A SURVEY OF RECENT CONTRIBUTIONS TO
THE THEORY OF ECONOMIC GROWTH
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THEORY OF ECONOMIC GROWTH

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Note: Professor Bruton is regularly a member of the Economics Department at Yale but has been spending the 1955-56 academic year as a Visiting Fellow at the Center for International Studies. This paper is a preliminary version of a paper he will present during a two-month summer seminar on "Doctrines of Economic Growth" to be held at Hanover, New Hampshire under the sponsorship of the Social Science Research Council. The paper, all parts of which are subject to possible elaboration and modification, is designed to be included in a larger work by several authors on the history of the theory of economic growth.

Center for International Studies
Massachusetts Institute of Technology
Cambridge, Massachusetts
April 1956
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Introduction

There is no body of thought or set of principles that may confidently be called the "modern theory of economic growth." Current and recent literature abound with seminal ideas, revealing insights, penetrating bits and pieces of analysis, loose ends, and unrealistic assumptions. There are elegant and rigorous models concerned with explaining a very narrowly conceived phenomenon; there are general discussions that introduce in an ambiguous, imprecise fashion all factors that may conceivably have any relation to the economic process; and there are contributions of all points between these extremes. Correspondingly there are writers who believe that all a theory of economic growth can hope to achieve is the establishment of a general framework consisting of a number of general propositions held together by intuition and ad hoc theorizing, and there are those who feel it may be possible to devise a theory of growth comparable in elegance and precision to (say) the modern short-run theory of income determination.

Despite this characterization of the state of and thinking about theorizing on economic growth, an essay purporting to report on this theorizing must have some kind of order. To establish this order however it is necessary to take a particular point of view as to the scope of growth theory, and then to try to make a cohesive and unified theory of the thought falling within this arbitrarily delimited area.
This introductory section is devoted to this delimiting process and to establishing the point of view from which we shall examine current thinking on our subject.

Modern concern with problems of growth cannot be attributed to a building up of a received body of thought which in recent years required as its next layer of bricks a long run theory. Rather current interest in the problems involved in explaining the behavior of an economy over an extended period results from two major events that have characterized the world economy since 1920.

In the first place, evidence accumulated that led many economists to believe that the Western European countries and the United States had reached a state of maturity such that large scale unemployment was a chronic problem rather than a periodic nuisance. Keynes' General Theory may be considered to a very significant degree to constitute a theoretical explanation of the proposition that it is possible for an economy to run down and to be unable to generate a sufficiently high level of activity to avoid involuntary unemployment. Thus although Keynes' theory is 'static and short-run,' it was explaining a phenomenon that had numerous long-run implications. Therefore the effort to 'dynamize Keynes' led to an interest in the formal properties of a growth theory.
Out of this awareness and out of the great difficulties created for these so-called underdeveloped countries by the depressed conditions of the 1930's and World War II grew a demand for programs and policies that would improve the economic well-being of the population of such countries. To formulate such programs and policies requires an understanding of the processes of economic growth, which is to say a theory of economic growth.

Despite this distinction between the growth process in mature countries and in underdeveloped countries in accounting for the origin of current thinking on the subject, we feel this distinction to be irrelevant insofar as theorizing about growth is concerned. A theory of economic change should proceed from a general definition of an economic system which is presumably the same for all countries (and for all writers), and then to explain how this system behaves over a reasonably long period of calendar time. Certain aspects may be isolated for study, or certain aggregations may be performed in order to direct the spotlight on what is held to be strategic in a particular situation at a given time. And in one country it may be useful to concentrate on one way of looking at the growth process while at another time or place it may be helpful to look at another part of the system, but any such incomplete or partial inquiries must be consistent with the larger, more general theory of which it is a part and which is applicable to all growing economies. Then by a deepening, widening,
or disaggregating process it should be found that all partial and/or aggregative theories resolve themselves into a consistent general formulation. 2

We propose therefore to examine modern growth theory in the following way: We begin with the simplest and most formal theory available—the capital stock adjustment theory associated with the names Harrod and Domar—and then step by step deepen, widen, and disaggregate in an effort to bring into the analysis the arguments and hypotheses of as many contemporary writers as seems warranted. Each section will therefore be an extension in one way or another of the theory described in the first section. We maintain the formal framework of the Harrod-Domar analysis throughout. This will not only provide a theme to hold our essay together, but has the merit of showing how the various components isolated and emphasized by the several authors fit together (or do not fit together) and act on each other.

As the length of the paper must be finite we solve several difficult problems by simple fiat.

In the first place we concentrate on the behavior of per capita real income. This means that we define the key problem of a theory of growth as that of explaining the time path of per capita income.

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2 We thus rule out discussion of the problems of the so-called underdeveloped countries as such. Of course the statement in the text does not mean that the "structural parameters" (e.g., the marginal propensity to consume) are the same for all countries, but it does mean that all countries have such parameters.
over a long period of time, say not less than a century. Per capita income is chosen as the main criterion of growth for two simple reasons: one, virtually all writers direct attention to this variable, and two, despite some obvious weaknesses in its use, there does not seem to be a practical alternative. 3

Secondly, it is necessary to take an explicit position with respect to short-run fluctuations. In discussions of short-run phenomena most authors assume that it is possible to ignore the slower changes going on in the economy. In an analysis of long-run growth, these slower changes must of course be examined and worked into the explanatory system; but then what about the short-run fluctuations—frequently called cycles—can they be ignored? It is evident that the long-run behavior of an economy is not at all independent of what happens in the short run, but the nature of such interdependence is far from clear and no simple assumption seems to be appropriate from all points of view. However it is possible to recognize the interdependence of cyclical fluctuations and longer-run phenomena and at the same time concentrate attention on the latter, and consider the former only in terms of how it affects the behavior of the system over a long period of time without giving a detailed examination of the modus operandi of the cycle itself. This is the procedure followed in this essay. 4

3 A strong opponent of the use of income as a gauge of economic growth is S. Herbert Frankel, Economic Impact on Underdeveloped Societies (Cambridge: Harvard University Press, 1953), especially Essay III.

4 Some such procedure is implied in much of the literature. Perhaps the best discussion is in William Fellner, Trends and Cycles in Economic
We therefore rule out discussion of the formal properties of the several types of cycle models that are currently extant, but we do recognize that the growth process is likely to generate fluctuations and these fluctuations in turn act on the growth process. We seek then to introduce into our analysis of the determinants of growth the effect of this fact of interdependence on these determinants and hence, to some extent at least, on the long run behavior of the economy itself.

Thirdly, we assume that the behavior of the money supply offers no problem in the growth process. 5

Finally, except for minor deviations, the discussion is limited to a closed economy and no effort is made to consider the role of the government. Omitting the international sector seems justified in light of the limited extent to which international relations have been


introduced into the formal theories of economic growth. We exclude the government from our discussion simply because the existing tools of economic analysis do not constitute effective methods of analyzing governmental economic endeavor.

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I. The Aggregative Capital Stock Adjustment Theory

By limiting his analysis to the short-run, Keynes was able to impound into ceteris paribus all phenomena and characteristics of an economy that change more slowly than the immediate determinants of income. The short-run mechanism is assumed to work itself out in a setting in which capital stock, technology, market structure, saving habits, social and cultural environment, population, etc., remain unchanged. With all these as given, the problem was to determine the equilibrium level of income.

It is possible by a comparative static technique to examine the effect on the equilibrium level of income of a once and for all change in any of the occupants of the ceteris paribus pound. And this has of course been done. For example much attention has been given to the effect of changes in income distribution on the consumption-income relationship, and the effect of a change in the extent of monopoly on the rate of investment. But such changes in these "underlying" or "basic" characteristics are exogenous to the equilibrium conditions of the "static" Keynesian model. This statement is true or approximately true with respect to each member of the group in the preceding paragraph, except one, capital stock. By the
way, the short-run system is established, if there is not positive saving, there is also not positive investment, and if there is not positive investment the capital stock must be changing. Thus the capital stock—surely a relevant determinant of the level of income—is not exogenous to the short-run mechanism, but changes in a way directly dependent upon how that mechanism works. The first effort to extend Keynesian short-run theory into a growth problem therefore was essentially to examine the effects of changes in the capital stock on the behavior of income.7

Since it is capital stock that is changed by saving, it appears reasonable to define equilibrium in such a manner that it involves the capital stock. Keynesian equilibrium requires the equality between desired savings and desired investment, while the growth form of the model requires for equilibrium the continuing maintenance of the desired ratio between capital stock and the rate of output. It is convenient and helpful to label this kind of theory the capital stock adjustment theory.8


The capital stock adjustment theory may be written in a variety of ways, but we may content ourselves with a single, simple form. It was stated above that the central proposition of this theory is the explicit recognition that investment is capacity creating as well as income generating; it is therefore useful to develop the capacity effect and the demand effect separately and then equate them to show the requirements for equilibrium.

The supply equations may be written in the following way: let $0_t$ be the equilibrium rate of output during period $t$; let $k_t$ be the capital stock available to the system during period $t$; and let $k$ be the optimal relationship between capital and output, a technological constant.

Therefore

$$O_t = \frac{1}{k} K_t$$

and

$$O_t - O_{t-1} = \frac{1}{k} (K_t - K_{t-1}) = \frac{1}{k} I_{t-1}$$

where $I_{t-1}$ is investment during the $t-1$ period that becomes producing capital in the $t^{th}$ period. Then

$$\frac{O_t - O_{t-1}}{O_{t-1}} = \frac{I_{t-1}}{O_{t-1}} = \frac{V}{k}$$

where $V$ is the ratio of net investment to capacity output in the

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9 D Hamberg. Economic Growth and Instability (New York: Norton and Company, 1956) discusses the numerous forms the theory may take and the implications of these several forms. Professor Hamberg also has extensive references to the literature on this general body of theory. The reader interested primarily in exploring the details of the Harrod-Domar model should consult the Hamberg volume; our problem is something else. In particular it might be noted that much depends upon the pattern of lags that is assumed.
previous period. Equation 1 states that capacity will grow at a constant percentage rate determined by the productivity of the additions to capital stock, \( k \), and the proportion of the capacity devoted to the creation of new capital.

For the effect of investment on demand we need an equation for consumption expenditures and one for investment expenditures. Maintaining simplicity, we may write consumption as a function \( -1 - s \), where \( s \) is average and marginal propensity to save -- of current income, and investment as a function \( - b \) -- of the change in income over the immediately preceding periods, all in constant prices. Thus

\[
C_t = (1 - s) Y_t
\]

and

\[
I_t = b (Y_t - Y_{t-1})
\]

then

\[
Y_t = (1 - s) Y_t + b (Y_t - Y_{t-1})
\]

and by simple algebraic manipulation

\[
\frac{Y_t - Y_{t-1}}{Y_{t-1}} = \frac{s}{b - s}
\]

Equation 3 asserts that income will grow at a constant percentage rate determined by the propensity to save and the extent to which changes in income induce investment.

Assume that in period 0 equilibrium prevails, i.e., \( Q_0 = Y_0 \); equilibrium growth requires that \( \frac{\nu}{K} = \frac{s}{b - s} \). If \( Q_0 = Y_0 \) then, since total saving equals total investment and the saving-income ratio
is assumed constant, \( v \) must equal \( s \), and the achievement of equilibrium growth depends upon the equality \( k = b - s \). Under these assumptions as to relationships and (especially) as to lags \( b \) must exceed \( k \) by the amount of the saving ratio. For this reason and for others to be discussed later it is of considerable importance to distinguish carefully between \( k \), a supply parameter, and \( b \), a demand parameter.\(^{10}\)

Given these assumptions the economy can achieve equilibrium growth, but if \( k \), \( b \), and \( s \) are constants the equilibrium path is unstable in the sense that deviations from path are not self correcting. Suppose the system is growing smoothly \( (b = k + s) \) but, because of a shock of some sort, income suddenly fails to grow at the required rate and excess capacity appears. Entrepreneurs\(^{11}\) will seek to reduce their capital stock by reducing investment, but a reduction in investment leads to further reductions in income and the desired ratio between capital and output cannot be achieved. If income happens to grow faster than expected, entrepreneurs finding themselves shy of capital seek to add to their capital stock but this act leads to further increases in income, and the capital-output ratio remains less than optimum. Since the theory of growth just described does not tell us

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\(^{11}\) We will use the word entrepreneur in a very general sense to mean those responsible for making decisions as to investment projects and innovations.
what happens when equilibrium is disturbed, it cannot explain the
time path of per capita income without further elaboration. As we
have assumed that the purpose of a theory of economic growth is to
explain the time path of per capita income, it is necessary to introduce
some hypotheses that either stabilize the equilibrium path or that
indicate the route that instability imposes on the system. This we
do at the end of this section after some remarks on the theory as it
now stands.

We stated earlier that the only modification made in the meta-
morphosis of Keynes' static, short-run theory into a dynamic, long-run
theory was the recognition that capital accumulation cannot occur
without the capital stock changing. This means that other strategic
Keynesian concepts were retained, and are presumed to be appropriate
in the long-run context. For example a linear saving-income relationship
that Keynes could draw fairly confidently as applicable for his static,
timeless model was, with no modification, plugged into a model designed
to explain the long-run growth of an economic system. The question
did not seem to arise as to whether or not the Keynesian parameters
were in fact parameters when the setting of the model was changed from
short- to long-run. But of course the question is relevant.

12 The fact that the early forms of this model were all linear
lead to the frightening result that income had to grow throughout
eternity at a constant percentage rate or all was lost. Surely in a
long-run model the linearity assumption is open to question. See
footnote 4 page 75 in the previously cited Solow paper.
It is useful then to begin our discussion of the capital stock adjustment theory of growth by an examination of the concepts of this theory with respect to their suitability as parameters of a growth model. As we are interested in explaining—in accounting for—the behavior of per capita income, the criterion of suitability is the effectiveness with which a given parameter contributes to this explanation.

The key new parameter in this formulation is the supply parameter, the capital-output ratio. In the simplest form of the theory it is assumed a technologically fixed constant. At this point we accept this assumption.

The conceptual problems involved in defining capital are made much more intricate than usual when the term is being used to define the capital-output ratio. The most satisfactory approach in computing the value of a stock is to discount the future stream attributable to that stock back to the present time. But to measure the capital stock in this way reduces the capital-output ratio to a tautological constant devoid of explanatory significance. Also of course two accumulations of capital stock alike in every respect may have different values simply because the discount factor is not the same in each case and this leads to undesirable results when attempting to determine capital needs. It is therefore necessary to rule out defining and measuring the numerator of the capital-output ratio in the way which in other problems has the most appeal.
Resort must be made then to the much less satisfactory technique of defining investment as the difference between total output and consumption, and capital as the accumulated value of investment (with all variables measured in constant prices). Under ideal circumstances this method is satisfactory. It implies that a quantity of resources are devoted to producing commodities that are not consumed, and these commodities add to the capacity of the system to produce more commodities. Since all measurements are in 'real' terms investment may be assumed to measure resources allocated to the production of capital goods. Capital is thus thought of in terms of resources (chiefly labor) required to reproduce the existing stock of machines, equipment, plant, buildings, etc. Problems arise due to the difficulties of deflating a series from current to constant prices, and from the difficulties involved in estimating depreciation. But the basic problem of course is that machines earn quasi-rents, and in less than ideal—equilibrium—circumstances the behavior of the quasi-rents may make any measure of capital in terms of its 'real' cost of production meaningless. As long as the system approaches equilibrium—i.e., as long as quasi-rents are about what they were expected to be—then this method of thinking about capital is at least respectable.

There is the further conceptual difficulty of the period of gestation

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with respect to capital goods whose productivity is at best indirect. It is a simple matter to see that the production of one hundred new looms will have a specific and measurable effect on the capacity of the textile industry, which effect will be evident immediately upon the completion of the construction of the looms. But it is not so clear what the effect on the capacity of the economy will be if the new capital creation is in the form of schools, hospitals, highways (or government monuments). The capacity of the system to supply school, hospital, and highway services is of course increased immediately (depending upon the availability of necessary labor), but this evidently is not the total effect of such activities as these. The total effect of such forms of capital will not be apparent until after the new institutions have been in operation long enough for their effects to have permeated the system.

These remarks suggest that the capacity creating effects of a given investment may be very difficult to determine. It also means that much of the simplicity of the capital-output ratio is lost, and it becomes necessary to introduce such slippery and unmanageable concepts as external economies, social overhead facilities, and other notions that can be handled only in a very loose, general way. It further means that the simple application of the laws of diminishing returns and variable proportions to a growing capital stock viewed as a homogeneous whole is at best a great oversimplification, and
at worst may lead to results that are misleading. Evidently not only is the composition of the new investment relevant, but more importantly—and more difficult to pin down—the relation of the composition of the new capital to the composition of the existing stock must be taken into account. If this is recognized it becomes unpleasantly clear that capital creation in a given interval of time may have any number of effects on the capacity of the system to increase output in succeeding periods, and upon the capacity of succeeding capital accumulation to affect capacity.

The other supply parameter—the saving function—has of course been the subject of countless articles and books. Conceptually it poses fewer problems than the capital-output ratio, but there is one point to which reference should be made in the current context. Our interest in saving arises out of the fact that it is necessary in order to release resources from producing for current consumption, so that they may be used to produce products that will increase the capacity of the system in the future. But evidently there are many forms of expenditure usually classified as consumption expenditure, that have an effect on the future capacity of the economy. This is especially true of spending on education and health services, but it is also true of other consumption expenditures as well. This means in effect that savings as usually computed do not measure the total amount of resources devoted to increasing the capacity of the economy. Therefore, the

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14 One of the major differences between consumption expenditures in high income countries and in low income countries is that only a very
ambiguity with respect to saving—for the growth problem—may be ex-
pected to contribute to the ambiguity and unpredictability of the capital-
output ratio, and so on the behavior of the capacity of the economy
through time.

On the demand side of the problem, little need be said about the
consumption function. Conceptually it is unambiguous, although of
course many writers question its use as a parameter in any kind of a
model.

With respect to the demand for capital accumulation the chief
conceptual problems are concerned with the appropriateness of the
accelerator and the distinction between induced and autonomous investment.
A detailed account of the accelerator is unnecessary for our purposes
here, and we need mention only one point. 15

The literature seems to concentrate on the technological relationship
between output and capital. Thus the equation is usually written as:

4) \[ I_t = b'(Y_t - Y_{t-1}) \]
or

5) \[ I_t = b''(Y_{t-1} - Y_{t-2}) \]

where \( b' \) and \( b'' \) refer solely to the technological requirement of capital in

small proportion of total consumption outlays in the latter countries
affect capacity, while in the former countries surely the percentage
is of considerable magnitude.

15 Autonomous investment was omitted from the equational system
outlined above simply for ease of exposition, and because we later
rule the concept out entirely. The literature on the accelerator is
vast indeed and references are hardly necessary: see Hamberg op. cit.
Many writers of course are reluctant to use it as an acceptable theory
of investment.
the productive process. These relations express the notion that income has increased, and this increase then induces investment. For such equations to be meaningful it is necessary to assume that it is possible to increase output briefly with no increase in capital stock. Firms maintain a rate of output higher than the optimum, given their capital stock, for a period or two then increase capital accumulation to re-obtain the optimum relation between stock and output. The argument is based on purely technological considerations: a given rate of output requires a given stock of capital, therefore if output rises new capital must be created. This kind of argument implies that investment demand is an automatic response to technological needs.

The other way of looking at the accelerator involves something more. One of two changes may be made. Rather than thinking of investment as responding to a previous change in output, it may be argued that entrepreneurs estimate demand for output in the next period, and invest according to their expected needs. We would then write

\[ I_t = b Y_t (Y_{t+1} - Y_t) \]

where \( Y_{t+1} \) is estimated income in the \( t+1 \)th period.\(^{16}\) Or we may argue that the change in income between periods results in entrepreneurial activity, but that behavior is induced by many factors in addition to

technological considerations. Thus \( I_t = b (Y_t - Y_{t-1}) \), where the \( b \) is the relation measuring investment response to changes in output, and of course involves primarily expectations created by the difference between \( Y_t \) and \( Y_{t-1} \). These last two equations are therefore quite similar with respect to the kind of phenomenon they represent: they both make it clear that the investment decision is something more than an automatic technological response.

