SECOND ESSAY IN DYNAMIC THEORY [1]

1. I AM offering this article as a companion piece to one that appeared rather a long time ago and contained a form of equation, which has since become fairly well known.[2] I am now presenting a second form of equation, and submit that the two together provide the inner core of the dynamic theory of an insulated economy.[3] Demand and supply are essentially static concepts and not strictly applicable in dynamic analysis. But in a certain sense the equation in the previous article may be regarded as a dynamic analogue of the static law of demand; if that is allowed, the equation in this article may be regarded as an analogue of the static law of supply.

2. I do not hold that the two equations constitute what is called a "model," any more than the laws of demand and supply taken together constitute a model. Rather they should be thought of as laws expressing certain necessary relations. They are not, of course, necessary in the sense of being *a priori*, for in that case they would be empty and uninformative. They are empirical, but necessary in the sense that they flow necessarily from postulating certain very general facts in the human situation, themselves known empirically, such as the existence of a multiplicity of needs and the availability of an insufficient amount of productive resources, which can be applied to alternative uses,[4] notably to present or future satisfactions. They are prolegomena to model building. In attempting to construct a model we seek to enter more deeply into the empirical phenomena. I believe that a model can properly be distinguished from a set of fundamental laws by the presence in the former of certain adjustable parameters.

3. There has been some terminological hesitation between the use of "dynamics" and "growth theory" in relation to certain matters. I believe that a distinction can be made, and that it would be convenient to use "dynamic theory" for the relations between the rates of increase (or decrease) of certain magnitudes in a growing economy. The theory of economic growth would have a wider ambit, including dynamic theory in this narrow sense. It would comprise also such matters as the sociological effects of the impact of economic progress, the contribution of the social pattern to it, the contribution of education, both general and technological, the need for political security, the usefulness of greater or less governmental intervention in successive phases, the development of moral codes, etc. For instance, there are wise men who hold that the prevalence of graft is the

[1] I am grateful to Mr. M. F. G. Scott for certain helpful suggestions.

[2] "An Essay in Dynamic Theory," ECONOMIC JOURNAL, March 1939.

[3] The dynamics of foreign trade and investment, on which Prof. H. Johnson and others have been doing notable work, must be an important part of the total theory.

[4] Cf. Lionel Robbins, *Nature and Significance of Economic Science*, Chapter 1, p. 15.

greatest single obstacle to growth in some developing countries. In fine, growth economics would then constitute the " political economy " of growth, while dynamic theory would be its pure economics.

4. My original equation has been criticised for excessive rigidity, notably for not allowing for the possibility of substitution in the productive process as between capital and other factors. In my *Essay* I used the term C for the optimum amount of capital required per unit of time, given current technology, for the output of an extra unit, and C_p for the actual accretion of extra capital per unit of extra output. In my book, *Towards a Dynamic Economics*, I used C_r for the optimum amount of capital required, reserving C for the amount that actually occurred. This latter symbolism seems better, and I shall adhere to it in what follows. It is argued that the value of C_r must depend on the rate of interest, and that consequently what I have called the " natural " and " warranted " rates of growth are so dependent. Recognition of this, it is claimed, could have far-reaching effects on the analysis.

5. In self-defence I may observe that I did recognise this dependence in the *Essay*. " The value of C_r may be somewhat dependent on the rate of interest " (p. 17). If I did not develop the implication of this any further, that was mainly owing to the maxim of attempting to do only one thing at a time. I must confess, however, that I was also somewhat influenced by the view, which was prevalent in those days, that producers were but little influenced by the rate of interest in their choice of more or less capital-intensive methods of production. When entrepreneurs reported that, owing to the risks of the market or of obsolescence, a piece of equipment was normally expected to pay itself off in four or five years, how could variations in the interest rate within the range commonly experienced have any appreciable effect? This was doubtless too sceptical. Even at that time it was recognised that the rate of interest had influence on long-lasting capital installations. Since then I have been much impressed with the significance of the imperfection of the capital market. The rate of interest should be regarded as the barometric reading in that limited part of the market which is perfect (organised stock exchange, discount market, etc.). When capital disposal is short, the perfect markets record high readings; but for many the shortage impinges on them simply by would-be borrowers finding it difficult to raise money. Accordingly, a wrong impression may be gained by putting the question to producers in the form—are you influenced by the rate of interest? This implies a nice calculation, balancing a rate of interest of so and so much against an expected yield of the projected assets on their cost of production. Many of the producers who deny ever making such a calculation may none the less be influenced for or against a more capital-intensive re-deployment of their productive set-up by whether the required finance is easy or difficult to obtain. In any case, a theory which makes no allowance for the possible variation in C_r in response to the abundance or

shortage of capital disposal is defective in principle. It is now sought to remedy this defect.

