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MONEY, PORTFOLIO BALANCE, CAPITAL ACCUMULATION, AND ECONOMIC GROWTH

BY PAUL DAVIDSON[1]

Most growth models, whether they be of the Keynesian-Kaldor, Harrodian, or Solow-Swan type, ignore or at least minimize the role of the money supply in the process of accumulation and growth. In general, real factors rather than monetary phenomena are emphasized. There has been little success in developing a theory of capital accumulation and growth which unites Keynesian marginal efficiency and liquidity preference concepts. Instead, full employment is often made a precondition of the analysis.

Tobin has, at least, attempted to study the relationship between money and growth but his system is defective since it omits the construction of a demand for capital schedule by entrepreneurs that can be formulated independently of the savings propensity and portfolio decisions of households. (An independent investment demand function—the essence of the static Keynesian system—is often omitted in growth analysis.) This paper shows Tobin's model is applicable only to nonmonetary Say's Law economies, and attempts to remedy the defects of such an analysis.

In a modern monetary, market-oriented economy, full employment is likely to be neither automatic nor a position of stable equilibrium (as Phillips curves imply a highly unstable full employment price level). To assume full employment as a precondition is to remove the problem of the role of the money supply in the process of accumulation and growth from the real world. This paper presents an analysis which allows the examination of the role of money within the context of a Keynesian system permitting independent savings, investment and liquidity preference functions. It does not make full employment a precondition of the model.

PROFESSOR TOBIN in his recent article [**29**], has emphasized the role of money in the process of capital accumulation and economic growth. Since most "Keynesian" growth models ignore the monetary requirements for accumulation,[2] Tobin's emphasis on the relationship between money and growth (which is closer in spirit to Keynes' *Treatise* than to his *General Theory*) deserves close study.

In essence, Tobin's argument is based on the fact that balanced growth at full employment requires the stock of capital to increase at the same rate as the natural rate of growth of the effective labor force, which Tobin assumes constant. Tobin's work is, therefore, directed towards uncovering the adjusting mechanism in both nonmonetary and monetary economies that will lead to this form of balanced growth.

[1] The author is indebted to M. Fleming, L. R. Klein, E. Smolensky, and S. Weintraub for many helpful comments on an earlier draft and to his colleagues who commented on a draft which was presented at a Rutgers Research Seminar in the autumn of 1966.

[2] It is not too difficult to understand why many of the students of Keynes (who was primarily a monetary theorist) have tended to ignore the role of money in the analysis of growth. In part it is due, as Harrod has noted, to the fact that Keynesians "base themselves largely, if not exclusively on his *General Theory*, which is taken to have superseded the *Treatise on Money* .... But there is much of value in the *Treatise* .... It is a paradox that the man whose world-wide fame during most of his life-time arose

1. TOBIN'S MODEL

The Conditions of Balanced Growth

Tobin's basic diagram (Figure 1) relates readily recognizable concepts while employing rather unusual and unfamiliar units. The A curve represents the average annual output per unit of capital—or the output/capital ratio—while the M curve is the marginal annual product of capital. Since the production function is assumed to be linear and homogeneous, the average and marginal products of capital depend only on the ratio of capital to labor, which is plotted along the abscissa.

On the same diagram, the S function is derived from the savings behavior out of disposable incomes of households [**29**, pp. 667–8]. Hence, the vertical distance between the A curve and the S curve at each capital/labor (K/N) ratio represents the amount of the average product of capital that households desire to divert to consumption uses. The distance between the absicca and the S curve, therefore, indicates the amount of the average product of capital that is available for non-consumption purposes, if household consumption demands are met and if the existing capital stock is actually employed. Tobin, however, prefers to interpret the vertical distance between the abscissa and the S curve as showing "the amount of net savings and investment per year, per unit of 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"[3] [**29**, p. 674]. Although this is not essential to the Tobin model, the S curve, in Figure 1, is so drawn that its height is

