPC may be a cause of the downturn of the business cycle, although this is not certain. The source of the downturn fundamentally must lie with the behavior of investment.

As the economy progresses, the supply of resources becomes more and more inelastic. Higher and higher prices have to be paid on the part of producers. This raises costs of production for an increasing number of industries. For some of them the effect of the increase in costs may be offset, or even more than offset, by the increase in demand as a result of income increases so that their output keeps growing. For others the net effect of costs increase and demand increase may be such that their output starts to decline or to grow at a lower rate.

Consider that there are only two industries in the economy, one consumer good industry and one investment good industry, and that the market supply of the consumer good is becoming perfectly inelastic due to shortage of a specific resource. The resource in shortage may be certain strategic materials or a certain kind of labor. If the latter is the case, the producer may attempt to substitute capital for labor. But substitution is not always technologically possible in a short period of time. Even if it is possible, he may still hesitate to do so, considering that the shortage is only temporary, not a permanent, phenomenon. The output of the product of any one firm of the industry can be increased by bidding resources from other firms. But the total output of the product cannot be increased. Hence, its net demand for investment good drops to zero. Total production of the economy will decline as a result. This approximates the situation of the full employment ceiling effect. When the economy reaches its full employment ceiling, output can no longer be increased at a desired rate, and therefore starts to decline due to the acceleration effect.

In the real world, there is, of course, more than one consumer good industry. Let it be assumed that the consumer good industry whose market supply can no longer be increased is industry A. While part of the increase in the consumer's income as a result of costs increase in industry A is spent on the product of industry A, and is met by a rise in the price of the product, without causing investment to occur, part of the increase will be spent on the consumer products of other industries, causing their output to increase. Compensating net investment will then occur in these industries. For this reason the magnitude of the aggregate net investment, although somewhat reduced by industry A's failure to expand, may still be large enough to support the continued growth of economy. But this compensation is unlikely to continue to be sufficient for as the economy keeps growing, shortages of strategic factors of production become widespread. More and more industries reach the point where further increases in demand no longer cause output to grow, but rather cause prices to rise. The number of other industries that can engage in sufficient investment to compensate for these declines diminishes. The effect of increases in demand on investment becomes weaker until finally it is insufficient. A downturn occurs.

The extreme case of perfectly inelastic supply has been assumed so far for purpose of simplification. The conclusion thus derived holds even if the market supply of various consumer products is not perfectly inelastic, but is becoming increasingly inelastic as the expansion proceeds. Under such a circumstance, increases in demand for the products will entail less than proportional increases in outputs. Because of the decline in growth of real output, the rate of investment in these industries will decline, given their respective accelerators.

The upward movement of the economy would continue until the full employment ceiling was reached, if resources were available in the same proportion as they were required, if there were perfect technical substitutability and complete mobility, or if there were downward price flexibility in the sense that the existence of unemployment would lower costs of production in certain industries, helping the economy reach its full employment level by attracting demand from the industries in which prices have been increasing. Since none of these is true, contractions always start when there are still resources of one kind or another in the economy left unemployed.

From the above analysis, it becomes quite obvious that accompanying the general expansion of the economy, individual prices increase as a result of demand increases and cost boosting. Since the general price level is a weighted average of individual prices, it increases as the economy approaches its full employment level. This can be illustrated by the following diagram. The vertical axis of the diagram measures the general price level, and the horizontal axis measures national output. The price level starts to rise some time before the full

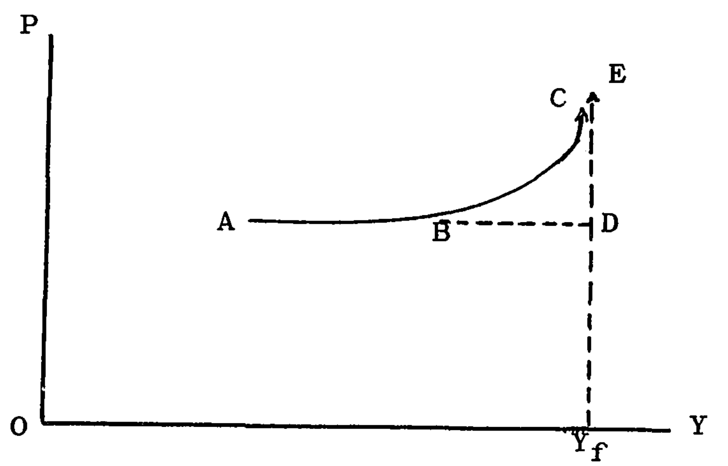

Figure V-5

employment level of output is reached. This is shown by the solid curve ABC. The idea underlying this curve is often stated in discussions of the general price level and inflation.[10] But, it has not been successfully integrated into business cycle as well as economic growth models.

Following Keynes, Hicks assuming that the rise in prices occurs during the full boom when output is creeping along the full employment ceiling.[11] This approximates[12] the situation of ABDE in Figure V-5. It implies that before the full employment level of output, Y_f, is reached output expansion is not accompanied by rises in the price level. After Y_f is reached, real output can no longer be increased. Any further increase in affective demand will lead only to a proportional increase in the price level. This apparently is not true in the real world.

C. The Upturn

Once the economy starts to decline, the interaction between the multiplier and the accelerator will

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[10] M. Bronfenbrenner and F. D. Holzman, "A Survey of Inflation Theory," in American Economic Association and Royal Economics Society, ed., Surveys of Economic Theory (London: Macmillan & Co., Ltd., 1965), I, 47-50.

[11] J. R. Hicks, A Contribution to the Theory of the Trade Cycle (London: Oxford University Press, 1950), pp. 124-126.

[12] The word "approximates" is used because Hicks assumes a full employment ceiling which continuously shifts to the right.

cause it to continue declining. However, there are floors to the decline. The behavior of disinvestment in response to contraction is not of the same nature as the behavior of investment in response to expansion. Disinvestment in fixed capital can only take the form of stopping reinvestment. Gross investment cannot be negative. Net investment can be negative but the amount of such disinvestment cannot exceed the amount of depreciation. Once gross investment drops to zero, the acceleration becomes inoperative downward because further declines in demand can no longer reduce investment.

Starting from the downturn of the cycle, perhaps even before that, there are firms and industries who have reached the floor of zero gross investment. As contraction proceeds, more and more industries will reach their respective floors, thereafter contraction of the economy can no longer reduce the investment of, and will therefore receive no further deflationary pressure from, these industries. In other words, the successive approach to their respective floors of the industries would alleviate the cumulative momentum of the downswing, and check the fall in national income.[13] When the rate of the decline begins to slow down, investment will tend to increase due to the acceleration effect, and the economy

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[13]Cf. R. C. O. Matthews, The Trade Cycle (Digswell Place, Welwyn, Herts: James Hisbet & Co., Ltd., 1959), p. 167.

will regain its force of growing.

The upturn, however, will not wait until the contractionary tendencies exhaust themselves. First, technical progress either in the form of the application of new methods of production, or in the form of the creation of new commodities, will make obsolescent old capital and encourage investment in new capital. Second, the growth of population tends to increase the marginal (and average) propensity to consume, causing a given level of investment to generate a larger amount of income. Third, an increase in the elasticity of various resources and a decrease in their prices during the contraction will shift cost curves downward. This will have the effect of increasing output and investment.

