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## EXPANSION AND EMPLOYMENT<sup>1</sup>

By EVSEY D. DOMAR\*

"A slow sort of a country," said the Queen. "Now, *here*, you see, it takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that."

Lewis Carroll: *Through the Looking Glass*

In these days of labor shortages and inflation, a paper dealing with conditions needed for full employment and with the threat of deflation may well appear out of place. Its publication at this time is due partly to a two-year lag between the first draft and the final copy; also to the widely held belief that the present inflation is a temporary phenomenon, and that once it is over, the old problem of deflation and unemployment may possibly appear before us again.

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Our comfortable belief in the efficacy of Say's Law has been badly shaken in the last fifteen years. Both events and discussions have shown that supply does not automatically create its own demand. A part of income generated by the productive process may not be returned to it; this part may be saved and hoarded. As Keynes put it, "Unemployment develops . . . because people want the moon; men cannot be employed when the object of desire (*i.e.*, money) is something which cannot be produced. . . ." <sup>2</sup> The core of the problem then is the public's desire to hoard. If no hoarding takes place, employment can presumably be maintained.

This sounds perfectly straight and simple; and yet it leaves something unexplained. Granted that absence of hoarding is a *necessary* condition for the maintenance of full employment, is it also a *sufficient* condition? Is the absence of hoarding *all* that is necessary for the avoidance of unemployment? This is the impression *The General Theory* gives. And yet, on a different plane, we have some notions about an increasing productive capacity which must somehow be utilized if unemployment

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<sup>1</sup> This paper forms a sequence to my earlier article on "The 'Burden' of the Debt and the National Income," published in this *Review*, Vol. XXXIV, No. 5 (Dec., 1944), pp. 798-827. Though their titles seem different, the two papers are based on the same logical foundation and treat a common subject: the economic rôle of growth.

<sup>2</sup> John M. Keynes, *The General Theory of Employment Interest and Money* (New York, 1936), p. 235.

is to be avoided. Will a mere absence of hoarding assure such a utilization? Will not a continuous increase in expenditures (and possibly in the money supply) be necessary in order to achieve this goal?

The present paper deals with this problem. It attempts to find the conditions needed for the maintenance of full employment over a period of time, or more exactly, *the rate of growth of national income* which the maintenance of full employment requires. This rate of growth is analyzed in Section I. Section II is essentially a digression on some conceptual questions and alternative approaches. It may be omitted by the busy reader. Section III is concerned with the *dual* character of the investment process; that is, with the fact that investment not only generates income but also increases productive capacity. Therefore the effects of investment on employment are less certain and more complex than is usually supposed. In Section IV a few examples from existing literature on the subject are given, and Section V contains some concluding remarks. The most essential parts of the paper are presented in Sections I and III.

As in many papers of this kind, a number of simplifying assumptions are made. Most of them will become apparent during the discussion. Two may be noted at the outset.<sup>4</sup> First, events take place simultaneously, without any lags.<sup>5</sup> Second, income, investment and saving are defined in the *net* sense, *i.e.*, over and above depreciation. The latter is understood to refer to the cost of replacement of the depreciated asset by another one of *equal* productive capacity. These assumptions are not entirely essential to the argument. The discussion could be carried out with lags, and, if desired, in gross terms or with a different concept of depreciation. Some suggestions along these lines are made in Section II. But it is better to begin with as simple a statement of the problem as possible, bearing in mind of course the nature of assumptions made.

### I. The Rate of Growth

It is perfectly clear that the requirement that income paid out should be returned to the productive process, or that savings be equal to investment, or other expressions of the same idea, are simply formulas for the retention of the income *status quo*. If underemployment was present yesterday, it would still remain here today. If yesterday's income was at a full employment level, that *income level* would be retained today. It may no longer, however, correspond to full employment.

Let yesterday's full employment income equal an annual rate of 150 billion dollars, and let the average propensity to save equal, say, 10 per cent. If now 15 billions are annually invested, one might expect full employment to be maintained. But during this process, capital equipment of the economy will have increased by an annual rate of 15 billions

—for after all, investment *is* the formation of capital.<sup>3</sup> Therefore, the productive capacity of the economy has also increased.

The effects of this increase on employment will depend on whether or not *real income* has also increased. Since money income has remained, as assumed, at the 150 billion annual level, an increase in real income can be brought about only by a corresponding fall in the general price level. This indeed has been the traditional approach to problems of this kind, an approach which we shall have to reject here for the following reasons:

1. The presence of considerable monopolistic elements (in industry and labor) in our economy makes unrealistic the assumption that a falling *general* price level could be achieved without interfering with full employment. This of course does not exclude *relative* changes among prices. As a matter of fact, if industries subject to a faster-than-average technological progress do not reduce their prices to some extent, a constant general price level cannot be maintained.

2. For an economy saddled with a large public debt and potentially faced (in peacetime) with serious employment problems, a falling price level is in itself undesirable.

3. A falling price level can bring about a larger real income only in the special case when prices of consumers' goods fall more rapidly than those of investment goods. For otherwise (with a constant propensity to save) money income will be falling as fast or faster than the price level, and real income will be falling as well. To prevent money income from falling so rapidly, the volume of real investment would have to keep rising—a conclusion which will be presently reached in the more general case.

4. Finally, the assumption of a falling general price level would obscure—and I believe quite unnecessarily—the main subject we are concerned with here.

For these reasons, a *constant general price level* is assumed throughout this paper. But, from a theoretical point of view, this is a convenience rather than a necessity. The discussion could be carried on with a falling or a rising price level as well.

To come back to the increase in capacity. If both money and real national income thus remain fixed at the 150 billion annual level, the creation of the new capital equipment will have one or more of the

<sup>3</sup> The identification of investment with capital formation is reasonably safe in a private economy where only a small part of resources is disposed of by the government. When this part becomes substantial, complications arise. This question will be taken up again in Section II. Meanwhile, we shall disregard it and divide total national income, irrespective of source, into investment (*i.e.*, capital formation) and consumption.

The term "national income" is understood here in a broad sense, as total output minus depreciation, and does not touch on current controversies regarding the inclusion or exclusion of certain items. Perhaps "net national product" would be more appropriate for our purposes.

following effects: (1) The new capital remains unused; (2) The new capital is used at the expense of previously constructed capital, whose labor and/or markets the new capital has taken away; (3) The new capital is substituted for labor (and possibly for other factors).

