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MONEY AND ECONOMIC GROWTH[1]

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In non-monetary neo-classical growth models, the equilibrium degree of capital intensity and correspondingly the equilibrium marginal productivity of capital and rate of interest are determined by "productivity and thrift," i.e., by technology and saving behavior. Keynesian difficulties, associated with divergence between warranted and natural rates of growth, arise when capital intensity is limited by the unwillingness of investors to acquire capital at unattractively low rates of return. But why should the community wish to save when rates of return are too unattractive to invest? This can be rationalized only if there are stores of value other than capital, with whose rates of return the marginal productivity of capital must compete. The paper considers monetary debt of the government as one alternative store of value and shows how enough saving may be channeled into this form to bring the warranted rate of growth of capital down to the natural rate. Equilibrium capital intensity and interest rates are then determined by portfolio behavior and monetary factors as well as by saving behavior and technology. In such an equilibrium, the real monetary debt grows at the natural rate also, either by deficit spending or by deflation. The stability of the equilibrium is also considered.

1. THE PURPOSE of this paper is to discuss the rôle of monetary factors in determining the degree of capital intensity of an economy. The models I shall use in discussing this question are both aggregative and primitive. But I believe they serve to illuminate the basic points I wish to make. At any rate, I have taken the designation of this talk as a "lecture" as a license to emphasize exposition rather than novelty and sophistication. And my subject falls naturally and appropriately in the tradition of Irving Fisher of my own university.

Fisher and Keynes, among others, have drawn the useful and fruitful analytical distinction between choices affecting the disposition of income and choices affecting the disposition of wealth. The first set of choices determines how much is saved rather than consumed and how much wealth is accumulated. The second set determines in what forms savers hold their savings, old as well as new. Considerable economic discussion and controversy have concerned the respective rôles of these two kinds of behavior, and their interactions, in determining the rate of interest.

[1] This is the Fisher Lecture that was presented at the Joint European Conference of the Econometric Society and The Institute of Management Sciences in Zürich, September 11, 1964.

2. Most models of economic growth are nonmonetary. They offer no place for significant choices of the second kind—portfolio choices. They admit only one type of asset that can serve wealth owners as a store of value, namely reproducible capital. It is true that some of these models, particularly disaggregated variants, may allow savers and owners of wealth to choose between different kinds or vintages of capital. But this is the only scope for portfolio choice they are permitted. Different questions arise when monetary assets are available to compete with ownership of real goods. I shall proceed by reviewing how the intensity and yield of capital are determined in a typical aggregative nonmonetary model of economic growth, and then indicating how their determination is modified by introducing monetary assets into the model.

3. In a nonmonetary model of growth and capital accumulation, so long as saving continues it necessarily takes the form of real investment. And so long as saving and investment augment the capital stock faster than the effective supplies of other factors are growing, nothing prevents the yields on capital investment from being driven to zero or below. Of course, low or negative yields may cause people to reduce or discontinue their saving or even to consume capital. This classical reaction of saving to the interest rate may help to set an upper limit to capital deepening and a lower bound to the rate of return on capital. But clearly this kind of brake on investment causes no problems of underemployment and insufficiency of aggregate demand. Increased consumption automatically replaces investment.

4. I can illustrate in Figure 1 the manner in which saving behavior determines capital intensity and the rate of interest in a nonmonetary growth model. (For the basic construction of the diagram I am indebted to my Yale colleague, John Fei, but he is not responsible for my present use of it.)

In Figure 1 the horizontal axis measures capital intensity k, the quantity of capital (measured in physical units of output) per effective manhour of labor. The significance of the term "effective" is to allow for improvements in the quality of labor inputs due to "labor-augmenting" technological progress. Thus, if a 1964 manhour is equivalent as input in the production function to two manhours in the base period, say 1930, then k measures the amount of capital per man half-hour 1964 or per manhour 1930.

The vertical axis measures various annual rates. Curve AA' represents y, the average annual product of capital. Since output and capital are measured in the same physical units, this variable has the dimension, pure number per year. It is the reciprocal of the famous capital-output ratio. In accordance with usual assumptions about the production function, y is shown to decline as capital intensity k becomes deeper.

Curve MM' represents the corresponding marginal product of capital. In

Figure 1 this becomes zero or negative for sufficiently intense use of capital. There are, of course, some technologies—Cobb-Douglas, for example—in which this cannot occur.