6. In my equation for warranted growth, which it is convenient to repeat,

$$G_w = \frac{s}{C_r}$$

s, the fraction of income saved, is taken as an independent variable. Its value is assumed to depend on the private convenience of many individuals, on the desires of many firms to finance themselves from their own ploughed-back profits, etc. This assumption of the independence of s is appropriate in its context. Indeed, the fact that the " warranted " rate of growth may not be equal to the " natural " rate depends precisely on the assumption that private motives may not yield the amount of saving that complies nicely with the needs of the society; they may generate too much or too little saving. The Keynesian origin of this idea is obvious. Natural growth (G_n) by contrast is conceived as a welfare optimum, in which resources are fully employed and the best available technology used. With natural growth so conceived, the amount to be saved becomes a " requirement," which may be greater or less than the actual s. But is not this " natural " rate itself indeterminate, unless the rate of interest is specified? There is clearly a lacuna in the theory.

7. I have to ask the reader in what follows to subject himself to a certain discipline, which may not be altogether easy. I regard the fundamental concept in dynamic economics as the rate of increase, just as the state of rest is that of statics. It is the rate of increase that obtains *at a given point of time*, given the fundamental determinants. In dynamics, or at least in Part I of dynamics—and I do not think that we can yet get beyond that—we are not, according to my view, concerned with a succession of events through time. The analogy with mechanics is, surely, precise. There we seek to determine the velocity of a particle in consequence of the forces acting upon it at a particular instant. Thereafter it may become subject to new forces. The dynamic determinants of economic progress change from time to time, and the consequence of such changes will have to be considered in due course. But, to begin with, we need to determine the rate of increase at one point. This is but applying in the realm of dynamics the procedure so well known, and, I would say, fruitful, in the theory of static equilibrium. It has always been recognised that the determinants of that equilibrium (desires of individuals, etc.) are constantly changing; none the less, it has been found serviceable to establish the equilibrium pattern required by a given set of determinants. I am convinced that we must do this in dynamics also, as an essential prelude to all else. Edgeworth once said of general value theory that " the path is short, but very slippery." If this is true of dynamics also, as is surely the case, we must proceed carefully, step by step. One consequence of this method of initial approach to dynamics is that time-lags do not appear in the equations.

8. This article is unlike the earlier *Essay* in that it will lead into the subject by reference to the welfare optimum. I believe that on a broad historic view we find that attention to the welfare optimum played a vital part in the formulation of static equilibrium theory. This may be a good precedent.

9. The second lecture in the course published as *Towards a Dynamic Economics* is called the *Supply of Saving*. This contrasts with the title of the third lecture, *Fundamental Dynamic Theorems*, and suggests, correctly, that what I had to say about saving could not be regarded as an integral part of dynamic theory. The *Supply of Saving* contains an equation (p. 42) which has been found, justifiably, somewhat obscure. The matter was rendered worse by inaccurate notation in the earlier editions. I will set it out in its most convenient form; the reader need not trouble himself, at this stage, about its justification, which will appear later. C_0 is consumption in year 0, C_r is consumption in year r, e is the elasticity of the schedule of the diminishing utility of income in its relevant range, T is " time preference " expressed in the form that, if a given unit of utility in year r is considered only half as preferable as the same unit of utility in year 0, $T^r = 0{\cdot}5$, and R^r is the amount of money to which 1 unit will have accumulated in r years at the current rate of interest.

$$C_r = C_0 + e\left(1 - \frac{1}{T^r R^r}\right)$$

In formulating this I was much influenced by F. P. Ramsey's famous article entitled " A Mathematical Theory of Saving." [1]

10. Ramsey's article contains a concept which he calls " Bliss," namely, " the maximum obtainable rate of enjoyment or utility." This concept is unsatisfactory for two reasons. It is unsatisfactory for dynamics, because Bliss is essentially a static concept. It is also unsatisfactory for any kind of welfare economics, because Ramsey's technique requires a comparison of the total utility achieved at " Bliss " with total and marginal utilities currently achieved, and this is manifestly altogether impracticable.

11. In my lecture on the *Supply of Saving* I gave a second equation, based on the assumption that it could be foreseen that the globe would be vaporised by a nuclear explosion n years hence. This second equation, along with n equations of the form given above, would suffice to determine the values of all the terms. Thus the Explosion would take the place of Bliss in governing the correct rate of saving. I next proceeded to some more realistic observations about a man's probable attitude to his own life and to his heirs. It was obvious that no precise theory could be based on such vague psychological speculations. Thus the matter lapsed, and my discourse on the supply of savings did not yield anything that could be included among the " fundamental dynamic theorems."

[1] Economic Journal, December 1928.

12. Although I had warned myself and others in the *Essay* that the formulation of a dynamic theory " involves something wider: a method of thinking, a way of approach to certain problems," [1] I was still so deeply rooted in static ways of thought, when I composed the Lectures, that I did not perceive that I had under my nose what was really a dynamic equation. As Keynes observed, in relation to a different problem, namely that of his *General Theory*, it is exceedingly difficult to wrench oneself from the habits of thought in which one has been educated.