The first case represents a waste of resources. That capital need not have been constructed in the first place. The second case—the substitution of new capital for existing capital (before the latter is worn out, since investment is defined here in the net sense)—takes place all the time and, in reasonable magnitudes, is both unavoidable and desirable in a free dynamic society. It is when this substitution proceeds on a rather large scale that it can become socially wasteful; also, losses sustained or expected by capital owners will make them oppose new investment—a serious danger for an economy with considerable monopolistic elements.

Finally, capital may be substituted for labor. If this substitution results in a *voluntary* reduction in the labor force or in the length of the work week, no objections can be raised. Such a process has of course been going on for many years. But in our economy it is very likely that at least a part of this substitution—if carried on at an extensive scale—will be involuntary, so that the result will be unemployment.

The tools used in this paper do not allow us to distinguish between these three effects of capital formation, though, as will appear later, our concepts are so defined that a voluntary reduction in the number of man-hours worked is excluded. In general, it is not unreasonable to assume that in most cases all three effects will be present (though not in constant proportions), and that capital formation not accompanied by an increase in income will result in unemployed capital and labor.

The above problems do not arise in the standard Keynesian system because of its explicit assumption that employment is a function of national income, an assumption which admittedly can be justified only over short periods of time. Clearly, a full employment income of 1941 would cause considerable unemployment today. While Keynes' approach—the treatment of employment as a function of income—is a reasonable first approximation, we shall go a step further and assume instead that *the percentage of labor force employed is a function of the ratio between national income and productive capacity*. This should be an improvement, but we must admit the difficulties of determining productive capacity, both conceptually and statistically. These are obvious and need not be elaborated. We shall mean by productive capacity the total output of the economy at what is usually called full employment (with due allowance for frictional and seasonal unemployment), such factors as consumers' preferences, price and wage structures, intensity of competition, and so on being given.

The answer to the problem of unemployment lies of course in a growing income. If after capital equipment has increased by (an annual rate of) 15 billions an income of 150 billions leaves some capacity unused, then a higher magnitude of income can be found—say 155 or 160 billions—which will do the job. There is nothing novel or startling about this conclusion. The idea that a capitalist economy needs growth goes back, in one form or another, at least to Marx. The trouble really is that the idea of growth is so widely accepted that people rarely bother about it. It is always treated as an afterthought, to be added to one's speech or article if requested, but very seldom incorporated in its body. Even then it is regarded as a function of some abstract technological progress which somehow results in increasing productivity per man-hour, and which takes place quite independently of capital formation. And yet, our help in the industrialization of undeveloped countries will take the form not only of supplying technical advice and textbooks, but also of actual machinery and goods. Certainly the 80 odd billion dollars of net capital formation created in the United States in the period 1919–29 had a considerable effect on our productive capacity.<sup>4</sup>

A change in productive capacity of a country is a function of changes in its natural resources (discovery of new ones or depletion of others), in its labor force (more correctly, man-hours available), capital and the state of technique.<sup>5</sup> Since changes in natural resources and technique are very difficult concepts, we can express changes in total capacity via changes in the quantity and productivity of labor or of capital. The traditional approach builds around labor. The several studies of the magnitude of total output corresponding to full employment, made in the last few years, consisted in multiplying the expected labor force (subdivided into several classes) by its expected average productivity.<sup>6</sup> This procedure did not imply that the other three factors (natural resources, technology and capital) remained constant; rather that their variations were all reflected in the changes in productivity of labor.

It is also possible to put capital in the center of the stage and to estimate variations in total capacity by measuring the changes in the quantity of capital and in its productivity, the latter reflecting changes currently taking place in natural resources, technology and the labor force. From a practical point of view, the labor approach has obvious advantages, at least in some problems, because labor is a more homogeneous and easily measurable factor. But from a theoretical point of

<sup>4</sup> This figure, in 1929 prices, is taken from Simon Kuznets, *National Income and Its Composition*, Vol. I (New York, 1941), p. 268. The actual figure was 79.1 billion dollars.

<sup>5</sup> Taking other conditions listed on p. 37 as given.

<sup>6</sup> See for instance E. E. Hagen and N. B. Kirkpatrick, "The National Output at Full Employment in 1950," *Amer. Econ. Rev.*, Vol. XXXIV, No. 4 (Sept., 1944), pp. 472–500.

view, the capital approach is more promising and for this reason: the appearance of an extra workman or his decision to work longer hours *only* increases productive capacity without, however, generating any income to make use of this increase. But the construction of a new factory has a *dual* effect: *it increases productive capacity and it generates income.*

The emphasis on this dual character of the investment process is the essence of this paper's approach to the problem of employment. If investment increases productive capacity and also creates income, what should be the magnitude of investment, or at what rate should it grow, in order to make the increase in income equal to that of productive capacity?<sup>7</sup> Couldn't an equation be set up one side of which would represent the increase (or the rate of increase) of productive capacity, and the other—that of income, and the solution of which would yield the required *rate of growth*?

We shall attempt to set up such an equation. It will be first expressed in symbolic form, and later (on p. 41) illustrated by a numerical example.

Let investment proceed at an annual rate of  $I$ , and let annual productive capacity (net value added) per dollar of newly created capital be equal on the average to  $s$ . Thus if it requires, say, 3 dollars of capital to produce (in terms of annual net value added) one dollar of output,  $s$  will equal one-third or 33.3 per cent per year. It is not meant that  $s$  is the same in all firms or industries. It depends of course on the nature of capital constructed and on many other factors. Its treatment here as a given magnitude is a simplification which can be readily dispensed with.

The productive capacity of  $I$  dollars invested will thus be  $Is$  dollars per year. But it is possible that the operation of new capital will take place, at least to some extent, at the expense of previously constructed plants, with which the new capital will compete both for markets and for factors of production (mainly labor). If as a result, the output of existing plants must be curtailed, it would be useless to assert that the productive capacity of the *whole economy* has increased by  $Is$  dollars per year.<sup>8</sup> It has actually increased by a smaller amount which will be indicated by  $I\sigma$ .<sup>9</sup>  $\sigma$  may be called the *potential social average productivity of investment*. Such a long name calls for an explanation.