In general, however, prices of output and input--costs--are not as sensitive to decreases in demand as to increases in demand. As the level of economic activities declines, the general price level is likely to resist returning to its original level in the previous cycle. Thus in every cycle, the price level moves upward from a higher starting point than it was at the previous one. This can be illustrated by a diagram in Figure V-6.[14] The S_1 curve describes the behavior of price as output rises toward the full employment level, Y_f. Because it

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[14]Reproduced with minor modification from W. C. Peterson, Income, Employment, and Economic Growth (New York: W. W. Norton & Company, Inc., 1962), p. 391.

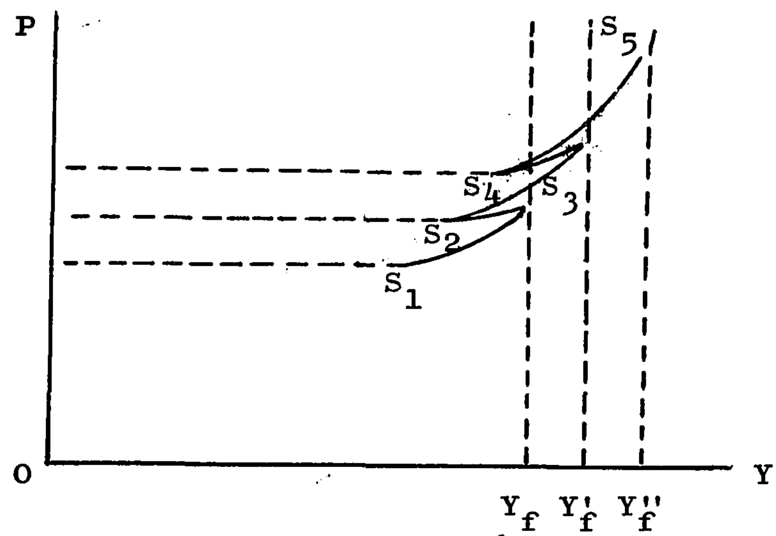

Figure V-6

does not fall off to the same degree in a recession, the downward movement of the general price level follows curve S_2, which is above S_1. During the next cycle this same process will repeat itself. As the recovery gets under way and the economy moves toward a new and higher level of full employment, Y_f', the general price level will move along the S_3 curve. The price level reached at the new full employment output will be higher than it was in the last boom. After the downturn, the movement of the price level will follow S_4 as the level of economic activity declines.

CHAPTER VI

A MULTI-SECTORAL MODEL OF THE BUSINESS CYCLE

A. A Basic Model of Interindustrial Relations

It has been argued in the last chapter that the downturn of the business cycle is, generally speaking, not caused by the existence of a full employment ceiling, but by the relative increase in costs as compared with that in demand in an increasing number of industries. The latter, in turn, is essentially a result of an increasing inelasticity of supply of certain types of resources as the economy progresses. Similarly, the upturn of the cycle is not caused by an overall floor in the aggregate sense, but by successive floors in certain industries due to the limitation of disinvestment in fixed capital together with technical progress and the recovery of supply elasticity of resource. The effect of production and investment behavior of individual industries upon the economy as a whole will be traced out in the present chapter with the help of an input-output model.

The following is an input-output table which shows the interdependence of sectors.[1]

		Purchasing Sectors (output)						
		Intermediate Use			Final Use		
		Sector			Invest-ment	Con-sumption	Total output
		1 ...	j...	n	n+1	n+2	n+3
	1	O_{11}...	O_{1j}...	O_{1n}	I_1	O_1	O_1
	.	.					
Producing	.	.					
	.	.					
	i	O_{i1}...	O_{ij}...	O_{in}	I_i	C_i	O_i
sectors	.	.					
	.	.					
	.	.					
	n	O_{n1}...	O_{nj}...	O_{nn}	I_n	C_n	O_n
Input							
Primary	n+1	W_1...	W_j...	W_n			W
	n+2	R_1...	R_j...	R_n			R
Inputs	n+3	D_1...	D_j...	D_n			D
	n+4	P_1...	P_j...	P_n			P
Total Outlays	n+5	O_1...	O_j...	O_n	I	C	O

Each row (reading from left to right) shows the <u>output</u> sold or distributed by each sector along the left-hand

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[1]The following input-output table and its description are based mainly on H. B. Chenery and P. G. Clark, <u>Interindustry Economics</u> (New York: John Wiley & Sons, Inc., 1959); W. H. Miernyk, <u>The Elements of Input-Output Analysis</u> (New York: Random House, 1965).

side of the table to each sector across the top of the table. Each column (reading from top to bottom) shows the input purchased by each sector across the top of the table from each sector along the left-hand side of the table.

To be more specific, the ith row of the table, for example, shows the output allocated by the ith sector to itself and other sectors of the economy: Of the total output, O_i, turned out by the ith sector, O_{i1} is delivered to and absorbed, as one of its inputs, by the 1st sector, O_{ij} is used by the jth sector, O_{in} is used by sector n, I_i for investment and C_i for consumption.

Now, turn to the jth column of the table, which shows the inputs purchased by the sector from itself and other sectors of the economy. The total purchased from all sectors is O_j, of which O_{1j} is from the 1st sector, O_{ij} from the ith sector, and O_{nj} from sector n. W_j is paid as wages, R_j as rent, D_j as interest, and P_j as profit by the sector to the owners of the production factors participated in the production of O_j.

Each row of the table can be expressed by an equation:

$$\begin{aligned} O_i &= O_{i1} + \ldots + O_{ij} + \ldots + O_{in} + I_i + C_i \\ &= \sum_{j=1}^{n} O_{ij} + I_i + C_i \qquad \text{(VI-1)} \end{aligned}$$

$\sum_{j=1}^{n} O_{ij}$ is the total intermediate use, i.e., use for further production, and $I_i + C_i$ are the final use, of the total output produced by sector i. If, as assumed throughout the paper, investment and consumption are the only elements of final demand, $Y = I + C$. Then equation (VI-1) can be rewritten as

$$O_i = \sum_{j=1}^{n} O_{ij} + Y_i \qquad \text{(VI-1a)}$$

It states that for each commodity total output is equal to total demand, which is composed of intermediate demand and final demand.

Similarly, an equation can be developed for each column of the table.

$$O_j = O_{1j} + \ldots + O_{ij} + \ldots O_{nj} + W_j + R_j + D_j + P_j$$

$$= \sum_{i=1}^{n} O_{ij} + W_j + R_j + D_j + P_j \qquad \text{(VI-2)}$$

$\sum_{i=1}^{n} O_{ij}$ represents the total use of produced inputs, and $W_j + R_j + D_j + P_j$, primary inputs, in sector j. The equation states that the total outlay in each sector is equal to the value of produced inputs and value added in that sector. If V represents $W + R + D + P$, equation (VI-2) can then be rewritten as

$$O_j = \sum_{i=1}^{n} O_{ij} + V_j \qquad \text{(VI-2a)}$$

Adding the equations (VI-1a) for each row gives:

$$\sum_i O_i = \sum_i \sum_j O_{ij} + \sum_i Y_i$$

Adding the equations (VI-2a) for each column gives:

$$\sum_j O_j = \sum_j \sum_i O_{ij} + \sum_j V_j$$

Since total outlays $(\sum_j O_j)$ of an economy is equal to total output of economy,

$$\sum_i Y_i = \sum_j V_j \qquad \text{(VI-3)}$$

where $\sum_i Y_i$ represents national output, and $\sum_j V_j$ represents national income.