13. I now set out my " second " equation, derived from my abortive attempt, based on Ramsey, in the lecture on the Supply of Saving. Its demonstration is given in the following paragraphs. I would venture to suggest that its *simplicity* entitles it to be regarded as a fundamental equation. Let r_n be the rate of interest appropriate to a natural (welfare optimum) rate of growth, and ${}_{pc}G_n$ the natural rate of growth *per caput*.

$$r_n = \frac{{}_{pc}G_n}{e}$$

This dispenses us both from having to have regard to " Bliss " or from having to make arbitrary assumptions about what a man may feel that he ought to do for his heirs.

14. The equation supplied in para. 9 above is based on the proposition set out in *Towards a Dynamic Economics* (p. 45) that the individual's distribution of his consumption between year 0 and year 1, in equilibrium, is given by

$$u(C_0) = RT \times u(C_1)$$

where $u(C)$ is the marginal utility of consumption. This signifies that, given the rate of interest and the time preference, consumption is so arranged that no re-distribution of it from year 0 to year 1, or conversely, would increase utility (as modified by time preference). Define, for the sake of simplicity, e as

$$e = \frac{C_1 - C_0}{C_1} \div -\frac{u(C_1) - u(C_0)}{u(C_1)}$$ [2]

Represent $\frac{C_1 - C_0}{C_1}$ by $G(\text{con})$

Reducing the above, it follows that, in equilibrium

$$RT - 1 = \frac{G(\text{con})}{e}$$

15. The equilibrium of static economics implies that saving is zero. A steady rate of increase implies that a constant fraction of income is saved. If the fraction of income saved is increasing or decreasing, that implies an

[1] *Op. cit.*, p. 15.

[2] The difference between this definition and $e = \frac{C_1 - C_0}{C_0} \div -\frac{u(C_1) - u(C_0)}{u(C_0)}$ disappears when the matter is expressed in terms of differential equations.

accelerating or decelerating increase of income. Accordingly, in the equation representing the rate of increase at a point of time it should be assumed that a constant fraction of income is saved. Thus for the equation last given we may substitute:

$$\text{In equilibrium,} \qquad RT - 1 = \frac{G}{e} \qquad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

This equation defines the equilibrium behaviour for an individual, if we abstract from his employment pattern (retirement in old age, etc.), and assume a constant rate of growth of his income. If we translate this into an equation representing the situation of the community as a whole, e must be a weighted average of the e's proper to each individual in it, subject to the abstractions of the last sentence. This assumes a constant income distribution. This assumption is simply carried over from the welfare optimum of static economics, where the income distribution is taken as given. Ultimately, we should be able to accommodate a steadily changing distribution of income in dynamic theory; this would (or might) entail a steadily changing rate of growth. (It is quite possible, however, the e does not differ much as between rich and poor.) With e thus re-defined, we can transform equation (1) into a community equation, in which ${}_{pc}G$ represents the growth of income *per caput.*

$$\text{In equilibrium,} \qquad RT - 1 = \frac{{}_{pc}G}{e} \qquad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

This has its own importance and should be borne in mind in what follows.

16. We may now go over to the " natural " (or welfare optimum) rate of growth. This may be regarded as, in the main (see below), exogenously determined, viz., by the growth of population and technological advance. This includes the rate of growth of skilled personnel, however obtained, *e.g.*, by governmental measures. If we are considering the welfare optimum, we should write, $T = 1$. There ought not to be a time preference! Any authority concerned with planning should, presumably, disregard it. Putting r $(= R - 1)$ for the rate of interest, we then have

$$r_n = \frac{{}_{pc}G_n}{e} \qquad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (I)$$

In other words,

$$r_n = \frac{G_n}{e} \Big/ G_{Pop}$$

where G_{Pop} is the rate of growth of the working population.

17. As G_n is (in the main) exogenously determined, and as e certainly is, equation (I) should be regarded as stating what determines the natural rate of interest.

18. It may be objected that G_n is itself determined by the rate of interest, so that there are two dependent variables in equation (I). This must be

[1] In the community equation T also must be taken to represent a weighted average.

recognised, subject to the important warnings given below, and, to accommodate the matter, we may have a second equation, showing the dependence of the natural growth rate on the rate of interest thus:

$$_{pc}G_n = f(r_n) \text{ (decreasing or increasing function)} \quad . \quad . \quad . \quad . \quad (Ia)$$