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from his specific contributions to monetary theory, which were rich and varied, should be studied mainly in one of his books which contains little about money as such" [**12**, p. 412]. In a conversation (May, 1965), Harrod suggested three reasons why Keynesians did not stress the role of money: (1) in the depression, cheap money alone could not bring about an expansion, (2) during the war, there was direct control over aggregate demand plus a desire to keep interest costs on the increasing debt as low as possible, so that cheap money policies were automatically advocated; inflation was fought by voluntary agreements between labor unions and the government and food subsidies kept the cost of living down; and (3) by 1951, the balance of payments and the Korean inflation required tight money policies. Consequently, considerations other than those of growth and capital accumulation were of primary importance in monetary affairs since the writings of *The General Theory*; thus, the English students of Keynes, at least, believed that there was not much purpose in advocating monetary policies to stimulate growth.

With Keynesian growth theorists emphasizing only the real (supply) aspects of growth, study of the financial requirements for growth have been left to essentially non-Keynesian scholars, such as members of the Chicago school [e.g., **6**], and others as Gurley and Shaw [**7, 8**].

[3] For Harrod, however, the warranted rate of growth in the capital stock is related to his capital requirements concept which is defined as "that addition to capital goods in any period which producers regard as ideally suited to the output which they are undertaking in that period" [**11**, p. 260; cf. **13**], i.e., warranted rate of growth of capital reflects entrepreneurial ex-ante investment desires. In Tobin's model, however, it reflects the ex-ante savings propensity. As indicated below, Tobin does not have an independent investment demand function and there can be no underemployment equilibrium in his model, since he implicitly assumes that ex-ante investment equals ex-ante savings.

always at the same constant proportion of the A curve. This reflects the common assertion of most growth models that the average propensity to save is invariant with respect to income (e.g., [**10**, p. 454]).

Tobin's interpretation of the vertical height of the S curve as the "warranted rate of growth of capital" is valid only if (1) both the existing capital stock and the labor force are fully employed at each point of time, and if (2) net investment goods are the only alternative to consumption goods, i.e., if there are no purchases of goods by governments or foreigners. Whether conditions (1) and (2) are met or not, it should be clear that the vertical distance to the S curve merely indicates the amount of nonconsumption aggregate demand which must be forthcoming to make it profitable to fully utilize the existing stock of capital and labor force at the point of time. This may, or may not, be equivalent to the warranted rate of growth

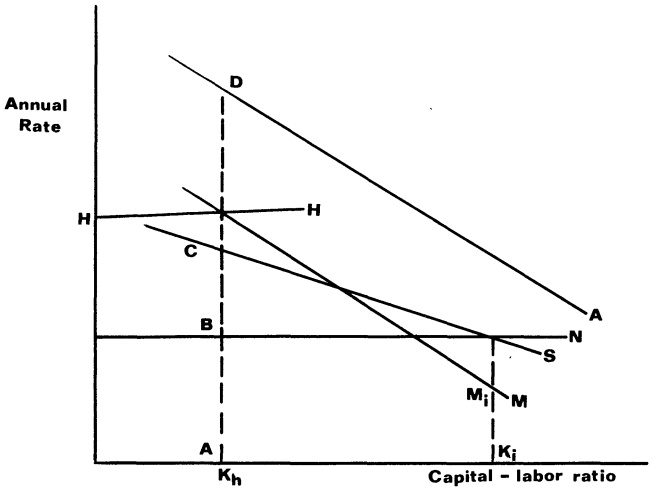

FIGURE 1

in the capital stock, since only under the highly restrictive assumptions of (a) full employment, and (b) no wearing out of capital in a two sector economy will this vertical gap depict the actual rate of capital accumulation.