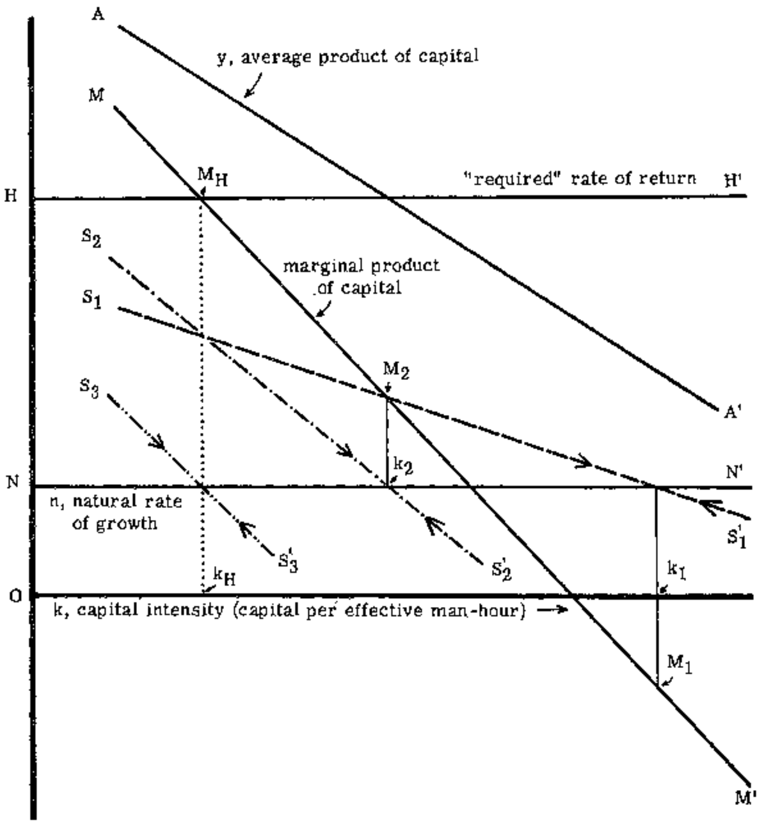

FIGURE 1

For present purposes it will be convenient to regard the average product y, shown by AA', and the corresponding marginal product of capital MM', as referring to output net of depreciation. If depreciation is a constant proportion δ of the capital stock, the average gross product of capital would simply be $y+\delta$, and the marginal gross product would likewise be uniformly higher than MM' by the constant δ.

Even after this allowance for depreciation, the yield on durable capital relevant to an investment-saving decision is not always identical with the marginal product of capital at the time of the decision. The two will be identical if the marginal product is expected to remain constant over the lifetime of the new capital. But if it is expected to change because of future innovations or because of future capital deepening or capital "shallowing" in the economy, the relevant marginal efficiency of current new investment is a weighted average of future marginal products. I shall, however, ignore this distinction in what follows and use the marginal product in Figure 1 as at least an indicator of the true rate of return on capital. For the most part I shall be concerned with equilibrium situations where the two are stationary and therefore identical.

A curve like $S_1 S_1'$ reflects saving behavior. It tells the amount of net saving and investment per year, per unit of the existing capital stock. Therefore it tells how fast the capital stock is growing. In Harrod's terminology, this is the "warranted rate of growth" of the capital stock. The particular curve $S_1 S_1'$ is drawn so that its height is always the same proportion of the height of $A_1 A_1'$. This represents the common assumption that net saving is proportional to net output.

The effective labor force, in manhours, is assumed to grow at a constant rate n, independent of the degree of capital intensity. The "natural rate of growth" n depends on the natural increase in the labor force and on the advance of labor-augmenting technology. This conventional growth-model assumption is indicated in Figure 1 by the horizontal line NN'.

5. So much for the mechanics of Figure 1. Now what determines the development and ultimate equilibrium value, if any, of capital intensity? A rate of growth of capital equal to n will just keep capital intensity constant. If the "warranted" rate of growth of capital exceeds the "natural" rate of growth of labor n, then capital deepening will occur. If capital grows more slowly than labor, k will decline. These facts are indicated in the diagram by the arrows in curve $S_1 S_1'$. With the saving behavior assumed in $S_1 S_1'$, the equilibrium capital intensity is k_1. The corresponding stationary marginal product is M_1. To emphasize the point suggested above, M_1 in the diagram is negative.