Dividing both sides of equation (VI-2) by O_j yields

$$1 = \sum_i b_{ij} + \frac{W_j}{O_j} + \frac{R_j}{O_j} + \frac{D_j}{O_j} + \frac{P_j}{O_j} \qquad \text{(VI-4)}$$

where $b_{ij} = \frac{O_{ij}}{O_j}$, represents the quantity of the output of sector i employed by sector j in producing one dollar's worth of the latter's output. The meaning of the other elements of the equation is self-explanatory. Substituting $b_{ij} = \frac{O_{ij}}{O_j}$ into equation (VI-1a) gives an equation for each sector:

$$O_i = \sum_{j=1}^{n} b_{ij} O_j + Y_i$$

or

$$\begin{aligned}
(1-b_{11})O_1 - b_{12}O_2 - \dots - b_{1n}O_n &= Y_1 \\
-b_{21}O_1 + (1-b_{22})O_2 - \dots - b_{2n}O_n &= Y_2 \\
\dots \qquad\qquad\qquad & \qquad \text{(VI-5)} \\
-b_{n1}O_1 - b_{n2}O_2 - \dots + (1-b_{nn})O_n &= Y_n
\end{aligned}$$

The b_{ij}s in the equations are called input coefficients, and are assumed to be constant.

In matrix form, equation (VI-5) becomes:

$$\begin{bmatrix} (1-b_{11}) & -b_{12} & \cdots & -b_{1n} \\ -b_{21} & (1-b_{22}) & \cdots & -b_{2n} \\ \cdot & \cdot & \cdot & \\ -b_{n1} & -b_{n2} & \cdots & (1-b_{nn}) \end{bmatrix} \begin{bmatrix} O_1 \\ O_2 \\ \vdots \\ O_n \end{bmatrix} = \begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix}$$

or $(I - \left\{b_{ij}\right\})O = Y$

I is the identity matrix.

Given the final demand, Y_1, Y_2, ... Y_n, the system can be solved for the n total outputs, O_1, O_2, ... O_n by finding the inverse matrix of $(I - \left\{b_{ij}\right\})$.[2]

B. Dynamization of the Basic Model

In the above treatment of interindustrial relations, no time reference has been made, and investment is considered an exogeneous variable determined by forces outside the system. The system is static in nature. It can be dynamized by introducing the acceleration principle developed in previous chapters into the model.[3]

Substitute $\sum_{j=1}^{n} \frac{d}{m}{}_{ij} \left\{O_j(t-1) - O_j(t-m-1)\right\}$ for I_i in equation (VI-1) to get

---

[2] $(I - \left\{bij\right\})\ O = Y$
$O = (I - \left\{bij\right\})^{-1} \cdot Y$
$(I - \left\{bij\right\})^{-1}$ is the inverse matrix of $(I - \left\{bij\right\})$.

[3] See M. Morishima, Equilibrium, Stability, and Growth (London: Oxford University Press, 1964), p. 54.

$$O_i(t) = \sum_{j=1}^{n} O_{ij}(t) + \sum_{j=1}^{n} \frac{d}{m}{}_{ij} \left[O_j(t-1) - O_j(t-m-1)\right] + C_i(t)$$

or $$O_i(t) = \sum_{j=1}^{n} b_{ij}O_j(t) + \sum_{j=1}^{n} \frac{d}{m}{}_{ij} \left[O_j(t-1) - O_j(t-m-1)\right] + C_i(t) \qquad \text{(VI-6)}$$

The second term in the right-hand side of the equation indicates the investment demand in periods t for the output produced by sector i by the various sectors from 1 to n. $\sum_{i=1}^{n} \frac{d}{m}{}_{ij} \left[O_j(t-1) - O_j\ (t-m-1)\right]$ is then the investment demand of sector j for the products produced by the various sectors of the economy in period t. The $\frac{d}{m}{}_{ij}$ is the quantity of good i required by sector j in order to increase the latter's output by one unit -- the investment, or capital, coefficient. These n equations of the $(m+1)^{th}$ order relate the outputs in period t to those in period (t-m-1). Given initial conditions and the C's they will determine a time path of outputs.

Comparing $\sum_{i=1}^{n} \frac{d}{m}{}_{ij} \left[O_j(t-1) - O_j(t-m-1)\right]$ with the investment function reached in Chapter IV for an industry,

$$I_t^j = \frac{d^j}{m}(O_{t-1}^j - O_{t-m-1}^j)$$

which is equivalent to equation (IV-6) except the superscript, it becomes apparent that $\frac{d^j}{m} = \sum_{i=1}^{n} \frac{d}{m}{}_{ij}$. In other words, the current accelerator of an industry is the sum of the quantities of the various products produced by sectors 1 to n required by the industry in order to increase the latter's output by one unit.

In Chapter IV, investment functions of individual industries have been summed up to get the aggregate investment function of the economy as a whole, which is

$$I_t = \frac{d}{m} (O_{t-1} - O_{t-m-1}) \qquad \text{(IV-8)}$$

It has been pointed out that $\frac{d}{m}$, the current accelerator for the economy as a whole, is a weighted sum of the $\frac{d^i}{m}$'s, the current accelerator for individual industries of the economy. The problem of aggregation is involved here which, so far, has not been brought up for discussion.[4] Two conditions have to be fulfilled in order to have a constant accelerator for the economy as a whole:

(1) The investment--or capital--coefficients, i.e., the $\frac{d}{m}{}_{ij}$'s, have to be constant.

(2) There must not be any structural change in the economy, or change of the structure of the economy must be in such a way that the change in one direction in the overall accelerator for the economy resulting from a non-proportional expansion or contraction of certain industries are offset by the change in the opposite direction in the accelerator resulting from

[4]For a brief discussion of the aggregation problem see R. G. D. Allen, Mathematical Economics (London: Macmillan & Co., Ltd., 1956), chap. 20.

a non-proportional contraction or expansion of certain other industries.

That the investment coefficients $\frac{d}{m}{}_{ij}$'s are constant implies: (1) that production functions are linearly homogeneous, and (2) that relative prices do not change. In his original formulation of the input-output analysis, Leontief assumed fixed technological coefficients; that is, that substitution among factors of production was technologically impossible. However, Samuelson and others have shown that even where variation of input proportions is possible, it will never pay to change them given fixed input prices and a linearly homogeneous production function.[5] It has been argued in Chapter IV that the entrepreneur would not base his choice of basic methods of production on short-run fluctuations of relative prices. If this is the case, the investment coefficients will not be affected to any significant extent even if there are changes in relative prices.[6]

As for the effect of structural changes of the economy during the business cycle, there is not much

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[5]See Chenery and Clark, op. cit., pp. 39-42; W. J. Baumol, Economic Theory and Operations Analysis (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 2nd ed., 1965), pp. 685-686, 261-262.

[6]Cf. L. Johansen, A Multi-Sectoral Study of Economic Growth (Amsterdam: North-Holland Publishing Company, 1965), pp. 26-27.

that can be said for sure, a priori. A more than proportional expansion of a capital intensive industry causes the overall accelerator to increase, and a less than proportional expansion of such an industry causes the overall accelerator to decline. A more than proportional expansion of a labor intensive industry causes the accelerator to decline, and a less than proportional expansion of such an industry causes it to increase. The only assumption which seems reasonable and which is also adequate for the present analysis is that the structural changes of the economy which occur during the upswing of the business cycle are such that no significant effect will be exercised on the overall accelerator of the whole economy.