Having recognized these restrictive provisos implicit in Tobin's interpretation of the height of the S curve, let us continue to follow the mechanics of his system. In Figure 1, Tobin introduces a constant natural rate of growth of the labor force as a horizontal line, N. Arguing that the S curve reflects the "warranted" investment demand of the system (rather than the necessary nonconsumption demand to insure full employment output), Tobin asserts that if the warranted rate of capital accumulation exceeds the natural rate of growth of labor, i.e., if the S curve lies above the N line at a given K/N level, then, assuming full employment of both factors, capital deepening will occur as the rate of capital growth increases more

rapidly than the labor force. The economy will move out along the X axis. (Of course, the economy would move inward if the "warranted investment" was less than the natural rate of growth of labor.) Accordingly, when the capital intensity is k_i, Tobin's warranted investment demand allows capital and labor to grow at the same rate and therefore "the equilibrium capital intensity is k_i" [**29**, p. 674]. If each factor is being paid its marginal product, then the annual rent per unit of capital in equilibrium will be M_i. According to Tobin, therefore, "the rate of return on capital, in long-run equilibrium, is a result of the interaction of 'productivity' and 'thrift,' or of technology and time preference" [**29**, p. 674].

It should be clear, however, that, since Tobin's S curve merely reflects the level of nonconsumption demand that must be forthcoming to fully employ the existing stock of capital, rather than net investment demand directly, Tobin's model will not uniquely determine the actual rate of capital accumulation, unless it is assumed that (1) there are no government or foreign sectors, and (2) Say's Law prevails, i.e., there is always full employment.

It is true that Tobin develops this diagram for a nonmonetary, two sector economy (where full employment and Say's Law must apply), but he then utilizes the implications of this figure for the analysis of a monetary economy (where Say's Law doesn't apply) by introducing the concept of portfolio balance. Of course, this is scarcely an accident in view of his concentration upon the concern with these matters in his work of recent years [**26, 27, 28**].

Portfolio Balance and Tobin's Monetary Growth Model

The decision of an individual as to how much of his income to consume in the current period and how much to postpone for the future depends on his time preference.[4] This decision was assumed by Keynes under the propensity to consume. Once the present consumption decision is made, however, an individual is faced with the second decision as to "what form he will hold the command over future consumption which he has reserved" [**20**, p. 166]. This second question is the one which Tobin has called portfolio balance.

In a nonmonetary model possessing only a single reproducible capital asset, Tobin argues that there can be neither a separation of the investment and savings act nor portfolio choices (other than vintage choices) [**29**, p. 672]. It is the introduction of monetary assets which permits (1) the separation of the investment from the saving decision and (2) portfolio choices for individuals, although for a closed economy as a whole, no such portfolio choice exists. Consequently in a non-

[4] There is a tendency for modern model builders to assign more precision to this process of time preference than either the neo-classicists or Keynes would have. Does the rational economic man have a precise plan for future consumption or is he merely altering his consumption time pattern in some vague way? Keynes argued that "an act of individual savings means— so to speak—a decision not to have dinner to-day .... But it does *not* necessitate a decision to have dinner or to buy a pair of boots a week hence or a year hence or to consume any specific thing at any specific date" [**20**, p. 210].

monetary, closed economy, household decisions to save for future consumption, if they are executed, must automatically increase the stock of capital. In a monetary economy, however, this is no longer necessarily true, for households may decide to increase their wealth holdings in the form of money and, as long as there are other economic units such as business firms, banks, or governments willing to provide additional funds either by drawing down their cash balances or increasing the supply of money, the increased wealth holdings by households does not automatically augment society's wealth. This was, of course, a fundamental tenet of Keynesian economics, i.e., there is an essential difference between monetary and nonmonetary economies and, therefore, there is a dichotomy of analysis for the two worlds, but in a monetary economy, a dichotomy between the real and monetary sectors is simply evanescent! (Cf. [**20**, p. 293; **4**, p. 198–204; **5**; **23**, pp. 70–2].)

Despite Tobin's emphasis on the need to analyze portfolio balance decisions (which is, of course, more in the spirit of Keynes' *Treatise*), there are three surprising aspects in his neo-Keynesian growth model: (1) the exclusion of uncertainty, expectational phenomena, and private debt in a model of a monetary economy which emphasizes the growth of the capital stock and money supply; (2) the absence of a separate investment demand function (separate, that is, from the savings function of households); and (3) neglect of the importance of the demand for money for transactions and finance purposes [**29**, p. 679]. Tobin simply assumes market clearance at full employment in a world of perfect certainty.