19. There is an inclination to suppose that G_n would be greater, the lower the rate of interest. As a generalisation, this is fallacious, and due to a confusion of dimensions, which it should be the first task of a " dynamic economics " to prevent. The confusion arises from regard to two quite different propositions, as follows: (i) If the rate of interest is low, more capital-intensive methods of production will be chosen by the producer, or more capital-intensive products will be preferred (because cheaper) by the consumer, than if it is high. The capital/output ratio will be higher. This means that, given the population and other factors (natural resources, trained personnel, etc.), output per person will be higher. It need hardly be said that higher production does not entail a higher growth rate. (Often the contrary!) (ii) If employment (including employment of skilled personnel) is not full, a drop in the rate of interest can increase it. While unemployed resources are coming into operation, G (actual growth rate) can exceed G_n. It need hardly be said that this does not entail a higher G_n either. It is quite an open question whether G_n will be higher or lower with a lower rate of interest. All depends on the nature of the technological innovations. If these are concentrated on substitute modes of production or substitute products where the yields on the modes and products for which they are substitutes are low, then the low-interest-rate economy will show a higher growth rate than the high-interest one. It will have the opportunity of taking advantage of a number of innovations which the high-interest economy has simply to ignore because, for it, they are outside the range of paying propositions. But if the innovations are such that the substituted processes or products were previously a long way inside the margin of substitution, the reverse may well be true. Compare two economies A and B of the same population increase, of which A uses more capital-intensive methods because its growth *per caput* and its natural interest rate are lower. A consequently has a higher income per head. Let there be an innovation available to both economies, which both will unquestionably adopt, because it is so manifestly high yielding. Thus for both it will cause the same increase in income in the sectors affected. But, because A is initially a higher-income economy, the growth entailed by this innovation will be greater in B, the high-interest country. Finally, there is the point that a *falling*, as distinct from a low, rate of interest could promote *per caput* growth. A falling *natural* rate of interest is a phenomenon of declining growth *per caput* (see para. 25). A fall in the interest rate from a supra-natural level towards its natural level is discussed in paras. 35–8 below.

20. The main objection to equation (I) is the difficulty of computing e.

It is supposed on general grounds to be less than 1. On the other hand, it would probably be wrong to suppose it *much less* than 1, since this would give an unrealistic decline in the marginal utility of income in the ranges of which we have experience. It would follow that the rate of interest ought to be above, but not much above, the growth rate *per caput*.

21. In *Towards a Dynamic Economics* (pp. 43–4) I suggested a method for measuring *e*. I proposed to take the eighth hour of work (or the sixtieth minute of the eighth hour) as a yardstick of constant disutility for a given individual. By appropriate conjoint variations in his basic rate of pay and his marginal rate (for the last hour or last minute thereof), and by allowing him freedom to vary the time worked, one could find out what increase in the marginal rate sufficed to keep him working exactly eight hours, neither more nor less, as his total income rose owing to an increase in the basic rate. It has been objected to this that a rise in income might make him find more utility in leisure, so that the sixtieth minute of the eighth hour would cease to be a yardstick of unvarying disutility, but would conflate the actual toil of work with the disutility of foregoing leisure, the latter rising as income grew. This objection could readily be overcome by varying the conditions of the experiment. Let us suppose the length of the working day not subject to variation, so that the rising utility of leisure, with higher income, became irrelevant. Let us suppose a piece-rate superimposed upon a basic rate, both variable. The target output, say 100 pieces, should be fixed so that it was quite a considerable effort to achieve it. What increase in piece-rates would be required to induce the man to produce exactly 100 pieces, neither more nor less, as his income went up owing to successive rises in his basic rate? This seems to give an inexpugnable yardstick for cardinal measurement of the rate of decline in the utility of income as income rises.

22. I have suggested applying the experiment to one individual to avoid interpersonal comparison. It will be objected that a single individual's reactions to changes of income—not known to be permanent, if this is a mere experiment—would be quite unreliable. In practice, of course, one would make the experiment with a *large number* of different individuals, who were normally on different income scales owing to their position in the factory hierarchy, and would rely on the large number to overcome differences of personal temperament from man to man. This is the way in which things are commonly done in the natural sciences. Of course, no such measurement could be relied on to be 100% accurate. It is impossible to get measurements of *perfect* accuracy in physics—I am not speaking of quantum physics —or in chemistry. The practitioners of those sciences would not have done so well if they had decided in consequence from the beginning to use no cardinal numbers in the formulation of physical and chemical laws. This is true of economics also.

23. It is next necessary to draw the threads together. The " supply "

equation, which should be regarded as determining the natural rate of interest, is

$$r_n = \frac{{}_{pc}G_n}{e}, \quad \ldots\ldots\ldots \quad \text{(I)}$$

where G_n is taken to be an almost entirely independent variable, but possibly depending to a slight degree upon the rate of interest:

$${}_{pc}G_n = f(r_n) \text{ (increasing or decreasing function)} \quad \ldots \quad \text{(I}a\text{)}$$

The capital intensity of methods used for increments of production, and of the basketful of goods selected by consumers for their additional purchases, depends on the rate of interest:

$$C_r = f(r_n) \text{ (decreasing function)} \quad \ldots\ldots \quad \text{(II)}$$

This equation should satisfy objectors who complain that I took no account of the substitutability of capital for other factors in my earlier equation. And finally, to repeat the equation from the earlier *Essay* in a somewhat different form,

$$s_r = C_r\, G_n \quad \ldots\ldots\ldots \quad \text{(III)}$$

By this formulation the fraction of income to be saved becomes a *desideratum*, s_r.