1. As stated above,  $\sigma$  is concerned with the increase in productive

<sup>7</sup> This statement of the problem presupposes that full employment has already been reached and must only be maintained. With a small extra effort we could begin with a situation where some unemployment originally existed.

<sup>8</sup> These comparisons must of course be made at a full employment level of national income. See also pp. 44-46.

<sup>9</sup> We are disregarding here external economies obtained by existing plants from the newly constructed ones.

capacity of the whole society and not with the productive capacity per dollar invested in the new plants taken by themselves, that is with  $s$ . A difference between  $s$  and  $\sigma$  indicates a certain misdirection of investment, or—more important—that investment proceeds at too rapid a rate as compared with the growth of labor and technological progress. This question will be taken up again in Section II.

2.  $\sigma$  should not be confused with other related concepts, such as the traditional marginal productivity of capital. These concepts are usually based on a *caeteris paribus* assumption regarding the quantity of other factors and the state of technique. It should be emphasized that the use of  $\sigma$  does not imply in the least that labor, natural resources and technology remain fixed. It would be more correct therefore to say that  $\sigma$  indicates the increase in productive capacity which *accompanies* rather than which is caused by each dollar invested.

3. For our purposes, the most important property of  $\sigma$  is its *potential character*. It deals not with an increase in national income but with that of the *productive potential* of the economy. A high  $\sigma$  indicates that the economy *is capable* of increasing its output relatively fast. But whether this increased capacity will actually result in greater output or greater unemployment, depends on the behavior of money income.

The expression  $I\sigma$  is the supply side of our system; it is the increase in output which the economy *can* produce. On the demand side we have the multiplier theory, too familiar to need any elaboration, except for the emphasis on the obvious but often forgotten fact that, with any given marginal propensity to save, to be indicated by  $\alpha$ , an increase in national income is not a function of investment, but of the *increment* in investment. If investment today, however large, is equal to that of yesterday, national income of today will be just equal and not any larger than that of yesterday. All this is obvious, and is stressed here to underline the lack of symmetry between the effects of investment on productive capacity and on national income.

Let investment increase at an absolute annual rate of  $\Delta I$  (e.g., by two billion per year), and let the corresponding absolute annual increase in income be indicated by  $\Delta Y$ . We have then

$$(1) \quad \Delta Y = \Delta I \frac{1}{\alpha},$$

where  $\frac{1}{\alpha}$  is of course the multiplier.

Let us now assume that the economy is in a position of a full employment equilibrium, so that its national income equals its productive capacity.<sup>10</sup> To retain this position, income and capacity should increase

<sup>10</sup> See note 7.

at the same rate. The annual increase in potential capacity equals  $I\sigma$ . The annual increase in actual income is expressed by  $\Delta I(1/\alpha)$ . Our objective is to make them equal. This gives us the fundamental equation

$$(2) \quad \Delta I \frac{1}{\alpha} = I\sigma.$$

To solve this equation, we multiply both sides by  $\alpha$  and divide by  $I$ , obtaining

$$(3) \quad \frac{\Delta I}{I} = \alpha\sigma.$$

The left side of expression (3) is the absolute annual increase (or the absolute rate of growth) in investment— $\Delta I$ —divided by the volume of investment itself; or in other words, it is the relative increase in investment, or the annual percentage rate of growth of investment. Thus the maintenance of full employment requires that investment grow at the annual percentage rate  $\alpha\sigma$ .

So much for investment. Since the marginal propensity to save— $\alpha$ —is assumed to be constant, an increase in income is a constant multiple of an increase in investment (see expression [1]). But in order to remain such a constant multiple of investment, income must also grow at the same annual percentage rate, that is at  $\alpha\sigma$ .

To summarize, the maintenance of a continuous state of full employment requires that *investment and income grow at a constant annual percentage (or compound interest) rate equal to the product of the marginal propensity to save and the average (to put it briefly) productivity of investment.*<sup>11</sup>

This result can be made clearer by a numerical example. Let  $\sigma = 25$  per cent per year,  $\alpha = 12$  per cent, and  $Y = 150$  billions per year. If full employment is to be maintained, an amount equal to  $150 \times \frac{12}{100}$  should be invested. This will raise productive capacity by the amount invested times  $\sigma$ , *i.e.*, by  $150 \times \frac{12}{100} \times \frac{25}{100}$ , and national income will have to rise by the same annual amount. But the relative rise in income will equal the absolute increase divided by the income itself, *i.e.*,

<sup>11</sup> The careful reader may be disturbed by the lack of clear distinction between increments and rates of growth here and elsewhere in the text. If some confusion exists, it is due to my attempt to express these concepts in non-mathematical form. Actually they all should be stated in terms of rates of growth (derivatives in respect to time). For a more serious treatment of this point, as well as for a more complete statement of the logic of the paper, see my article "Capital Expansion, Rate of Growth, and Employment," *Econometrica*, Vol. XIV (Apr., 1946), pp. 137-47.

$$(4) \quad \frac{150 \times \frac{12}{100} \times \frac{25}{100}}{150} = \frac{12}{100} \times \frac{25}{100} = \alpha\sigma = 3 \text{ per cent.}$$

These results were obtained on the assumption that  $\alpha$ , the marginal propensity to save, and  $\sigma$ , the average productivity of investment, remain constant. The reader can see that this assumption is not necessary for the argument, and that the whole problem can be easily reworked with variable  $\alpha$  and  $\sigma$ . Some remarks about a changing  $\alpha$  are made on pp. 48-49.

The expression (3) indicates (in a very simplified manner) conditions needed for the maintenance of full employment over a period of time. It shows that it is not sufficient, in Keynesian terms, that savings of yesterday be invested today, or, as it is often expressed, that investment offset saving. Investment of today must always exceed savings of yesterday. A mere absence of hoarding will not do. An injection of new money (or dishoarding) must take place every day. Moreover, this injection must proceed, in absolute terms, at an accelerated rate. The economy must continuously expand.<sup>11a</sup>

## II. *The Argument Re-examined*

The busy reader is urged to skip this section and proceed directly to Section III. The present section is really a long footnote which re-examines the concepts and suggests some alternative approaches. Its purpose is, on the one hand, to indicate the essential limitations of the preceding discussion, and on the other, to offer a few suggestions which may be of interest to others working in this field.