The absence of uncertainty and expectations about the future yield of real capital [**29**, p. 673–4] and future prices [**29**, p. 676] and the absence of placements (i.e., titles to debts or shares) in his model, requires Tobin to posit a strange form of money—one which pays interest if you hold on to it—in order to have a portfolio choice at all. Tobin has ignored his earlier caution that "if cash is to have any part in the composition of ... [portfolio] balances, it must be because of expectations or fears of loss on other assets" [**27**, p. 66].

In a world of certainty, money holdings serve no purpose and have no place [**28**, p. 26]. Consequently, the savings decision will still determine investment; increments to wealth will be held only in the form of real assets which have a positive yield. Since Tobin, at least initially, introduces portfolio balance decisions and an assumption of constant prices, his money must have an exogenously determined positive yield for the public to hold it at all. This strange institutional arrangement of paying interest for holding money in a world with a "money-void", allows money to enter portfolios. Paradoxically, Tobin fails to note that once money serves as a store of value, the saving decision of households no longer determines the level of real investment. The desire to accumulate wealth by households does not require society to increase its stock of real assets for "there is always an alternative to the ownership of real capital-assets, namely the ownership of money and debt" [**20**, p. 212].

Thus the introduction of money into the model immediately severs the connection between the determinants of the savings decision and the determinants of the investment decision. It is at this point that Tobin requires, and yet fails, to introduce into his model an explicit investment demand function based on entrepreneurial expectations of profit. Rather Tobin lets ex-ante savings determine the level of investment[5]—except in the nonequilibrium impasse (which he attributes to Harrod) where investors insist upon a minimum rate of return above the yield savers will accept.[6]

Tobin has portfolio decisions determine the disposition of savings between the two alternative stores of value—money and real wealth. (There are no placements in his model!) Thus, given the propensity to save, the only demand for capital goods in Tobin's system is a demand for real wealth as a store of value by savers! If there are positive supplies of both money and capital goods, then, in portfolio balance equilibrium, the yield on each must be equal. Since the institutionally determined yield on money is given, then, according to Tobin, capital must be demanded until its certain return (as given by the M curve in Figure 1) is equal to the certain yield on money. Thus, given the savings propensity, in the simplest Tobin model, if the institutionally determined yield on money is equal to M_i (in Figure 1), then the long-run equilibrium rate of accumulation will be established; otherwise, an impasse will occur in the sense that the savings behavior of the community is inconsistent with the rate of capital accumulation that will bring the yield on capital into equality with the yield on money. Under these circumstances, unless the savings propensity can be changed, the Tobin model cannot reach an equilibrium position [**29**, pp. 676–8].

Tobin's analysis implies that entrepreneurs are, in long-run equilibrium, obliged to accumulate at a rate determined by the savings behavior of the public. This is clearly contrary to the spirit of Keynesian analysis where the rate of accumulation depends on the desire of entrepreneurs to invest and not on savers' propensities (Cf. [**15**, pp. 226–32; **23**, p. 83]).

Although Tobin recognizes that savers and investors can have different motivations that may ultimately end in an impasse [**29**, p. 675], he questions the relevance of post-Keynesian growth models that "separate the investment decision from savings behavior" [**29**, p. 675]. In his model, Tobin emphasizes primarily "the forms of saving and wealth rather than their total amounts" [**29**, p. 676]. In other

[5] Kaldor, on the other hand, has insisted that it is the investment, rather than the savings propensity, that is "the ultimate stuff and substance which *make* societies progressive" [**15**, p. 228].

[6] The Harrod impasse occurs, according to Tobin, when investors desire a minimum return per unit of capital of HH (in Figure 1), and therefore they would tolerate a maximum K/N ratio of k_h. For k_h to be an equilibrium capital intensity, ex-ante investment per unit of capital would have to be the distance AB, while ex-ante consumption is CD. Hence, there will be a deflationary gap of BC. In Tobin's words this is an "impasse" because in his model, in the absence of other nonconsumption demand, the savings behavior assumed in the S curve would prevent the establishment of any equilibrium and the economy would plunge towards a zero level of output.

words, Tobin's analysis assumes that the level of output (and therefore savings) is given and predetermined at any point of time. To analyze the role of money in a model where the full employment level is predestined, and future events are known with absolute certainty, is like "Hamlet" without the melancholy prince.