24. Two points may be made in passing. In equation (III) the required amount of saving is stated as depending on the amount of capital required for the increment of output. But technical progress may alter, and often increase, the amount of replacement capital required per unit of output; it may also raise the required rate of replacements by rendering obsolete equipment hitherto expected to have a longer life. To take account of this it will be needful to re-work the theory that has been outlined in *gross* terms. This task is not attempted here.

25. This article is concerned with a steady shift of the " production function " outwards from the origin. It is not implied that the successive functions, moving outwards with time, are parallel to each other; the analysis has been consistent with innovations being neutral, labour saving or capital saving. Some students of growth have laid stress on the phenomenon of a movement *along* the productivity function in consequence, not of innovations, but of a rise in the ratio of capital to other factors due to the accrual of fresh saving. Such a movement implies a falling rate of interest (by Equation (II)). A falling natural rate of interest implies a falling natural rate of growth *per caput* (by Equation (I)), save in the event of e increasing, which seems improbable. Thus a shift along the production function, as distinct from a movement outwards of the production function, should occur only in periods when the rate of technical progress is falling. Such a shift may ensure that the rate of growth *per caput* does not fall as quickly as the rate of technical progress. None the less, it is essentially a phenomenon of a falling natural rate of growth.

26. To return to our main theme: it might be thought that, since e is a weighted average, s, the fraction of income actually saved would tend to approximate to s_r, the social requirement. There are a number of reasons why this may not be so, of which I will mention only the most outstanding. (i) T may be less, indeed much less, than 1, especially in developing societies. This would tend to depress saving. (ii) Individuals have their own youth–maturity–old-age patterns, which might cause them to save more or less than they would, if each was immortal and had an income continually growing at the same rate as the weighted average of incomes *per caput* for the economy. (iii) Companies save importantly. It would be wrong to suppose that these shape their policies to conform to the saving patterns required by the weighted average of their shareholders, or that the shareholders treat company savings as in effect their own, and save correspondingly less for themselves. Companies have their own motives, some springing from the long run; they may desire to expand capacity without the forfeit of power or the expense involved in relying on the capital market for fresh funds. The sharohelder, on his side, cannot be sure when the companies will distribute the profit on their ploughed-back savings, nor can those who determine current share values in the organised market for shares.

27. To revert to the terminology of the earlier *Essay*, the warranted rate of growth is above the natural growth rate, if actual saving (s) exceeds the required rate of saving (s_r), and conversely. While the natural rate of growth is determined almost entirely exogenously in relation to the variables of the equations and is therefore taken to *require* a specified amount of saving (s_r), the warranted rate of growth is taken to be determined by the actual rate of saving (s). Let us take the two cases, viz., an excess or deficiency of s compared with s_r, in turn.

28. If $s > s_r$, then we have the situation which Keynes diagnosed and about which he feared, along with other proponents of the "stagnation thesis." The warranted rate is then greater than the natural rate; but the actual rate cannot exceed the natural rate save for temporary phases. The natural rate is indeed the greatest that can be achieved on the long haul.[1] If the actual rate of growth is retarded by the full-employment ceiling, then it must fall below the warranted rate and a depression will set in.[2] Or a downturn can come, for reasons explained in an earlier article,[3] before the full-employment ceiling is reached, if producers correctly believe that demand cannot continue to expand indefinitely above the natural rate, viz., at its

[1] It has been suggested to me that this is not *necessarily* true, since, if the rate of interest were pushed and kept down *below* its natural level, a rate of growth above the natural level could in certain circumstances be sustained. This possibility must be recognised. It must be borne in mind, however, that a below-natural rate of interest may equally well be associated with a *lower*, as with a higher, rate of growth (cf. p. 283 *sup.*).

[2] This is in accordance with the instability principle, as described in the first *Essay*, and I need not revert to it in this one.

[3] "Domar and Dynamic Economics," ECONOMIC JOURNAL, September 1959.

rate in the recent past. The special circumstances of the post-war period have caused us to think less about the dangers of "stagnation"; but they may still be lurking, especially if the maximum feasible rate of investment in developing countries proves to be disappointing.

29. A suggested recipe for the threat of stagnation, in addition to stimulating all kinds of public investment, or other investments the utility of which might be reckoned to exceed their monetary yields, is a Budget Deficit. As Political Economists we should not wish to discourage the propensity to save. It may be useful to have a high propensity to save deeply ingrained, in case times should change. Furthermore, the ownership of some capital funds gives a man a special kind of happiness and a sense of freedom. Without property we remain, although not in so severe a sense as Marx may have intended, wage slaves. Ownership promotes a spirit of independence. And so, if it happens that the sum total of citizens desire to hold, in the form of savings available for future use, a value greater than the sum total of the capital value of the land, buildings, equipment, work in progress, stock-in-trade, etc., that the community requires, the Government should provide reliable savings certificates. It is essential, of course, that in such a situation it should treat the proceeds of the sale of such certificates as income and remit taxation accordingly, with a view to sustaining the aggregate of demand for goods and services at a level conformable to the growth potential of the economy.