C. The Business Cycle in Outline

Starting from the upturn of the business cycle, the interactions of the multiplier and the accelerator will lead aggregate demand and hence national output to move upward cumulatively. The movement in the final demand sector will be transmitted throughout the intermediate sectors. As demand for final products increases, that for intermediate products increases correspondingly, and so follows demand for primary inputs. The process will continue as long as the supply of primary inputs is perfectly elastic.

As the economy approaches its full employment level, however, the supplies of more and more productive factors become increasingly inelastic. Their prices start to rise. Changes in factor prices, including profit margins, which can be considered as the price for entrepreneurial services, will affect the relative prices in the economy and the level of prices as well. With the help of an input-output table, it is possible to trace the effect of a change in factor prices in a given industry, or a group of industries, in terms of the cumulative repercussions that result when the output of one industry becomes input for another.[7]

Suppose that as output increases the price of a particular type of labor, say W_1, rises, due to an increasing inelasticity of supply, and that prices of all other factors remain unchanged. The cost of commodity 1 will rise. This will have the effect of reducing the output of the commodity, unless its income elasticity of demand is so high that the tendency of the decrease in output is offset, or more than offset, by the increase

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[7]Leontief studied the different effect on prices of an assumed 10 per cent wage rise in all non-agricultural industries, of a 10 per cent increase in all non-agricultural profit margins, of a 10 per cent rise in agricultural wage and non-wage income, and of a 10 per cent rise in business and excise tax in all taxes. In all four cases computation was made on the basis of structural relationships prevailing in American economy in 1939. W. Leontief, "Wages, Profits, Prices, and Taxes," Dun's Review, June 1947; reprinted in Input-Output Economics (New York: Oxford University Press, 1966), chap. 3. For a general discussion of prices in an input-output system, see pp. 143-145 of the same book.

in demand.

As the level of output of commodity 1 decreases, its purchases of inputs from other sectors decreases proportionally. This will have further contractionary repercussions. In the meantime, money income increases, as a result of the rise of W_1, which will have expansionary repercussions. The net effect is yet indeterminate.

As the economy proceeds in the upswing, the supply of another type of labor, say labor j, becomes more and more inelastic, resulting in an increase in W_j. This raises the cost of production for commodity j and tends to reduct its output.

The same process continues. The supplies of more and more primary production factors become increasingly inelastic. Contractionary forces accumulate until they retard the rate of expansion. The multiplier-accelerator effect turns against the upward movement. This is the downturn of the business cycle.

The increasing inelasticity of the supply of labor as a factor retarding the expansion of the economy is only one of the possibilities, perhaps the one most likely to become effective. Scarcity of other production factors, such as increasingly inelastic supply of money which raises the rate of interest, at the later stage of the upswing will have the same effect.

As the prices of productive factors increase, money national income increases, and so does the effective demand. Since the elasticities with respect to both income and prices are different for different commodities, the effect of an increase in demand on the output of different industries is different. For the commodities whose income elasticity is low, price elasticity is high, and the scarcity of the productive factors required for their production is severe, the increase in demand may be fully or partly offset by the increase in the production costs, so that their outputs do not increase or only increase slightly. For others whose income elasticity is high, price elasticity low, and the supply of production factors relatively abundant, outputs may increase more than proportionally, sustaining the upswing of the cycle. As the process continues, however, the favored industries will doubtless bid vigorously for resources. This will further raise production costs and force more and more underprivileged industries to curtail production, until a critical point comes at which the growth rate of the aggregate production starts to decline.[8]

The downswing and the upturn are opposite processes

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[8]Cf. B. G. Hickman, "Diffusion, Acceleration, and Business Cycles," American Economic Review, XLIX (Sept., 1959); reprinted in J. J. Clark and M. Cohen, Business Fluctuations, Growth and Economic Stabilization: A Reader (New York: Random House, 1963).

to the upswing and the downturn which will not be discussed in detail here.

CHAPTER VII

HISTORICAL VERIFICATIONS

It has been argued in the preceding chapters that each business cycle is a unique historical phenomenon. In spite of certain similarities, each cycle differs from others in important aspects such as duration, amplitude, and the sector or sectors which dominate the course of individual cycles.

In the United States, from December 1854 to February 1961, there were 26 cycles counted from trough to trough according to the National Bureau of Economic Research. The duration of the business cycles varied from 28 months (1919-1921) to 99 months (1870-1879) with an average of 50 months. There was a tendency toward greater uniformity in duration between 1883 and 1914, during which period all cycles were within the range of 35-46 months. Nevertheless, the length of their expansion and contraction phases differed considerably. (See Table VII-1 below).

Business cycles differ in amplitude as well as in duration. In the 25 business cycles from 1854 to 1958 in the United States, the median rise of expansions,

TABLE VII-1

DURATION OF BUSINESS CYCLE EXPANSIONS AND CONTRACTIONS IN THE UNITED STATES 1854-1961

Business Cycle				Duration of			
						Cycle	
Trough		Peak		Expansion	Contraction[a]	Trough to trough	Peak to peak
				(months)			
Dec.	1854	June	1857	30	18	48	40
Dec.	1858	Oct.	1860	22	8	30	54
June	1861	April	1865	46	32	78	50
Dec.	1867	June	1869	18	18	36	52
Dec.	1870	Oct.	1873	34	65	99	101
March	1879	March	1882	36	38	74	60
May	1885	March	1887	22	13	35	40
April	1888	July	1890	27	10	37	30
May	1891	Jan.	1893	20	17	37	35
June	1894	Dec.	1895	18	18	36	42
June	1897	June	1899	24	18	42	39
Dec.	1900	Sept.	1902	21	23	44	56
Aug.	1904	May	1907	33	13	46	32
June	1908	Jan.	1910	19	24	43	36
Jan.	1912	Jan.	1913	12	23	35	67
Dec.	1914	Aug.	1918	44	7	51	17
March	1919	Jan.	1920	10	18	28	40
July	1921	May	1923	22	14	36	41
July	1924	Oct.	1926	27	13	40	34
Nov.	1927	Aug.	1929	21	43	64	93
March	1933	May	1937	50	13	63	93
June	1938	Feb.	1945	80	8	88	45
Oct.	1945	Nov.	1948	37	11	48	56
Oct.	1949	July	1953	45	13	58	48
Aug.	1954	July	1957	35	9	44	48
April	1958	May	1960	25	9	34	34
Feb.	1961						
Averages							
26 cycles, 1854-1961				30	19	49	49[b]
10 cycles, 1919-61				35	15	50	54[c]
4 cycles, 1945-61				36	10	46	46[d]

[a]From peak on same line to trough on next line.

[b]25 cycles, 1857-1960.

[c]9 cycles, 1920-60.

[d]4 cycles, 1945-1960.

Source: U.S. Department of Commerce, Bureau of the Census, Business Connections Digest (Washington, D.C.: Government Printing Office, 1969), October, 1969, p. 112.

according to a National Bureau of Economic Research Study,[1] based on the average rise or fall in three indexes of business activity, is 18.1% (1861-1865), whereas the lowest percentage rise is 6.9 (1867-1869), and the highest 72.7 (1938-1945). Based on the median, the lowest percentage rise was only 38%, whereas the highest rise was 402%. As for the percentage decline, the median was 21.8 (1923-1924), the lowest 7.9 (1869-1870), and the highest 75.1 (1929-1933). As a percentage of the median fall, the smallest contraction was 36%, and the highest fall was 344%. These are shown in Table VII-2 below.