Earlier we wrote the capital stock adjustment theory in such a way that the capital-output ratio and investment demand parameter had to be different if equilibrium growth were to be attained. Under this form of the model it is possible to interpret the \( b \) as a technological parameter although there must be an assumption as to entrepreneurial expectations explicitly stated. However it seems much more rewarding, in spite of the increased difficulty, to look upon the \( b \) as a behavioristic parameter with certain technological limitations and not as merely a technological coefficient handed to the economist by the engineer. If we do this we are required in addition to say something more about the determinants of investment decisions. This we do later. The point here is that there must be a clear indication in the investment equation as to whether the accelerator is a purely technological parameter or whether it is a behavioristic parameter as well; and, as we just observed, the notion accepted in this essay is that it is a behavioristic parameter with certain technological limitations. ¹⁷

¹⁷ This interpretation seems to be consistent with numerous writers. See for example Joan Robinson, The Rate of Interest and Other Essays (London: MacMillan and Co., 1952) and Fellner, op. cit.
Finally there remains to be mentioned the catch all, autonomous investment. It is usually defined as investment that is not induced by changes or expected changes in output. Besides a virtually insurmountable measurement problem there is also a conceptual problem. Evidently all increases in capacity are made with the expectation that output will be increased in some future period. Indeed if we make the period short enough all investment is autonomous as investment plans are not changed in response to hourly or daily changes in sales, and similarly if we make it long enough there is no autonomous investment.\(^{18}\)

Besides these difficulties it seems completely inappropriate to introduce an unexplained "trend" of autonomous investment into a growth model. Especially does it seem unsatisfactory to assume a trend of investment that behaves independently of short-run fluctuations or that is a constant percentage of total income.\(^{19}\) The notion of autonomous investment means that some part of investment is outside the explanatory system, and if such investment constitutes a large proportion of total investment then evidently the explanatory system is of little use. It is tempting for example to argue that it is only with respect to working capital that induced investment has a precise and unambiguous

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meaning and therefore to apply the accelerator only to this type of capital accumulation leaving other investment as autonomous.

But as just noted, this leaves a large segment of investment unexplained and reduces the usefulness of the theory. We may conclude that autonomous investment in the sense of unexplained investment has no place in a theory of growth.

With respect to each parameter the further question must be asked as to whether the process of growth itself results in its changing in a systematic, predictable fashion. It would seem beyond a doubt that none of the parameters used above is completely independent of the performance of the system through time if income is rising. Therefore, if we are to understand the behavior of per capita income over time, it becomes necessary to deepen the explanatory system to the extent that these immediate determinants of growth are themselves explained, at least to the extent that these determinants are functions of the growth process. However, before proceeding to this task it is useful to examine further the equilibrium path defined by the theory outlined a few pages back.

As we have seen equilibrium growth will be achieved if income and capacity grow in such a way that the desired capital-output ratio is constantly effective, and under present assumptions this means capacity and income must grow at the same percentage rate. If the

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20 If the parameters change in a random, haphazard fashion there isn't much to be done (except seek other parameters). The kind of changes that we will seek to discover later are those that arise systematically as a result of the growth process.
economy were visualized as one giant firm then the equilibrium path has a clear meaning. The firm anticipates a market for an increased output, and to meet this growing demand it invests; and by so doing it increases capacity at the same time that it generates the necessary increment of demand. If it is assumed that all firms are exactly alike, and each entrepreneur expects the demand for his product to increase at the same rate in the future that it has in the past and so seeks to increase capacity by the necessary amount, then the situation is essentially the same as if there were only one large firm. In this case all firms would grow at the same percentage rate. But if entrepreneurs are assumed to have different expectations then it must be possible for firms to be expanding at different rates, and the achievement of equilibrium requires the remarkable event that the weighted average rate of growth of the individual units equals the equilibrium rate. Though this is conceptually possibly, it is indeed unlikely and more importantly, there is no force in the economy that tends to achieve this result. And as we have already observed the equilibrium path if achieved is unstable. We reach the unhappy conclusion


22 More accurately no force within the theory that tends to achieve this equality. One might for example introduce monetary and fiscal policy into the analysis and show that such policy may produce that equality.
then that equilibrium growth is achieved only by accident, and, if this
accident occurs, equilibrium will be maintained only if no shock occurs
which knocks the system off that path.

We would therefore emphasize again the characteristic of this
kind of equilibrium: in no sense is it (nor does anyone claim for it)
a time path describing what the actual behavior of an economy may in
fact be. It is unstable and the path of instability is not specified,
nor can it be specified with the tools and concepts described in the
previous section. As our primary concern is with the time path of
income, it is necessary to seek a way of interpreting the model to
make it more appropriate as a device to explain such a time path.

The equilibrium rates of growth were found to be $s/k$ for capacity
and $\frac{s}{b-s}$ for income (therefore $k = b-s$) on the assumption that the
parameters of the theory were constant. This means of course that
growth is defined in terms of one input, capital, and nothing is said
about the employment of labor. If input coefficients are assumed
constant, there is not much more that can be said since then the rate
of growth of total output is limited by the rate of growth of the

\[23\] Mrs. Robinson in her book (The Rate of Interest and Other Essays
p. 92) suggests the path should not be called an equilibrium path,
but rather a path that is free from internal contradictions. See
also T. C. Schelling, "Capital Growth and Equilibrium," American Economic

\[24\] Hicks of course seeks to devise a theory that will do just
this. See his book previously mentioned and his review of Mr. Harrod's
input whose supply is growing at the slower rate. If we rule out excess capital capacity in the long run, it is possible only for the rate of growth of population to exceed the rate of growth of capital and therefore unemployment to prevail. With constant input coefficients the equilibrium rate of growth will be the full employment of labor rate of growth only if the rates of growth of capital and labor are equal.\textsuperscript{25} And with the assumption of constant input coefficients and a constant saving-income relationship we may define quite clearly the maximum rate of growth that an economy may achieve. On the other hand if we admit substitutability there arises difficulty with respect to what the maximum rate of growth is, and also what is happening to employment. The question of substitutability therefore is of considerable importance.

The simplest way to introduce substitutability is to assume the textbook form of a production function and textbook behavior of factor prices.\textsuperscript{26} Under these assumptions changes in the relative supply of factors result in changes in their relative prices, and this in turn results in a change in the proportion in which the factors are used.

\textsuperscript{25} The possible distinction between a full capacity rate of growth and a full employment of labor rate of growth has been emphasized by Hamberg, \textit{op. cit. passim}.

With such a perfectly flexible system, deviations from the equilibrium would set in motion forces that would tend to alter the parameters of the equations in such a way as to produce a return to equilibrium or, more accurately, to produce a new equilibrium path. Thus there is always some capital-output ratio or some saving-income ratio that will produce equilibrium. Under these conditions the equilibrium path of growth becomes in effect stable, where stability is meant to refer to the condition that a new path is established immediately that is consistent with the desired $k$ and the desired $s$.

This position requires two things: first it is necessary for capital costs and labor costs to change in the prescribed way as the relative supplies of capital and labor diverge. And secondly, it is necessary for the productive process to change in response to the change in relative costs of inputs. There seems little question but that such adjustments cannot occur with sufficient rapidity to eliminate deviations from equilibrium in the short-run. And equally there seems little doubt that over a longer period of time adjustment of 'parameters' will occur. It seems best then to try to find an in between position that is a bit more realistic than either 'perfect' substitutability or no substitutability at all. We therefore accept the proposition that there is at all times an optimum input mix which optimum is a function of technology and relative prices of the inputs. When deviations from such an optimum combination of inputs develop their relative
prices and/or technology begin to change in such a fashion as to restore equilibrium. Since neither supply of inputs nor technology can adjust immediately the system will not be constantly in equilibrium, but neither is it uselessly unstable as there are limits within which—during any short-run interval—the coefficients can move; and since we allow for equilibrating movements of both technology and input prices, the investigation of the determinants of the optimum values of the input coefficients is a meaningful thing to do and so too is the investigation of the time path of income traced out by such coefficients.

An additional word on the rate of change of the level of employment is useful. An overabundance of capital in the long-run is unlikely since the supply of capital can hardly be considered independent of the demand for it except for a given moment of time; the same certainly is not true of the labor force (except possibly under extreme Malthusian conditions). It is evident in many countries that labor is unemployed

27 The assumption that the parameters are rather flexible, rather than iron-fisted rulers of the system, is a major part of Professor Fellner's argument (op. cit. passim). See also R. M. Goodwin, "Secular and Cyclical Aspects of the Multiplier and the Accelerator," in Income, Employment and Public Policy. Essays in Honor of Alvin Hansen (New York: W. W. Norton and Co. 1948) pp. 108-132.

28 Robert Eisner, "Underemployment Equilibrium Rates of growth," American Economic Review, Vol. XLII (March 1952), pp. 43-58 works out the implications of the assumption that entrepreneurs continue to accumulate capital in spite of existing idle capacity. The analysis has certain interesting results but the basic assumption seems to be so contrary to fact as to be of little applicability.
because savings do not permit a rate of capital accumulation sufficient to provide employment for all those willing to work. Such a situation as a long-run characteristic of an economy implies that input coefficients are to some extent fixed or that input prices do not move in such a way as to bring about the change in the combination of inputs necessary to achieve full employment. We can admit this kind of limitation on the adjustment process by saying that there are extremes that the adjustment process cannot handle. One such extreme is the current problem in many low-income countries where the factor proportions are such that no adjustment of input prices could possibly eliminate unemployment. This situation means that capital may grow more rapidly than the labor force without producing diminishing returns to capital until the reserve army of unemployed is exhausted. Another extreme that would prohibit adjustment could result from a peculiar behavior of technology, and this we discuss later. Therefore although continued full employment is not a necessary condition for equilibrium growth, the assumption is made that the capital-output ratio tends to adjust in response to different rates of growth of capital and labor in such a way that more of the relatively abundant factor is used in the productive process.


30 Professor Domar solves the problem by defining his capital-output ratio as the one obtaining with full employment.
There are additional problems of adjustment having to do with the composition of output. As per capita income the composition of output may be expected to change and this imposes upon the system the necessity of moving resources among industries and possibly geographically. Under these conditions to increase output requires not only an increase in capital stock but an increase in a particular kind of capital stock. Thus because of the purely physical relationships between inputs and outputs, today's outputs are tomorrow's inputs, and unless today's outputs are consistent with the demands for tomorrow's inputs then the system cannot function at all and certainly cannot grow. Relaxation of the assumption of constant input coefficients lessens the problem but does not eliminate it. And even if we assume a price system that works relatively smoothly, there will be delays and short-run bottlenecks that constitute barriers to continuous and equilibrated growth. The point here is that because of these "structural problems" we need more information than is available in the aggregative form of the capital-stock adjustment theory to determine the conditions for stable growth. Sectors of the economy grow at divergent rates, and their responses to changes in national income vary considerably among each other and

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through time. We suggest two things at this point. First, the requirements following from the reference to structural relationships demand capital formation to proceed at different rates among the several sectors. And secondly, investment decisions are so complex and vary so widely among sectors, that it seems essential to seek a theory of investment which is much less aggregated and recognizesthe different forces that play on the different sectors of the system.

It is useful to regard the theory contained in the equational system discussed earlier in this section as a "short-run growth theory." Over a short-run interval the assumption of a constant $a$, $k$, and $b$ are perhaps reasonable approximations to reality, and their magnitudes may contain the explanation of the failure of the system to behave satisfactorily. But over a long period of time these same parameters are surely responsive to forces released by the growth process, and these responses and these forces must be examined and understood if a theory is really a long-run theory. To do this however it is necessary to allow the parameters of this theory to become in effect variables, adjusting to the changing composition of total output, changing relative supplies of inputs, changing saving habits, and

32 It may be noted that in discussing his theory in 1951 Harrod chose to call his article "Notes on the Trade Cycle" (See note 18 above).

33 It appears that few new policy implications are to be found in the dynamized Keynes that were not also contained in the timeless Keynes theory. Perhaps this is to be explained in terms of the fact
changing circumstances affecting the relationship between investment
demand and growing output. The problem now is to examine the behavior
of these "parameters" over time, and how that behavior is reflected
in the time path of per capita income. The discussion of the short-
run theory has made clear two things that are of use in a longer-run
analysis and to which attention will be devoted in succeeding sections.
In the first place it has indicated the requirements that must be met
if the system is to achieve smooth—non-fluctuating—growth, and
secondly it has revealed the proximate prime mover of an economy,
entrepreneurial activity.

We may now proceed to examine what current thinking has to offer that
will enable us to make a long-run growth theory out of this short-run
growth theory. It is helpful to begin with disaggregation.

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that the capital-stock adjustment theory proceeds so nearly in a purely
Keynesian model that nothing new is revealed by the new theory that is not
really contained in the Keynes' treatment itself. The most notable ex-
ception to this statement is Professor Domar's proposition (contained in his
Econometrics paper, note 7 above) that if the government guaranteed that the
equilibrium rate of growth of income (for Domar this also means the full
employment rate) would be achieved, then the private sector alone would act
in such a way as to achieve that rate. The difficulty with this proposal
is that for an individual entrepreneur a guarantee that total income will
grow at a given rate may not be sufficient incentive for him to invest his
share. It would be necessary for the government to guarantee each firm that
the rate of growth of demand for its products would continue in the future as
now. Such a proposal hardly seems feasible. John G. Gurley, "Fiscal Policy
pp. 523–535, suggests other new policy implications of the Harrod-Domar theory
but these are for the most part implicit in much of previous Keynesian literature.
II. Some Implications of Disaggregation

The most widely known sectoral model available is the input-output system of Professor Leontief, and we may make use of this system with some slight modification as to form and interpretation. 34

We let $a_{ij}$ represent the technical coefficient determining the amount of the product of industry $i$ absorbed by industry $j$ per unit of output of $j$. The $a$'s are measured in terms of per dollars worth units; i.e., for every dollar of output of $j$, a dollars of output $i$ are used. Now if we assume given and unchanging prices, $X_j$ is the total output of the $j$th sector measured in money units but also of course representing real output. Therefore $a_{ij}X_j$ represents the total payments of industry $j$ to industry $i$ for a given interval of time for a given flow of output $X_j$.

If the $j$th industry wishes to increase its capacity, this may require purchase of $i$'s products to increase $j$'s capital stock. Let $b_{ij}$ be the investment demand coefficient of industry $j$ for $i$'s products.

34 See Part I of the Leontief volume cited in footnote 16. See also two papers by R. M. Goodwin: "The Multiplier as a Matrix," *Economic Journal*, Vol. LIX (December 1949), pp. 537-555 and "Static and Dynamic Linear General Equilibrium Models," in Input-Output Relations (Leiden, Holland: H. E. Stenfort Kroese N. V., 1953) pp. 68 ff. It is emphasized that we are using this system for a specified purpose and therefore do not discuss many complex and intricate problems that arise in the use of such a high-powered machine. In fact we are using the formal apparatus itself in a purely descriptive manner.
indicating how an increase in the rate of output of the $j^{th}$ sector affects the demand of that sector for $i$'s products as capital stock.

The $b$'s are measured in the same terms as the $a$'s. If $X_{jt}$ represents the capacity output rate, then we may write $b_{ij}(X_{jt} - X_{jt-1})$ to represent the total payments of industry $j$ to industry $i$ for a given increase in capacity of $j$. Thus $b_{ij}$ is the equivalent of the economy-wide $b$ except here it is applicable to a single sector.

The total receipts of the $i^{th}$ sector is simply the sum of the $a_{ij}X_{jt}$'s and the $b_{ij}(X_{jt} - X_{jt-1})$'s, while its total outlay is the sum of the $a_{ji}X_{it}$'s and the $b_{ji}(X_{jt} - X_{it-1})$'s. Thus we may describe the economy divided into $l$ sectors in terms of a set of balance equations written in the following way:

$$6) \quad X_{it} = \sum_{j=1}^{l} a_{ij} X_{jt} + \sum_{j=1}^{l} b_{ij} (X_{jt} - X_{jt-1})$$

Written in this way we have a closed system, that is one with no given final bill of goods. This means that included in the $l$ sectors is the household sector, and that we assume that the input of consumption is a necessary requisite for the output of labor. If this is accepted then we may look upon all the $a$'s not only as input requirements per unit of output—technological relationships—but we may also look upon them as indicating the amount of output which must be "consumed" in order to produce the total output. Thus $\sum a_{ij}X_{ji} "consumption"$ is required for the production of the remaining $I - \alpha X$ output. We are in effect

\[35\] The $|\alpha|$ is the matrix of $a_{ij}$'s and $X$ is a vector. The $I$ is an identity matrix corresponding to unity in scalar algebra. Solow (see
saying that just as we may interpret the household sector in terms of an input of consumption and an output of labor, so we may interpret the other sectors' inputs in terms of consumption. The system of equations 5 may then be considered a disaggregated version of equation 3 in the previous section.

We may then think of the $a_{ij}$ as the marginal and average propensity to consume, and $|I - a_i|$ as the proportion of output of the $i^{th}$ sector not required to produce the flow of output of the $j^{th}$ sector. If $x_i$ exceeds $\leq a_{ij}x_j$, then evidently not all of $x_i$ is being used as inputs for the flow of $x_j$, and equilibrium in the $i^{th}$ industry requires the condition:

$$7) \quad |I - a_i| x_{it} = \sum b_{ij} (x_{jt} - x_{jt-1})$$

This is to say that the amount of $x_i$ not consumed in the flow of output of $x_j$ must be used by $x_j$ in additions to the capacity of the latter industry. The equilibrium condition expressed by equation 7 is the disaggregated equivalent of the equilibrium expressed earlier for the economy as a whole; if each sector is in equilibrium then the system in its entirety is in equilibrium. However, now instead of a single valued parameter for the capital-output ratio and the investment demand

footnote 5) discusses the rationale of interpreting the a's in terms of consumption and of writing the Leontief system as identical with the Harrod model.

36 It seems unnecessary to introduce a supply equation explicitly. One of course is implied in equation 7.
function, we have a matrix of $k$'s and a matrix of $b$'s indicating that
different sectors of the economy have different capital requirements
and that investment demand in different sectors responds differently
to changes in the rate of its output. This disaggregation is useful
in several respects.

If we write the investment equation in the $j^{th}$ industry as:

$$I_{jt} = \sum b_{ij} (X_{jt} - X_{jt-1})$$

where the $b_{ij}$ is a purely technological coefficient, then we have
ruled out disturbances in the system because of investment in the
'wrong' sector. This equation states—as did the aggregative equation
in the previous section (equation 4)—that entrepreneurs act after
the increase in demand for their product has already occurred, and
therefore we may expect the new capital to be created in the sector
where the demand increase has become effective. If however we recognize
here, as earlier, that $b_{ij}$ is a behavioral as well as technological
coefficient then clearly mistakes and miscalculations are not at all
unlikely. But independent of mistakes and miscalculations, investment
may turn out to be malallocated because of changed conditions between
the time the investment is initiated and the time the increased output
results. This may be due to many things not the least of which is the
fact that investment in the same industry is being undertaken by different
and uncoordinated entrepreneurs, and this may result in entrepreneurs
proceeding to invest in sectors that will become oversupplied very
quickly. This suggests the proposition that the system may deviate
from equilibrium not only because of the inappropriate level of total investment in relation to total saving, but also because of investment in the 'wrong' sector. This in turn suggests that equilibrium requires not only the aggregative equality between intended savings and intended investment, but also it requires a 'balance' among the several sectors of the economy with respect to the demand, supply, and technological relationships prevailing in the growing system. More on this point in a moment. A further comment or two seems useful on other information revealed by the sectoral model.

We managed to make the aggregated capital stock adjustment theory stable by permitting the parameters to adjust, i.e., to become variables. The disaggregated model suggests another reason why such a system may be relatively stable. Suppose that sector 3 experiences an increase in output greater than expected with the result that the capital output ratio falls below optimum. Entrepreneurs will seek to eliminate this non-optimum condition by accumulating more capital relative to the existing rate of output. In the aggregative form of this theory this attempt resulted in more demand, and therefore the capital stock remained below the desired level. For a single sector however the story

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37 This is a key point in the model of growth developed by W. W. Rostow. See his The Process of Economic Growth (New York: W. W. Norton and Co. 1952) especially Chapters 5 and 6. We shall make considerable use of this argument in the following sections.