A different kind of saving behavior is depicted by $S_2 S_2'$. Here the ratio of net investment to output declines with k. This decline could be the result of one or both of two factors which have played a rôle in the theory of saving. One factor is that capital deepening lowers the yield on saving and therefore increases the propensity to consume. The other is that capital deepening implies an increase in wealth relative to current income; according to some theories of consumption, this should diminish the saving ratio quite apart from any accompanying decline in the rate of return. With saving behavior $S_2 S_2'$, the ultimate equilibrium has a capital intensity k_2 and a marginal product M_2.

6. The theory of interest sketched in Section 5 is classical. The rate of return on capital, in long-run equilibrium, is the result of the interaction of "productivity" and "thrift," or of technology and time preference. To dramatize the conflict of this theory and monetary theories of interest, I shall begin with an extreme case—so extreme that the crucial monetary factor is not even specified explicitly.

Some growth models assume a lower limit on the marginal product of capital of quite a different kind from the limit that thrift imposed in Section 5. Harrod, for example, argues that investors will simply not undertake new investment unless they expect to receive a certain minimum rate of return. Savers, on the other hand, are not discouraged from trying to save when yields fall to or below this minimum. The result is an impasse which leads to Keynesian difficulties of deficient demand and unemployment. In Harrod's model these difficulties arise when the warranted rate of growth at the minimum required rate of profit exceeds the natural rate. The rate of saving from full employment output would cause capital to accumulate faster than the labor force is growing. Consequently, the marginal product of capital would fall and push the rate of return on investment below the required minimum.

In Figure 1, suppose HH to be the required minimum. Then, correspondingly, k_H is the maximum capital intensity investors will tolerate. Yet the saving behavior depicted in the diagram would, if it were actually realized, push marginal product toward M_1 and capital intensity toward k_1, given saving behavior $S_1 S_1'$ (or M_2 and k_2, given saving behavior $S_2 S_2'$). It is this excess of *ex ante* S over I which gives rise to the Keynesian difficulties.

The opposite problem would arise if there were a *maximum* return on investment *below* the equilibrium return (M_1 or M_2) to which saving behavior by itself would lead. At this maximum, the warranted rate of growth would fall short of the natural rate. So long as actual yields on investment exceeded the critical maximum, investment demand would be indefinitely large. In any event it would exceed saving.

The consequences of this impasse in Harrod's model are less clear than the events that follow the deflationary or Keynesian impasse. At this stage the two cases lose their symmetry, though it is possible for output to fall short of the technologically feasible, when *ex ante* investment is less than *ex ante* saving, it is not possible for output to surpass its technological limits in the opposite case. Presumably an excess of *ex ante* investment is an "inflationary gap," and its main consequence is a price inflation which somehow—for example, through forced saving—eliminates the discrepancy. But this only makes the point that monetary assets had better be introduced explicitly. For it is scarcely possible to talk about inflation in a nonmonetary model where there is no price level to inflate.

7. I have spoken of Harrod's model, but I have the impression that the concept of a required rate of profit plays a key rôle in other theories of growth, notably those of Mrs. Robinson and Mr. Kaldor. Indeed I understand one of the key characteristics of their models—one of the reasons their authors consider them "Keynesian" growth models in distinction to classical models of the type sketched in Section 5 above—is that they separate the investment decision from saving behavior.

A minimal rate of return on capital (a required rate of profit) cannot exist in a vacuum, however. It must reflect the competition of other channels for the placement of saving. For a small open economy, a controlling competitive rate might be set by the yield available on investment abroad. This would, however, leave unexplained the existence of such a limit for a closed economy, whether a national economy or the world as a whole. In any case the growth models under discussion are closed economy models.

In a closed economy clearly the important alternative stores of value are monetary assets. It is their yields which set limits on the acceptable rates of return on real capital and on the acceptable degree of capital intensity. To understand these limits, both how they are determined and how they may be altered, it is necessary to introduce monetary assets into the model explicitly. It is necessary to examine the choices of savers and wealth owners between these assets and real capital. I continue, I remind you, to make the useful distinction between saving-consumption choices, on the one hand, and portfolio choices on the other. The choices I am about to discuss are portfolio choices; that is, they concern the forms of saving and wealth rather than their total amounts.