The differences in duration and in amplitude of business cycles are consistent with the model developed in the preceding chapters. Generally speaking, the length and intensity of an expansion are dependent upon the sustaining increase in demand in certain industries that dominate the expansion, in relation to the cost conditions of the industries. The larger and more rapid the increase in demand for the products of certain industries, and the less and slower the increase in costs of the products, the more intensive will the expansion tend to be. The more lasting is the increase in demand relative to that in costs, in the growing industries to offset

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[1]Geoffrey H. Moore, "Leading and Confirming Indicators of General Business Changes," in G. H. Moore, ed., <u>Business Cycle Indicators</u> (Princeton, N.J.: Princeton University Press, 1961), 45-109.

TABLE VII-2

AVERAGE AMPLITUDE OF RISE AND FALL IN THREE INDEXES OF BUSINESS ACTIVITY DURING TWENTY-FIVE BUSINESS CYCLES, 1854-1958

Expansions				Contractions			
Business Cycle		Average Per-centage Rise	Index (per cent of median rise)	Business Cycle		Average Per-centage Fall[a]	Index (per cent of median fall)
Trough	Peak			Peak	Trough		
Dec. 1854	June 1857	12.3	68	June 1857	Dec. 1858	21.0	96
Dec. 1858	Oct. 1860	16.8	93	Oct. 1860	June 1861	14.1	65
June 1861	Apr. 1865	18.1	100	Apr. 1865	Dec. 1867	11.4	52
Dec. 1867	June 1869	6.9	38	June 1869	Dec. 1870	7.9	36
Dec. 1870	Oct. 1873	18.4	102	Oct. 1873	Mar. 1879	26.9	123
Mar. 1879	Mar. 1882	27.6	152	Mar. 1882	May 1885	27.9	128
May 1885	Mar. 1887	22.7	125	Mar. 1887	Apr. 1888	11.2	51
Apr. 1888	July 1890	16.6	92	July 1890	May 1891	17.0	78
May 1891	Jan. 1893	16.3	90	Jan. 1893	June 1894	30.7	141
June 1894	Dec. 1895	25.3	140	Dec. 1895	June 1897	24.3	111
June 1897	June 1899	26.6	147	June 1899	Dec. 1900	14.4	66
Dec. 1900	Sep. 1902	14.2	78	Sep. 1902	Aug. 1904	14.4	66
Aug. 1904	May 1907	20.2	112	May 1907	June 1908	29.5	135
June 1908	Jan. 1910	25.6	141	Jan. 1910	Jan. 1912	12.0	55
Jan. 1912	Jan. 1913	13.6	75	Jan. 1913	Dec. 1914	23.2	106
Dec. 1914	Aug. 1918	29.8	165	Aug. 1918	Mar. 1919	22.0	101
Mar. 1919	Jan. 1920	17.9	99	Jan. 1920	July 1921	34.7	159
July 1921	May 1923	38.0	210	May 1923	July 1924	21.8	100
July 1924	Oct. 1926	17.8	98	Oct. 1926	Nov. 1927	9.3	43
Nov. 1927	Aug. 1929	16.7	92	Aug. 1929	Mar. 1933	75.1	344
Mar. 1933	May 1937	63.7	352	May 1937	June 1938	45.4	208

TABLE VII-2 (cont.)

Expansion				Contractions			
Business Cycle		Average Percentage	Index (per cent of median rise)	Business Cycle		Average Percentage	Index (per cent of median fall)
Trough	Peak	Rise		Peak	Trough	Fall[a]	
June 1938	Feb. 1945	72.7	402	Feb. 1945	Oct. 1945	41.0	188
Oct. 1945	Nov. 1948	14.7	81	Nov. 1948	Oct. 1949	17.5	80
Oct. 1949	July 1953	23.9	132	July 1953	Aug. 1954	14.3	66
Aug. 1954	July 1957	13.9	77	July 1957	Apr. 1958	22.7	104
Median rise, 1854-1957		18.1	100	Median fall, 1857-1958		21.8	100

Source: G. H. Moore, <u>op. cit.</u>, 104.

Since 1879, the figures are averages based on three trend-adjusted indexes: American Telephone and Telegraph Company index of business activity, index of industrial production and trade constructed by Warren M. Persons and continued by Barron's Publishing Company, and Ayres' index of business activity compiled by the Cleveland Trust Company. Before 1879, the entries are for Ayres' index alone.

the decline in others, the longer will be the duration of the expansion.[2]

Increases in demand for the products of certain industries cause prices of their production to rise. Since an increase in costs will lag behind for a period of time and may actually fall in certain cases due to more fully utilization of the existing fixed equipment, profit margins of these industries therefore increase. The increase in profit margins encourages existing firms to expand their production and will induce new firms to enter when the profit margins are above a certain level. As the expansion accumulates, demand for the products of more and more industries increases, and so follow prices of the products and their profit margins.

However, at later stages of the expansion, when factor prices start to rise, which raises costs of production to different extends for different industries, and when increases in the demands for the products of more and more industries stop, or slow down, profit margins for certain industries begin to decline. Some

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[2]Geoffrey H. Moore points out that there is a certain relationship between the decline during a business contraction and the rise during the succeeding expansion--a severe contraction is very often followed by a vigorous expansion. (See Moore, op. cit., 90-92.) This is understandable because at the end of a severe contraction there are more unused resources ready for employment, which would enable the expansion to go further without causing costs of production to increase than the case when the expansion starts from the end of a moderate contraction.

of the firms in these industries withdraw while others will reduce their level of output. This will have a contractionary effect on the general expansion of the economy. The number of industries with improving profits decreases, while the number of industries with declining profits increases. But the economy will remain expanding so long as the contractionary effect of certain industries is offset by the expansionary effect of others.

By using the quarterly data on profits of individual companies compiled by the National City Bank of New York in conjunction with some additional data collected by Harold Barger, Thor Hultgren studies the cyclical diversities in the fortunes of industrial corporations and arrives at essentially the same result concerning the cyclical behavior of profits.[3] The data cover the period from the first quarter of 1920 to the fourth quarter of 1938, consisting of three cycles. Hultgren finds,

> "When economic activity at large begins to rise, the number of companies with improving profits is rising and continues to rise during the earlier stages of the business expansion. Long before the decline in economic activity at large, however, the number of companies with improving profits begins to diminish. The fall in the number continues to the end of the expansion in business and on into the earlier stages of the following contraction. Long before economic activities revive,

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[3]Thor Hultgren, "Cyclical Diversities in the Fortunes of Industrial Corporations," in Geoffrey H. Moore, op. cit., 325-385.

> however, the number of companies with growing profits again begins to increase."[4]

Hultgren also finds,

> "Although numerous companies experienced declining profits while business activity was still in its ascendant phase, the aggregate profits of all the companies studied continue to grow practically up to the end of the business expansion. . . . In contraction, similarly, aggregate profits diminished up to the end, even though a gradually increasing number of companies were becoming more prosperous."[5]

In a more recent study by Hultgren, based on data of fifteen manufacturing industries in the United States, 1947-61, more information concerning cyclical relations among cost, prices, and profits is revealed.[6] The fifteen manufacturing industries are food and beverages, tobacco, textiles, apparel, lumber and products, paper and products, chemicals, petroleum refining, rubber, leather and products, stone, clay, glass, primary metals, fabricated metals, machinery, and electric equipment.[7] Total sales of the fifteen industries under review constituted approximately 80 percent of that of all manufacturing.[8]

In this study Hultgren discovers that while there

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[4] Moore, op. cit., 329.