30. I made a cardinal mistake in *Towards a Dynamic Economics*, owing to still being sunk in static slumber. It occurred to me that, if saving were really so plentiful that the Government had to take a surplus off the market and plough it back into current expenditure, the logical corollary of such a state of affairs was that the rate of interest should be zero. If interest is the charge for a scarce factor, the economic function of which is to prevent capital being used for low-yielding projects and ensure that enough exists for all the higher-yielding projects, what need was there to have a positive rate of interest when revenue-yielding projects for capital outlay were so short that one had to plough saving back into public expenditure on current account? This point of view is plausible enough. But in the light of equation (I) it is seen to be wrong. If $\frac{pcG}{e} = 3$, it does not increase community welfare to plough savings into projects that yield less than 3%. We do not want by investment to transfer goods away from present consumption to consumption in subsequent years, if the investment increases the quantum of goods available in the subsequent years by no more than 2%. For the marginal utility of goods will in any case be down by 3% in the next year and by more later; therefore we do not want to give up the enjoyment of goods now unless we thereby get at least 3% more goods in subsequent years. Therefore the maintenance of a positive rate of interest is not inconsistent with the desirability of ploughing back some savings into current government expenditure, not merely

in depression, but on the overall average year by year, providing that productivity per head is still growing. A positive rate of interest should be maintained, even when some savings are being made available to the general body of citizens for current expenditure, in order to prevent savings being ploughed into investments the yield of which is less than the current natural rate of interest, $\frac{{}_{pc}G_n}{e}$. The rate of interest should fall to zero only if output per head ceases to grow and ${}_{pc}G/e$ becomes zero.

31. If $s < s_r$ the economy may have a chronic tendency to inflation. This occurred for a number of years in mature countries after the Second World War, and it may explain the persistent tendency to inflation in some Latin American countries. For such inflation to occur there is no need for there to be any increase in banking credits; the excess investment, if it occurs, is automatically financed by the excess (inflationary) profits due to the investment. This is a crucial point that divides anti-Keynesians from Keynesians, in the dwindling band of whom I would still align myself. None the less, I would not go so far as to hold that in these circumstances (viz. $s < s_r$) an inflationary tendency *necessarily* develops. The realisation of excess investment seems to imply, not indeed an increase in banking credit, but an accommodating spirit in the capital market. Developing countries may have a very narrow domestic capital market, or none, save for a tribe of " usurers " lending at exorbitant rates. In mature countries investors can usually pre-arrange finance, even if the total amount so arranged is running ahead of normal savings, *i.e.*, if there is excess of *ex ante* investment; if they do so and proceed on their business the aggregate of savings that they require will become available *en courant* through the inflationary process. But where capital markets are narrow or non-existent it may be impossible to make these pre-arrangements; the inflationary finance will not be generated and the investments will not be undertaken. Lack of saving will prevent the growth that would otherwise be possible.

32. It may be well to dwell a little longer on this point. The Keynesian scheme of thought had an attractive symmetry. If the propensity to save was excessive in relation to the propensity to invest, there would be a lapse into depression and unemployment. In the converse case there would be over-full demand and inflation; this second proposition seemed well confirmed by experiences in war-time and, to a lesser extent, during industrial investment booms. But somehow it has never seemed very plausible in relation to developing countries. There over-full demand does not usually arise in consequence of a deficiency of saving. In fact, the tendency of deficient saving to generate over-full demand must not be taken as a general law, but one dependent on the existence of an accommodating capital market, which allows the process by which excess investment generates the saving required for it (by the inflationary process) to get under weigh. Nor would the introduction of easy finance into developing countries be a satis-

factory recipe, since inflation is something to be avoided and likely to militate against growth in the long run.[1] The true view surely is that, to obtain the optimum rate of growth, which is also in some sense a maximum, saving must be neither redundant nor deficient.

33. It is necessary to look closely at the equation, $s_r = C_r G_n$ when $s < s_r$. It might be thought that the dearth of savings would push the rate of interest up so high as to reduce C_r to a level at which G_n could be sustained. But this may not be so. C_r may not be very responsive, outside certain limits, to a high interest rate. Even if it is, there is no guarantee that it is sufficiently responsive and, more important, no guarantee that the brunt of the shortage of savings will be borne by C_r rather than by G, which can fall below G_n. If the actual growth (G) falls short of the natural growth (G_n), the demand for goods will be deficient and the shortage of savings will not be apparent. If, owing to the lack of demand for goods, producers do not expand orders, G will be low and there will not be inflation nor a felt shortage of savings nor any tendency for the rate of interest to rise.[2]

34. It is desirable to surround any remarks about developing countries by qualifications. The major obstacle to growth may well be lack of personnel or, to revert to a point mentioned earlier, graft. The concept of natural growth embodies not only technological progress but also the increase of personnel well adapted to enterprise and business management, and the increase of know-how, whether natural or artificially stimulated. Shortages in these respects may account for a low growth rate, rather than any deficiency of s, compared with s_r. If, on grounds of personnel and know-how, a rapid growth is not feasible, s_r will be low, and s, though low, may not fall short of it.