8. The simplest way to introduce monetary factors is to imagine that there is a single monetary asset with the following properties:

(a) It is supplied only by the central government. This means that it represents neither a commodity produced by the economy nor the debts of private individuals or institutions.

(b) It is the means of payment, the medium of exchange, of the economy. And it is a store of value by reason of its general acceptability in the discharge of public and private transactions.

(c) Its own-yield (i.e., the amount of the asset that is earned by holding a unit of the asset a given period of time) is arbitrarily fixed by the government. This may, of course, be zero but is not necessarily so.

Furthermore, it will be convenient for expository reasons to introduce money in two stages, avoiding in the first stage the complications of a variable value of money, a variable price level. Suppose, to begin with, that the value of money in terms of goods is fixed. The community's wealth now has two components: the real goods accumulated through past real investment and fiduciary or paper "goods" manufactured by the government from thin air. Of course the non-human wealth of such a nation "really" consists only of its tangible capital. But, as viewed by the inhabitants of the nation individually, wealth exceeds the tangible capital stock by the size of what we might term the fiduciary issue. This is an illusion, but only one of the many fallacies of composition which are basic to any economy or any society. The illusion can be maintained unimpaired so long as the society does not actually try to convert all of its paper wealth into goods.

9. The simplest kind of two-asset portfolio behavior is the following: If the yields of the two assets differ, wealth owners will wish to place all of their wealth

in the asset with the higher yield. If they are the same, wealth owners do not care in what proportions they divide their wealth between the two assets. Evidently, if there are positive supplies of both assets, they can be willingly held in portfolios only if the two yields are equal. On this assumption about portfolio behavior, it is easy to see how the institutionally determined rate of interest on money controls the yield of capital. In particular, it is this rate of interest which is the minimal rate of profit that leads to the deflationary impasse discussed in Section 6 above.

At the same time, we can see two ways in which government policy can avoid this impasse. Returning to Figure 1, suppose that HH is the yield on money and therefore the minimal yield acceptable to owners of capital. The corresponding capital intensity is k_H. One measure the government could take is to reduce the yield on money, say to M_1. Such a reduction might—and in Figure 1 it does—entail a negative rate of interest on money, reminiscent of the "stamped money" proposals of Silvio Gesell. Manipulation of interest rates on monetary assets within more normal limits is, in more realistically complex models, accomplished by the usual instruments of central banking.

Alternatively, the government could channel part of the community's excessive thrift into increased holdings of money. Thus, let us now interpret $S_1 S_1'$ to measure the amount by which the public wishes to increase its total wealth relative to its existing holdings of capital. This leads to the Harrod impasse if all the saving must take the form of capital. But if only part of it goes into capital accumulation, if in particular the rate of increase of the capital stock can be lowered to $S_3 S_3'$, then all will be well. Equilibrium capital intensity will be k_H, consistent with maintaining the marginal product of capital at the required level HH. This can be done if the government provides new money to absorb the saving represented by the difference between $S_1 S_1'$ and $S_3 S_3'$.

The only way for the government to achieve this is continuously to run a deficit financed by issue of new money. The deficit must be of the proper size, as can be