What is lacking from Tobin's system is an attack on the problem of the simultaneous determination of the total size of savings (and output) and the forms that the savings magnitude will take. One of the essential elements necessary for this concomitant determination is the introduction and construction of an explicit demand for capital goods by entrepreneurs (investors) that can be formulated independently of the savings propensity and the portfolio decisions of households. As we will argue below, placements are a much more preferable store of value than capital goods. The latter are demanded primarily to obtain the future flow of capital services in production in the expectation of making profits, rather than being demanded as a store of value per se.

The serious limitations of the Tobin model and its apparent non-Keynesian espousal of Say's Law are enough to invite a reconsideration of the problem of the monetary requirements for accumulation and growth in a monetary, market-oriented economy that does not automatically maintain full employment. This is the important topic that Tobin has opened for view.

2. ECONOMIC GROWTH IN A MONETARY ECONOMY

The Demand for Capital

Recently, Witte has revived an exposition of the aggregate investment function that can be modified and usefully employed here [**33**] (also see [**2**]). A firm desires capital for its expected profit stream over time. What is actually desired by the firm is the services of capital goods. To obtain these services, firms normally need to acquire the use of capital goods. Thus, according to Witte, the firm's demand for the flow of capital services leads to a demand for a stock of capital goods, and, for any given set of circumstances, there will be an optimal size of capital stock for each firm. Consequently, the aggregate demand for capital goods (where the demand is really for the services of capital which is functionally related to the stock of capital) is derived from the summation of the demand curves of all firms. Thus, following Witte, in Figure 2a, a demand curve is derived (for a given set of profit expectations and the rate of interest) that relates the "quantity of the capital good desired to be held to the market price of the capital goods" [**33**, p. 445]. This stock demand curve for capital, D_k, in Figure 2a includes the Wicksteedian reservation demand of capital owners at each moment of time. This demand function can be stated as

$$(1) \qquad D_k = f_1(p_k, i, \phi, E),$$

where D_k is the stock demand for capital, p_k is the market price of capital goods, i is the rate of interest, ϕ is a set of profit expectations, E is the number of entre-

preneurial investors who can obtain finance for their demand for capital goods, and $f'_{1p_K} < 0$, $f'_{1i} < 0$, $f'_{1\phi} > 0$, $f'_{1E} > 0$.

The stock supply schedule for capital goods (S_k) can be drawn as vertical in Figure 2a, since stock supply is the aggregate of existing capital goods inherited from the past. Thus, at any point of time,

$$S_k = \alpha_k \tag{2}$$

where S_k is the stock supply of capital and α_k is a predetermined constant at any instant of time.

If there was no production or depreciation of capital goods (e.g., in a pure exchange economy), then, of course, the resulting market price would be whatever is necessary to divide up the stock without remainder among demanders. For a production economy, however, flow considerations must be added to the stock analysis of capital. Flow demand for capital is due to the depreciation per unit of time of the existing stock. For simplicity we will assume that depreciation is a (small) fraction, n, of the existing stock of capital per unit of time. Hence, the flow demand for capital is

$$d_k = nS_k = n\alpha_k \tag{3}$$

where d_k is flow demand (depreciation) and $0 < n < 1$.

Combining equations (1) and (3) yields the total market demand for capital

$$D_k + d_k = f_1(p_k, i, \phi, E) + n\alpha_k \tag{4}$$

which, because of our simplifying assumption about the rate of depreciation, implies that the market demand curve, $D_k + d_k$ is parallel and to the right of the stock demand curve in Figure 2a. The horizontal difference between the two curves represents depreciation.