35. None the less, it is desirable to consider the case where s is below s_r and where inflation does not occur because the capital market is insufficiently accommodating. In such a case, to obtain the social optimum, it may be expedient to raise s towards the level of s_r by a budget surplus or compulsory levy. If such measures are introduced *for the first time*, or abruptly intensified, there will follow what we may call a " transitional period." If actual growth has been running below natural growth, solely by reason of the shortage of saving, this entails that there is some underemployment or mis-employment of general or special personnel; output may be low because the capital/output ratio is low owing to the time preference being high (T low). If it were decided to take some action to remedy this state of affairs by causing more saving, then the economy would proceed through a transitional period in which actual growth was above natural growth, owing to the harnessing of previously under-employed personnel and/or owing to the increase of the

[1] See Ohlinschrift, *Inflation and Investment in Under-developed Countries*, by R. F. Harrod (1959).

[2] It will be evident to the judicious reader that this point, although entirely outside the ambit of Keynes' theories, is profoundly influenced by his mode of thought. It is analogous, within the realm of dynamics and in reverse, to Keynes' point that, if the *propensity* to save is excessive, causing depression, there will not be any felt excess of saving nor tendency for the rate of interest to fall.

capital/output ratio in various sectors of the economy, through the reduction of the operative rate of interest towards r_n.

36. The features of such a transitional period lie for the most part outside the scope of the analysis of this paper. But some general remarks may be made. Since growth during the transitional period would be above the natural rate, which implies continuing full employment, the equilibrium rate of interest, assuming $T = 1$, during the transitional period (let us call it r_{tn}), would lie above r_n. Often the ruling rate of interest in developing countries, if there be such, is above r_n owing to the low value of T. Cf. equation (2) (p. 282). On the other hand, the equilibrium rate in such countries is kept down by the low rate of growth. Thus it might, in certain conditions, be expedient to establish, during the transitional period, a rate of interest above that previously obtaining. This may seem a paradoxical accompaniment of the imposition of forced saving. But if the special measures taken raise the prospective growth rate, this will temporarily raise the natural rate of interest (r_{tn}) (equation (I)), and may raise it above the rate previously obtaining, except in economies where T is very low. In a developing economy there may be two rates, the high open-market rate, such as it is, largely governed by the low value of T, and a lower rate used to sieve official investment projects. It is important that the latter be kept high, to ensure the maximum rate of growth and prevent capital being deflected into low-yielding projects.

37. It is often stated that developing countries, which are short of capital, should concentrate on labour-intensive projects. This dictum can be accepted only with reserve. Its intellectual basis is presumably that, if $s < C_r G_n$, and if measures are taken to raise s, it is important that the accretion of s should benefit growth rather than C_r. All depends on how great the shortfall of s (by comparison with s_r) is in relation to available personnel and know-how. There is a danger of this shortage being exaggerated if constant attention is not paid to personnel and know-how. If the shortage is not great and if it is feasible within a relatively short term of years to bring capital disposal up to the level required, having regard to available resources of personnel and know-how, then the criterion for investment should be its *yield* and not whether it is capital-intensive or labour-intensive.

38. While it is true that the arrangement for extra saving in a developing country may give rise to a substantial " transitional " period, there is some danger of exaggerating its importance. If at a given point of time, t_o, growth is running below its natural rate through lack of saving, this implies that there is available personnel to implement improved methods of production, including those arising simply from an increase in the capital/output ratio. It is the process of bringing this personnel into fuller play that constitutes the " transitional " period. But there is not likely to be at t_o more than a limited fund of such personnel to spare; once that is taken up, " transitional " growth is merged into ordinary natural growth. It is quite

true that, if in the country in question growth has been held back for a number of years owing to deficient saving, its current output at t_0 may be far below the level, let us call it O_n, at which it would have been, if growth had been proceeding at its natural rate in the preceeding years. It by no means follows that an arrangement for extra saving at and after t_0 can raise output to O_n at once or during the " transitional " period. For natural growth *per caput* occurs through the cumulative accretion of experience and know-how and the improvement of personnel. *Lost years cannot be regained in full.* The very essence of growth (*per caput*) is education by practice and the gradual drawing out of the latent potentialities of personnel. *Vires acquirit eundo.* From t_0 onwards it is to be expected that, with the provision of more saving, growth will be raised to a higher level, namely to its natural level, the height of which depends essentially on the capacity of the population to improve itself.[1] The compulsory provision of extra saving should be regarded as releasing the growth potential of the community from bondage. It is important to avoid over-simplified ideas about the consequences of the mere provision of additional saving. This view might be regarded as pessimistic, in that it sets a limit to what can be done by one simple recipe (more saving); but it is optimistic in that it enables us to curb the impulses of those who believe that Utopia can be gained solely by the imposition of harsh austerity.