[5] Ibid., p. 334.

[6] Thor Hultgren, Cost, Prices, and Profits: Their Cyclical Relations (New York: Columbia University Press, 1965).

[7] Ibid., p. 15. Table 4.

[8] Ibid., pp. 189-191. Table 13-1.

are tendencies for both prices and costs to increase over time, the frequency of price increases rises steadily from the first to the last segment of expansion and decreases steadily from the first to the last segment of contraction. The frequency of cost increases rises steadily in expansions, lasts into the first two segments of contraction, and then gradually declines. Since in both frequency and percentage change costs increase more than do prices after the early stages of the expansion, the percentage of observations indicating rise in profit margins starts to decline at an early stage of expansions. These are shown in Table VII-3.

Hultgren's new work reconfirms what he has found in the previous study cited above that aggregated profits continue to grow until the end of the expansion despite the decline in profit margins in an increasing number of firms and that aggregate profits diminish up to the end of the contraction, even though an increasing number of firms are becoming prosperous. These can be seen from Table VII-4. The table covers four full contractions and three full expansions. In the 1949-53 expansion of sales, the profit margins followed a rise-fall-rise pattern from stage to stage. In 1954-57 and 1958-60 expansions it followed a rise-fall pattern. This is the most common pattern in sales expansions.[9] In the

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[9] Ibid., p. 87. Table 46.

TABLE VII-3

PRICES, COST PER UNIT, AND PROFIT MARGINS: DIRECTION OF CHANGE FROM STAGE TO STAGE OF CYCLES IN QUANTITY SOLD, FIFTEEN MANUFACTURING INDUSTRIES, 1947-61

From Stage	To Stage	Number of Observations	Percent of Observation Indicating Rise: Prices	Percent of Observation Indicating Rise: Cost Per Unit	Percent of Observation Indicating Rise: Profit Margins	Median Percentage Change In: Prices	Median Percentage Change In: Cost Per Unit
I	II	46	41	22	65	-0.3	-1.2
II	III	46	63	39	80	0.6	-0.2
III	IV	46	74	67	57	0.8	0.8
IV	V	46	80	74	50	0.4	0.7
V	VI	40	85	85	50	1.5	2.0
VI	VII	40	78	90	20	0.8	2.0
VII	VIII	40	45	65	18	-0.1	0.4
VIII	IX	40	35	45	30	-0.2	-0.2
I	V	48	73	56	79	2.4	0.9
V	IX	60	70	90	5	1.1	3.9

Source: Thor Hultgren, op. cit., Tables 10, 14, and 43 on pp. 25, 27, and 80 respectively.

Note: Concerning the division of the cycle into stages, see Werley C. Mitchell, What Happens During Business Cycles (New York: Columbia University Press, 1951), p. 14. Each cycle is divided into nine stages. Stage I includes three months centered on the initial trough, stages V three months centered on the peak, and stage IX three months on the terminal trough. The phase of expansion between stages I and V is divided into thirds, which constitute stages II, III, and IV. The contraction phase is similarly divided into stages VI, VII, and VIII.

TABLE VII-4

SALES, MARGINS, AND PROFITS: AVERAGES FOR STAGES OF SALES CYCLES, ALL MANUFACTURING INDUSTRIES, 1947-61

Stage of Cycle in Sales	First Quarter Included	Sales (million dollars)	Margins (per cent of sales)	Profits (million dollars)
V	3Q 1948	50,346	10.0	5,035
VI	4Q 1948	49,799	9.9	4,930
VII	1Q 1949	47,202	8.2	3,875
VIII	3Q 1949	46,444	8.5	3,948
IX / I	4Q 1949	44,664	8.3	3,707
II	1Q 1950	54,399	11.6	6,390
III	1Q 1951	63,558	10.9	6,919
IV	2Q 1952	66,312	9.2	6,073
V	2Q 1953	70,446	10.0	7,045
a	3Q 1953	70,334	9.7	6,822
a	4Q 1953	65,823	7.1	4,673
IX / I	1Q 1954	63,942	8.2	5,243
II	2Q 1954	65,670	8.8	5,806
III	2Q 1955	74,169	10.3	7,654
IV	3Q 1956	79,038	9.4	7,431
V	3Q 1957	82,084	8.7	7,141
a	4Q 1957	77,803	7.6	5,913
IX / I	1Q 1958	73,071	6.5	4,750
II	2Q 1958	77,096	7.7	5,930
III	1Q 1959	84,741	9.1	7,746
IV	4Q 1959	85,580	8.3	7,108
V	3Q 1960	87,478	7.7	6,[illegible]36
a	4Q 1960	84,785	7.0	5,935
IX	1Q 1961	83,258	6.6	5,495

[a]Contraction too short for division into five stages. Full quarterly detail shown instead.

Source: Thor Hultgren, op. cit., Table 49 on p. 94.

contraction of 1948-49 there was a fall-rise-fall, fall-rise in 1953-54, and a fall in 1957-58 and 1960-61. This verifies the proposition developed in previous chapters that profit (margins) start to decline sooner or later as the economy expands as a result of costs increasing more rapidly than demand.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The common feature of most business cycle theories is their macroscopic approach, i.e., to use concepts of broad averages and aggregates of a collective nature, such as total output, national income, total employment, money supply, and the general price level. However, relations among aggregates are the result of many decisions by individual units of the economy. The present study goes behind the macro-relations, to see how individual decisions lead to stable relations in aggregates--if they do so at all.

The study started with a review of the acceleration principle in conventional terms and the business cycle theory of J. R. Hicks. Hicks' theory was shown to be based on: (1) the assumption of interactions between the accelerator and the multiplier, which account for the cumulative process of the cycle, and (2) the concepts of the full employment ceiling and the floor, which explain the upper and the lower turning point of the cycle.

Hicks' theory has been criticized on two basic points. First, it was argued that the acceleration principle is a crude and unsuitable analytical tool that is not consistent with the rational behavior of individual firms. Second, the use of the concept of the ceiling is crucial but unrealistic. In the real world, a full employment ceiling in the sense that all resources are fully utilized has never been reached. The actual rate of growth begins to decline well before the ceiling is reached. As for the lower turning point of the cycle, the recovery of the economy does not wait until the floor is reached either.

In fact, all difficulties in Hicks' theory stem from the use of the conventional acceleration principle. If the concept is reformulated in terms of price-cost relationship, many of the weak points in Hicks will be avoided, and the business cycle theory based on the acceleration principle will have a more solid micro-economic foundation. The attempt was made to do this.

Starting with the firm, the study considered the accelerator as the normal capital-output ratio in the Marshallian long-run equilibrium, and modified the acceleration principle in terms of the price-cost relationships. The following conclusions concerning investment behavior of the firm were drawn:

(1) Given relative factor prices, the acceleration principle, which maintains that investment is a

function of the rate of change in output, holds if the production function of the firm is homogeneous of degree one. If the production function is homogeneous of degree greater than one, less proportional changes in capital will be required as the demand for, and production of, the product changes. The required increase in capital will be more than proportional if the production function is homogeneous of degree less than one.

(2) Short-run fluctuations of relative prices of factors of production will not affect the method of production that is actually adopted by the entrepreneur to a significant extent.