38 For a more analytical discussion of the stability of a matrix multiplier-accelerator model see the Goodwin papers cited in note 34.
may be different. The consumption (as defined above) induced by the increased income generated by Sector 3's investment could all be directed toward sectors other than 3. Thus in the immediate period Sector 3 would be able to reestablish the desired ratio between capital stock and output. However the demand—both flow and stock demand—for the other sectors' output has risen, and to meet this increased output it is unlikely that none of Sector 3's products would be required. Under these conditions the instability of Sector 3 exists, but the existence of a substantial lag may serve as a dampening device. And this may be sufficient to eliminate the instability by virtue of revised expectations. Evidently of course idle capacity in sectors other than 3 would also tend to make Sector 3 (and the system as a whole) stable. It seems fair to say that there is a stabilizing factor here that is not evident in the aggregative model; namely that of lags while the increased expenditures make their way through the system. This gives all sectors a chance to revise expectations and entrepreneurs an opportunity to revise investment plans in accordance with the new situation.

The multi-sectored model is revealing in other respects. In the first place it shows clearly what may be referred to as the supply problem. In the aggregative model all we had to worry about was the total supply of labor and capital. But now we face the problem of getting the factors into the appropriate sector (and out of the inappropriate sector). Little need be said about finance. In a country
with a highly developed money and banking system there seems to be only a small problem in getting funds to the sector requiring them. Therefore the relevant supply of savings is still the total national savings and disaggregation here seems necessary. 39

With labor of course the story is different. Labor immobility--both geographical and industrial--is sure to be a significant problem in situations where sectors of the system are growing at different rates and especially where some sectors are growing and others are declining. Several writers have indicated reluctance to attach much importance to labor supply as a ceiling on the overall rate of growth of the economy. 40 But it does seem evident that particular skills do frequently constitute significant barriers to the rate of growth of given sectors, and because of the interdependence of the system this can have an effect on the economy's overall rate of growth as well as its equilibrating tendencies. Indeed it is frequently the labor mobility problem--as opposed to an overall labor shortage--that creates the inflationary situation in advanced countries experiencing economic growth. Similarly inadequate labor mobility may be a major problem in eliminating unemployment without first producing a rising price level. 41

39 Cf. Mrs. Robinson's remarks on this in her The Rate of Interest and Other Essays, pp. 86-87. The situation may not be the same in low income countries where the banking system is ill-equipped and unorganized. More on this later.

40 See especially the several reviews of Hicks' book on the trade cycle.

41 A useful and informative quantitative study of labor mobility
A final characteristic of the multi-sectored that is of great importance concerns the nature of the solution of the set of equations 6.

Assuming the supply requirements met and equilibrium maintained, the solution to these equations is:

$$ X_{it} = C_1 h_{i1} e^{\lambda_1 t} + C_2 h_{i2} e^{\lambda_2 t} + \ldots + C_n h_{in} e^{\lambda_n t} $$

A numerical solution would involve estimating the value of the roots $\lambda_1, \lambda_2, \ldots, \lambda_n$, the coefficients $h_{i1}, h_{i2}, \ldots, h_{in}$ and $c_1, c_2, \ldots, c_n$. The $\lambda$'s and the $h$'s depend on the $a$'s and $b$'s, and the $c$'s reflect the initial conditions of the system. The path of $X_i$ will be dominated by the largest root, and after a sufficient period of time the equation may be written simply in terms of the expression containing this largest root. The relative size of the outputs of any two sectors would be the same through time, and therefore the rates of growth of all sectors would be the same. This of course is common sense. With constant $a$'s and $b$'s over a long period of time, no industry may grow more rapidly than the rest of the system as all sectors must keep pace in order to supply the inputs necessary for the given industry to grow at a specified pace. If the $a$'s and $b$'s remained


42 The equation here is written as if 6 were a differential equation. This is simply for convenience and no change of interpretation is involved.
constant long enough for the dominant root to assert itself the economy will be getting larger and larger while all sectors maintain their position relative to other sectors and to total output. 43

But evidently over a long period of time—one long enough for the dominant root to assert itself—the a's and b's will change, changing the roots and coefficients in Equation 10. The effect on the rate of growth of $X_1$ depends upon how the a's and b's change. However, it is also clear that in a shorter period of time the effects of the a's and b's may be washed out by a high rate of growth in a single sector of the system. For example suppose that because of a shock to the system—in the form say of an unexpected invention—Sector g begins to grow at a rate much higher than other sectors. Even though the a's and b's are relatively small, the high rate of growth of $X_g$ would overcome the effect of the a's and b's with the result that the growth of other sectors tends to be affected by the behavior of $X_g$ itself rather than the set of a's and b's appropriate to it. We may say then that $X_g$ tends to "carry" the system for a given interval of time. Under this condition smooth, undisturbed growth is almost impossible without "perfect knowledge," but more important for our

purposes it suggests the need for a theory of the behavior of individual sectors and an investigation of the implications of this behavior for the economy as a whole. It is to this problem that we now turn.

The work of Kuznets, Burns, Frickey, and Hoffmann provide the basic sources of data and theoretical discussion for this general problem, and we rely heavily upon their findings and their analysis.

For those countries and for those industries for which data are available over an extended period of time it seems reasonably clear that industries narrowly defined tend to grow at a diminishing percentage rate. This is to say that no one industry will continue to grow at a constant percentage rate, but rather it may be expected to grow strongly in the period immediately after its inception and then to taper off as it catches up with the rest of the economy. This in turn suggests that if total income is to grow at a fairly constant rate, some industries must be growing more rapidly than total output while other industries are growing at a rate less than that of total output. This means that at any one period of time there are a few industries that are experiencing vigorous and rapid development and in effect holding the economy at its rate of growth. This rapid rate of growth however does not continue indefinitely. Rather it begins to tail off toward the

44 Leontief, op. cit., Chapter 3.

level of the rate of growth of income as a whole and eventually to fall below that rate, and possibly to decline in absolute terms. To shoulder the burden of maintaining the rate of growth of total output it is necessary for a new or another industry to experience a rate of growth higher and stronger than that of the economy as a whole.

The theoretical support of this empirical material rests on arguments as to behavior of demand, population, and technology. These may be briefly outlined. The population argument is simple. Assuming that population growth is an independent variable and that its rate of growth is declining, then this fact may be expected to produce the decline in the rate of growth of a single industry once it has reached its optimum size within the economy. This means in effect that a new industry is formed, grows rapidly until it reaches a size that, given the level of income of the society and the members of that society's preference functions, it is producing at the rate that equals the rate at which the product is being absorbed by inputs in other sectors of the system. When this point is reached the growth of the industry is dependent entirely upon population growth, and as it is declining so the rate of growth of output of the industry must be declining.

But this is hardly a sufficient condition since per capita income is rising and may well counter the influence of the declining rate of population growth. Therefore something has to be said about the behavior of demand. The simplest hypothesis to make is that the demand for a single product or type of product has a definite upper limit, and that
no matter what happens to per capita income the rate of growth of demand for a given product will not increase beyond that promoted by population growth. This upper limit is in many cases difficult to define—impossible to measure—but surely it does exist for all products. Therefore, if population growth is small—or zero—then it is necessary for the rate of growth of output of a single new industry to decline after it catches up with the system as a whole.

It is primarily this hypothesis about demand that is used to account for the change in the composition of output as an economy grows. The argument has been used chiefly to explain the decline in the relative role of agricultural products in total output that seems to accompany the development of an economy from comparatively low per capita income to comparatively high per capita income. Thus as per capita income rises the relative increase in demand for agricultural products is less than that of income. The supporting argument is that demand for agricultural products may be completely satisfied, and that as income continues to rise it will be devoted to the purchase of non-agricultural products. This results in the development of new industries—usually referred to as secondary industries—to supply the demand that arises as a consequence of income being high enough that resources are available after necessary agricultural commodities have been produced. And if income continues to rise, demand will tend to become effective in service—tertiary—industries. It is to be emphasized that although

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46 Too much emphasis has probably been devoted to an effort to classify industries as primary, secondary, and tertiary. The key
both secondary and service industries grow at the expense of agricultural activity, within each of the two growing sectors new products must be formed to meet new demands. For just as agricultural products meet a demand which at some level of per capita income must be inelastic, so too must individual products in each of the advanced sectors. Therefore the composition of output must change so that within the secondary and service sectors new products are forthcoming. It is not just that demand for food is income inelastic that results in a shift of resources as income rises, but rather that the range of products produced in agriculture is relatively limited while in secondary and tertiary activities the range is much greater and when an inelastic demand is hit with one product other products may be easily supplied. This discussion of demand also suggests that in those areas where population growth overshadows the increase in output, demand remains at the level where it is concentrated on agricultural products and hence the economy of most low income countries is predominantly agricultural.

There are several implications contained in these propositions as to the behavior of the composition of demand.

Point for our argument is that no single product has a per capita income elasticity of unity over an indefinite range of income and therefore the demand for agricultural products is at some income level less than unity. There are numerous references with respect to the primary, secondary, and tertiary classification. A recent one is Martin Wolfe, "The Concept of Economic Sectors," Quarterly Journal of Economics, Vol. LXIX (August 1955), pp. 402-420.
In the first place as income rises and the composition of output changes, the nature of the products that "carry" the economy change. The goods and the b's of the new industries may be quite different from those of the type of industries that were previously responsible for maintaining the rate of growth of the system. In particular it seems the b's are likely to be quite different in secondary industries from those in primary activities, and different in tertiary activities from what they are in secondary activities. This may lead to several kinds of repercussions. It may lead to a more rapid rate of growth for the economy as a whole. It may lead to a requirement for increased savings in order to maintain a given rate of growth. Perhaps it might be asserted that prevailing opinion would suggest that what we have called secondary industry—light and heavy manufacturing, public utilities, etc.—have in general higher b's than do the industries usually classified as primary. As we have seen, this means that in order to maintain the overall rate of growth of output a larger rate of savings will have to be forthcoming. The evidence is less clear as to the b's in those activities usually included in the tertiary group. It seems reasonable to say that for such industries the capital coefficients will be less than they were on the average for the secondary activities. This means that if the aggregative demand problem is solved—or is not present—the rate of growth of output should increase due to a change in the composition of output.
It may be also that the a's of the tertiary group are less than their counterparts for secondary activities. In this event the development of the system to the point where industries dominate its growth behavior may also result in the industries of the primary and secondary categories declining more rapidly than was the case with respect to the primary activities when the secondary industries were 'carrying' the system. The result of this is that as fewer resources are needed to support the growth of the old established industries, more will be available to aid in the growth of the new industries. This suggests that as tertiary industries begin to dominate the economy, the lower a's and b's will permit a rising rate of growth of total output. 47

A second factor of importance at this point has to do with the general social and cultural patterns that dominate the system. As secondary industry develops there is an increase in the proportion of the population living in urban areas. This comes about because in order to carry on a manufacturing enterprise it is necessary to have a labor force fully committed to earning its livelihood by industrial activity. 48

47 Whether growth should increase or saving decrease is of course another problem.

And it seems clear that only urban workers are in this category. Also in order to carry out most manufacturing techniques it is necessary to have a group of firms together supplying the needed raw materials, the needed finance, the needed skills, etc. We may expect that as the level of per capita income reaches the point where demand forces resources into areas other than agriculture, the extent to which the population is concentrated in urban areas is increased, and in particular the extent to which it is concentrated in other than small agricultural villages is greatly increased.

A corollary factor to be mentioned has reference to the occupational distribution of the population. It is evident that a larger and larger proportion of the labor force must be drawn into manufacturing and service activities as the process of growth continues. This means they come into contact with new ideas, and may become more adaptable and more sympathetic to change than are those people who remain in isolated agricultural regions. They also are in closer contact with each other and are more importantly affected by the actions of the society as a whole than is the agricultural population. Also it seems acceptable to say that for almost all societies one of the service industries most likely to grow is education. The effects of increased education on the system are difficult to isolate and to generalize upon. However it does seem clear that as a result of education members of society tend to examine the consequences of their actions more carefully, and to try—at least—to act in a manner consistent with
desired aims. This fact—if it is a fact—has relevance in many parts
of the growth process, some of which we will examine later; e.g., birth
control, job selection, political stability, etc. In addition as the
society becomes more and more devoted to formal education, it also
becomes less antagonistic toward innovations of all kinds, and less
willing to hang on to old habits simply because they are old.

These phenomena contribute to the increased flexibility and fluidity
of the social system within which the economic system functions.
And as we shall discuss later such fluidity and flexibility are of
considerable importance in the achieving of a satisfactory rate of
economic growth.

This brings us to the technological argument as to why individual
industries tend to experience a deceleration in their rate of growth.
The proposition put forth by both Burns and Kuznets is that within
a single industry the rate of technological change must decline.
In the infancy of the industry there are wide areas which are amenable
to technological improvement, but as the obvious improvements are made
it becomes more and more difficult to maintain a constant rate of innovations
so long as the basic technological framework is intact. The result
is that the cost reductions that may accompany innovations, and hence

49 This hypothesis is suggested by W. Arthur Lewis, The Theory
of Economic Growth, (London: George Allen and Unwin Ltd. 1955) Chapters
III and IV and H. G. Barrett, Innovations: The Basis of Cultural Change,
(New York: McGraw-Hill Book Company 1953) passim. And other writers
also of course.

50 Burns op. cit., Chapter IV and Kuznets (reference in Note 45) passim.
the increase in output of the product, decline, and this contribution to growth therefore tends to result in a relative decrease in the rate of growth of the industry. If this hypothesis is accepted it has a number of implications for the process of growth of the system as a whole and the role of technology in that process, which implications shall be discussed when we direct specific attention to technology in a later section.

The relevance of the preceding discussion varies with the kind of economy being examined. For the so-called underdeveloped country the importance of the movement of resources out of agriculture into light and heavy manufacturing (or out of service industries into the manufacturing area) may be a major task, and for many reasons associated with the institutional and social framework of such societies this movement itself may be difficult to accomplish. For the advanced economy, the problem is unlikely to be a transfer of labor and capital but rather a problem of demand. 51

It also seems likely that the contribution that can be made to economic growth by urbanization and the other social changes referred to above have exhausted themselves in such countries as the United States, United Kingdom, Belgium, and the like. This would suggest that the growth of an economy in its early stages was facilitated by the breakdown of certain social and cultural obstacles, while once the

51 Perhaps the next group of "industries" after "tertiary" is "leisure." Among the many problems created by such a development would be that of the measurement of economic growth, but let's not worry about this now.
system has reached an advanced stage the social and cultural factors become less of an obstacle. This of course does not mean that non-economic factors become irrelevant to a study of economic growth as the economy becomes highly developed. The changed attitudes toward profit maximization, toward economic security, etc., are of great relevance. Such changes however do not seem to follow from the composition of output argument discussed in this section, and further elaboration may be postponed until Section V.

The disaggregation of the capital stock adjustment model has revealed further characteristics of the growth process. In particular we have seen the necessity of achieving and maintaining 'balance' among the several sectors of the system as growth proceeds. The equality of the rate of growth of overall demand and capacity must also be matched by the same equality of the rate of growth of overall demand and capacity must also be matched by the same equality within each sector. If all sectors are growing at the same percentage rate, this internal adjustment problem is of little consequence. When however it is recognized that increases in the capacities of the several sectors depend upon investment in these sectors, and this in turn depends upon the behavior of independent entrepreneurs--with varying expectations, varying periods of gestation, varying access to loanable funds, varying degrees of efficiency--it is apparent that perfectly smooth adjustment is most difficult to achieve. Therefore even if the
aggregative problem is solved the system seems sure to experience
a disturbed growth process. Whether this disturbance expresses itself
in the form of a cycle depends upon the specific assumptions made as
to the response of the system to bottlenecks and/or disequilibria and
to government fiscal and monetary policy. Also, the complete inter-
dependence of the economy indicated by equations 6, 7, and 9 enabled
us to see the role of a single industry or group of industries in the
growth process. Furthermore, the introduction of specific hypotheses
as to the behavior of individual industries revealed important features
of the modus operandi of growth not available in an aggregative approach.
Finally we may say that reducing the level of aggregation also tends
to lessen the conceptual problems associated with the model.
III. The Long-Run Behavior of the Short-Run Parameters

To deepen the analysis in the present context means that we seek an explanatory system that includes as variables the 'parameters' of the model discussed in the previous sections. We have argued that the chief contribution of the capital stock adjustment theory is that it provides an examination of the conditions necessary for the stable growth of income. When we move on to attempt to explain the magnitude of the parameters and their behavior through time, we are concerned directly with the level of income and its rate of growth over an extended period of time and only incidentally with stability. To do this requires that we account for the behavior of the labor supply, the supply of capital, the effectiveness with which they are combined, and the extent to which they are utilized. We need therefore a theory of population growth and of the relationship between the quantity of labor and population, a theory of capital accumulation, a theory of technological invention and innovation, and a long-run theory of aggregative demand and its composition. We also need a theory explaining the relationship between the non-economic area of society and the economic area; such a theory is particularly necessary insofar

52 If income is growing at the percentage rate, \( y \), and population at the percentage rate \( p \), the rate of growth of per capita income, \( y' \), is \( \frac{y - p}{1 + p} \).
as light is shed upon entrepreneurial endeavor and the attitude of the society toward material advancement. And all of these separate theories must be worked into a mutually consistent whole.

It perhaps is not betraying a professional secret to acknowledge that contemporary economics does not provide these theories in a rigorous, well defined fashion. Nor perhaps even is there a loose body of principles for which general acceptance may be claimed, and almost anything that may be said as representative of current thinking is open to dispute. It should be kept in mind in reading the following that this is the case, and that no claim is made that we are presenting received doctrine or even that there is such a thing as received doctrine on the matters discussed here.
A. Population Growth

We may begin with a consideration of population. Population theory was of course an integral part of economics until the last decades of the nineteenth century when, along with other aspects of economic growth, economists lost interest in it. And with certain notable exceptions there has been little recent effort on the part of economists to incorporate into their explanatory system a population equation that would indicate the determinants of the behavior of population growth. The usual practice is to consider it an exogenous variable. It will therefore be possible to be brief. Our problem is to try to indicate the time path of the percentage rate of growth of population \( p \) and of changes in the labor force-population ratio \( L/P \) insofar as they are dependent upon the economic sector of the society.

53 Literature on population problems is surely without end. Happily the United Nations has recently published a useful review of much of this literature, both old and new, in The Determinants and Consequences of Population Trends (New York: United Nations, Department of Social Affairs 1953). This is at once an exceedingly impressive work and a very sad one. It is impressive in that it includes such a tremendous number of authors and treats them in a well-organized, coherent fashion. It is sad because it reveals so clearly our lack of understanding and agreement with respect to a problem that has been attracting the attention of men ever since man became aware that there was population. Economists of course are indebted to Professor J. J. Spengler for his work in the area of economic-demography: see especially his essays in Harold F. Williamson and John A. Buttrick (editors) Economic Development (New York: Prentice-Hall 1954) Chapter III and in Haley, op. cit., Chapter III.

54 To the extent that the behavior of these parameters depends on factors outside the growth process our analysis is incomplete. We include such effects as shocks to the system, about which more later.
Population growth enters the system in two ways. In the first place it is the chief governing factor of the supply of labor, and therefore is of importance in accounting for the behavior of the productive capacity of the system. In the second place population growth affects the total and composition of demand and in so doing evidently enters directly into the analysis of the extent to which the growing capacity of the economy is utilized. In this section we limit ourselves to seeking an explanation of the behavior of $p$ and $I/P$.