It was established in Section I that the maintenance of full employment requires income and investment to grow at an annual compound interest rate equal to  $\alpha\sigma$ . The meaning of this result will naturally depend on those of  $\alpha$  and  $\sigma$ . Unfortunately neither of them is devoid of ambiguity.

The marginal propensity to save— $\alpha$ —is a relatively simple concept in a private economy where only a small part of resources is handled by the government. National income can be divided, without too much trouble, into investment and consumption, even though it is true that the basis for this distinction is often purely formal.<sup>12</sup> But on the whole it

<sup>11a</sup> After this paper was sent to the printer, I happened to stumble on an article by R. F. Harrod, published in 1939, which contained a number of ideas similar to those presented here. See "An Essay in Dynamic Theory," *Econ. Jour.*, Vol. XLIX (Apr., 1939), pp. 14-33.

<sup>12</sup> Thanks are due to George Jaszi for his persistent efforts to enlighten me on this subject. The division of national income into investment and consumption is really a more difficult task than my text might imply.

sounds quite reasonable to say that if marginal propensity to save is  $\alpha$ , then an  $\alpha$  fraction of an increase in income is saved by the public and invested in income-producing assets.

When a substantial part of the economy's resources is disposed of by the government, two interpretations of the marginal propensity to save, or of savings and investment in general, appear possible. The first is to continue dividing the total output, whether produced by government or by private business, into consumption and investment. This method was implicitly followed in this paper. But a question arises regarding the meaning and stability of  $\alpha$ . It makes sense to say that a person or the public save, in accordance with the size of their incomes, their habits, expectations, etc., a certain, though not necessarily constant, fraction of an increment in their *disposable* (*i.e.*, after income and social security taxes) income, but can a similar statement be made regarding total national income, a good part of which is not placed at the disposal of the public? Also it is not easy to divide government expenditures into consumption and investment.

The other method would limit  $\alpha$  to disposable income only, and then provide for government expenditures separately. It would be necessary then to find out the effects of these expenditures on productive capacity.

Depreciation raises another problem. Since all terms are defined here in the net sense, the meaning and magnitude of  $\alpha$  will also depend on those of depreciation, irrespective of the choice between the above two methods. Depreciation has been defined here (see page 35) as the cost of replacement of a worn out asset by another one with an equal productive capacity. While this approach is about as bad or as good as any other, the difficulty still remains that businesses ordinarily do not use this definition, and therefore arrive at a different estimate of their net incomes, which in turn determine their propensity to save.

I do not have ready answers to these questions, though I do not consider them insurmountable. I am mentioning them here partly in order to indicate the limitations of the present argument, and also as obstacles which will have to be overcome if a more exact analysis is undertaken.

$\sigma$  is even more apt to give rise to ambiguities.  $s$ , from which it springs, has been used, in one form or another, in economic literature before, particularly in connection with the acceleration principle.<sup>13</sup> Here it indicates the annual amount of income (net value added) which can be produced by a dollar of newly created capital. It varies of course among firms and industries, and also in space and time, though a study recently

<sup>13</sup> See for instance Paul A. Samuelson, "Interactions between the Multiplier Analysis and the Principle of Acceleration," *Rev. Econ. Stat.*, Vol. XXI (May, 1939), pp. 75-79; also R. F. Harrod, *The Trade Cycle* (Oxford, 1936). These authors, however, used not the ratio of income to capital, but of consumption to capital, or rather the reciprocal of this ratio.

made seems to indicate that it has been quite stable, at least in the United States and Great Britain, over the last 70 years or so.<sup>14</sup> Whether  $s$  has or has not been relatively stable is not essential for our discussion. The real question is whether such a concept has meaning, whether it makes sense to say that a given economy or a plant has a certain capacity. Traditional economic thinking would, I fear, be against such an approach. Unfortunately, it is impossible to discuss this question here. I believe that our actual experience during the last depression and this war, as well as a number of empirical studies, show that productive capacity, both of a plant and of the whole economy is a meaningful concept, though this capacity, as well as the magnitude of  $s$ , should be treated as a *range* rather than as a single number.

In some problems  $s$  may be interpreted as the minimum annual output per dollar invested which will make the investment worth undertaking. If this output falls below  $s$ , the investor suffers a loss or at least a disappointment, and may be unwilling to replace the asset after it has depreciated.

All these doubts apply to  $\sigma$  even more than to  $s$ . As explained on pages 39–40,  $\sigma$  differs from  $s$  by indicating the annual increment in capacity of the *whole economy* per dollar invested, rather than that of the newly created capital taken by itself. The possible difference between  $s$  and  $\sigma$  is due to the following reasons:

1. The new plants are not operated to capacity because they are unable to find a market for their products.
2. Old plants reduce their output because their markets are captured by new plants.

As productive capacity has no meaning except in relation to consumers' preferences, in both of the above cases productive capacity of the country is increased by a smaller amount than could be produced by the new plants; in the limiting case it is not increased at all, and  $\sigma = 0$ , however high  $s$  may be. But it must be made clear that the test of whether or not  $\sigma$  is below  $s$  can be made only under conditions (actual or assumed) of full employment. If markets are not large enough because of insufficiency of effective demand due to unemployment, it cannot yet be concluded that  $\sigma$  is below  $s$ .

3. The first two cases can take place irrespective of the volume of current investment. A more important case arises when investment proceeds at such a rapid rate that a shortage of other factors relative to capital develops. New plants may be unable to get enough labor, or more likely, labor (and other factors) is transferred to new plants from previously constructed ones, whose capacity therefore declines. In its

<sup>14</sup> See Ernest H. Stern, "Capital Requirements in Progressive Economies," *Economica*, n.s. Vol. XII (Aug., 1945), pp. 163–71.

actual manifestation, case 3 can hardly be separated from cases 1 and 2, because to the individual firm affected the difference between  $s$  and  $\sigma$  always takes the form of a cost-price disparity. The reason why we are trying to separate the first two cases from the third lies in the bearing of this distinction on practical policy. The first two cases arise from an error of judgment on the part of investors (past or present) which is, at least to some extent, unavoidable and not undesirable. The struggle for markets and the replacement of weaker (or older) firms and industries by stronger (or newer) ones is the essence of progress in a capitalist society. The third case, on the other hand, may result from poor fiscal policy. It constitutes an attempt to invest too much, to build more capital than the economy can utilize even at full employment. Such a situation can develop if an economy with a high propensity to save tries to maintain full employment by investing all its savings into capital goods. But it should be made clear that the expressions "too much capital" or "high propensity to save" are used in a relative sense—in comparison with the growth of other factors, that is natural resources, labor and technology.