(3) Increases in resource prices at a later stage of an expansion tend to reduce output and, therefore, the demand for additional capital.

It was assumed that all firms in the economy have a production function which is homogeneous of degree one, and that there is no structural change in the economy, or that changes of the structure of the economy are in such a way that they offset each other in their effect on the overall accelerator. It was further assumed that the investment period consists of m income periods. Then the investment function for the firm was extended to the economy as a whole to obtain a distributed lag investment function:

$$I = \frac{a}{m}(Y_{t-1} - Y_{t-m-1})$$

where a/m is the current accelerator.

Assume $C_t = (1-s)Y_{t-1}$

and $Y_t = C_t + I_t$

then $Y_t = (1-s)Y_{t-1} + \frac{a}{m}(Y_{t-1} - Y_{t-m-1})$

This is a homogeneous difference equation of the $(m+1)^{th}$ order with constant coefficients.

Following Hicks, the study accepted the proposition that the accelerator, the marginal propensity to save, and the lags are of such magnitudes that an explosive process of Y, i.e., national income, will be generated, if the process is without any check.

Technical progress, by improving productivities of factors of production, has the effect of pushing potential production capacity (the ceiling) upward, and gives the business cycle an upward trend.

The downturn of the business cycle is brought about by the relative increases in costs with respect to prices, which squeeze the profit margins at later stages of the expansion. This is mainly due to the increasing inelasticity of the supplies of some, and eventually, all factors of production, as the upswing gets beyond a certain point. The decline of the income elasticities of demand as a result of income increases, which slows down or stops the increase in demand for various commodities, also plays a part in the downturn of the business cycle.

The upturn of the cycle can be explained by the successive approach to their respective "floors" of various industries, which alleviates the cumulative momentum of the downswing, and checks the fall in national income. In addition, there are three forces which help the economy regain its power in moving upward. They are: (1) technical progress which makes obsolescent old capital and encourages investment in new capital; (2) the growth of population which tends to raise the marginal propensity to consume, causing a given level of investment to generate a larger amount of national income; and (3) an increase in the supply elasticity of resources and a decrease in resource prices which shift the cost curves downward.

The forces are first felt in certain, and then gradually in more and more, industries. Their overall effect on the economy as a whole can be, and has been in the present paper, traced out with the help of input-output analysis.

Finally, the validity of the model developed in the paper was tested by reference to historical data from two studies by T. Hultgren of National Bureau of Economic Research. Hultgren's studies reveal that while there are tendencies for both prices and costs to increase over time, the frequency of price increases rises steadily from the first to the last segment of expansion and decreases steadily from the first to the last segment of contraction. The frequency of cost increases rises steadily in expansions, last into the first two segments of contraction, and then gradually declines. Since in both frequency and percentage change costs increase more than do prices after early stages of expansion, the percentage of observations indicating rise in profit margins starts to decline at an early stage of expansion. This verifies the proposition that the relative increase in costs with respect to prices which squeezes the profit margins at later stages of expansion causes the economy to decline.

BIBLIOGRAPHY

Books

Ackley, G. Macroeconomic Theory. New York: Macmillan Company, 1961.

Allen, R. G. D. Macroeconomic Theory. New York: St. Martin's Press, 1967.

_______. Mathematical Economics. London: Macmillan Company, 1956.

Baumol, W. J. Economic Dynamics. New York: Macmillan Company, 1957.

_______. Economic Theory and Operations Analysis. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 2nd ed., 1965.

Blaug, M. Economic Theory in Retrospect. Homewood, Ill.: Richard D. Irwin, Inc., 1962.

Bober, S. The Economics of Cycles and Growth. New York: John Wiley & Sons, Inc., 1968.

Braff, G. J. Microeconomic Analysis. New York: John Wiley & Sons, Inc., 1969.

Burns, A. F. The Business Cycle in a Changing World. New York: Columbia University Press, 1969.

Chenery, H. B. and Clark, P. G. Interindustry Economics. New York: John Wiley & Sons, Inc., 1959.

Clark, J. J. and Cohen, M. Business Fluctuations, Growth and Economic Stabilization: A Reader. New York: Random House, 1963.

Croxton, F. E. and Cowden, D. J. Applied General Statistics. Englewood Cliffs, N. J.: Prentice-Hall, Inc., 2nd ed., 1955.

Dewey, D. Modern Capital Theory. New York: Columbia University Press, 1965.

Domar, E. D. Essays in the Theory of Economic Growth. New York: Oxford University Press, 1957.

Duesenberry, J. S. Business Cycle and Economic Growth. New York: McGraw-Hill Book Company, 1958.

Fellner, W. J. Trends and Cycles in Economic Activities. New York: Holt, Rinehart, and Winston, Inc., 1956.

Ferber, R. (ed.) Determinants of Investment Behavior. New York: Columbia University Press, 1967.

Ferguson, C. E. Microeconomic Theory. Homewood, Ill.: Richard D. Irwin, Inc., revised ed., 1969.

Gordon, R. A. Business Fluctuations. New York: Harper & Brothers, Publishers, 2nd ed., 1961.

Haberler, G. Prosperity and Depression. New York: Atheneum Publishers, 4th ed., paper back, 1963.

________, (ed.) Readings in Business Cycle Theory. Homewood, Ill.: Richard D. Irwin, Inc., 1951.

Hamberg, D. Business Cycles. New York: Macmillan Company, 1951.

________. Economic Growth and Instability. New York: W. W. Norton & Company, Inc., 1956.

Hansen, A. H. Business Cycles and National Income. New York: W. W. Norton & Company, Inc., expanded ed., 1964.

________. Fiscal Policy and Business Cycles. New York: W. W. Norton & Company, Inc., 1941.

________ and Clemence, R. V. (ed.) Readings in Business Cycles and National Income. New York: W. W. Norton & Company, Inc., 1953.

Harrod, R. F. The Trade Cycle. London: Oxford University Press, 1936.

________. Toward a Dynamic Economics. London: Macmillan Company, 1948.

Hayek, F. A. Prices and Production. London: George Routledge & Sons, Ltd., 1931.

_______. Profits, Interest, and Investment. London: George Routledge & Sons, Ltd., 1939.

_______. The Pure Theory of Capital. Chicago: The University of Chicago Press, 1950.

Henderson, J. M. and Quandt, R. E. Microeconomic Theory. New York: McGraw-Hill Book Company, 1958.

Hibdon, J. E. Price and Welfare Theory. New York: McGraw-Hill Book Company, 1969.

Hicks, J. R. A Contribution to the Theory of the Trade Cycle. London: Oxford University Press, 1950.

Hultgren, T. Cost, Prices, and Profits: Their Cyclical Relations. New York: Columbia University Press, 1965.

Johansen, L. A Multi-Sectoral Study of Economic Growth. Amsterdam: North-Holland Publishing Co., 1965.

Kaldor, N. Essays on Economic Stability and Growth. London: Gerald Duckworth & Co., 1960.

Kalecki, M. Theory of Economic Dynamics. London: George Allen and Unwin, 1954.

Keynes, J. M. The General Theory of Employment, Interest and Money. London: Macmillan Company, 1936.

Klein, L. R. Economic Fluctuations in the United States, 1921-1941. New York: John Wiley & Sons, Inc., 1950.