The flow supply schedule of capital goods indicates the output quantities which will be offered on the market by the capital goods industry at alternative expected market prices, i.e.,

$$s_k = f_2(p_k) \equiv I_g \tag{5}$$

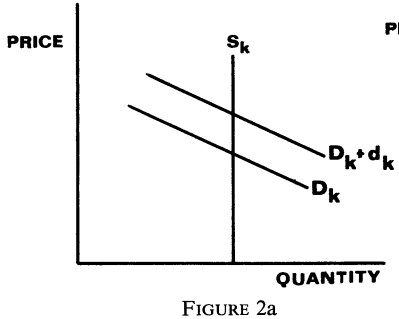

FIGURE 2a

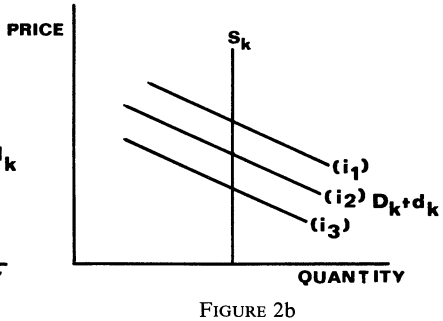

FIGURE 2b

where s_k is flow supply of capital, and I_g is gross investment. This schedule, like all supply schedules, will, in a purely competitive environment, merely reflect rising marginal costs because of diminishing returns due to fixed plant and equipment in the investment goods industry, i.e., $f'_{2p_k} > 0$. The flow supply curve, s_k, is represented in Figure 3. There is a minimum flow supply price, p_m in Figure 3, which is the shut-down price for the industry. If the market price falls below p_m, then no flow supply offering will be made as capital goods producers find that shutting down involves smaller losses than producing for market.

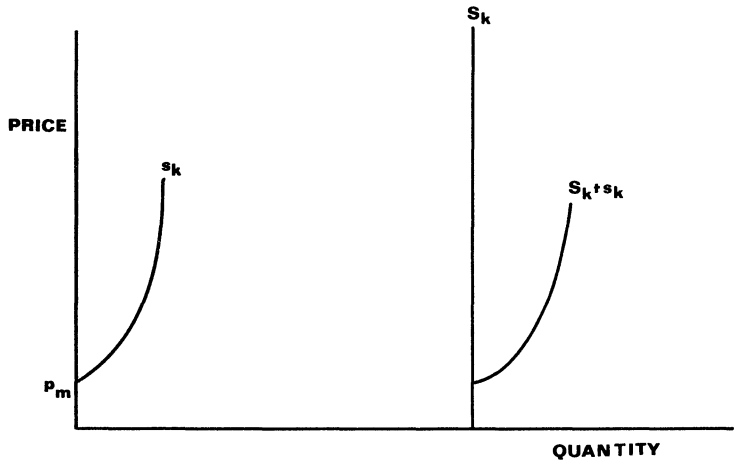

FIGURE 3

The market supply situation can be obtained by laterally summing the stock and flow supply schedules (Figure 3), i.e., by combining equations (2) and (5) to obtain

$$(6) \qquad S_k + s_k = \alpha_k + f_2(p_k) .$$

The horizontal difference between the stock supply schedule and the flow supply curve in Figure 3 represents the gross output of the investment goods industry that will be forthcoming at any given market price in a given period of time.

Combining the market demand function $(D_k + d_k)$ with the market supply function $(S_k + s_k)$ in Figure 4, it can be shown that at a market price of p_1, the capital goods market will clear, i.e.,

$$(7) \qquad (D_k + d_k) - (S_k + s_k) = 0 .$$

According to Figure 4, at the market price of p_1, the gross output of the investment goods industry will be $k_3 - k_1$, while depreciation equals $k_3 - k_2$. The value of net investment $(p_k I_n)$ is equal to the difference between the flow supply quantity and the flow demand quantity multiplied by the market price, i.e.,

(8) $\qquad p_k I_n = p_k(s_k - d_k)\,.$

In Figure 4, net investment output equals $k_2 - k_1$. The growth of capital during the period will be $(k_2 - k_1)/k_1$.