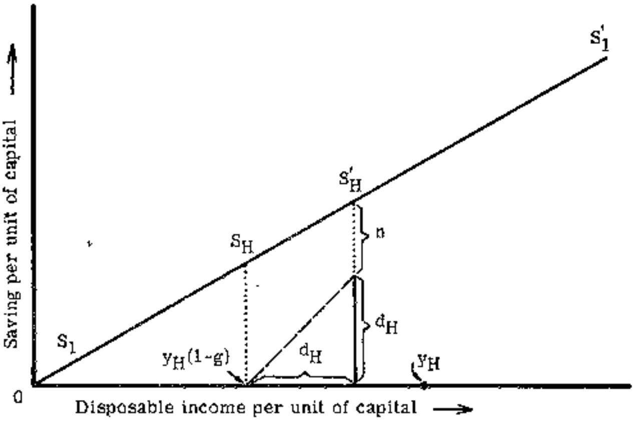

FIGURE 2

illustrated by Figure 2. Here saving is measured vertically, and output and income horizontally. Both are measured in proportion to the capital stock, as in Figure 1. y_H is the output per unit of capital corresponding to the required equilibrium capital intensity k_H. Government purchases of goods and services are assumed to be a fraction g of output. Consequently, $y_H(1-g)$ is output available for private use, and if the budget is balanced it is also the disposable income of the population. Taking $S_1 S_1'$ as the function relating saving to disposable income, S_H is the amount of private saving, (relative to the capital stock) when the budget is balanced. By assumption, however, this is too much investment—it causes the warranted rate to exceed the natural rate. Now n is the natural rate of growth; it is therefore the "right" amount of investment relative to the capital stock. A deficit of d_H (per unit of capital) will do the trick. It increases disposable income to $y_H(1-g)+d_H$, and this raises total saving to S_H'. But of this, d_H is acquisition of government debt, leaving only n for new tangible investment.

The arithmetic is simple enough: Since

(1) $$S = s[y(1-g)+d] = d+n\,,$$

(2) $$\frac{d}{y} = \frac{s(1-g)-n/y}{1-s}$$ gives the required deficit as a fraction of income.

On these assumptions about portfolio choice, the size of the government debt, here identical to the stock of money, does not matter. The deficit must absorb a certain proportion of income, as given in (2). But since wealth owners will hold money and capital in any proportions, provided their yields are in line, the size of the cumulated deficit is immaterial.

The opposite case would correspond to Harrod's inflationary impasse. Just as there is a deficit policy that will resolve the deflationary impasse, so there is a surplus policy that will remedy the opposite difficulty. In this case a balanced budget policy would leave the yield on capital so high that no one wants to hold money. To get the public to hold money it is necessary to increase capital intensity and lower the marginal product of capital. But a higher capital intensity takes more investment relative to output. To achieve a higher investment ratio, the resources that savers make available for capital formation must be supplemented by a government budget surplus. The mechanics of this can be seen by operating Figure 2 in reverse.

10. The portfolio behavior assumed in Section 9 is too simple. A more realistic assumption is that the community will hold the two assets in proportions that depend on their respective yields. There is a whole range of rate differentials at which positive supplies of both assets will be willingly held. But the greater the supply of money relative to that of capital, the higher the yield of money must be relative to that on capital. I shall not review the explanations that have been offered

for this kind of rate-sensitive portfolio diversification. One explanation runs in terms of risk-avoiding strategy where one or both yields are imperfectly predictable. Other explanations are associated with the specific functions of money as means of payment. Yield differentials must compensate for the costs of going back and forth between money and other assets. They must also offset the value of hedging against possible losses in case of unforeseen and exigent needs for cash.

The demand for money, presumably, depends also on income. Other things equal (i.e., asset yields and total wealth), more money will be required and less capital demanded the higher the level of output.

11. One implication of the assumption about portfolio behavior made in Section 10 can be stated very simply. Capital deepening in production requires monetary deepening in portfolios. If saving is so great that capital intensity is increasing, the yield on capital will fall. Given the yield on money, the stock of money per unit of capital must rise. Provided the government can engineer such an increase, capital deepening can proceed. There is a limit to this process, however. As in the previous cases discussed, there is an equilibrium capital intensity. Monetary deepening cannot push capital intensity beyond this equilibrium because the deficit spending required would leave too little saving available for capital formation.

In such an equilibrium, the shares of money and capital in total wealth must be constant so that their yields can remain constant. To maintain the fixed relation between the stocks, money and capital must grow at the same rate. That is, new saving must be divided between them in the same ratio as old saving.

Let $m(k, r)$ be the required amount of money per unit of capital when the capital intensity is k and the yield of money is r. We know that m is an increasing function of r: more money is demanded when its yield is higher. At the moment, we are taking r as fixed. I take m to be also an increasing function of k because an increase in k lowers the yield of capital. It is true that an increase in k also lowers y and therefore reduces the strict transactions demand for means of payment. But I assume the yield effects of variations in capital intensity to be the more powerful.