_______. The Keynesian Revolution. New York: Macmillan Company, 2nd ed., 1966.

_______ and Goldberger, A. S. An Econometric Model of the United States 1929-1952. Amsterdam: North-Holland Publishing Co., 1955.

_______ and Gordon, R. A. Readings in Business Cycles. Homewood, Ill.: Richard D. Irwin, Inc., 1965.

Kuznets, S. Modern Growth Theory. New Haven: Yale University Press, 1966.

Lancaster, K. Introduction to Modern Microeconomics. Chicago: Rand McNally & Company, 1969.

Lee, M. W. Macroeconomics: Fluctuations, Growth, and Stability. Homewood, Ill.: Richard D. Irwin, Inc., 4th ed., 1967.

Leontief, W. Input-Output Economics. New York: Oxford University Press, 1966.

Lerner, A. P. The Economics of Control. New York: Macmillan Company, 1944.

Lloyd, C. Microeconomic Analysis. Homewood, Ill.: Richard D. Irwin, Inc., 1967.

Lundberg, E. and Knox, A. D. (ed.) The Business Cycles in the Post-War World. New York: St. Martin's Press, 1955.

Lutz, F. A. (ed.) The Theory of Capital. New York: St. Martin's Press, 1961.

_______ and Mints, L. W. (ed.) Readings in Monetary Theory. Philadelphia: Blakiston Company, 1951.

Malanos, G. Intermediate Price Theory. Chicago: J. B. Lippincott Company, 1962.

Matthews, R. C. O. The Trade Cycle. Welwyn, Herts., England: James Nisbet & Co., Ltd., 1959.

Miernyk, W. H. The Elements of Input-Output Analysis. New York: Random House, 1965.

Mitchell, W. C. Business Cycles and Their Causes. Berkeley: University of California Press, 1950.

_______. What Happens During Business Cycles. New York: Columbia University Press, 1951.

Moore, G. H. (ed.) Business Cycle Indicators. 2 vols. vol. I Contributions to the Analysis of Current Business Conditions; vol. II Basic Data on Cyclical Indicators. Princeton, N. J.: Princeton University Press, 1961.

Morishima, M. Equilibrium, Stability and Growth, A Multi-Sectoral Analysis. London: Oxford University Press, 1964.

Mueller, M. G. (ed.) Readings in Macroeconomics. New York: Holt, Rinehart and Winston, Inc., 1966.

Peterson, W. C. Income, Employment and Economic Growth. New York: W. W. Norton & Company, Inc., 1962.

Schumpeter, J. A. Business Cycles. New York: McGraw-Hill Book Company, 1939.

________. The Theory of Economic Development. Cambridge, Mass.: Harvard University Press, 1936.

Scitovsky, T. Welfare and Competition. Homewood, Ill.: Richard D. Irwin, Inc., 1951.

Watson, D. S. Price Theory and Its Uses. Boston: Houghton Mifflin Company, 2nd ed., 1968.

Williams, H. R. and Huffnagle, J. D. Macroeconomic Theory: Selected Readings. New York: Meredith Corporation, 1969.

Winding, P. Some Aspects of the Acceleration Principle. Amsterdam: North-Holland Publishing Co., 1957.

Articles

Alexander, S. S. "The Accelerator as a Generator of Steady Growth," Quarterly Journal of Economics, LXIII (May, 1949), 174-97.

________. "Issues of Business Cycle Theory Raised by Mr. Hicks," American Economic Review, XLI (December, 1951), 861-78.

________. "Mr. Harrod's Dynamic Model," Economic Journal, LX (December, 1950), 724-39.

Baumol, W. J. "Acceleration without Magnification," American Economic Review, XLVI (June, 1956), 409-12.

________. "Some Notes on Dynamic Models," Economic Journal, LVIII (December, 1948), 506-21.

Bronfenbrenner, M. and Holzman, F. D. "A Survey of Inflation Theory," American Economic Review, LIII (September, 1963), 593-661.

Burns, A. F. "Hicks on the Real Cycle," Journal of Political Economy, LX (February, 1952), 1-24.

Clark, J. M. "Business Acceleration and the Law of Demand: A Technical Factor in Economic Cycle," Journal of Political Economy, XXV (March, 1917), 217-235.

Chenery, H. B. "Overcapacity and the Acceleration Principle," Econometrica, XX (January, 1952), 1-28.

Duesenberry, J. S. "Hicks on the Trade Cycle," Quarterly Journal of Economics, LXIV (August, 1950), 464-76.

Eckaus, R. S. "The Acceleration Principle Reconsidered," Quarterly Journal of Economics, LXVII (May, 1953), 209-30.

Eisner, R. "A Distributed Lag Investment Function," Econometrica, XXVIII (January, 1960), 1-29.

________. "Investment: Fact and Fancy," American Economic Review, LIII (May, 1963), 237-46.

Goodwin, R. M. "A Non-Linear Theory of the Cycle," Review of Economics and Statistics, XXXII (November, 1950), 316-20.

Harrod, R. F. "An Essay in Dynamic Theory," Economic Journal, XLIX (March, 1939), 14-33.

________. "Domar on Dynamic Economics," Economic Journal, LXIX (September, 1959), 451-64.

________. "Notes on Trade Cycle Theory," Economic Journal, LXI (June, 1951), 261-75.

Hickman, B. G. "Diffusion, Acceleration, and Business Cycles," American Economic Review, XLIX (September, 1959), 535-65.

Kaldor, N. "A Model of the Trade Cycle," Economic Journal, L (March, 1940), 78-92.

________. "Capital Intensity and the Trade Cycle," Economica, new series, VI (February, 1939), 40-66.

________. "Hicks on the Trade Cycle Theory," Economic Journal, LXI (December, 1951), 833-47.

________. "Professor Hayek and the Concertina Effect," Economica, new series, IX (November, 1942), 359-82.

Knox, A. D. "The Acceleration Principle and the Theory of Investment: A Survey," Economica, new series, XIX (August, 1952), 269-97.

Koopmans, T. C. "Measurement without Theory," Review of Economic Statistics, XXIX (August, 1947), 161-72.

Liebhafsky, H. H. "Diminishing Returns and Linear Homogeneity: Comment," American Economic Review, LIV (June, 1964), 739-44.

Nutter, G. W. "Diminishing Returns and Linear Homogeneity: Reply," American Economic Review, LIV (June, 1964), 751-53.

Rostow, W. W. "Some Notes on Mr. Hicks and History," American Economic Review, XLI (June, 1951), 316-24.

Rowe, J. W., Jr. "Diminishing Returns and Linear Homogeneity: Comment," American Economic Review, LIV (June, 1964), 745-46.

Samuelson, P. A. "Interaction between the Multiplier Analysis and the Principle of Acceleration," Review of Economic Statistics, XXI (May, 1939), 75-78.

Sato, R. "Diminishing Returns and Linear Homogeneity: Comment," American Economic Review, LIV (June, 1964), 744-45.

Solow, R. M. "Technical Change and the Aggregate Production Function," Review of Economics and Statistics, XXXIX (August, 1957), 312-20.

Tinbergen, J. "Statistical Evidence on the Acceleration Principle," Economica, new series, V (May, 1938), 164-76.

Tsiang, S. C. "Acceleration, Theory of the Firm and the Business Cycle," Quarterly Journal of Economics, LXV (August, 1951), 325-41.

Witte, J. G., Jr. "The Microfundation of the Social Investment Function," Journal of Political Economy, LXXI (October, 1963), 441-56.