The use of  $\sigma$  certainly does not imply that these factors remain fixed. As a matter of fact, it would be very interesting to explore the use of a more complex function as the right side of expression (2) instead of  $I\sigma$ , a function in which the growth of labor, natural resources, and technology would be presented explicitly, rather than through their effects on  $\sigma$ .<sup>15</sup> I did not attempt it because I wished to express the idea of growth in the simplest possible manner. One must also remember that in the application of mathematics to economic problems, diminishing returns appear rapidly, and that the construction of complex models requires so many specific assumptions as to narrow down their applicability.

And yet it may be interesting to depart in another direction, namely to introduce lags. In this paper both the multiplier effect and the increase in capacity are supposed to take place simultaneously and without any lag. Actually, the multiplier may take some time to work itself out, and certainly the construction of a capital asset takes time. In a secular problem these lags are not likely to be of great importance, but they may play an essential rôle over the cycle. We shall return to this question on pages 50–51.

Finally, it is possible to approach the problem of growth from a different point of view. It was established here that the rate of growth required for a full employment equilibrium to be indicated by  $r$  is equal to

<sup>15</sup> Some work along these lines has been done by J. Tinbergen. See his "Zur Theorie der langfristigen Wirtschaftsentwicklung" in the *Weltwirtschaftliches Archiv*, Vol. LV (May, 1942), pp. 511–49.

$$(5) \quad r = \alpha\sigma,$$

so that if  $\alpha$  and  $\sigma$  are given, the rate of growth is determined. But the equation (5) can also be solved for  $\alpha$  in terms of  $r$  and  $\sigma$ , and for  $\sigma$  in terms of  $r$  and  $\alpha$ . Thus if it is believed that  $r$  should be treated as given (for instance by technological progress), and if it is also decided to keep  $\sigma$  at a certain level, perhaps not too far from  $s$ , then it is possible to determine  $\alpha = r/\sigma$ , as being that marginal propensity to save which can be maintained without causing either inflation or unemployment. This approach was actually used by Ernest Stern in his statistical study of capital requirements of the United Kingdom, the United States and the Union of South Africa.<sup>16</sup> I also understand from Tibor de Scitovszky that he used the same approach in a study not yet published.

It is also possible to treat  $r$  and  $\alpha$  as given and then determine what  $\sigma = r/\alpha$  would have to be. Each approach has its own advantages and the choice depends of course on the nature of the problem in hand. The essential point to be noticed is the relationship between these three variables  $r$ ,  $\alpha$ , and  $\sigma$ , and the fact that if any two of them are given, the value of the third needed for the maintenance of full employment is determined; and if its actual value differs from the required one, inflation in some cases and unused capacity and unemployment in others will develop.

### III. *The Dual Nature of the Investment Process*

We shall continue the discussion of growth by returning to expression (2) on page 41.

$$\Delta I \frac{1}{\alpha} = I\sigma,$$

which is fundamental to our whole analysis. As a matter of fact, the statement of the problem in this form (2) appears to me at least as important as its actual solution expressed in (3). To repeat, the left part of the equation shows the annual increment in national income and is the demand side; while the right part represents the annual increase in productive capacity and is the supply side. Alternatively, the left part may be called the "multiplier side," and the right part the " $\sigma$  side."

What is most important for our purposes is the fact that investment appears on both sides of the equation; that is, it has a *dual effect*: on the left side it generates income via the multiplier effect; and on the right side it increases productive capacity—the  $\sigma$  effect. The explicit recognition of this dual character of investment could undoubtedly save much argument and confusion. Unless some special assumptions are made, the discussion of the effects of investment on profits, income, employ-

<sup>16</sup> Stern, *Economica*, n.s. Vol. XII, pp. 163-71.

ment, etc., cannot be legitimately confined to one side only. For the generation of income and the enlargement of productive capacity often have diametrically opposed effects, and the outcome in each particular case depends on the special circumstances involved.<sup>17</sup>

Analyzing expression (2) further, we notice that even though investment is present on both its sides, it does not take the same form: for on the  $\sigma$  side we have the *amount* of investment as such; but on the multiplier side we have not the amount of investment but its annual increment or its absolute *rate of increase*.

The amount of investment (always in the net sense) may remain constant, or it may go up or down, but so long as it remains positive (and except for the rare case when  $\sigma \leq 0$ ) productive capacity increases. But if income is to rise as well, it is not enough that just any amount be invested: *an increase in income is not a function of the amount invested; it is the function of the increment of investment*. Thus the whole body of investment, so to speak, increases productive capacity, but only its very top—the increment—increases national income.

In this probably lies the explanation why inflations have been so rare in our economy in peacetime, and why even in relatively prosperous periods a certain degree of underemployment has usually been present. Indeed, it is difficult enough to keep investment at some reasonably high level year after year, but the requirement that it always be rising is not likely to be met for any considerable length of time.

Now, if investment and therefore income do not grow at the required rate, unused capacity develops. Capital and labor become idle. It may not be apparent why investment by increasing productive capacity creates unemployment of labor. Indeed, as was argued on page 37, this need not always be the case. Suppose national income remains constant or rises very slowly while new houses are being built. It is possible that new houses will be rented out at the expense of older buildings and that no larger rents will be paid than before; or that the new houses will stand wholly or partly vacant with the same result regarding the rents.<sup>18</sup> But it is also possible, and indeed very probable, that the complete or partial utilization of the new buildings which are usually better than the old ones, will require the payment of larger rents, with the result that

<sup>17</sup> The effects of labor saving machinery on employment of labor is a good case in point. Some economists, particularly those connected with the labor movement, insist that such machines displace labor and create unemployment. Their opponents are equally sure that the introduction of labor saving devices reduces costs and generates income, thus increasing employment. Both sides cite ample empirical evidence to prove their contentions, and neither side is wrong. But both of them present an incomplete picture from which no definite conclusion can be derived.