Let w (for "warranted") be the rate of growth of the capital stock, and let d represent, as before, the deficit per unit of existing capital. Then, constancy of amount of money per unit of capital at $m(k, r)$ requires that $d=m(k, r)w$. Assuming as before that saving is a constant proportion of disposable income, the basic identity is essentially the same as (1) above:

$$S=s(y(1-g)+d)=d+w\,.$$

Using the fact that $d=m(k, r)w$, we have

$$w(k, r) = \frac{sy(k)(1-g)}{1+(1-s)m(k, r)}\,. \tag{3}$$

In equilibrium $w=n$: the warranted and natural rates must be equal. The equilibrium degree of capital intensity is the value of k that equates $w(k, r)$ in (3) to n.

I have written w and y in (3) as functions of k as a reminder that these variables, as well as m, depend directly or indirectly on capital intensity. Since y is a decreasing and m an increasing function of k, it is clear that w declines with k. Moreover, the amount by which w in (3) falls short of the hypothetical w for $m=0$ $(sy(1-g))$ increases with k.

This analysis may be presented diagrammatically, following the format of Figure 1. In Figure 3, $S_1 S_1'$ reflects, as before, the balanced budget ($d=0$) saving function, with saving a constant fraction of disposable income. This would be the warranted rate of growth of capital if m were zero. $W_1 W_2'$ represents for every capital intensity the warranted rate of growth of capital, assuming that the stock of money is adjusted to that capital intensity and maintained in that adjustment by deficit spending. The intersection of $W_1 W_2'$ with NN', the natural rate of growth, gives the equilibrium capital intensity k_1. As before, the equilibrium yield on capital is M', its marginal product at k_1. This yield, however, is not necessarily equal to the yield on money r.

The curve $W_1 W_2'$ is drawn for a particular yield on money $\bar{r}_1$. Lowering the yield on money, say to $\bar{r}_2$, would shift the curve to the right, to $W_2 W_1'$—increasing equilibrium capital intensity and lowering the equilibrium rate of return on capital.

12. I turn now to the more interesting and realistic case where the value of money in terms of goods is variable. Its variability has two important consequences. The real value of the monetary component of wealth is not under the direct control of the government but also depends on the price level. And the real return on a unit of money—a favorite concept of Fisher—consists not only of its own-yield but also of the change in its real value.

Once again, we may ask whether there is an equilibrium capital intensity and, if so, how it is determined. The analysis of Section 11 tells us that there is an equilibrium capital intensity associated with a stable price level. But this requires a particular fiscal policy that maintains through deficit spending of the right magnitude just the right balance between stocks of money and capital. Now what happens when fiscal policy is determined independently so that a stable price level cannot necessarily be maintained?

In particular, suppose that a balanced budget policy is followed and the nominal stock of money remains constant. Real capital gains due to deflation play the same rôle as deficits did in Section 11. That is, they augment real disposable income and they absorb part of the propensity to save. Therefore, we can use the same apparatus as before, illustrated in Figure 3, to find the equilibrium capital intensity.

There is, however, one important difference. In the equilibrium the real stock of money must be increasing as fast as the capital stock, namely at the natural rate n. In the present instance this can happen only if the price level falls at rate n. If so, the real return on money r is not simply the nominal yield $\bar{r}$ but $\bar{r}+n$. Consequently the demand for money will be larger than if prices were expected to remain stable.

Equilibrium will require a greater stock of money per unit of capital and a lower capital intensity if deflation is substituted for money creation. This is indicated in Figure 3 where W_3W_3' is the curve corresponding to a yield on money n points higher than the yield behind W_1W_2'.