The oldest theory of population of relevance to economic analysis is that associated with Malthus. If we interpret Malthusianism to mean simply a linear relationship between proportionate increases in population and income then, ignoring the complexities of possible lags, per capita income would remain about constant. Whether or not it remained constant at subsistence levels of income would depend upon the relationship itself, which in turn rests upon the 'socio-economic institutions' that determine the human race's reproductive habits. Empirically this proposition does not seem to have been applicable over the entire experience of those countries that have achieved the most rapid rates of economic growth. If we accept the proposition that at some point of income growth Malthus proved wrong, it seems useful to say that the economic-demographer seeks to answer the question as to why the population growth function changed from Malthusian to non-Malthusian. The implication of this question is that as per capita
income grows the "socio-economic institutions" that determine the response of population growth to income growth change. The question then requires that the relevant socio-economic institutions be identified and their relationship to income growth be specified. Evidently in a closed economy this requires consideration of the effect on the mortality rate and on the fertility rate.

The problems are simpler on the mortality side, and agreement is much more widespread here than with respect to explanation of changes in the fertility rate. The death rate may be expected to decline very rapidly as per capita income grows from a low level. This is to be explained in the simple terms that as per capita income rises, more resources may be devoted to health, sanitation, and medical activities plus the fact the population has a more satisfactory diet and lives in more comfortable houses. The result is that death attributed to malnutrition, epidemics, exposure, and lack of medical care is reduced, while improved transportation and communication help to eliminate local famines that so often in the past have resulted in huge loss of life. There seems to be no instance in the world where this mortality rate effect of rising per capita income has not been operative.

The major reductions in the mortality rate that growing countries have experienced has only to a very small degree been due to curative

55 Rostow (op. cit., Chapters 1 and 2) includes among his propensities explaining growth, the propensity to have children. Until the propensities are more clearly established this approach seems to be simply another way of asking the question posed in the text. For a general view of the usefulness of the Rostow propensities see J. R. Hicks' review of the book in the Journal of Political Economy, Vol. LXI (April 1953), pp. 173-174.
medicine, but rather to the control of infection and contagion and improved environmental conditions. It seems clear however that the impact of such factors on the death rate has reached a maximum in the high income countries of the world, and further reductions in these countries must depend upon advances in medicine. The results to date suggest that such medical advances work relatively slowly once major diseases are conquered. Therefore the decline in the death rate may be expected to taper off as the advantages of sanitation, etc., are more fully exploited and reliance for further reduction begins to rest on increased medical knowledge. Hence we would expect the death rate to fall rapidly but at a decreasing rate, and finally to be falling very slowly as a system progresses from a very low per capita income to a very high per capita income.

The determinants of the natality rate are much less easily isolated. In general writers in this field suggest the following factors as having a negative effect on the birth rate: 1) urbanization, 2) education, 3) occupation, 4) death rate, 5) socio-economic status. The argument supporting each of these and its relation to per capita income growth is fairly simple and straightforward.

56 See the Spengler paper in the Williamson and Buttrick volume pp. 98 ff.

57 Numerous other factors might be mentioned: for example, improved status of women, increasing number of activities open to women, increased desire to give children an education, and so on. See Part II of the UN document cited in note 53.
The effect of urbanization is at two levels. In the first place, the economic advantage of children is less in urban areas compared to rural areas. Thus where on a farm a large family is frequently an economic asset in that it reduces the necessity of employing outside labor, in urban areas, where most of the population are employees, children have low earning potential and a high cost. Given the extent therefore that families plan their size, the purely economic considerations would tend to make families smaller in towns and cities than in rural areas. Also it is frequently emphasized that urban dwelling increases the awareness of alternative outlets for income. It becomes evident that increased family size may be achieved only at the expense of forgoing certain (other) desirable durable assets. The result seems to be that the advantages of the other assets outweigh the advantages of a large number of children.

In the second place urbanization results in increased awareness of the need and capacity to limit family size. This is true for several reasons. Information circulates more easily in urban than rural areas, vertical social and economic mobility is greater, and a greater degree of social flexibility in cities tends to permit a more rapid rate of change and adaptation than does the social rigidity that characterizes the rural areas of almost all countries. The relative greater social fluidity not only permits but encourages urban residents to change all their habits—including reproductive habits—in such a way that they become more nearly consistent with the existing social and economic
environment. As such environmental factors discourage large families in cities we expect the response of increased urbanization to be in the form of a reduced birth rate.

Education's role is similar to that of urbanization outlined in the previous paragraph. There seems little doubt but that education results in persons approaching all problems—including marriage and child bearing—in terms of a more careful appraisal of alternative lines of action, and the result of this for family size and population growth is that marriage occurs at a later age and family size is reduced. Since the chief factor that postpones marriage seems to be economic uncertainty, it may be that the elimination of the fear of unemployment, poor housing, and the like will tend to lower the average age of marriage and this in turn may lead to a larger number of children. However, if it is accepted that the effect of education on the birth rate is to make family size the result of a conscious examination of the effects, it seems safe to say that for most countries of the world increased education will result in a reduction in the birth rate. In those areas where it does not, we may conclude that a rising birth rate will have no negative effect on the rate of growth of per capita output.

The third factor referred to above, occupation, may be quickly disposed of. The literature leans to the point of view that clerical workers, professional workers, and workers in "tertiary" industry in general have a lower birth rate than workers in "primary" activities.
The explanation is essentially the same as that with respect to the urban-rural argument. Farm life offers an economy wherein children can begin at a very early age to earn an income; the same is not true with respect to service industries. If economic growth is accompanied by an increase in the proportion of the population engaged in activities other than agriculture and mining, then this would result in a tendency for the rate of growth of population of the society as a whole to decline.

The proposition that the birth rate is affected by the death rate rests on a simple assumption as to the behavior of parents. There is evidence to the effect that parents think in terms of the number of children they wish to raise to adulthood, and then have the number necessary to achieve an acceptable probability of raising the desired number to maturity. Evidently then if the death rate falls--especially if infant mortality declines--this fact should result in a decline in birth rate. This point gains added merit when it is recalled that income growth is also accompanied by increased awareness of methods of birth control.

The effect of socio-economic status is not so easily spelled out as were the effects of income growth on the birth rate. The evidence is consistent with the hypothesis that the birth rate is lower in

58 Several societies think in terms, not of total number of children, but of the desired number of sons. This complicates matters considerably.
social classes that are generally accepted as "higher" than they are in those classes generally recognized as "low." Historical evidence suggests that this has been the case throughout most of recent time in almost all societies. It is not clear however what the net effect of economic growth is in this connection. To the extent that a rising per capita income results in a larger proportion of the population moving into the "higher" classes, the rate of growth of population will tend to decline. To the extent that any socio-economic status is only a relative notion, and approximately the same proportion of the population is always in the "higher" class, then a rising per capita income may have little if any effect on the rate of growth of population because of this factor.

However it does seem that there is some evidence that the "lower" groups seek to emulate the higher classes insofar as they have knowledge of the behavior of the latter group. For reasons already referred to a rising per capita income is accompanied by wider and greater availability of information about all aspects of society. It may be argued therefore that a rising per capita income results in facilitating the emulation of low natality rate groups by the high natality rate groups. Something of this "demonstration effect" may have prevailed in some Western European countries and the United States. Even more than the other parts of this theory of population growth, this factor is difficult to isolate conceptually and perhaps impossible to measure.
All of these arguments, to a more or less degree, require acceptance of the earlier discussion as to the effect of rising per capita incomes on the composition of output and the changes in economic organization and institutions that accompany these changes in output. If economic growth results in a contrary evolutionary pattern—e.g., if urbanization decreases rather than increases—then evidently the effect on the rate of growth of population of a rising per capita income will be other than that that we have suggested here. And as we have noted there are many demographers and economists with good theoretical arguments and acceptable empirical materials who question each step in our argument, and in questioning a single step they also question the whole journey. This will be true in other places as well.

The factors affecting mortality are much more specific and immediate than those affecting the birth rate. There appears to be no modern society where the introduction of life-saving changes are unacceptable once the population is aware of their effectiveness. On the other hand, the relationship between income and the birth rate is anything but sure, and certainly the factors isolated above will work themselves out only very slowly compared to the speed with which the impact on the death rate is felt. The result is that in societies where income is so low that the advantages of medical and sanitation facilities are not fully exploited, and so low that a large part of the population is ill-housed and ill-clothed that society is subjected to
a potentially high rate of growth of population. However if per capita income is rising and if the structural changes outlined above accompany the income growth, then most modern authors seem to agree that the rate of population growth will decline at some point. The result is that we may expect population and the labor force to grow at a declining percentage rate over very long periods of time. It may be useful to remind ourselves that shocks to the system may temporarily distort this pattern. Such things as wars, unusually severe and long depressions or upturns, and major new discoveries of arable land may in effect change the location and shape of the growth curve. But once the shock has been absorbed by the system the more lasting factors discussed above will tend to dominate the behavior of population growth again.

The behavior of population will also affect the age composition of the population and hence the ratio of the labor force to the population.

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59 Harvey Leibenstein, A Theory of Economic-Demographic Development (Princeton: Princeton University Press, 1954) presents an analysis of the difficulties a country may have in breaking out of the Malthusian trap because of the possibility of rapid rates of growth of population in the early stages of growth. Leibenstein has little to say in the way of a theory of population growth however, except relating it in an unspecified way to income.

60 Many overpopulated, underdeveloped countries are faced with a fearsome problem in the fact that they have such a high population growth potential to overcome. The United Nations report suggests that in countries where the birth rate has only recently begun to decline, it has declined more rapidly than in those countries where its decline began in the first half of the 19th century. This evidence is perhaps encouraging.
may change. Most low income countries have a relatively low labor force-population ratio due to the high infant adolescent mortality rate. Where population increases result from a fall in the mortality rate due to a rising standard of living the L/P ratio will tend to rise, and this of course should facilitate raising per capita income. On the other hand as the birth rate begins to fall as per capita income continues to rise, the average age of the population will rise and may even reach the point where L/P declines because such a large part of the population is in the retired category. Thus if medical science increases life expectancy from 65 to 90 years without increasing the interval during which a person is able to work then evidently with a slowly falling birth rate, the L/P ratio will tend to fall.

These remarks suggest a general evolutionary pattern of population growth and age composition that seems to accompany the growth of real per capita income. The population tends to pass from a high growth potential characterized by a constant birth rate and a rapidly falling death rate to a situation with a low growth potential where both the birth rate and the death rate are very low, with the former slightly larger but falling. The L/P ratio tends to be relatively low in high growth potential situation, then begins to rise as the mortality rate falls, and possibly to fall again as the population achieves greater and greater life expectancy. We shall assume in what follows that

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61 This behavior of the L/P ratio may be complicated by the increase in the number of women in the labor force. This number—in terms of
this evolutionary pattern prevails, and consider the consequences of such a pattern upon the functioning of the system in general and in particular upon the capacity of the system to generate a positive rate of growth of *per capita* income. It is of course a simple matter to trace out the effect on *per capita* income growth of this pattern of population behavior if we assume that there are no other repercussions on the system. *Per capita* income will tend to rise slowly—possibly decline—at first and then as population growth falls off and the labor force-population ratio rises *per capita* income will tend to rise more and more rapidly. If in later stages L/P falls again, this will serve as a braking factor on the behavior of *per capita* income. But obviously the question of interest is to seek to isolate any possible effects of our hypothesized population behavior on other parameters of our income growth model and to incorporate these effects into the explanation of the time path of *per capita* income.

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the total labor force—probably rises along with *per capita* income, although possibly not because *per capita* income rises.
B. The Saving-Income Ratio

The saving function in Part I was written in as simple a way as possible; saving was made to depend only upon current income, and the marginal and average propensity to save were assumed to and constant through time. The problem in this section is to assume the saving ratio to a variable, and to seek to isolate those factors that determine its time path. It is convenient however to write the equation as \( S = s(Y - m) \) rather than as simply \( S = sY \) as earlier.\(^6^2\) This is useful because there is reason to believe that the behavior of \( m \) is of as much relevance to a long-run problem as is the behavior of \( s \).

There are two problems in connection with the behavior of \( S/Y \) that it seems useful to keep separate although perhaps the distinction is to some degree artificial. In the first place in any economy where the majority of the population receive an income well above subsistence why does the saving-income ratio hover around the value it does rather than (say) twice as high or half as high? The second part of the problem is that referred to above, namely how does \( S/Y \) change as an economy experiences economic growth? This latter question will be discussed first, and we shall consider individual and corporate savings separately.

The population pattern that we have accepted may have some effect on the behavior of S/Y. The rise in the proportion of the population in the labor force that accompanies the early stages of income growth may have a stimulating effect on the propensity to save, and similarly the rise in the proportion of the population who have retired from the labor force in later stages of income growth will have a depressing effect on the capacity and willingness to save out of a given income. Persons 65 and over and children under 15 or so normally consume more than they produce, and the suggestion is that the larger these dissaving groups are relative to the total population, the smaller will be the capacity of the economy to save. Under these assumptions we would expect S/Y to rise as the population characteristic of the country changed from a relatively low L/P ratio to a higher one and then to decline as the L/P ratio falls in response to an aging population. The maximum S/Y ratio—so far as the population effect is concerned—seems to be reached when the proportion of the population between the ages 40-55 is a maximum. The argument is simply that by middle age most families are established—houses and furniture are bought, children are productive, and other major consumption expenditures have been made—and retirement begins to come well within the time horizon; thus


64 Cf. the discussion by Irwin Friend, Individuals' Saving (New York: John Wiley and Sons, 1955), pp. 137 ff.
the incentive to make consumption expenditures is falling and the incentive to save is rising with the obvious result that the proportion of saving to income rises.

Another effect of importance arising out of population behavior concerns the composition of output. In the high growth potential situation with children composing a relatively large proportion of the population, a major share of expenditures on what are usually classified as consumption items have a significant effect on the capacity of the system to produce. Thus expenditures on school services, health facilities, and the like designed to facilitate the training of young people have an effect comparable to investment expenditures with very long gestation periods. At the end of such a gestation period the workers, the training, and the improved health are, in effect, capital equipment and should increase capacity in some prescribed way.

Similarly in a population with an age structure that yields a significant proportion of the population over (say) 65, expenditures on health and welfare facilities will have no such long-run effects on the capacity of the system. In two situations alike with respect to the rate of saving, the rate of income, and the $k$ and $b$ matrix but one with a high growth potential population and the other at the opposite end with a low growth potential, the capacity of the first system is rising more rapidly than that of the second. Given that income of the society is such that it allows expenditures on school services and children's health facilities, the capacity rate of growth
will tend to rise as the population follows the path from low average age, high growth potential to one where the average age is older and a smaller proportion of consumption expenditures are of the kind to affect capacity. The rate of growth of capacity will then tend to decline as the age composition of the population becomes such that an increasing proportion of the population are in the older age brackets.

There are several other (potential) propositions about the behavior of $S/Y$ that can be deduced from the growth process outlined above.

We have shown reason to believe that a long period of rising per capita income results in a shift in the occupational distribution of workers so that the relative number of workers in agricultural activities declines. And also the over-all number of entrepreneurs—including farmers—also will decline relative to other groups in the economy. Both farmers and other individual entrepreneurs tend in general to save a larger proportion of their income than do non-farmers and employees. The farmer is in general less in contact with new objects and new ideas than his urban-dwelling counterpart, and perhaps also is under less pressure to match his neighbors in consumption habits.

For the entrepreneur, the argument is usually stated in terms of incentives to save: since the economic life and professional and social prestige of the entrepreneur depend to a large degree upon the success of his business enterprise, he is under greater pressure to accumulate capital.

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65 The argument could well be set in terms of urban and non-urban dwelling units.
to assure its success than he is to achieve recognition by his consumption habits. This 'entrepreneur effect' may well be washed out by a 'profit effect' to be discussed in a moment.

Among the service activities that seem to respond to a rising per capita income are insurance companies, saving banks, and other financial institutions that provide available and trustworthy depositories for savings. This may lead to actual increases in the proportion of income saved, and surely will lead to a more effective utilization of the saving that does occur. In either case the resources made available for investment will be increased. The effect of these developments, however, has a definite ceiling, and is likely to be of much greater relevance early in the growth process than after per capita income has risen to a relatively high level. It seems clear for example that improved saving institutions will increase the amount of resources that may be put at the disposal of investors in a country like India or Ecuador, but it is doubtful if the same is true for (say) the United States and the United Kingdom or has been true in recent years.

The hypotheses that have received the most attention have of course been that $S/Y$ is a rising function of the level of per capita income, and that the greater the inequality in the size distribution of a given level of income the greater the amount of savings out of that income.
Available data show rather clearly that at a given level of national income persons in the higher income brackets save a larger proportion of their income than do those in the lower income groups, and from this empirical evidence it is tempting to go on to the proposition that as per capita income rises all along the line, total saving will rise relative to income. But this is a questionable jump. If we rule out cyclical effects and lags then this proposition means in effect that "wants" are more nearly satisfied at higher income levels than at lower. But surely within the range of income that now appears attainable, this proposition has little to recommend it. Historical experience suggests rather that "wants" vary with the power to satisfy them, and tend to increase with knowledge of new products and new services.\(^66\) This in turn implies that "wants" do not constitute a definite, finite quantity, but rather they are a function of the extent of our capacity to exploit our economic resources. This becomes especially true when improved communication, transportation, and advertising make possible the rapid spread of information about new consumer goods and their accessibility in all parts of the world.

Persons in the higher income brackets at a given level of income do save a larger share of their income than the lower income groups,\(^66\) Qualifications due to changes in values and/or social structure will be mentioned later.
but this is explained on grounds other than mere magnitude of income. Most of the highest income recipients are entrepreneurs rather than employees and, as we have noted, this tends to result in a high $S/Y$, and probably the age factor works in this direction also. It has also been suggested that higher income groups lead the way in creating new wants and in finding ways to satisfy them. Higher income groups create the pattern of consumption, and this in turn is emulated by lower income groups as their income rises enough to permit it. This has led to the rather widely accepted view that an individual's propensity to consume (save) depends upon his rank in the income scale, given his attitude toward competitive imitation of the pacesetters in consumption. 67

The effect of this set of arguments is sure to move the saving-income curve to the right, i.e., to increase $a$. The effect on the slope of the curve, however, seems to depend much more on the effect of income growth on the size distribution of income rather than upon its actual level. If at any level of income higher income groups save a larger proportion of their income than do low income groups, 68


68 It seems unlikely that the curve moves continuously and at an even rate, but it is difficult to formulate the exact way in which it does move.
the larger the share of income going to a given percentage of the population the larger will be the overall S/Y ratio. And if as the system develops—as per capita rises—income becomes more unequally distributed then this will contribute to a rising proportion of income saved. It appears necessary therefore to examine the behavior of income distribution by size as the system achieves higher and higher per capita income before a final conclusion can be drawn as to the time path of individuals' savings-income ratio.

Available evidence is such that few if any propositions can be accepted with a clear conscious, and here more than elsewhere we are limited to a simple, inconclusive discussion of the pros and cons.

We may deduce one proposition from our previous analysis. Inequality in income distribution appears to be significantly less in rural, agricultural areas than in urban areas and, as we have seen, the evidence suggests that increased urbanization is a feature of a long term growth of per capita income. The increased inequality may be explained in terms of the larger variety of occupations in urban areas, and the greater concentration of ownership of earning assets. Thus the increasing weight of the urban, relative to the rural, population should contribute to an over-all increase in inequality.

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70 It could conceivably be offset by an increase in rural income relative to urban income but this is unlikely.
As we have observed earlier a very large proportion of total saving in any country is performed by the highest income groups. In the United States the upper ten per cent of income recipients account for almost the entire amount of saving.\textsuperscript{71} The cumulative effect of this inequality in saving would be for the upper income groups to gain an increasing proportion of income earning assets, and this in turn should lead to further inequality in income distribution.\textsuperscript{72}

There are two other factors that are frequently mentioned as accompanying economic growth and acting to increase the inequality of income distribution: one concerns the extent of monopoly and the other the behavior of innovations.

Several writers have suggested that the degree of monopoly may increase as income growth continues,\textsuperscript{73} and that increasing monopoly contributes to a rising share of income going to profits. Monopoly might be expected to increase with income growth for several reasons.


\textsuperscript{72}This point is developed in detail by Kuznets in the paper cited in note 69.