<sup>18</sup> It is worth noticing that in both cases the construction of the new houses represents a misdirection of resources, at least to some extent. But a complete avoidance of such misdirection is perfectly impossible and even undesirable.

less income will be left for the purchase of, say clothing; thus causing unemployment in the clothing trades. So the substitution of capital for labor need not take the obvious form of labor-saving machinery; it may be equally effective in a more circuitous way.

The unemployment of men is considered harmful for obvious reasons. But idle buildings and machinery, though not arousing our humanitarian instincts, can be harmful because their presence inhibits new investment. Why build a new factory when existing ones are working at half capacity? It is certainly not necessary to be dogmatic and assert that no plant or house should ever be allowed to stand idle, and that as soon as unused capacity develops the economy plunges into a depression. There is no need, nor is it possible or desirable, to guarantee that every piece of capital ever constructed will be fully utilized until it is worn out. When population moves from Oklahoma to California, some buildings in Oklahoma will stand idle; or when plastics replace leather in women's handbags, the leather industry may suffer. Such changes form the very life of a free dynamic society, and should not be interfered with. The point is that there be no vacant houses while prospective tenants are present but cannot afford to live in them because they are unemployed. And they are unemployed because income and investment do not grow sufficiently fast.

The extent to which unused capacity, present or expected, inhibits new investment greatly depends on the structure of industry and the character of the economy in general. The more atomistic it is, the stronger is competition, the more susceptible it is to territorial, technological and other changes, the smaller is the effect of unused capacity on new investment. One firm may have an idle plant, while another in the same industry builds a new one; steel may be depressed while plastics are expanding. It is when an industry is more or less monopolized, or when several industries are financially connected, that unused capacity presents a particularly serious threat to new investment.

Strictly speaking, our discussion so far, including equation (2), was based on the assumption that  $\alpha$  remained constant. If  $\alpha$  varies within the time period concerned, the relation between investment and income becomes more involved. What the left side of the equation (2) requires is that *income* increase; and investment must grow only in so far as its growth is necessary for the growth of income. So if  $\alpha$  declines sufficiently fast, a growing income can be achieved with a constant or even falling investment. But years of declining  $\alpha$  have evidently been offset by others of rising  $\alpha$ , because whatever information is available would indicate that over the last seventy years or so prior to this war the percentage of income saved was reasonably constant, possibly with a slight

downward trend.<sup>19</sup> Therefore, in the absence of direct government interference, it would seem better not to count too much on a falling  $\alpha$ , at least for the time being.

In general, a high  $\alpha$  presents a serious danger to the maintenance of full employment, because investment may fail to grow at the required high rate, or will be physically unable to do so without creating a substantial difference between  $s$  and  $\sigma$ . This difference indicates that large numbers of capital assets become unprofitable and their owners suffer losses or at least disappointments (see pages 44-45). Space does not permit me to develop this idea at greater length here.<sup>20</sup> But it must be emphasized that what matters is not the magnitude of  $\alpha$  taken by itself, but its relation to the growth of labor, natural resources, and technology. Thus a country with new resources, a rapidly growing population, and developing technology is able to digest, so to speak, a relatively large  $\alpha$ , while absence or at least a very slow growth of these factors makes a high  $\alpha$  a most serious obstacle to full employment.<sup>21</sup> But the problem can be attacked not only by lowering  $\alpha$ , but also by speeding up the rate of technological progress, the latter solution being much more to my taste. It must be remembered, however, that technological progress makes it *possible* for the economy to grow, without guaranteeing that this growth will be realized.

In a private capitalist society where  $\alpha$  cannot be readily changed, a higher level of income and employment at any given time can be achieved only through increased investment. But investment, as an employment creating instrument, is a mixed blessing because of its  $\sigma$  effect. The economy finds itself in a serious dilemma: if sufficient investment is not forthcoming today, unemployment will be here today. But if enough is invested today, still more will be needed tomorrow.

It is a remarkable characteristic of a capitalist economy that while, on the whole, unemployment is a function of the difference between its actual income and its productive capacity, most of the measures (*i.e.*, investment) directed towards raising national income also enlarge productive capacity. It is very likely that the increase in national income will be greater than that of capacity, but the whole problem is that the increase in income is temporary and presently peters out (the usual multiplier effect), while capacity has been increased for good. So that as

<sup>19</sup> See Simon Kuznets, *National Product since 1869*, National Bureau of Economic Research (mimeo., 1945), p. II-89. I do not mean that we must always assume a constant  $\alpha$ ; rather that we lack sufficient proof to rely on a falling one.

<sup>20</sup> See my paper, *Econometrica*, Vol. XIV, particularly pp. 142-45.

<sup>21</sup> Cf. Alvin H. Hansen, *Fiscal Policy and the Business Cycle* (New York, 1941), particularly Part IV.

far as unemployment is concerned, investment is at the same time a cure for the disease and the cause of even greater ills in the future.<sup>22</sup>

#### IV. *An Economic Excursion*

It may be worth while to browse through the works of several economists of different schools of thought to see their treatment of the  $\sigma$  and of the multiplier effects of investment. It is not suggested to make an exhaustive study, but just to present a few examples.

Thus in Marshall's *Principles* capital and investment are looked upon as productive instruments (the  $\sigma$  effect), with little being said about monetary (that is, income or price) effects of investment.<sup>23</sup> The same attitude prevails in Fisher's *Nature of Capital and Income*,<sup>24</sup> and I presume in the great majority of writings not devoted to the business cycle. It is not that these writers were unaware of monetary effects of investment (even though they did not have the multiplier concept as such), but such questions belonged to a different field, and the problem of aggregate demand was supposed to be taken care of by some variation of Say's Law.