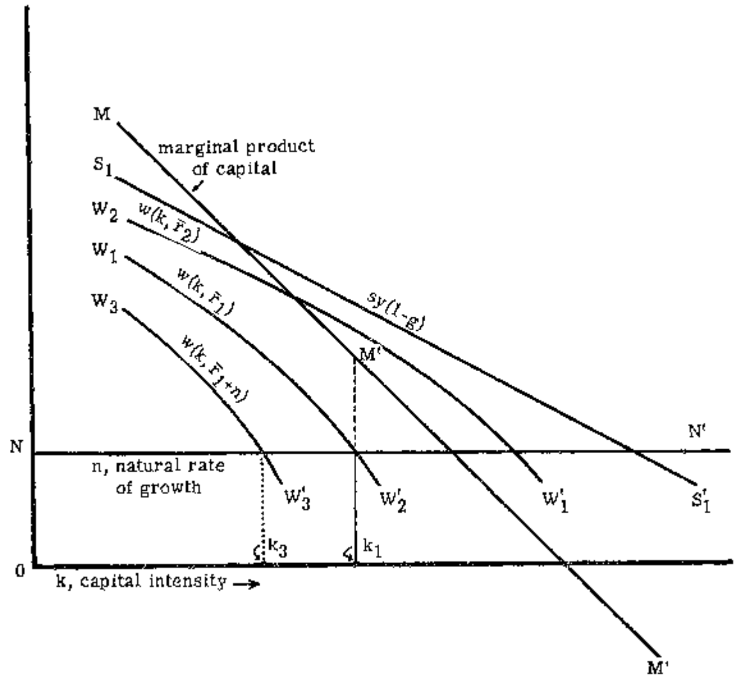

FIGURE 3

13. It is natural to ask whether there are symmetrical *equilibrium* situations in which a budget surplus or inflation is called for. The most obvious symmetrical case occurs when the natural rate of growth of the effective labor force is negative. But this is not a very interesting case of "growth."

The Harrod inflationary impasse, discussed above, would mean that at the hypothetical equilibrium capital intensity and rate of profit achievable when 100 per cent of saving goes into capital formation there is zero demand for money. Any money in existence, therefore, would have to be wiped out by surpluses or price increases; but these would be temporary rather than permanent.

One might, I suppose, imagine the public to desire a negative monetary position, i.e., to be net debtors to the government. Then there would be an equilibrium in which the public's net debt to the government grows in real value at the natural rate, thanks either to budget surpluses (with which the government acquires IOU's from its citizens) or to price inflation. In either case capital formation exceeds normal saving because the public saves extra either through taxes and the government budget or through the necessity to provide for the increased real burden of its debt to the government.

A negative monetary position is not as far-fetched as it sounds, if "money" is interpreted in a broad sense to connote the whole range of actual fixed-money-value assets, not just means of payment. It is quite possible, then, for the government to be a net creditor over this entire category of assets, while still providing a circulating medium of exchange.

14. So far only the existence of an equilibrium path of the kind described in Section 12 has been discussed. Its stability is something else again. I can only sketch the considerations involved.

What happens when the community is thrown out of portfolio balance either by some irregularity in technological progress, labor force growth, saving behavior, change in yield expectations, or portfolio preferences? If the result of the shock is that the public has too much capital and too little money for its tastes, goods prices will fall faster or rise more slowly than before. In the opposite case, the public will try to buy capital with money and will push prices up faster or retard their decline.

Evidently there are two effects, at war with each other. One we might call the Pigou effect, the other the Wicksell effect. The Pigou effect is stabilizing. Consider the case of a deflationary shock. The accelerated decline in prices, by augmenting

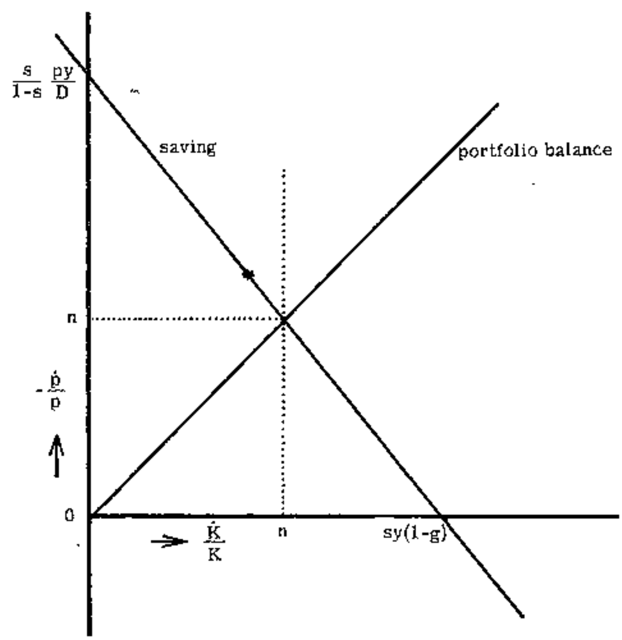

FIGURE 4

the real value of existing money balances, helps to restore portfolio balance. Moreover, by increasing total real wealth it retards the flow of saving into capital formation. The Wicksell effect is destabilizing. An accelerated decline in prices means a more attractive yield on money and encourages a further shift in portfolio demand in the same direction as the original shock.