Any increase in the stock demand for capital goods will, *ceteris paribus*, raise the market price and consequently lead to an increased flow of output of capital goods, as the producers of investment goods attempt to maximize profits by producing where marginal costs equal market price.

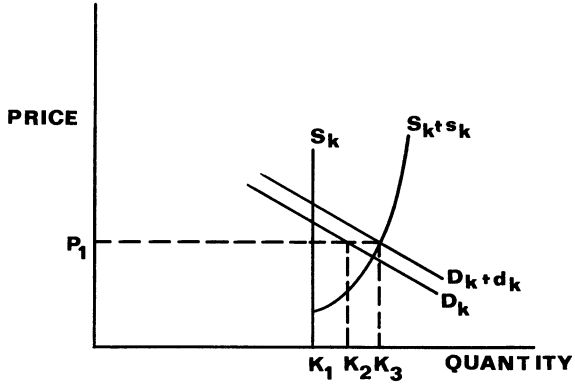

FIGURE 4

Investors determine the stock quantity of capital goods they desire by computing the present value of the expected future earnings of the future flow of productive services of the stock of capital and comparing it to the current market price of capital goods. Consequently, it is the expectations of investors about future profits relative to the current rate of discount and their ability to obtain finance—in order to execute this demand—which determines the position of the stock demand curve, and given the rate of depreciation, the market demand curve in Figure 2a.

For any given set of expectations about the prospective money yield of capital, a higher rate of interest implies a higher rate of discount, and therefore, a leftward shift in the stock demand for capital schedule in Figure 2a. Thus, given entrepreneurial expectations and the rate of depreciation, there is a different demand for capital schedule for every possible rate of interest (Figure 2b) (cf. [**16**, pp. 202–3]). Given expectations of entrepreneurial investors, the rate of interest, the existing stock of capital, and its rate of depreciation, a market price for capital will be determined. If this price exceeds the minimum flow supply price of capital goods, p_m, new gross investment will be undertaken. The resulting rate of capital accumulation will depend on the rate of capital depreciation and the elasticity of supply in the capital goods industries [**2**]. Thus, as Keynes pointed out, "A fall in the rate of interest stimulates the production of capital goods not because it

decreases their costs of production but because it increases their demand price" [**16**, p. 211].

Contrary to Tobin's position, therefore, the rate of capital accumulation in a monetary economy is not solely determined by either the savings or portfolio decisions of households; rather the growth of the capital stock depends on entrepreneurial expectations of profits from the future flow of capital services, the rate of interest and the ability to obtain finance, the rate of capital depreciation, and the supply elasticity of the capital goods industries. It is the demand by the users of capital assets in combination with the profit maximizing decisions of the suppliers of capital goods which, according to Lerner, determine the schedule of the marginal efficiency of capital[7] [**21**, p. 334]. It is only Tobin's implicit assumption that ex-ante investment must equal the ex-ante savings level at full employment which allows Tobin to ignore these latter aspects in his system. Once we admit the inapplicability of Say's Law in a monetary economy, these aspects of entrepreneurial expectations, finance, wearing out, and supply elasticities become essential elements in understanding accumulation and growth phenomena.

To assume full employment is to sweep all the problems of short-run equilibrium adjustments behind the scenes. In the real world of monetary economies, full employment is not automatic and short-run adjustments in the level of effective demand and the rate of capital accumulation are not independent phenomena. Would anyone deny that the rate of capital accumulation in the United States was affected by the "Great Depression?" To postulate that automatic short-run adjustments leading to full employment occur instantly behind the scenes is to remove the problem of the role of money in the process of growth from the problems of the real world!

A Digression on the Stationary State

As long as net investment is positive, the stock of capital will increase each period. If there is no change in the stock demand schedule for capital over time —that is, if there is no change in profit expectations (ϕ), the rate of interest (i), or the number of entrepreneurial investors (E)—then ultimately a stationary state will be reached where the gross output of the capital goods industry equals the rate of depreciation of the capital stock. Such a situation is represented in Figure 5. This stationary state is, of course, completely compatible with a less than full employment effective demand level.