In the business cycle literature we often find exactly an opposite situation. The whole Wicksellian tradition treated economic fluctuations as a result of monetary effects of excessive investment. It is curious that all this investment did not lead to increased output which would counteract its inflationary tendencies. Indeed, as one reads Hayek's *Prices and Production*, one gets an impression that these investment projects never bear fruit and are, moreover, abandoned after the crisis. The  $\sigma$  effect is entirely absent, or at least appears with such a long lag as to make it inoperative. Prosperity comes to an end because the banking system refuses to support inflation any longer.<sup>25</sup>

$\sigma$  fares better in the hands of Aftalion.<sup>26</sup> His theory of the cycle is

<sup>22</sup> That income generating effects of investment are temporary and that new and larger amounts must be spent to maintain full employment, has been mentioned in economic and popular literature a number of times. Particular use has been made of this fact by opponents of the so-called deficit financing, who treat government expenditures as a "shot in the arm" which must be administered at an ever increasing dose. What they fail to realize is that exactly the same holds true for private investment.

<sup>23</sup> Marshall was very careful, however, to distinguish between the substitution of a particular piece of machinery for particular labor, and the replacement of labor by capital in general. The latter he regarded impossible, because the construction of capital creates demand for labor, essentially a sort of a multiplier effect. See *Principles of Economics*, 8th ed. (London, 1936), p. 523.

<sup>24</sup> Irving Fisher, *The Nature of Capital and Income* (New York, 1919).

<sup>25</sup> Friedrich A. Hayek, *Prices and Production* (London, 1931). I don't mean to say that Professor Hayek is not aware that capital is productive; rather that he did not make use of this fact in his theory of the business cycle. See, however, his "The 'Paradox' of Saving," *Economica*, Vol. XI (May, 1931), pp. 125-69.

<sup>26</sup> Albert Aftalion, "The Theory of Economic Cycles Based on the Capitalistic Technique of

based upon, what I would call, a time lag between the multiplier and the  $\sigma$  effects. Prosperity is started by income generated by investment in capital goods (the multiplier effect), while no increase in productive capacity has taken place as yet. As investment projects are completed, the resulting increase in productive capacity (the  $\sigma$  effect) pours goods on the market and brings prosperity to an end.

A similar approach is used by Michal Kalecki. The essence of his model of the business cycle consists in making profit expectations, and therefore investment, a function (with appropriate lags) of the relation between national income and the stock of capital. During the recovery, investment and income rise, while the accumulation of capital lags behind. Presently, however, due to the structure of the model, the rise of income stops while capital continues to accumulate. This precipitates the downswing.<sup>27</sup>

Space does not allow us to analyze the works of a number of other writers on the subject, among whom Foster and Catchings should be given due recognition for what is so clumsy and yet so keen an insight.<sup>28</sup> I am also omitting the whole Marxist literature, in which capital accumulation plays such an important rôle, because that would require a separate study. The few remaining pages of this section will be devoted to Hobson and Keynes.

Hobson's writings contain so many interesting ideas that it is a great pity he is not read more often.<sup>29</sup> Anti-Keynesians probably like him not much more than they do Keynes, while Keynesians are apt to regard the *General Theory* as the quintessence of all that was worth while in economics before 1936, and may not bother to read earlier writings. I may say that Keynes's own treatment of Hobson, in spite of his generous recognition of the latter's works, may have substantiated this impression.<sup>30</sup>

Production," *Rev. Econ. Stat.*, Vol. IX (Oct., 1927), pp. 165-70. This short article contains a summary of his theory.

<sup>27</sup> Michal Kalecki, *Essays in the Theory of Economic Fluctuations* (New York, 1939). See particularly the last essay "A Theory of the Business Cycle," pp. 116-49. What Mr. Kalecki's model shows in a general sense is that accumulation of capital cannot proceed for any length of time in a trendless economy (*i.e.*, an economy with a secularly constant income). His other results depend upon the specific assumptions he makes.

<sup>28</sup> William T. Foster and Waddill Catchings, *Profits* (Boston and New York, 1925) This book is the most important of their several published works. It is interesting to note that they did come to the conclusion that "... as long as capital facilities are created at a sufficient rate, there need be no deficiency of consumer income. To serve that purpose, however, facilities must be increased at a constantly accelerating rate" (p. 413). This they regarded quite impossible.

<sup>29</sup> I am particularly referring to his *Economics of Unemployment* (London, 1922) and *Rationalization and Unemployment* (New York, 1930).

<sup>30</sup> See *The General Theory*, pp. 364-71.

Even though both Keynes and Hobson were students of unemployment, they actually addressed themselves to two different problems. Keynes analyzed what happens when savings (of the preceding period) are not invested. The answer was—unemployment, but the statement of the problem in this form might easily give the erroneous impression that if savings were invested, full employment would be assured. Hobson, on the other hand, went a step further and stated the problem in this form: suppose savings are invested. Will the new plants be able to dispose of their products? Such a statement of the problem was not at all, as Keynes thought, a mistake.<sup>31</sup> It was a statement of a different, and possibly also a deeper problem.

Hobson was fully armed with the  $\sigma$  effect of investment, and he saw that it could be answered only by growth. His weakness lay in a poor perception of the multiplier effect and his analysis lacked rigor in general. He gave a demonstration rather than a proof. But the problem to which he addressed himself is just as alive today as it was fifty and twenty years ago.<sup>32</sup>

This discussion, as I suspect almost any other, would be obviously incomplete without some mention of Keynes's treatment of the  $\sigma$  and of the multiplier effects. Keynes's approach is very curious: as a matter of fact, he has two: the familiar short-run analysis, and another one which may be called a long-run one.<sup>33</sup>

Keynes's short-run system (later expressed so admiringly by Oscar Lange<sup>34</sup>) is based on ". . . given the existing skill and quantity of available labor, the existing quality and quantity of available equipment, the existing technique, the degree of competition, the tastes and habits of the consumer . . ." <sup>35</sup> Productive capacity thus being given, employment becomes a function of national income, expressed, to be sure, not in money terms but in "wage units." A wage unit, the remuneration for "an hour's employment of ordinary labor" (page 41), is of course a perfect fiction, but some such device must be used to translate real values into monetary and *vice versa*, and one is about as good or as bad as another. The important point for our purposes is the assumption that the amount of equipment (*i.e.*, capital) in existence is given.

<sup>31</sup> *Ibid.*, pp. 367-68.

<sup>32</sup> Contrary to popular impression, Hobson does not advocate a maximum reduction in the propensity to save. What he wants is to reduce it to a magnitude commensurable with requirements for capital arising from technological progress—an interesting and reasonable idea.

<sup>33</sup> This whole discussion is based on *The General Theory* and not on Keynes's earlier writings.