\textsuperscript{73}The degree of monopoly is usually defined in terms of the relation between price and marginal cost. The writers referred to include Joan Robinson, Kalecki, Schumpeter, Domar, Steindl, and many others. G. Warren Nutter has attempted to measure changes in the extent of monopoly over time in his The Extent of Enterprise Monopoly in the United States, 1899-1939, (Chicago: University of Chicago Press 1951).
The technological requirements of large scale industry tend to raise the minimum (and optimum) size of the firm to a point that limits the number of firms to the extent that each has a significant effect on the market price. This high cost of entry constitutes a barrier to the customary competitive process by which an excess of price over marginal cost is competed away. Similarly it is frequently observed that by means of advertising, price competition is limited and replaced by product competition which also tends to maintain and even increase profit margins. And finally it is necessary to mention the tendency to amalgamation and cartellization that seems to inhere in a system of profit-seeking enterprises. The effect of monopoly is of especial importance with respect to the behavior of the $S/Y$ ratio as it results not only in growing inequality in income distribution, but that inequality is also reflected in increased profits. And for reasons previously referred to profit earners tend to save more than those whose source of income is chiefly wages and salaries or land.  

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74 See B. S. Keinstead, The Theory of Economic Change (Toronto: The MacMillan Company of Canada, 1948), Chapter XI.

The empirical validity of these several arguments is difficult to assess. Although much has been written on the subject it is no simple matter to find an hypothesis that seems to represent prevailing doctrine, or data to support any hypothesis. Few persons would argue that an increasing degree of monopoly is a necessary companion with growth, but perhaps it is true that most western countries have experienced increasing monopoly pressure in the course of their development. Technological development and the difficulties created thereby for the entry—or the threat of entry—of new firms is probably the strongest argument supporting the proposition that monopoly power increases as income grows, and seems more nearly universally applicable than any other argument. 76 But even if increasing monopolization does accompany growth it does not necessarily follow that there are not antidotes to the effect of monopoly on profit margins. Both Mrs. Robinson and Mr. Kalecki put considerable confidence in the capacity of labor unions to limit the profit margins of a firm despite its monopolistic power in its selling markets. If the labor unions are able to achieve this result, then the effect of monopolization on income distribution may be nil or at least greatly reduced.

The effect of innovations on income distribution depends upon the accepted hypothesis as to the pattern that innovations follow through time.

76 Whether monopoly does in fact increase by virtue of the growth process depends upon government action in controlling it. The question here is not whether the government should or should not limit monopoly, but rather whether there are factors in the structural changes accompanying growth that produce a climate increasingly favorable to monopolization.
Possible hypotheses will be examined in the next section. Without defending the position we merely assert here that there is no very good reason to believe that innovations have anything but a neutral effect on income distribution.

Each argument discussed above unhappily may be matched by an argument supporting the proposition that the growth process creates forces that lead to income being more equally distributed.

In his paper cited in note 69 Kuznets discusses several such factors. Evidently the actions of government has in many cases resulted in increasing equality. Such practices as inheritance and income taxes, unemployment insurance, social security, etc., will tend to redistribute income in favor of the lower income groups. However, there is no good reason to believe that this particular behavior on the part of the government is in any sense a characteristic of a growing economy. Examples could easily be provided in which government action was the opposite. Therefore it is impossible to count on such political developments as a continuing antidote to the forces contributing to increasing inequality in income distribution.

Other factors may be mentioned that may be considered more reliable. We have argued above that growth is accompanied by a specific change in the pattern of demand and hence in the composition of output. This has meant that the industries dominating the growth of the economy tend to change, and the source of the largest returns on capital change hands. The result seems to be that occupancy in the top income
brackets is a changing rather than cumulative process. As long as a changing structure accompanies growth, and as long as there is vertical freedom of movement in the system, this movement in and out of the upper brackets may tend to prevent the cumulative factors noted above from working themselves out. 77

Other long-run forces apparently accompanying growth and leading to decreasing inequality in size distribution of income may be briefly mentioned. Wider knowledge of the labor market and increased mobility of workers tends to reduce wage differentials among comparable jobs and also throughout the economy. The development of extensive use of the corporate form of business enterprise and the concomitant development of a stock market may result in a widening distribution of the ownership of earning assets. And finally the development of saving institutions insurance companies, and pension plans work toward averaging income over a longer period of time, and empirical and a priori evidence support the proposition that life time distribution of income is less unequal than that for a given year. 78

77 Kuznets in his paper cited in note 69 discusses this. He also points out that there is considerable difficulty in passing on to one's heirs the abilities that result in high incomes from personal services (e.g., acting, singing, etc.).

What can be said in summary about the behavior of income distribution as per capita income grows? It would seem that the implication of our arguments suggest that in the early stages of growth the factors making for increasing inequality are likely to prevail. Especially when the urbanization movement gets underway and manufacturing activities begin to develop it appears that monopoly, technology, and profit behavior all favor the higher income groups. And it is not until income has reached comparatively high levels that distribution equalizing factors begin to be effective. If this conjecture is right—and it is only a conjecture—then we may expect income inequality to increase initially, then to level off, and finally to experience a long period of slow decline as income per capita rises. To the extent that the distribution of income affects \( S/Y \), we expect \( S/Y \) to tend to behave in a similar way. This would mean that as income rises and the saving-income curve moves to the right, it will become steeper at first and then gradually become less and less steep; i.e., in our equation \( S \) rises and then declines as \( Y \) and \( m \) increase.

A final factor in accounting for the behavior of \( S/Y \) through time that must be mentioned is the rate of interest. The effect of

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79 Harry G. Johnson has devised a case where increased income inequality leads to increased consumption even with customary assumptions as to the consumption habits of the several income groups. See his "The Macro-Economics of Income Redistribution," in Alan T. Peacock (editor) Income Redistribution and Social Policy (London: Jonathan Cape, 1954).
changes in the rate of interest on saving is of course now customarily doubted. If we accept the proposition that the rate of interest tends to decline secularly as per capita income rises, this fact will surely result in some people saving more and others less (independent of the income effect) depending upon their motives for saving. It may be noted however that total interest payments may be sufficiently large so that a change in interest rates affects saving via its effect on the distribution of income. 80 Thus a secular decline in interest rates occurring simultaneously with a rising per capita income would result in the share of interest return in total product being less than it would have been had interest rates remained constant. Since most interest payments go to higher income groups, this phenomenon will tend to reduce income inequality, and therefore saving. Once more it may be observed that such an interest rate effect on saving, to the extent that it is effective at all, would be much more relevant in areas where interest rates were high relatively to labor costs and could therefore decline to a degree that the distribution effect may be expected to be of significant proportions. As the interest rate structure becomes so low that even over a long period of time it is able to change only by a couple of percentage points or so, it is doubtful if much attention need be given even to this effect of interest behavior on saving.

80 This has been discussed by Harrod and Hamberg in their works previously cited.
A mere list of factors that might affect changes in individuals' saving behavior through time is not very revealing unless some general proposition emerges, and conclusions are not easy to find in connection with saving habits. However the following hypothesis seems worthy of attention: The factors contributing to a rising $S/Y$ are strongest in the earlier stages of industrialization, and as the economic system begins to change from an essentially agricultural society to one where other economic pursuits are increasingly important the saving-income ratio will rise. This means that the income distribution effect due to monopoly power and technology outweighs the effect of increased urbanization and the effect of occupational status. However, as income continues to rise, those factors making for a decreasing $S/Y$ become dominant and saving as a proportion of income begins to taper off and eventually to decline. This conclusion is the same as that reached when considering the effect of income distribution alone, and it may be that this is the major influence operating on $S/Y$ although surely such developments as unemployment insurance, stock markets, increased mobility, etc., have not been completely insignificant, nor more recently have taxes on profits.

The question of the determinants of corporate (and government) saving is much less explored in current literature than is individual saving, and there is little that can be said on the subject here.  

31 A recent study of corporate saving behavior (largely concerned with refuting the notion that the Duesenberry-Modigliani hypothesis as
The motives of corporations in saving are not clearly established, but it appears unlikely that they save without reference to investment plans. Therefore an explanation of corporate saving involves an explanation of corporate investment plans, and this is no mean task. The literature and the data do suggest one hypothesis that is of great relevance for our problem. As corporate enterprises expand and become more and more firmly established, they rely increasingly on retained earnings for additional expansion and correspondingly we expect corporate saving to rise in relation to corporate earnings. To the extent that this is true it suggests that just about the time that individuals are beginning to reduce the proportion of their income that they save, corporations are beginning to raise the proportion of their income that they save.

If we accept this last proposition—that the observed constancy of total saving over total income is due to diverse movements in individuals and corporation saving-income ratio—our previous discussion suggests that this is of considerable relevance in understanding the growth process. A decreasing proportion of total saving will be available for new industries, and an increasing proportion available for old established firms. We have argued that to a very large extent

to individual saving habits is equally applicable to corporations.

the maintenance of a constant rate of growth of total output depends upon the constant emergence of new firms (or at least new products), and the gradual reduction of the rate of uncommitted savings results in a drying up of finance available to new industries. The result may be to impede the establishment of new firms that supply the necessary lift to the system as old industries slow down in their rate of expansion. The tendency released by this trend will be to slow down the system's of over-all rate of growth simply because available finance is in inadequate supply to industries that can experience the most rapid rate of growth.

The practical importance of this consideration is difficult to appraise. Many large firms are the source of new products and in this event undistributed profits would facilitate their development, but of course it is easy to find examples where established firms acted as barriers to the introduction of new products. It is almost impossible to find examples of industries that never developed solely because of lack of finance, but in a highly developed economy it is surely a very small number of potentially profitable firms that never see the light of day because they are unable to gain access to the necessary finance. Some further observations on this point will occur in the section on aggregative demand.

We have been concerned to this point with an attempt to explain changes in the saving income ratio that accompany economic growth.

82 Cf. Professor Lewis' book cited in note 75.
We have yet to ask the question why do such movements occur in the general neighborhood of (say) five to twenty per cent rather than twice those values. It is clear enough why a society that is barely able to earn subsistence saves little or nothing. And there is no great problem involved in understanding why, as income rises above subsistence, the population is more interested in becoming comfortable than in saving. And changes in the proportion of income saved of the order of ten or fifteen percentage points may well be explained in terms of those factors already discussed. But to explain why, in those countries where it would be possible to enjoy a relatively high level of consumption and still save half or more of total income, only twelve to twenty per cent is, in fact, saved it appears necessary to introduce the general pattern of mores and the social structure that govern all aspects of social behavior.

This of course is what Professor Rostow seeks to do with his propensity to consume. As we have observed Rostow's general solution is such that it sheds very little specific light on this problem. Few contemporary authors have addressed themselves to the issue in any detail, and our discussion here will be brief.

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83 The Process of Economic Growth, Chapters 1-3.
The most specific theory in this connection is that of W. Arthur Lewis. Professor Lewis argues that the chief explanatory factor is the class structure of society, in particular the extent to which that structure is dominated by "capitalists." Saving, says Professor Lewis, is not significantly affected by income distribution as such but rather by the proportion of income going to profits. As an economic system develops—because of the change in the composition of output—the role of the capitalist increases in importance. The capitalist is a heavy saver because (as we noted above) he has a good reason to save and does not need to engage in conspicuous consumption to impress his neighbors. The profit maker knows that his power lies in increased command over finance, and rather than seeking to increase his land holdings, or his political prestige, or his religious standing, he seeks to accumulate more and more productive assets. To do this he must save. But the capitalist class cannot grow indefinitely, and as it becomes larger real wage rates begin to rise, profit rates show a leveling off or a declining tendency and the incentive and capacity on the part of the capitalist to accumulate further is reduced. This analysis leads to a pattern of saving in which $S/Y$ rises as the economy develops from agriculture dominated (run by peasants and absentee landlords) to industry dominated (run by capitalists). When the

84 Op. cit., Chapter V.
capitalist sector has reached its optimum size—determined largely by what happens to real wage rates—it stops expanding, and the S/Y ratio will then be at that level around which it moves in response to the behavior of the explanatory factors discussed above.

Such a theory places considerable weight on the evolution of a capitalist class. Professor Lewis implies that given the opportunities for profitable investment such a class will emerge to exploit them, although at the same time he recognizes that social and political institutions of all kinds can help or hinder the development of such a class. Much of the literature on the problems of underdeveloped countries emphasizes the lack of entrepreneurs and the problems created thereby, but little attention has been given to formalizing the conditions necessary for the creation and perpetuation of a continuing supply of entrepreneurial talent. It is possible of course to accept the general hypothesis of Professor Lewis and not ignore other social characteristics that may influence the general level of saving. It would be useful indeed if we could simply incorporate into our model the established relationships between saving and religion, saving and family life, saving and the governmental system, but in this area the literature is unrevealing, and truistic generalities are all that are available.

To this point we have sought to examine the sources of saving and the behavior of S/Y through time, and have ignored the more commonly discussed question as to whether or not savings impose a barrier to
growth or encourage it. The general discussion of this question will be taken up in the section on demand, however, one remark does seem worth making here as it flows out of our discussion to this point. Most economists seem agreed that in a short-run problem, private and public investment provide the chief source of impetus in moving the system while consumption is essentially passive. In the context of a long-run analysis these roles may be reversed. Not in the sense that saving releases resources, which in turn reduce the interest rates and so increases investment; but rather in the sense that pressures on consumption are such that the consumption function is constantly moving upward, and it is investment that responds to this shift in consumption with the ceiling on investment being imposed by the rate of saving. We may say the same thing in other words: There are forces in a growing society—urbanization, new products, etc.—that result in a secular trend upward in the consumption function. This movement creates new and increasing profit opportunities and so encourages capital accumulation. The investment process then in effect creates its own saving.

This general position finds much to support it in the writings of Kuznets, Duesenberry, Goodwin, and others and additional elaboration may conveniently be postponed until later.
C. The Capital-Output Ratio

We turn now to the set of problems involved in explaining the time path of the productivity of capital, i.e., the time path of the k's in our model. We have already considered one aspect of this general problem in the discussion of population. There we argued that although population growth entered the per capita income growth equation negatively, changes in k are not independent of changes in r, and therefore the rate of growth of per capita income may tend to decrease because of the failure of population to grow at a sufficiently rapid rate. That discussion was carried on in the context of the assumption of no technological change, and also no attention was given to the problem of how the system shifted to more capital intensive processes.

In this section we consider these two issues as well as other factors that may affect the behavior of k over time.

First consider the process by which an economy becomes more capital intensive without innovations. Since we have assumed a positive y', capital is increasing relative to labor and so also an increase in the capital-output ratio. To effect this shift in the productive process used requires one of two possible events. The composition

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85 By a change in process we mean the switching to known techniques of production using merely a different combination of inputs from that currently in use. Since few firms know their production surface in any detail, the distinction between this kind of a change in technique and a change in technology (where it is assumed that the production surface itself changes) is of doubtful practical importance. It is however useful theoretically.
of output must change in such a way that a larger proportion of output is devoted to products requiring relatively more capital per unit of output and per unit of labor. The other event would be the use of relatively more capital in the input mix. The composition of output will change as income rises and this change will affect the capital output ratio, but, as we shall see in a moment, there is no reason to expect changes in composition to occur merely because the relative supply of inputs has changed. This then puts the burden of adaptation on changes in the cost of capital relative to the cost of labor so the producers will seek to use more capital in the input mix.

In earlier less complicated days such an adaptation process posed no problem at all. The rate of interest declined as capital accumulated reducing the price of time, and so encouraging the use of more capitalistic techniques. Now few economists would place such faith in the rate of interest in performing this task in the more advanced countries of the world. The rate of interest is very low and changes very little, and possibly not at all in response to changes in the supply of capital. The empirical evidence also supports the position that the rate of interest is ineffective in this respect. Other costs of capital are very difficult to change relative to labor costs because labor costs are of such importance in these other costs. Thus in a highly developed economy there is no reason to
expect labor costs in capital goods industries to behave otherwise than as labor costs throughout the economy. A change in wage rates then tends to affect capital costs to about the same extent that it affects labor costs, and therefore affords no incentive to alter the input mix. It would appear then that modern theory relies heavily upon technological innovations to supply the mechanism by which the system becomes more mechanized.

The situation may be quite different in the less developed countries. In such societies the rates of interest are generally very high compared to (say) the United States and the United Kingdom and therefore may be of considerable importance—even in the short run—in determining the technique used in the productive process, and a declining rate of interest may stimulate the use of relatively more capital as it becomes available. Similarly we may argue that as an economy develops from a rather primitive state to an advanced state the cost of production of capital equipment may be expected to decline relatively to other costs. The reason for this is to be found in the increased availability of skilled labor and entrepreneurial talent—essential for the construction of capital equipment—compared with other types of labor. For these reasons we may conclude that in underdeveloped, but developing, economies changes in the relative prices of inputs do constitute an effective means of producing changes in the input mix.

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86 This point is made by several writers, see for example Mrs. Robinson's paper referred to in note 13.
However, even if the adjustment process to the rising $K/L$ ratio is made smoothly, the rate of growth of income (total and per capita) must at some point decline. This follows from the fact that as capital becomes more and more plentiful relative to labor, the substitutability between capital and labor declines, and the increment of output attributable to increments of capital--beyond that matched by an equal increment of labor--must fall. As this occurs $k$ will of course rise, and this results in the rate of growth of income declining. This means that even though a rate of growth of capital greater than the rate of growth of population is necessary for per capita income to be rising, this situation itself leads to conditions that result in that rate of growth falling. Furthermore since the profit rate equals the share of income going to capital over the capital-output ratio ($=q/k$), as $k$ rises the rate of return on capital will fall unless there is a change in the distribution of income between capital and labor. Therefore, innovations must be introduced into our model for three reasons. First, they are necessary to effect the shift in the productive process in order to use the increasing relative amounts of capital. Second, they are necessary

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88 Let $Q$ be the total return to capital and $K$ the capital stock. Then $Q/K$ is the profit rate, and dividing numerator and denominator by $Y$ we obviously get $q/k$. 
to maintain $y'$ positive. And third a particular pattern of innovations is necessary to keep the rate of return on capital at values acceptable to investors. We consider now the problem of innovations.

An innovation is usually defined as a change in the relationship between inputs and output, i.e., in the production function. Innovations therefore have three effects. First they evidently effect the rate of output with given inputs. We may therefore define the rate of innovations $-n-$ as the percentage rate of increase in output that would occur if inputs remain constant. Innovations also affect the coefficients in the production function, and thirdly by virtue of the effect on the input coefficients they also produce changes in the distribution of the total product and the profit rate.

We are concerned at this point with the effect of changes in technical knowledge on the behavior of $y'$ and $k$, and we will consider in the section on aggregative demand the effect on the profit rate. The usual approach to this problem is to set up a scheme of classifying innovations, and then to trace out the consequences of the various types of innovations falling within the several categories.

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89 The proportion of the total product going to capital, $q$, is $\frac{\partial y}{\partial k}$ and that going to labor is $\frac{\partial y}{\partial L}$. These are commonly referred to as the elasticity of productivity with respect to capital and labor respectively.

90 Such classification schemes probably began with Hicks in his The Theory of Wages, (London: MacMillan and Co. 1932). Mrs. Robinson, R. F. Harrod, William Fellner, Yule Brozen and others have made extensive examinations of the implications of various kinds of innovations.
It is necessary to content ourselves here with the most frequently used system of classification, that of capital saving, capital using, and neutral.

The discussion is facilitated by making use of the following diagram adopted from Mrs. Robinson, and to simplify further we assume that the rate of growth of population is zero. With no change in technical knowledge the behavior of output will be as indicated by curve 1. The slope of this curve is the elasticity of productivity and the share of output going to capital, q. If capital accumulation is proceeding at the percentage rate r, then at point F output is growing at a rate r q. Since q is almost certainly less than unity, r q is less than r and capital is growing more rapidly than output which of course contributes to a rising capital output ratio.


92 This assumption is eliminated later.
The effect of introducing a constant rate of innovations, is reflected by the entire curve moving up at the given rate, \( n \). Now the rate of growth of output is \( rq + n \). Consider for the moment a single innovation that changes the effective curve from that marked 1 to that marked 2. If the curve moves up isoelastically at all points, then the innovation may be referred to as neutral since the only effect on the production function is one of scale. What happens to \( k \) in this instance depends upon the value of \( n \).