There is no *a priori* reason why one effect should be stronger than the other in the neighborhood of equilibrium. In the model under discussion, the Pigou effect will eventually win out, but only after what may be a prolonged period of deflation, zero or negative capital formation, and retarded growth.

Figure 4 concerns the question of stability. Here the vertical axis measures the rate of price deflation, $-\dot{p}/p$, and the horizontal axis the rate of capital accumulation, $\dot{K}/K$. On each axis the natural rate of growth n is shown. On the horizontal axis, a rate of capital accumulation larger than n means capital deepening and a decline in yield, while capital accumulation at a rate slower than n means the opposite. It is assumed that a balanced budget policy is being followed so that the nominal stock of money is constant. The real value of this stock increases at the rate of deflation. It is, furthermore, assumed that existing real money balances and capital are in equilibrium; that is, their relative supplies are adjusted to the prevailing rate of profit on capital and to a real rate of return on money equal to n, the natural rate. The 45° line from the origin, labelled "portfolio balance," shows the combinations of price deflation and capital formation that will preserve portfolio balances at the existing rates of return. The negatively sloped line labelled "saving" shows the combination of $-\dot{p}/p$ and $\dot{K}/K$ that exhausts saving, assuming once again the saving behavior of Figure 2. The values of the intercepts on both axes are indicated. On the horizontal axis, $sy(1-g)$ is the rate of capital growth if all saving goes into capital. On the vertical axis, $s/(1-s)\cdot py/D$ (where D is the nominal stock of money per unit of capital) measures a rate of price deflation at which the entire propensity to save would be satisfied by capital gains on monetary assets. The "saving" line crosses the "portfolio balance" line at the point (n, n). This is another representation of the equilibrium of Section 12. At this point, new saving will be divided so as to maintain both portfolio balance and capital intensity.

But suppose the rate of deflation were to exceed n. The point describing the division of saving would move to the north~~east~~ along the saving line. This means that the yield on money is higher—too high for the initial portfolio balance. Portfolio behavior may not reflect this rise in yield at once, since it will take time for the new rate of deflation to register in expectations and for wealth owners to try to adjust to new expectations.

Meanwhile, the yield on capital will be rising because capital accumulation is falling short of the natural rate. Moreover, via the Pigou effect the price decline is increasing the stock of money relative to the stock of capital. These two effects take time and increase in strength with time. They tend to satisfy or offset the increased demand for money due to the rise in yield on money, but they may do so too little and too late. If so, the rate of deflation will increase even further, and the point describing the course of the economy moves even further northeast on the saving curve. But the further it moves and the longer this process goes on, the smaller becomes capital's share in wealth and the higher its yield. The stabilizing effects become stronger, destabilizing effects weaker. As the ratio of income to money stock (py/D) declines, the vertical intercept of the saving line moves down. That is, the rate of deflation that would divert all saving away from capital formation becomes smaller and smaller. So the yield on money declines, the yield on capital rises, while the relative supplies are moving in the opposite direction. Eventually the rate of deflation will fall to n again, and we know that this is compatible with balanced growth.

This mechanism contains some cyclical possibilities. The cycle would be one in prices and in the composition of output as between consumption and investment. More realistic is the familiar possibility which I do not consider here, i.e., that downward stickiness of money wages prevents or limits deflation and substitutes underproduction and underemployment. In that case, capital formation is shut off, not because saving is diverted into government deficits or into real capital gains on monetary assets but because saving is curtailed by reduction of income and employment. The interruption of capital formation and growth is qualitatively the same either way, but the real losses of welfare during the process are of course much greater when employment rather than prices bears the brunt of adjustment.

15. In classical theory, the interest rate and the capital intensity of the economy are determined by "productivity and thrift," that is, by the interaction of technology and saving propensities. This is true both in the short run, when capital is being accumulated at a rate different from the growth of the labor force, and in the long-run stationary or "moving stationary" equilibrium, when capital intensity is constant. Keynes gave reasons why in the short run monetary factors and portfolio decisions modify, and in some circumstances dominate, the determination of the interest rate and the process of capital accumulation. I have tried to show here that a similar proposition is true for the long run. The equilibrium interest rate and degree of capital intensity are in general affected by monetary supplies and portfolio behavior, as well as by technology and thrift.

Cowles Foundation for Research in Economics, Yale University