<sup>34</sup> Oscar Lange, "The Role of Interest and the Optimum Propensity to Consume," *Economica*, n.s. Vol. V (Feb., 1938), pp. 12-32. This otherwise excellent paper has a basic defect in the assumption that investment is a function of consumption rather than of the rate of change of consumption.

<sup>35</sup> *The General Theory*, p. 245. See also pp. 24 and 28.

Now, the heart of Keynesian economics is the argument that employment depends on income, which in turn is determined by the current volume of investment (and the propensity to save). But investment (in the net sense) is nothing else but the rate of change of capital. Is it legitimate then first to assume the quantity of capital as given, and then base the argument on its rate of change? If the quantity of capital changes, so does (in a typical case) productive capacity, and if the latter changes it can be hardly said that employment is solely determined by the size of national income, expressed in wage units or otherwise. Or putting it in the language of this paper, is it safe and proper to analyze the relation between investment and employment without taking into account the  $\sigma$  effect?

The answer depends on the nature of the problem in hand. In this particular case, Keynes could present two reasons for his disregard of the  $\sigma$  effect. He could assume that the latter operates with at least a one-year period lag, the period being understood here as the whole time span covered by the discussion.<sup>36</sup> Or he could argue that over a typical year the net addition (*i.e.*, net investment) to the stock of capital of a society, such as England or the United States, will hardly exceed some 3 or 5 per cent; since this increment is small when compared with changes in income, it can be disregarded.<sup>37</sup>

Both explanations are entirely reasonable provided of course that the period under consideration is not too long. A five-year lag for the  $\sigma$  effect would be difficult to defend, and an increase in the capital stock of some 15 or 20 per cent can hardly be disregarded. I am not aware that Keynes did present either of these explanations; but there is just so much one can do in four hundred pages at any one time.

It would be perfectly absurd to say that Keynes was not aware of the productive qualities of capital. In the *long run* he laid great stress on it, possibly too great. All through the *General Theory* we find grave concern for the diminishing marginal efficiency of capital due, in the long run, to its increasing quantity.<sup>38</sup> There is so much of this kind of argument as to leave the reader puzzled in the end. We are told that marginal efficiency of capital depends on its scarcity. Well and good. But scarcity relative to what? It could become less scarce relative to other factors, such as labor, so that the marginal productivity of capital in the real sense (*i.e.*, essentially our  $\sigma$ ) declined. But then on page 213 we read: "If capital becomes less scarce, the excess yield will diminish, without its having become less productive—at least in the physical sense."

<sup>36</sup> This again is not quite safe unless some provision for investment projects started in preceding periods and finished during the present period is made.

<sup>37</sup> The second assumption is specifically made by Professor Pigou in his *Employment and Equilibrium* (London, 1941), pp. 33–34.

<sup>38</sup> See for instance pp. 31, 105–106, 217, 219, 220–21, 324, and 375.

Why then does the marginal efficiency of capital fall? Evidently because capital becomes less scarce relative to income.<sup>39</sup> But why cannot income grow more rapidly if labor is not the limiting factor? Could it be only a matter of poor fiscal policy which failed to achieve a faster growing income? After all we have in investment an income generating instrument; if investment grows more rapidly, so does income. This is *the* multiplier effect of investment on which so much of the *General Theory* is built.

I don't have the answer. Is it possible that, while Keynes disregarded the  $\sigma$  effect in the short-run analysis, he somehow omitted the multiplier effect from the long-run?

### V. Concluding Remarks

A traveller who sat in the economic councils of the United States and of the Soviet Union would be much impressed with the emphasis placed on investment and technological progress in both countries. He would happily conclude that the differences between the economic problems of a relatively undeveloped socialist economy and a highly developed capitalist economy are really not as great as they are often made to appear. Both countries want investment and technological progress. But if he continued to listen to the debates, he would presently begin to wonder. For in the Soviet Union investment and technology are wanted in order to enlarge the country's productive capacity. They are wanted essentially as labor-saving devices which would allow a given task to be performed with less labor, thus releasing men for other tasks. In short, they are wanted for their  $\sigma$  effects.

In the United States, on the other hand, little is said about enlarging productive capacity. Technological progress is wanted as the creator of investment opportunities, and investment is wanted because it generates income and creates employment. It is wanted for its multiplier effect.

Both views are correct and both are incomplete. The multiplier is not just another capitalist invention. It can live in a socialist state just as well and it has been responsible for the inflationary pressure which has plagued the Soviet economy all these years, since the first five-year plan. And similarly,  $\sigma$  is just as much at home in one country as in another, and its effect—the enlarged productive capacity brought about by accumulation of capital—has undoubtedly had much to do with our peacetime unemployment.

But what is the solution? Shall we reduce  $\sigma$  to zero and also abolish technological progress thus escaping from unemployment into the

<sup>39</sup> There is a third possibility namely that income is redistributed against the capitalists, but Keynes makes no use of it.

“nirvana” of a stationary state? This would indeed be a defeatist solution. It is largely due to technology and savings that humanity has made the remarkable advance of the last two hundred years, and now when our technological future seems so bright, there is less reason to abandon it than ever before.

It is possible that  $\alpha$  has been or will be too high as compared with the growth of our labor force, the utilization of new resources, and the development of technology. Unfortunately, we have hardly any empirical data to prove or disprove this supposition. The fact that private investment did not absorb available savings in the past does not prove that they could not be utilized in other ways (*e.g.*, by government), or even that had private business invested them these investments would have been unprofitable; the investing process itself might have created sufficient income to justify the investments. What is needed is a study of the magnitudes of  $s$ , of the difference between  $s$  and  $\sigma$  which can develop without much harm and then of the value of  $\alpha$  which the economy can digest at its full employment rate of growth.

Even if the resulting magnitude of  $\alpha$  is found to be considerably below the existing one, a reduction of  $\alpha$  is only one of the two solutions, the speeding up of technological progress being the other. But it must be remembered that neither technology, nor of course saving, guarantee a rise in income. What they do is to place in our hands the *power* and the ability of achieving a growing income. And just as, depending upon the use made of it, any power can become a blessing or a curse, so can saving and technological progress, depending on our economic policies, result in frustration and unemployment or in an ever expanding economy.