In order for \( k \) to remain constant and so contribute to a stable rate of growth, it is necessary for the innovation effect to cancel the effect of \( q \) being less than unity. Therefore if \( n = r - rq \), i.e., if \( n/r = 1 - q \) then output and capital stock will be growing at the same percentage rate and evidently the capital-output ratio will remain constant. If \( n/r > 1 - q \) \( k \) will have declined, and the rate of growth of output tend to rise. And if \( n/r < 1 - q \) then evidently \( k \) will rise and the rate of growth of output tend to fall.

If curve 1 moves up so that at every point on curve 2 \( q \) is larger than the corresponding point on curve 1, the innovation may appropriately be called capital using. In this event the innovation effect on \( q \) must be included to determine the net effect on output, so now the rate of growth is \( rq + rdq + n \). If \( k \) is to remain constant then the equality \( \frac{dq}{r} = 1-q-dq \) must obtain. Evidently if innovations are on balance capital using, the rate of innovations may be less
and \( k \) remain constant than if innovations are neutral.

If curve 1 moves up in such a way that every point on curve 2 has a smaller elasticity, the innovation may be called capital saving. Now the rate of growth of capacity is \( r - rdq + n \), and to keep a constant \( k \) it is necessary that \( \frac{n}{r} = 1-q + dq \). In this case \( n \) must be larger than if innovations were on balance neutral, and \textit{a fortiori} than if they were capital using.

It seems reasonable to say that \( q \) can approach neither zero nor unity indefinitely, but must remain in a range well above zero and well below unity. If this is an acceptable proposition then it would appear that only if innovations were on balance neutral would the system not run into interval difficulties due to \( q \) getting too near zero or unity. But there is a further difficulty which we could ignore to this point because we were concentrating attention on only two curves 1 and 2, and only a slight movement along the capital axis. But if we consider a long period of time, then there will be a substantial movement to the right along the capital axis, and if this occurs it seems evident that \( q \) must decline due to the rising capital-labor ratio. The argument that \( q \) must at some point decline is essentially the same kind of argument that leads us to the opinion that the marginal product curve of any input is negatively sloped from left to right.
Now if q is declining as the capital stock increases, the rate of innovations must be rising in order to keep k constant. The necessary rate of increase in n depends upon the rate of fall of q and upon whether innovations are neutral, capital using, or capital saving, but in all cases it must rise or the rate of growth of capacity will tend to decline. Although we know little about the innovative process, there seems no evidence that would suggest that n has in the past or will in the future tend to rise consistently over long periods of time in any country of the world. If we rule out a rising n as being improbable to the point of being impossible, then it follows that innovations must on balance be capital using if k is to be kept from rising and the system remain internally consistent. This is to say that innovations must be such that they counteract the effect of the falling q that accompanies the rising capital labor ratio. The net effect on q of the innovation and the change in the capital-labor ratio will be to leave it approximately constant, and therefore the result is comparable to that when innovations are neutral. If n/r = 1-q then the system will go smoothly on at a constant rate of growth (insofar as the effect of k is concerned). \(^93\)

This brief statement of the necessary behavior of innovations indicates their crucial role in the growth process. They are crucial

\(^93\) This is further elaborated in the Fellner source cited in note 4.
with respect to the maintenance of the growth of income and to the maintenance of the internal consistency of relatively free economies. It is therefore especially regretful that the inventive and innovative processes are so little understood by economists. Some further remarks as to a "theory of innovations" will occur in the following section. Let us now assume that the innovation requirement is met, and consider other factors that may affect $k$ or more appropriately the matrix of $k$'s.

Two kinds of factors seem of particular relevance: the type and extent of cooperating inputs and the composition of output.

With respect to cooperating factors, we have already considered the role of labor and nothing more need be added here. The argument with respect to natural resources is simple. If there are rich and abundant resources, then evidently this will tend to make the productivity of capital high and facilitate the maintenance of the desired rate of growth. As resources become depleted then we would expect more capital to be required to create the same rate of output, therefore raising the $k$'s. In this event natural resources would have an effect comparable to a declining $K/L$ ratio, and could be treated in the same way that we treated the role of population.

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94 The point suggests a problem of importance to those underdeveloped countries lacking internally generated innovations. Technology borrowed from abroad where the need is for capital using innovations may be completely unsuited for countries which are plagued by capital shortages.
The difficulty with this approach is that "natural resources" are not a datum, but depend upon the state of technology. Objects of no economic value may become valuable because of a new invention, and similarly objects of great economic value at one point may be worthless at another time because of a change in technical knowledge. In a system where innovations are more or less regular events it is not possible to predict what happens to inputs of natural resources without a prior consideration as to the behavior of innovations. Presumably it would be possible to discuss natural resources, the capital-output ratio, and technology in somewhat the same terms that we discussed the changing I/L ratio and technology above. This might be revealing if we knew more about the inventive and innovational process in relation to natural resources, but as of now it would be mere formalism revealing few if any useful implications.

The key point however is worth keeping in mind. In any analysis of the growth process natural resources are augmentable, and must be so considered. 96

95 This point is discussed in a helpful way in the first four chapters of the revised edition of Professor A. P. Usher's History of Mechanical Inventions (Cambridge: Harvard University Press, 1954).

96 A point similar to that made in note 34 is once more applicable, this time with respect to natural resources rather than capital.
Another aspect of the cooperating input effect on the matrix of k's is concerned with the fact that 'capital' is not a homogenous factor, but rather is made up of many diverse types of machines, equipment, plants, and buildings. This is indeed one of the basic reasons for employing a multi-sector model in an analysis of growth. The result is that the productivity of new capital depends not only upon non-capital cooperating inputs, but upon existing capital as well. Any new enterprise must use the services of public utilities, highways, raw material suppliers, etc., and the extent to which such services exist and are supplied cheaply and regularly determine in a large measure the productivity of newly created capital. It seems easy enough to indicate the general proposition involved here, but it is very difficult to bring it down from a high level of abstraction to the level of practical application. The importance and nature of external economies and increasing returns to capital are further areas of the growth process that though of great relevance are difficult to pin down with confidence.

Perhaps one point may be made. In the early stages of capital accumulation, the absence of existing capital overhead is likely to be a major barrier to the realization of a satisfactory growth rate. However, it seems equally clear that there is an early limit on this interdependence effect on the growth rate. It is unlikely that in the United States (for example) there are further effects on the $k$'s to be derived by economies growing out of the interdependence of capital equipment with other capital equipment.

We may summarize this position by saying that for a system developing from a state of little or no capital to one where capital is used extensively in the productive process, the interdependence effect of capital on the $k$'s will contribute to an increasing rate of growth as capital becomes more and more plentiful up to a certain point and then the contribution becomes negligible. At this point it seems safe to apply the variable proportions argument to capital as a single factor of production.

Consider now the effects of the composition of output on the nation's capital requirements. It seems clear that the capital-output ratio is higher in agriculture than in manufacturing, if the former activity is carried on with the most modern capitalistic techniques. However, in those countries where agriculture is the dominant industry, it is likely that the capital-output ratio will be greater in manufacturing because agriculture is carried on in
such a primitive fashion. Also in a developing economy it is unlikely that agriculture will become capital intensive to any extent before it is necessary to devote resources to manufacturing enterprises. If this is correct it means that as per capita income rises to the point where the composition of output must change to include an increasing proportion of nonagriculture products, the k's will tend to rise contributing to a slowing down of the overall rate of growth.

When the economy reaches the point where it can afford public utilities, harbor facilities, and educational plants the direct effect of these expenditures is sure to raise the capital-output ratios. It seems equally acceptable however to argue that it is such capital equipment as this that contributes to external economies and therefore they may, for the system as a whole, facilitate growth especially in some long-run sense. Brief reference has been made to the development of so-called service industries as per capita income continues to rise. Prevailing opinion seems to imply that these industries are less capital using than so-called secondary activity, and this--plus the possibility of capital-saving innovations--has of course been a bulwark in the argument of several writers who are concerned about secular stagnation. If there is no demand problem--and at the moment we are assuming this--then this characteristic of 'tertiary industries' will of course tend to raise the rate of growth
of the system. The reader is reminded however of the difficulties and ambiguities associated with the concept of service industries and the corollary problem of whether there is a sequence through which an economy passes that may be appropriately classified as primary, secondary, and tertiary.

With respect to the effect of the composition of output on the k's perhaps the most important factor involved after the system becomes fairly advanced is the extent to which construction activity dominates total investment outlays. Construction in all forms requires great amounts of capital per unit of output, and therefore where this activity is carried on in a large scale the rate of growth of capacity will tend to be less that it would be if resources were devoted to (say) more textile machinery. Housing needs are related primarily to population growth and the internal movement of the population, especially that of farmers to urban areas. We therefore expect construction to be more important in a system where population is growing rapidly than in a system where it is growing slowly, and to be of greater consequence where the economy is changing from a largely rural economy to largely urban than where the urbanization process has worked itself out. For reasons already referred to we may therefore expect construction to be especially important in the early stages of growth and continue to be so during the process of urbanization. After this the housing component of total construction may be said to depend upon the shocks to the system that are reflected in changes in the rate of growth of population.
It also seems likely that the initial building of factories, public utilities, schools, and hospitals require more capita per unit of output than do extensions of these facilities after they have become integrated into the system. This leads to the view that construction requirements and capital requirements for construction are greatest when the economy is in the early stages of becoming industrialized, or perhaps more accurately when it is becoming relatively less agricultural.

Where does this leave us with respect to the time path of the matrix of k's. Even if we make specific assumptions about the behavior of innovations, is it possible to make any assertion as to the behavior of the k's of the system? The right answer would involve knowing the weights that should be attached to the factors discussed above and how these weights change through time. Unhappily we do not know these things. Empirical material on several countries suggest that for a period 1880-1950 the ratio of the total stock of capital to total output seem to remain about constant to 1920 or 1930 and then to tend to decline after that date. It is a simple matter to explain this behavior in terms of our discussion above, but caution is called for in doing so. Data on capital stocks are notoriously unreliable, and conclusions derived therefrom are equally suspect. Nevertheless it seems to be a defensible position to take to assume that capital requirements per unit of output rise as the
economy becomes relatively less agricultural and then to level off and possibly decline after employment in agricultural activity falls to 15-30 per cent. At this point further changes in the k's become dependent upon the shocks to the system reflected in population growth and technology.
IV. The Aggregative Demand Problem

To this point we have assumed the system to grow at the rate permitted by the growth of capacity, and have ignored the problem of demand. Analysis of the behavior of aggregative demand has of course been discussed in countless books and articles over the last twenty years, but despite this there does not seem to have emerged a common set of ideas that we may plug into our model. Since this problem has been so much discussed in the literature, it appears most useful to concentrate on those aspects of the problem that seem to be of most relevance in a long-run context. We shall see that for the most part these aspects can all be included under one or the other of the general headings: population growth, invention and innovation, and entrepreneurship.

The dominant opinion is clearly that investment demand is the crucial factor and provides the mainspring to growth, while consumption is passive and simply responds to income changes. Keynes assumed investment autonomous and put entire weight on it to move the system. In a recent survey article on growth theory, Professor Domar

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98 Moses Abramovitz essay on growth economics in A Survey of Contemporary Economics Vol. II, is concerned very largely with this problem.
also assumed investment autonomous. In light of this it is appropriate to begin our discussion assuming the key problem to be investment, although later this assumption itself will be challenged.

We have written the investment equation for a sector as

\[ I_{it} = b_i (X_{jt} - X_{jt-1}) \]

where \( b_i \) it is recalled, is a behavioristic and technological parameter rather than merely technological. The problem then may be defined in terms of the time path of \( b' \), and this time path we suggest is dependent to a very large extent upon the behavior of inventions and innovations and entrepreneurship through time.

We introduce as our primary behavioristic assumption the notion that investors seek to earn a rate of return on their outlay equal to that that they in a given social environment feel is suitable. We may refer to this as the equilibrium profit rate, \( E_e \), and write the actual profit rate as \( E_a \). Investment decisions then hinge on the relation between \( E_e \) and \( E_a \); if \( E_e < E_a \) this is a deterrent to further investment and if \( E_a > E_e \) evidently increased investment is encouraged. Since \( I_t \) will not become capital until period \( t+1 \), the \( b \) reflects the investor's attitudes with respect to the rate of return on the newly created capital. It can easily be seen that the pure accelerator theory of investment will fit in this argument as a special case under specific assumptions as to expectations. If

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the entrepreneur expects the rate of growth in demand for his product in the succeeding periods to be equal to that he has just experienced and that his share of return will remain unchanged, he will invest in such a way that the accelerator model holds. But also the theory emphasizes what is surely necessary to emphasize, namely the fact that investors think in terms of expected rate of return rather than in terms of achieving a specific capital-output ratio.

The basic question then at this point in explaining the behavior of investment is to explain the behavior of $E_e$ and $E_a$.

Once more it is appropriate to begin with our remarks on population. Much depends upon the population situation when the economy begins its developmental process. As we noted in the section on population few—if any—presently advanced countries began their growth with an overwhelming population problem, and consequently were never faced with the problem that now confronts most of Asia and parts of Africa and Eastern Europe. We have shown reason to expect the rate of growth of population to rise rapidly in the early stages of development and then to taper off. If this growth proceeds from a low base then the scale added to the economy by the new population may react favorably on investment decisions in several ways. The increasing labor supply will tend to supply capital with cooperating inputs, and this in turn may result in the capital-output ratio declining or at least not rising which in turn acts favorably on the profit rate. The increased size of the economy may also permit the use of
more efficient techniques associated with large-scale output, and
this too may encourage more investment because of its effect on the
profit rate. We have already spoken of the effect of population
growth on the composition of demand in our analysis of the behavior
of the capital output ratios. From that discussion it follows that
the demand generated by rapid population growth—housing, schools,
health facilities, etc.—are likely to be capital intensive, and
absorb large amounts of savings. Then as income continues to rise
population growth falls, and the demand due to it declines.
Also even if consumption continues to grow at the same rate, it is
likely to be channelled into areas that require less capitalistic
productive techniques, and consequently the demand for capital goods
will tend to decline.

A high rate of population growth proceeding from an optimum
or less than optimum base may also effect investment demand in another way.
It has been argued that with a high rate of population growth mistakes
are less likely to be permanently damaging. Temporary oversupply of
a particular kind is quickly eliminated and exercises little or no
negative effects on investment plans. Similarly it has been argued

100 Several writers have worked out what is in effect an ac-
ccelerator theory of investment based on population changes. See for
example H. A. Adler, "Absolute or Relative Rate of Decline in Population
pp. 625-634 and Clarence L. Barber, "Population Growth and Demand
that the demand accompanying a rising population, being concentrated on essentials and staples of living, is more dependable than demand accompanying merely a rise in per capita income because that demand tends to be concentrated on luxury items, and presumably is therefore less stable. The result is held to be that entrepreneurs are usually more optimistic in a society with a growing population, and so maintain a higher rate of investment than they would in the same circumstances if population were stable or growing at a slower rate.

A final point deserving mention concerns the effect of population behavior on labor mobility and adaptability. A young and growing population is perhaps the most effective way to assure maximum mobility of labor geographically and occupationally. Middle-aged workers are reluctant to move across town, not to mention across country, and frequently are unable to learn new skills, while there is fairly convincing evidence that younger people are more adaptable and flexible in almost all respects. The effect of this will be to tend to eliminate labor bottlenecks and to provide the entrepreneur with a more reliable and adequate labor supply at lower wage rates. And, as we shall see later, any development that contributes to fluidity and flexibility in the economy system also contributes to making the task of carrying out investment plans easier and less risky. Indeed there is possibly little exaggeration in saying that the negative effects on total demand of a falling rate of growth of population are much more severe—and much less tractable—because of
the effect of such a decline in the ease and speed with which the labor force adapts itself to changing circumstances than because of the effect of the absolute amount of demand created by population growth itself. This is to say that if a stationary population could remain as flexible and adjustable as a growing population, this fact itself would tend to offset the changes (in demand) due to the behavior of absolute numbers.

For the country that begins its growth with a population that is well above the optimum the preceding analysis requires some modification. The advantages arising out of increased scale that we suggested earlier might accompany population growth will in this situation depend upon the growth of per capita income. Population growth when proceeding from a less than optimum base creates an enlarged market, but when proceeding from a larger than optimum base it prevents that enlarged market—and the advantages accruing therefrom—from materializing. In this kind of circumstance there is no oversaving problem in the usual sense of this term, and the key task is to limit population in order that per capita income may rise.

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101 This is a fairly common argument applied to underdeveloped countries. It was first given theoretical elegance in Ragnar Nurkse, Problems of Capital Formation in Underdeveloped Countries, (Oxford: Blackwell, 1953).
When the rate of growth of population begins to fall—for reasons discussed in Section III—the effect on aggregative demand may possibly be of significance. However, it seems clear that for most of the countries now in the category of overpopulated, per capita income will long remain so low that the over-saving problem may be safely ignored.

Whether or not the growth process begins from a population base of optimum or more than optimum size, the population effect on aggregative demand tends to act contrariwise to the needs of the system. It seems clear enough that in the early stages of growth—as the industrialization process gets under way—the demand problem, irrespective of the population effect, is less severe than in later stages. But as we have pointed out, the contribution of population growth to demand is greatest in the early periods and then tapers off. Demand generated by population behavior is therefore greatest when it is needed the least, and the least when it is needed the most. It should of course always be remembered that shocks to the population behavior equation may change (temporarily) this conclusion. 102

It may be observed also that even if a declining rate of growth of population can be ascertained as the chief factor responsible for a failure of demand to grow at a rate approaching the limits of

102 Population growth effects on other aspects of the system may of course be favorable; e.g., the labor supply may behave in a way to encourage growth.
capacity, it does not follow that the correct policy action involves an attempt to raise the rate of growth of population. This may be the case in some rare instances, but for most countries at the present time—and certainly for the world as a whole—it is very likely that a rapid rate of population growth is objectionable for many rather obvious reasons. And since a mere deficiency of total demand can easily be eliminated by government action, it is doubtful if it is necessary to resort to rapid population growth as a means of creating the appropriate amount of demand.

We have already discussed the role of innovations on the growth of the capacity of the system, and now we may use the same set of ideas to examine the effect of innovations on the profit rate and hence on investment demand.

Complications arise because we assume that the entrepreneur seeks not to maintain a given capital—output ratio, but rather he seeks to maintain a given profit rate, \( \text{E} \). Since the profit rate is equal to \( q/k \) (where \( q \) is the share of output going to capital), a change in the value of \( q \) must be exactly matched by a corresponding change in \( k \) in order to maintain equilibrium. It is however a simple matter to introduce the new equilibrium requirement into the discussion of innovations of the previous section.

103 This is meant to be an interpretation of prevailing opinion, not my own value judgment.

104 The discussion that follows is based on Fellner op. cit., and Bruton op. cit. Professor Fellner emphasizes that innovations must not be so labor-saving that they impose an unobtainable adjustment problem on the system so that increasing unemployment results.
Let \( q' \) be the percentage rate of change of \( q \) due to the innovation.

If the innovation is neutral then \( q' \) is zero and there is no change in our previous findings. If the innovation is capital using then \( q' \) is positive, and if equilibrium is to prevail it is necessary for \( k \) to rise in the same proportion. Since income will grow at a rate equal to \( rq + rdq + n \), the equality of \( E_e \) and \( E_a \) requires that

\[
q' = r - (rq + rdq + n)
\]

that is

\[
\frac{n + q'}{r} = 1 - q - dq.
\]

But since \( q' \) is positive, \( k \) must rise and this in turn will contribute to a reduction in equilibrium rate of growth of capacity. Evidently under these assumptions \( n \), the rate of innovations, may be less than when equilibrium required a constant \( k \).

It can easily be seen that if the innovations are capital saving, the equilibrium condition is

\[
\frac{n - q'}{r} = 1 - q + dq
\]

and here evidently as \( k \) will be falling, the equilibrium rate of growth of the capacity of the system will be rising. To achieve this \( n \) must be greater than in the case where equilibrium required a constant \( k \).