39. In mature economies also s may fall short of s_r, and this may generate demand inflation, as already noticed. But the authorities may and should seek to prevent demand inflation. Their problem is complicated by the superimposition of cycles on the trend. During the boom all available measures, monetary, fiscal and others, may be needed to damp demand. Monetary measures are probably quicker-working than fiscal. Similarly, all available measures may be needed to prevent a recession gathering momentum. What should be the trend of policy, taking bad times and good together, when actual saving is running below the required level?

40. Keynes and others have held the view that the current long-term rate of interest can be influenced by varying the quantity of money. This has been strikingly borne out by the British experience since the War. Keynes explicitly repudiated the idea of a natural rate of interest. Both Professor Hicks and Sir Dennis Robertson have reproached him for this, the former saying that he left the rate of interest hanging by its own boot-straps,[2] and the latter making a similar point in a brilliant passage—claiming that we have, after all, to give it an anchorage in the fundamental phenomena of Productivity and Thrift.[3] Despite Keynes' disclaimers, I have always held that there is a " natural " rate of interest implicit in the doctrines of the *General Theory of Employment, Interest and Money*, namely that required to sustain investment and aggregate demand at the full-employment, and at no

[1] This is subject to the limitation imposed on the analysis of this article, which relates to an insulated economy and thereby excludes the international flow of capital and know-how.

[2] *Value and Capital*, second edition, p. 164.

[3] *Essays in Monetary Theory*, p. 25.

more than the full-employment, level. If we ask what are the determinants of the value of that " natural " rate of interest in Keynesian theory, the answer must be the Propensity to Invest and the Propensity to Save, the latter determining the value of the " Multiplier." But these are only other names for Productivity and Thrift; so that it turns out that the classical doctrine finds its place in Keynesian doctrine. Keynes was, after all, bred up in that tradition.

41. But the natural rate of interest of the dynamic theory expounded in this article, and by that is simply meant the rate of interest that it is necessary to have if the economy is to advance at the optimum rate in accordance with its growth potential, is determined by the prospective growth of income and the elasticity of the community income utility curve (equation (I)). Thus this dynamic theory is in sharper conflict with Keynes than ever Keynes was with Robertson.

42. Let there be a situation in which s is less than s_r and it is desired to prevent a chronic tendency towards demand-inflation. Classical theory suggests that a rise in the interest rate would be desirable, so as to reduce investment demand and, possibly, encourage saving. But some voices can be heard from the wings suggesting that there is also something called a " fiscal " remedy—or is this allowable only to control the cycle? The voices may suggest that a Budget surplus would be better than a high interest rate, since a high interest rate bridges the gap mainly by lowering investment requirements, while the budget surplus bridges the gap mainly by raising savings. And is it not better to raise savings than to reduce investment requirements? But is it better? Was there discernible, in the voices off, a note that would be condemned by Mr. Little, something persuasive, something emotive, possibly even a " value judgment " itself? Dynamic theory should enable us to resolve the issue on purely rational grounds.

43. Happily in that theory the natural rate of interest is determined independently of the demand for or supply of savings, present or prospective. If we can make approximate guesses about the growth potential per head (*i.e.*, ${}_{pc}G_n$) and the elasticity of income utility, then we can determine what rate of interest is consistent with that. I must not be supposed to be here deprecating such manipulation of the interest rate as may serve to iron out booms and slumps, *i.e.*, to prevent actual growth running away in either direction from a steady path. I am referring now to the average interest rate in both phases taken together. If the actual rate seems low by the criterion of the formula, then there is a case for raising it. (Raising the interest rate should be taken to include making borrowing difficult in imperfect markets.) This may indeed render some investment projects unpayable, but only those whose yield is so low that from the point of view of the social optimum they are undesirable. But if there is no reason to suppose that the rate is below its natural level as defined in equation (I), *then there should be resort to a Budget surplus.*

44. I may interject a topical observation. I deem it unlikely that Britain will be subject to chronic inflationary pressure on the demand side in the coming decade. But if I am wrong, the evil should be cured by a Budget surplus rather than by any further raising of the interest rate. And indeed, unless national income per head is destined to grow at a much greater rate in the coming period than it has done in the last decade, it would be surprising if 5% were not considerably too high.

45. What has been said is not inconsistent with the idea of easing a transition period by a high interest rate. Reference to such a period has already been made in relation to developing countries, where it may be a phenomenon of substantial magnitude. Big transitions are less likely in mature countries, but not impossible. Suppose a very large capital-requiring innovation. This will raise required saving by raising C_r. The innovation may also affect the nature of replacement equipment and indeed raise the required rate of replacements (cf. p. 285 *sup.*). In fine, the change in a dynamic determinant will have considerably raised the requirement for saving (s_r). The rise in the requirement may be permanent or it may not be, that depending on the nature of future innovations. In the former event it might be expedient to ease the transition by allowing a temporary rise in the interest rate rather than by jacking up saving too suddenly and abruptly. But if the rate is raised above its natural level to ease a transition, the target should always be to reduce it again to that level at an early date.

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