There are two points of interest here. On the one hand, it becomes evident that the requirements of entrepreneurs with respect

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105 It is evident of course that the larger is \( k \), the lower is the percentage rate of growth of income. The increase in \( k \) is produced simply by stepping up the rate of capital accumulation relative to the increases in labor. Incidentally, it is easy to devise a model of a cycle with this apparatus.
to the rate of return on capital has a major effect on the rate of
growth of the system. This effect works itself out by virtue of
r responding to changes in $E_a$; if $E_a > E_e$ this will encourage further
capital accumulation, and as we have seen further capital accumulation
will tend to raise $k$ relative to $q$ and so depress $E_a$. And evidently
if $E_a < E_e$, entrepreneurs will seek to reduce the amount of capital
that they have then $r$ will become negative. On the other hand there
is the question of whether innovations will be forthcoming at the
rate and the direction required to keep $E_a$ (or more appropriately
expected $E_a$) high enough that investors will be willing to continue
to accumulate capital. In the previous section we simply assumed
that innovations behaved appropriately, but it seems clear that
the role of innovations in growth is so crucial that some effort
must be made to include their behavior within the boundaries of the
explanatory framework.

Contemporary economics does not offer a 'theory of innovations'
in the sense of a systematic theory accounting for the behavior of
all aspects of innovations through time. This is true even of those
authors whose theory relies heavily upon the behavior of innovations,\(^{106}\)

\(^{106}\) Thus Schumpeter is concerned with tracing out the implications of
innovations, not with explaining their origins. Clarence E. Ayres,
Theory of Economic Progress (Chapel Hill: University of North Carolina
Press, 1944) believes that the key to understanding all aspects of
economic reality depends upon understanding technology, but he makes
no effort to provide an analytical apparatus that contributes to that
understanding. The several papers by Yale Brozen on this subject
are however useful and enlightening.
and what follows should be considered largely as conjectures that seem to pervade the literature.

It is necessary to keep separate two distinct phenomena: invention and innovation. If we think of an invention as the creation of a new technique or new product and an innovation as the putting it into effect, then evidently inventions are a necessary prerequisite to innovations. The distinction is further called for since the factors contributing to the achievement of a rapid rate of invention are not always those that contribute to a rapid rate of innovation.

We consider first the process of inventing. 107

Historical evidence among currently advanced countries suggests that as an economy becomes more and more developed it allocates an increasing quantity of resources to the search for improved techniques and improved products. Entrepreneurs, managers, and engineers are learning all the time, and are continuously putting into effect the results of their newly acquired knowledge. Many firms maintain research and development departments whose very purpose is to provide a constant stream of inventions eligible to be turned into innovations by the policy makers. Under these circumstances the inventive (and innovational) process is as much a part of the economic process as is adjustment to a given technology, and therefore is subject to the

107 The problems here discussed would fall into the area included in W. W. Rostow's first, second, and fourth propensities.
maximization scheme that governs the firm's policy decisions. Indeed in many instances expenditures on research are treated as an outlay which results in revenue just as any other outlay made by the firm is assumed to do.\textsuperscript{108}

The result seems to be that economic growth is accompanied by a regularization of inventions or, perhaps more accurately, an attempt at regularization. It suggests also that the patterns of inventions become less subject to chance and luck as they become more and more a strategic part of the firm's effort to maintain its profit rate. If this kind of argument is accepted it appears that the firm's activities are such as to contribute to a behavioral pattern of inventions that is consistent with the requirements as to direction laid down previously. That requirement, it will be recalled, was that inventions must in the long run be capital using, i.e., they must raise $q$. Now a rise in $q$ will tend to raise the profit rate, and if inventions are a part of the routine of business enterprise we expect inventive efforts to tend to produce a rising $q$.

As for the rate of inventions, little can be said with confidence even in purely formal terms. It seems generally agreed now that inventions do not constitute a major and sharp break with the past, but rather evolve out of an existing situation. It would appear not unreasonable to expect that purposeful and directed research programs would tend to speed up this evolutionary process. At the same time however, there is evidence that the devoting of resources to inventive activity is itself haphazard in relation to the requirements outlined above, and also that the effect varies widely in relation to "inputs." Indeed it seems impossible by definition to specify an exact relation between inputs and outputs where the latter is "knowledge." Therefore, even if it were acknowledged that business enterprises or governments did direct a given percentage of their resources to "inventive activity," there is no assurance that the results will be equally constant. Even though more and more firms consider technology as a variable and to some extent subject to control, the application of the customary rules of production theory do not seem applicable. And until the inventive process is understood more clearly it is doubtful that technical knowledge can be made a control variable similar say to a government surplus or deficit.


110 Perhaps the most useful work that it is now possible to do is in the area of case studies of the history of inventions and innovations.
With respect to innovations the situation is somewhat different. Since innovating consists of introducing a new process, it presumably will be done when the policymaker thinks the potential effect on his profit rate warrants the action. The act of innovating is therefore probably much more certain than the act of inventing. In the case of inventing, the decision to devote resources to research is filled with uncertainty as to the rewards obtainable from that investment. However, the effecting of an innovation is much less of a blind act, and even more than is the case with respect to invention may be brought within the limits of the profit maximization scheme of the individual firm. In this way then the analysis of innovations is essentially an analysis of market situations that provide incentives to the introduction of technical change.

The most frequently discussed relationship is of course that between innovations and monopoly. Even here in this widely discussed area there seem to be few propositions that can safely be said to be part of the current thinking of a modern economist. Unhappily in given industries. See for example A. A. Bright Jr., The Electric Lamp Industry: Technological Change and Development from 1800 to 1947, (New York: The MacMillan Co. 1949) and W. R. MacClaurin, Invention and Innovation in the Radio Industry, (New York: The MacMillan Co. 1949).

like almost all of the other problems with which we are concerned, much can (and has been) said on both sides.

On the negative side fears of excess capacity and/or losses in sunk capital seem to be most important. As a monopolist exercises control over the market by virtue of his control over supply, he seeks to maintain a market structure permitting the earning of a satisfactory rate of return of his invested capital. In an oligopolistic situation it is difficult to expand at the expense of competitors, and the tendency is therefore to create a reluctance to experiment with a new technique or new product. The monopolist by virtue of his control over the market seeks to prevent innovations which will result in existing capital being made obsolete, while in a competitive situation the entrepreneur knows that he must innovate in order to protect himself from competitors who will innovate. Therefore, an economy dominated by large monopolistic enterprises tends to be slower in introducing changes in technique than an economy—with an equivalent flow of inventions—dominated by competitive firms.

Independently of the monopolistic aspects of large scale enterprises, frequent mention is made to the effect that large corporations are necessarily run by a bureaucracy. And one of the characteristics of a bureaucracy is conservatism, and a tendency to seek to achieve

security at the expense of progress with uncertainty. Management decisions are therefore aimed at maintaining the status quo and trying to avoid risky undertaking, rather than yielding to the lure of possible profits due to innovations. Under these circumstances the very form of corporate enterprise militates against the introduction of new techniques and new ideas. 113

On the positive side the arguments are usually one of two kinds. In the first place large-scale—and hence monopolistic—enterprises are necessary to supply inventions. The assumption that the flow of invention is the same in a competitive economy as in a monopolistic economy is therefore an untenable assumption. In the second place, it has been argued that monopoly profits are a necessary incentive to innovate. The possibility of a temporary gain competed away is not a sufficient inducement, rather it is necessary to allow the prospects of a permanent gain in profit or market position before firms will trouble themselves to introduce innovations.

Such a list of pros and cons leaves us nowhere. It seems clear furthermore that growth or existence of monopolies and cartels have had different effects in different countries. This means either that the effects of monopoly on innovational activity depend on other factors, or that other factors completely submerge the effects of monopoly and bigness. Perhaps the key point that can be made with confidence is with respect to inventions rather than innovations.

If it could be shown that only in the research laboratories of large-scale firms could technical knowledge be advanced, then all arguments against such firms must fall to the ground. As inventions are a necessary prerequisite to innovations it does not matter how conducive the market structure is to innovations, if there are no available inventions no innovations will be possible. Over the long-run surely the invention problem itself is of more concern, and as we noted above, little formal analysis has been applied to the process involved.\textsuperscript{114}

Perhaps one possible conclusion of considerable importance can be reached. With respect to both inventions and innovations it seems clear that the rate is likely to be higher in new industries and new firms than in old established ones. Several reasons may be mentioned why this seems reasonable. New firms are much more interested in finding a place in the market as opposed to maintaining the status quo. Thus, the incentive to seek new inventions and to put them into effect immediately may be greater in new enterprises than in old. We may also expect that business leaders in new industries would be more optimistic and more alert as to the advantages of a dynamic policy with respect to innovations and investment.\textsuperscript{115} Possibly the

\textsuperscript{114} Although there may be doubt—as we have noted—with respect to the development of monopoly through time, there seems little doubt that large-scale industry increases as an economy grows. To the extent that the degree of monopoly does not increase as the economy develops the problems—or advantages—accompanying that increase would not be present.

The most important factor of all (mentioned in Section II) is that the possibilities for technical progress in a single productive activity are limited. The more improvements that are made in the technical aspects of a given process the less scope there may be for further improvement, and therefore we may expect the rate of technical progress in old industries to taper off. We may also expect that the new industry or the new activity faced with the problem of catching up with the rest of the economy is likely to be more willing to incur the risks accompanying innovations than are the leaders of enterprises whose growth depends upon the growth of the economy and/or competing customers away from other firms.

We may argue then that new industries provide more possibilities for inventions and also more incentives for innovations than old industries. From this it follows that a key factor in the growth process of an economy is the extent to which new products and new firms are forthcoming. This suggests that the policy aims of a society should include that of maintaining a market structure that permits ease of entry of new firms with new blood and new ideas into old industries, and that of simplifying the development and exploitation of new products. More on this later.

a heavy emphasis on optimism among entrepreneurs as a factor explaining growth.
One further remark, applicable to both inventions and innovations, seems useful at this point and will lead us into our discussion of entrepreneurial activities. It seems clear that a fluid economic and social atmosphere is a major inducement to the discovery and exploitation of new techniques and new ideas. We have already suggested that as a country changes from a rural, agriculture-dominated community to an urban, industrial society, acceptance of change appears to become less reluctant. As we have accepted the proposition that economic growth is accompanied by a relative deemphasis of agriculture and an increase in urbanization and the variety of activities associated with urban living and manufacturing enterprises, we may expect the community to become more open-minded about technical change as growth proceeds. For this reason then we would expect the social atmosphere within which the economy functions to become increasingly encouraging to the development and exploitation of new ideas of all sorts.\footnote{Several writers--e.g., Barrett and Gilfillan--also point to the need for leisure time to permit concentration on methods of solving current problems. This point is elaborated upon a little in the following section.}  

We have to this point acted as if the whole investment decision process was a completely objective problem independent of the personalities of those who perform or are responsible for performing the entrepreneurial function. Clearly this is not a very realistic assumption, and we need to recognize--at least--that differences
in the rates of growth between two countries or in the same country
at two different time periods may be explained, in part, by reference
to the behavior of entrepreneurship. We need to know two things:
first, it is necessary to specify the role of the entrepreneur in
the growth process, and secondly, it is necessary to examine the
behavior through time of the supply of entrepreneurial talent.

In using b, a behavioristic parameter, as our investment function
we have stated that investment is in no sense automatic and does not
respond passively to changes in income. The initiating and pursuing
of investment projects evidently depends upon the availability of
persons willing and able to do this initiating and pursuing. As
an entrepreneur is defined as such a person, it is almost tautological
to say that the role of entrepreneurs is crucial to growth. An econ-
omy may lag not because there are no resources, no profit opportunities
but simply because there is no one around to provide the driving
force essential to exploit these latent advantages. The entrepreneur
then is simply the instrument by which investment plans are made
and put into effect. Since under rather general assumptions the
actions of entrepreneurs to some extent justify themselves,117 a
society blest with a large group of dynamic, optimistic leaders
may be able to grow rapidly despite lack of 'objective' profit
opportunities. This is to say that entrepreneurs not only exploit

117 See footnote 33.
profit opportunities generated by the system, but by their own action they may create profit opportunities and therefore move the system. Evidently then changes in the supply of entrepreneurial talent as the economy grows is of interest in accounting for the behavior of aggregative demand through time.

To a considerable extent the issues involved are tied up with 'socio-economic values' and 'socio-economic structure,' and, as the values and structure that are most conducive to the development and exploitation of entrepreneurial talent are the same as those that contribute to the effective performance of other parts of the system, we may postpone considerations in this sphere until the last section. Here we limit our discussion to the propositions that seem to follow from our preceding analysis.

Does a developing system generate changes that tend to increase entrepreneurial talent? For several reasons the answer seems to be yes.

Perhaps the most important single factor in this respect is simply precedence. As a country's income grows, evidence must accumulate that private gain may be had by finding and exploiting new opportunities. As it becomes apparent to society that profit may be made, then we may expect this evidence to serve as encouragement to potential entrepreneurs to take the plunge. Entrepreneurial emulation is surely as prevalent as consumption emulation, and of course even more important in explaining investment activity. Also
as entrepreneurial activity succeeds, barriers—of all kinds—to be overcome in carrying on such activity may be reduced. This suggests that as a consequence of the successful carrying out of investment projects, inventions, and innovations entrepreneurial activities become less deviant and more nearly orthodox. As is the case with almost all kinds of behavior orthodoxy facilitates its expression, and repetition makes for orthodoxy; it would therefore seem that successful entrepreneurship breeds on itself and once a system begins to grow, that growth itself tends to create a situation which is conducive to an increased supply of entrepreneurial services.

We have mentioned in several places the fact that urbanization is almost sure to accompany the early stages of growth. Evidence is consistent with the hypothesis that traditionalism is less in cities than in rural areas, and this in turn may facilitate independent thought and action and so contribute to an atmosphere more acceptable to new ideas and new techniques. The urbanization movement may also break down family ties to the extent that individuals cannot rely upon lifetime support from their family or relatives, and consequently find it necessary to discover ways and means of earning a livelihood.

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118 Schumpeter produces the upward phase of his cycle by a bunching of innovations; the bunching occurs because after a couple of innovations have been successfully launched, it is easier to carry out others. The suggestion in the text is that something like this occurs secularly as well. We may solve the problem of the source of the first entrepreneur by saying that it is not a question answerable with the economist's tools. W. A. Lewis says that he is imported.
This development may force people into new areas of work and indeed may force them to create new areas. It should also be emphasized that the incentives work in favor of the entrepreneur in towns while probably not in rural areas, or certainly not as much so. Two further considerations are indicated by our previous analysis. The improved banking and credit institutions may ease the capital supply problem. As we have noted such institutions may not increase the saving-income ratio, but they do tend to assure a more productive use of savings that are available. And this greater ease in borrowing—including lower interest rates—removes a hurdle of major proportions from the path of potential entrepreneurs. In the very earliest stages of growth unavailability of funds may constitute the chief barrier to small, village industrialization efforts. To some extent it is also true that increased knowledge and the ease with which information is transmitted reduces the uncertainty that is inherent in any new undertaking. To reduce the risk to the risk bearer will presumably make him willing to bear more risk and will enable more persons to bear some risk.

Several writers—e.g., Schumpeter, Brozen, Lewis—have emphasized the importance of 'new men' in maintaining entrepreneurial supply. By new men is meant men who become entrepreneurs after having been in some other occupation. This would seem to require a pool in which

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119 In a very significant way the attitudes and atmosphere in urban areas—especially new urban areas—is similar to that on the frontier.
potential entrepreneurs are in effect warmed up or trained, and out
of which they may easily move into the entrepreneurial groups. It
is not easy to define such a pool nor the conditions for its existence,
but one characteristic does seem essential: a strong middle class.
A strong middle class does several things. First it prevents the
complete dominance of an economy by any kind of an elite; entrenched
power is virtually always interested in prolonging the status quo,
and historical evidence suggests that a large middle class is a most
effective antidote to domination by an elite.

At the same time that ruling groups rarely supply people whose
very job is to effect a change, so also peasants, sharecroppers,
or day laborers cannot be relied upon to supply such people with any
degree of regularity. We are left therefore to rely on the middle
class not only to prevent domination by an elite, but also to supply
the carrier of change. Members of such a group may be expected to
be acquainted with existing techniques and methods and with the
problems that seem to be most acute at a given moment. They may
also be expected to be aware of the possibilities and advantages of
growth--i.e., to possess the idea of progress--and therefore to have
the incentive as well as the know-how necessary to be the instruments
of growth.

There are undoubtedly numerous and complex factors that are
necessary to produce a strong middle class, but some evidently evolve
along with economic growth. In particular it is appropriate to mention
the effects of increasingly widespread education, the growth of government services, and the development of a social awareness all of which seem to work in the direction of producing a middle class with cohesion and yet with considerable flexibility. We have argued also that all tend to accompany economic growth.

This discussion presents an encouraging view of entrepreneurship supply problems in a growing economy. However, there is one consideration that is less heartening. We have shown that the continued growth of the system requires the frequent entry of new firms, and we have also suggested that there is possibly a tendency for venture capital to become increasingly difficult for new firms and new men to come by due to the behavior of personal and corporate saving habits. When it is recalled that technological factors in advanced societies are likely to require even new firms to be large firms, the shortage of finance—not total savings—for potential new entrepreneurs may have a significant negative effect on entrepreneurial supply. It is difficult to examine this possibility empirically since there are few records of entrepreneurs that did not come into being for lack of funds. It should also be emphasized that the hypothesized behavior of personal and corporate saving is indeed very questionable, and that the existence of a well equipped banking and credit system may itself prevent this possibility from becoming a reality.

Perhaps the generalization may be ventured that the obstacles to effective entrepreneurial activity are declining as the movement away from agricultural dominance becomes firmly established and on its way.
In later stages increasingly complex technology that requires large initial outlays plus possible difficulties in securing financial backing may then create new obstacles or at least prevent further improvements in the entrepreneurs lot. This leads to the notion that the matrix of b's--to the extent that it depends on entrepreneurial talent--may well be relatively weak in a stagnant, low income country, but become increasingly strong as the economy grows, and then tend to level off and possibly even to weaken again.

What can be said in conclusion about the behavior of investment demand over a long period of historic time? We have written the investment equation in terms of changes in output, but emphasized that the functional relationship was not purely technological--as is implied by the accelerator--but also represented a behavioristic parameter as well. We also introduced two effects on the function; that produced by the profit rate and that produced by the supply of entrepreneurial talent. The behavior of the profit rate in our survey was found to depend primarily upon the behavior of population growth and inventions and innovations, being positively related to both. We decided against population growth as a continuing factor contributing to the maintenance of the profit rate, and this then left the full burden on technical change. The nearest thing to a

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120 A qualification is needed for the case when population growth proceeds from a base much larger than optimum.
firm proposition about inventions and innovations that we could find indicated that the maintenance of their rate depended on the emergence of new firms and new industries. And at this point we hooked onto entrepreneurs. The discussion here gave some reason to think that obstacles to effective entrepreneurial activity increased somewhat—at least did not decline indefinitely—as growth progressed, and this would mean a negative effect on the rate of creation of new industries and new firms as well as on the rate of expansion of old firms.

Does this mean that stagnation on the demand side is a definite threat to an economy that has experienced a long period of relatively rapid growth of per capita income? Surely no one knows.121 Shocks to the system that have major (but possibly temporary) effects on population growth and technology may for long periods be such as to negate stagnation tendencies that might be present.122 In addition we repeat—again and again—that both the arguments and the empirical evidence supporting our conclusions are far from unassailable.

Inventions and innovations are of course especially crucial, and our knowledge and understanding especially inadequate.

121 The most recent paper on the stagnation hypothesis is that of B. Higgins, "Interactions of Cycles and Trends," Economics Journal, Vol. LXV (December 1955), pp. 594-614. Mr. Higgins is perhaps the most convinced of all writers that the United States economy is threatened by "increasing underemployment."

122 Trygve Haavelmo, A Study in the Theory of Economic Evolution (Amsterdam: North-Holland Publishing Co. 1954) Part IV discusses the stochastic approach to theorizing about long term processes and the difficulties created thereby for long run prediction.
It is worthwhile to examine very briefly the proposition that
the chief motivating force of growth is not the entrepreneur with
his capital accumulation and innovations, but rather it is the consumer
with his consumption behavior. A bare reference to this was made
in the section on saving, and we are able to expand only slightly
here. 123

Two arguments are immediately available. The Duesenberry--
Modigliani hypothesis that the floor under consumption outlays tends
to rise as income rises means that income tends to be kept from falling
back to the low level reached in previous cyclical troughs. Richard
Goodwin has also suggested a similar proposition for business firms.
In periods of rising income Mr. Goodwin suggests that all outlays
rise easily and some tend then to become fixed--e.g., interest,
stable dividends, managerial, maintenance, and sales staff, etc.,--
and are not easily reduced in the course of a cycle. In the same
way that consumption does not fall back to previous lows, neither
do flow expenditures of firms fall all the way back to previous
low levels. 124 If we also introduce the Lewis hypothesis that national
saving is chiefly out of profits and that wage and salary earners

123 Simon Kuznets discusses this point briefly in Simon Kuznets,
W. E. Moore, and J. J. Spengler (editors), Economic Growth: Brazil, India,

124 Evidently the longer the downturn and trough last the less
is the Goodwin proposition applicable.
save little or nothing of their income, we have additional reason for
the consumption outlays to be less responsive downward than upward as
wage and salary income seem to fluctuate less cyclically than do profits.
These arguments indicate that non-capital accumulating expenditures tend
to rise readily in periods of rapid growth, but are sticky in their down-
ward response to a falling income. It is therefore consumption behavior
that prevents income from falling to the same low level during the down-
turn of successive cycles. To say the same thing differently, it is con-
sumption habits that prevent 'the cycle' from fluctuating around a
'horizontal trend.'

It seems clear also that few societies with relatively high incomes
could support an average propensity to save of say .5, and therefore this
upward push on total demand resulting from what is in effect an upward
shift in the consumption function seems almost essential if huge and in-
creasing government deficits are to be avoided. This is largely the old
form of the oversaving problem and we need say no more about it.

There is another exceedingly important way that consumption seems
especially strategic as a motivating force in growth. We have empha-
sized frequently the role of new industries and new firms as essential
to continuing growth. We have also observed that the income elasticity
for virtually any single product or type of product will at some level
of income become less than unity. Thus as income rises through time,
demand for old products will decline relatively to income, and demand
will switch to new products. The change in the composition of
demand facilitates -- indeed requires -- new industries and
new firms producing new products, and the growth of new enterprises then tends to 'carry' the system in the manner described earlier.

If the income elasticity of demand for each product--at any given time--equals unity, then the increasing resources available to the society would have to all be used to produce the existing composition of output. The less-than-unity income elasticity for some products means that resources are available to produce new products. If the hypothesis that inventions and innovations are much more difficult and therefore less likely to occur in old industries than in new is reasonable, this behavior of the composition of consumption is of great relevance. It is necessary to prevent the rate of return on capital from falling toward zero and the capital-output ratio rising to the point where income virtually ceases to grow.

Furthermore it seems apparent that new industries manned by new men constitute an important source of optimism and willingness to bear risk that is absent in old industries--even though the latter are growing. And as we have also suggested a changing composition of demand of consumer products is perhaps a strong counterforce to monopoly tendencies.

If these (and other evident) conjectures about consumer behavior are approximately correct, it is clear that further study of the 'dynamics of consumption' may be rewarding to the economist interested in growth. It may even lead to a reformulation of the effect of consumption on aggregative demand in terms other than the consumption function.
It is unnecessary to seek a definitive answer to the question as to whether it is the entrepreneur or the consumer that produces the spark necessary to move the system. Indeed the question itself is perhaps not a meaningful question. It is surely correct to think in terms of entrepreneurial behavior as the strategic factor in the short run and consumption passive. Over a long period of time it is—equally surely—misleading to think simply in terms of a "long run consumption function" and act as if nothing more remained to be said.
V. The Social Setting

It is almost truistic to say that the effectiveness with which an economic system performs depends to a significant degree upon the whole culture of which the economy is a part. It is therefore equally almost truistic to say that the rate of growth of income depends upon the restraints imposed upon that growth by the prevailing value system and the social structure that represents these values. It is clear also that the non-economic part of the cultural universe is not independent of the economic part, and that it responds to changes that are in some sense or other 'purely economic'. This is simply to say that the economic and the non-economic react upon each other in a complex fashion, and it is difficult if not impossible to ascertain the source of initiating disturbances. Almost all economists pay lip service to these notions, but there is little in the way of a systematic formulation of hypotheses and their introduction into a growth model.


126. A few sources that seem to me to be most useful in this area are Alexander Gerschenkron, "Social Attitudes, Entrepreneurship, and Economic Development," Explorations in Entrepreneurial History, Vol. VI (October 1952) pp. 1-19; Bert F. Hoselitz, "Social Structure and Economic Growth," Economia Internazionale, Vol. VI (August 1953) pp. 52-78 and the references here to
We can do little more here than suggest the more obvious forms of the above mentioned interaction that seem to be relevant in an analysis of economic growth.

A value system is of course not merely a jumble of unrelated parts but rather it is a set of consistent and related components reflecting the several segments of behavior, beliefs and attitudes that go to make up the values of a given system. We may indeed think of a general "Walrasian" model encompassing all aspects of society, and indicating that there must be a consistency among the parts of the system in precisely the same way that a Walrasian (or Leontief) economic model shows that there must be internal consistency within the economic system taken alone. For the societal model the "purely economic system" would constitute only a single part, but by thinking of it as a sector within a larger whole we can see more clearly the interdependence with which we are concerned. The questions at hand are limited to two: first, what kind of characteristics of the whole society are most useful in facilitating the growth of the economic sector, and secondly, how do the characteristics of the society as a whole change as the economy grows and how do these changes in turn affect the performance of the economic sector?

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In very general terms the first question can be answered easily enough, albeit somewhat tautologically. In the first place there is general agreement that institutional arrangements that permit to the maximum extent possible (without anarchy) flexibility and adaptability within the economic sector will contribute positively to economic growth. In the second place the value system of the community must be such that high prestige is attached to economic achievement and to the creation and possession of productive wealth if economic progress is to be encouraged.

It seems self-evident that the lower the barriers to mobility—especially vertical mobility—the more easily and smoothly will a system grow. The arbitrary limitation of certain economic roles to certain social groups irrespective of capacity may of course prevent resources from being allocated in an optimum fashion. Similarly the prevalence of a familial relationship that dictates that a son must pursue the same occupation in the same geographic area as his father is an obstacle to the creation of a pool of new men ready and eager to assume the risks of new investments and innovations, and, as we have observed earlier, such a pool may be crucial for continuing economic growth. Similarly, favorable attitudes toward new ideas, new products, and new techniques make the tasks of the entrepreneur simpler and less risky. There are numerous other examples that one might give of how the effect of a society dominated by a caste system (of any kind) affects the behavior of the economic sector in a negative way; the key point however is in need of little elaboration: a society and institutional system that interferes with freedom in the seeking out and
exploiting of economic opportunities by all levels of society interferes with economic growth. For the most part such effects are reflected in the matrix of k's and b's, causing the latter to be low due to a downward pressure on the profit rate and the supply of entrepreneurial service and the former to be high due to the depressed efficiency of the labor force.

With respect to the value system effect on economic growth the points usually are made that the most competent and alert young men go into professions to which society attaches the greatest prestige and that the supply of labor tends to be more stable and more responsive to economic incentive in those social systems where there are no ethical, religious, or moral scruples against improving one's economic well being. Once more such observations are largely self-evident and need little defense. If the goals and values of a society prescribe patterns of normative behavior such that increased material welfare is not acceptable conduct, then it is not surprising that an economic system in such a culture is faced with severe and perhaps insurmountable difficulties. Indeed given the inter-dependence system we previously described, such a value system--i.e., such a pattern of normative conduct--and a rapidly growing economic sector simply cannot coexist. On the other hand, a society that attaches great importance to the accumulation of productive wealth may be expected to produce an economic system that is limited only by the resources available to it.

The description of the kind of social and value system that contributes to economic growth is--as we noted--relatively simple and unrevealing. The
major problem both in terms of difficulty and in terms of importance is that of making explicit the relationships between economic change and social change and between social change and economic change. Unhappily we seem to know very little about such relationships, and it is necessary to content ourselves with a few brief generalities.

To fix our ideas consider an economic and social system that are consistent with each other but per capita income is constant, i.e., no economic growth is taking place. Now suppose a shock occurs somewhere in the system that results in the economic sector beginning to grow. The question we are interested in is this: Does this growth produce changes in the non-economic sector that facilitate the continuation of that growth or do changes result that increase the difficulties of maintaining growth?

It seems clear enough that the longer that growth can be maintained the more will the non-economic sector change to make the growth process easier. As growth continues the old institutions and old values become increasingly obsolete, and no longer fulfill the purpose for which they were originally intended. In the same way that attitudes and beliefs are formed because they are convenient and useful, they tend to be discarded when they become a barrier to what the people want. As the economy expands those patterns of conduct that impede further growth become increasingly unacceptable to an increasingly large proportion of the population, and will exercise less and less control over the behavior of the society in general. This is especially true if new men are responsible for or involved in the upsurge of growth and previous leaders are obvious losers, with the result that those most in favor of the new ideas and new institutions that lead to growth gain positions of authority in influencing behavior and attitudes.

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127. Chicken and egg problems abound in such an area of discussion. Which came first, religion or the rise of capitalism?
Since as some parts of the value system change the remainder must also change to maintain internal consistency, we may expect the system as a whole to become more suited to economic growth. 128

Our previous discussions suggest something of the modus operandi by which such cumulative social and institutional changes work themselves out. We have accepted the proposition that urban living itself tends to result in a reduction in the extent to which the society is tradition bound, and correspondingly to increase the ease with which innovation of all kinds—not just technical—are accepted and become effective. Perhaps the most relevant consideration in this respect is the loosening of family ties, especially those having to do with economic dependence. As it becomes more and more difficult to maintain family unity and family responsibility the individual is forced to rely upon his own imagination and initiative in order to survive. 129 This will presumably make him more open minded toward the new ideas of others as well as more alert for innovation from which he personally can profit and which will contribute to the growth of the system.

The increased extent and frequency of personal contact may also lead to creation of new wants and new 'needs' that in turn may affect the incentives of members of the labor force and possibly create new sources of profits for

128. On the cumulative nature of cultural change see the discussion in Lewis, op. cit. pp. 142-162.

129. This point is given prime importance by Hsu, op. cit.
potential investors. If we accept the proposition that wants are—at least to some extent—a function of knowledge of available products and the capacity to acquire new products, institutional and structural changes that increase the awareness of new objects will thereby increase the effort of the population to acquire such objects.130

In the same way that increased personal contact and greater knowledge act to make the consumer more amenable to new ideas and new products, it makes the spread of new techniques among producing units simpler and less risky. Also contributing to the ease with which new techniques are introduced is the decreased role of household production in total output. Where production units are under the supervision and control of full time entrepreneurs and managers, we may expect obstacles imposed by imperfect knowledge, frictions, etc. concerning new methods to be more effectively overcome than in those cases where the units are small and production is largely oriented around the household. Indeed the breakdown of barriers to technological and management innovations due to widespread and more effective contacts and communication among entrepreneurs may be the most important institutional change that accompanies growth.131

We have already had occasion to mention the effect of growth on the evolution of a middle class, or perhaps more appropriately we should speak of the evolution of several classes—income or otherwise—between the lowest and the highest.


In many pre-industrial societies there are only two groups, the rich and the poor. If classes emerge between these two extremes, it is suggested that this will act positively on incentives for both consumer and producer. A more or less continuous gradation from bottom to top simplifies the understanding of what an upward movement in income means, increases the contact of persons in several groups, and makes easier the movement between classes. 132 By increasing awareness of the advantages of higher income and at the same time making it appear much more nearly possible to move up the income ladder—at least a step or two—we may expect incentives and effort to be increased.

Other factors contributing to making the social system more conducive to economic growth may be mentioned briefly. The age composition of the population will tend to move in such a way that an increasing proportion of the population are in the more flexible, adaptable age groups. It is probably also helpful that more and more persons receive high school and college educations. Finally it is perhaps useful to call attention to a point that has been emphasized by several writers on innovations; namely, the importance of leisure in facilitating the discovery and implementation of new products and new techniques. If such a positive relationship between leisure and innovations exist, increasing per capita income, making leisure possible (and probably more acceptable to all elements of the society), may also contribute to a speeding up on innovations.

If the preceding suggestions as to the nature of cultural change are reasonable the early stages of economic growth are marked by a slow breakdown of those attitudes and institutional arrangements that are incompatible with a growing economic system. The behavior of the non-economic sector is such that it permits the economic sector to grow relatively slowly at the outset of the growth process, but the longer that economic growth proceeds the more compatible to growth do the social and institutional factors become, thus permitting a rising rate of growth of income.

Some writers have suggested that after a long period of growth further changes occur that result in a society less adaptable and less encouraging to change. Reference is frequently made for example to the increased emphasis on security as opposed to growth as a goal of large segments of society. Such emphasis may result in opposition to technological change because of fear of unemployment or to the development of institutional arrangements such as pension plans and unemployment insurance schemes that reduce labor mobility. The security consciousness may also result in legislation that, in order to prevent certain elements of the population from being hurt by economic change, discourages the incentives necessary to achieve an optimum allocation of labor. Also writers have noted that the growth of large scale technology and of bureaucratic big business tends to create an atmosphere that is detrimental to individualism in general and new ideas as to productive techniques and business practices in particular. This, in turn, is reflected not only...

in the supply of suggested new processes, but in the willingness and
capacity of the system to institute changed programs of any sort. Not only
may the society develop attitudes and behavior characteristics that are oriented
toward security and stability at the expense of growth, but so also do the
business leaders that govern the system's productive firms develop such
attitudes.

The argument that the non-economic sector of society changes to facilitate
the growth of the economic sector in the early stages of the growth process is
considerably more convincing than the proposition that attitudes and insti-
tutions become antithetical to growth after the economy has become well
developed. But whether we accept the latter argument or not it seems clear
that the positive effect on growth of cultural change will become progressively
less and less as the system achieves higher and higher per capita income. We
may expect them that imsofar as the contribution of changes in the social sector
are concerned, per capita income may grow with difficulty in the initial stages
of development, then experience fewer and fewer obstacles and therefore grow
more rapidly, and eventually the growth facilitating changes in the social
system at large become in effect negligible (or possibly even negative).
Conclusion

The preceding sections were aimed at collecting contemporary thoughts on the several aspects of the growth process that seem to have been emphasized in recent literature, and trying to put them into a single unified analytical framework. What can be said in summary about the usefulness and applicability of the set of ideas that we have put together?

It is of course clear that here—as with any theory—to apply it to any particular area over any particular interval of time numerous special assumptions, appropriate to the area and the time, must be introduced into the general framework. This is especially true in the case here as we have omitted any but casual reference to governmental activity and international trade. But to say that a general argument must be modified—must be particularized—before it is applied in a given instance is not a criticism or a limitation of the general argument, it is simply a characteristic of the theory-making process.

It is well to emphasize also that shocks to a system are crucial to the explanation of its time path, and shocks—by definition—are outside the explanatory mechanism of the theory. Such random events interrupt the performance of the explained behavior of the variables, and therefore unless the shocks are relatively mild they may dominate.
the behavior of the system making the exact part of the theory somewhat superfluous. The assumption then must be made that the shocks are infrequent enough and mild enough that it makes sense to establish the exact part of the theory.

Recognizing these last two principles—inherent in theorizing about almost any phenomenon—what seem to be the strategic features of the growth process?

First of all, it is evident that nothing begets growth like growth. If a country is able to generate enough steam to get the growth process under way, that process itself tends to create conditions and an atmosphere that are conducive to further growth. Thus in discussing the parameters of the short-run model we found reason to think that in each case the parameter would in the early stages of growth be inimical to rapid growth but then as growth proceeded would change in such a way as to facilitate a rise in the rate of growth. We were more confident in some cases than in others, but in each instance the presumption was that each aspect of the growth process tended to contribute to a slowly growing system at first and then a gradually rising growth rate.

Secondly, however, as growth proceeds two developments present themselves that suggest that continued increases in the rate of growth of income become increasingly difficult to achieve: first, many of the social and institutional factors that early in growth are barriers to be destroyed, once destroyed are unable to continue contributing to a speeding up of growth. For example, the absence of a well
equipped banking system may be a significant barrier that, as it is corrected, allows growth to proceed more rapidly; but once an effective banking system is established it seems clear that it will not keep on aiding in raising the growth rate. This is to say, that we found that some factors have a once-and-for-all effect on growth, the effect then becomes permissive rather than contributory. The other factor that seemed to contribute to increasing difficulty in maintaining a rising rate of growth of income is connected with the scale effect on growth. Increasing size of an economy proceeding from a small base results in various kinds of economies of scale, but such economies are finite in quantity and effect. It seems clear that after an economy has reached a given size, further increases in the size of the system itself will not result in further economies of scale and indeed may create a classical diminishing returns problem.

If we put result one and two together we evidently get a growth picture something like the following: at the outset growth is likely to be very slow (possibly even negative because of population behavior), then, to gather speed and proceed at a rush for a period, and eventually to tend to taper off.

But then however, in the third place, it was necessary to introduce two variables that are very difficult to manage analytically: inventions and innovations. We found it impossible to reach very firm results as to the time path of the invention and innovation effect on the economic system, and therefore concluded that it was impossible to arrive at a decision as to whether or not an economy would run
down and cease to grow. We would go further and assert that until we know more about the determinants of technological change, it is not possible to say with confidence what the prospects are with respect to secular stagnation or secular exhilaration.

We found in the fourth place, that the immediate determinant of growth was the activity of entrepreneurs as capital accumulators, inventors, and innovators. In making the investment process something more than a mere automatic response to changing output, we put considerable weight upon the behavior of entrepreneurs and the supply of entrepreneurial services through time in explaining the growth process. We made investment decisions chiefly a function of the expected profit rate and the extent of entrepreneurial services. The profit rate behavior is determined chiefly by innovations, while the supply of entrepreneurial services seem to be more appropriately explained in terms of the value and social system and the institutions representative thereof. Thus innovations are seen to be crucial on the demand side—to prevent a declining profit rate—as well as on the supply side—to prevent diminishing returns.

But though entrepreneurial activity is the immediate moving force of the system consumer behavior—and this is our fifth point—is equally relevant, if not more so, over a long pull. Of particular importance are two points: consumer behavior is one of two factors (the other is technological change) responsible for the changing
composition of output, and as we have seen the changing composition of output has exceedingly important ramifications throughout the system. In particular in the early stages of growth it results in a rise in the tempo of the urbanization movement and from this increased urbanization we deduced several important consequences. Also, changing output composition requires the creation of new industries and this is, we have seen, crucial in a number of ways to continuing growth.

The other characteristic of consumer behavior that is important for growth (and this may be true of business firms as well) is the proposition that consumption expenditures hold the system up in periods of cyclical downturn and so prevent the troughs of successive cycles from all being on the same level. Investment activity alone probably is not able to do this, and innovations seem too erratic.

The final point may be made in this way: We have assumed that the economy continued to grow and we traced out the nature of this growth process. At any point, any number of obstacles—e.g., population behavior, savings, inventions, entrepreneurial services, etc.—may result in growth being aborted. In an analysis of why a system is not growing it becomes important to isolate the immediate bottleneck and eliminate it. Our analysis is useful for this task, but empirical material of a more specific kind would be necessary in attacking a given problem of "not growth."
Undoubtedly many readers will find reason to object to much of the preceding essay either because of misrepresentation of current thinking on some one or more aspects or because the analysis as I have set it down is open to dispute due to questionable theorizing and/or questionable empirical assertions. Perhaps it is possible to conclude on an observation for which complete agreement may be expected: There is an awful lot that we do not know about economic growth.