At the stationary state price of p_s in Figure 5, there is no capital accumulation. As long as the market price exceeds p_s, however, net investment is undertaken. If

[7] This way of viewing the investment decision does have an advantage in more closely identifying the question of the elasticity of the marginal efficiency schedule to the rate of accumulation. The elasticity of the marginal efficiency schedule will, for a given change in the rate of interest, affect the magnitude of the shift in the market demand schedule for capital. The actual change in investment goods output will depend on the supply elasticity in the capital goods industry as well. (See [**20**, p. 334].)

the market price is less than p_s but greater than p_m, net investment is negative while gross investment is positive. At a market price below p_m, gross investment falls to zero and the rate of decline in the capital stock is equal to the rate of depreciation.

Since the interest rate is constrained to positive values, the ultimate source of continual capital accumulation for a profit-maximizing, market-oriented, monetary economy lies in investors believing in the continuous growth of profit op-

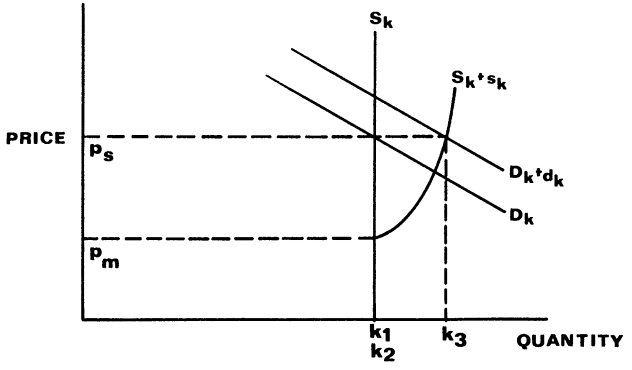

FIGURE 5

portunities over time ($\Delta\phi > 0$). Profit expectations depend primarily on the expected value productivity of capital services over time. There is no natural law of diminishing value productivity over time as long as either new consumer goods can be continually introduced, or the income elasticity of demand for all existing goods equals unity, or the population and their total purchasing power grows at least as rapidly as output, or some combination of these factors. Consequently there is no a priori reason to believe in the inevitability of the stationary state.

The Influence of Portfolio Balance

How then do nonconsumption (savings) and portfolio decisions enter into this model? As Keynes pointed out the consumption (and therefore, the saving decision) and the investment decisions are wholly related to current economic activity. The portfolio decision by individuals, on the other hand, relates "... to the whole block of their existing wealth. Indeed, since the current increment is but a trifling portion of the block of existing wealth, it is but a minor element in it" [**16**, p. 141]; i.e., the level of current investment is of secondary importance in the portfolio balance decision and vice versa. Moreover, the motivations of savers and investors are different.[8]

What savers are interested in is protecting, and possibly increasing, the value of

[8] For simplicity in the analysis that follows, we will completely identify the saving (store of value) function with households, and the investing (flow of future capital services) function with business firms.

their wealth holdings for the future. Since there are only two types of instruments that link the uncertain economic future with the present—durable equipment and monetary claims (i.e., financial assets including money) [**20**, pp. 145–6, 212]—savers must store their value in one or both of these instruments. Savers are not primarily interested in capital goods for the same reasons that investors are, i.e., for the future flow of services to be derived from the capital goods; rather savers are merely interested in the title to the capital goods as a store of value. Investors, on the other hand, are not primarily interested in the title to capital; what is relevant to them is the marginal supply price per unit of the service of the factor of capital. (Similarly, entrepreneurs do not care whether they own their own labor force (slaves) or allow others to hold title to the factor called labor; what is relevant is the marginal supply price of labor services.)

Although the value of the future productivity of a capital good ordinarily exceeds its carrying costs over its useful life, its liquidity premium is negligible (cf. [**20**, Ch. 17]). Consequently, if the saver expects to convert his store of value into future consumption goods in a different time pattern than the stream of anticipated earnings over the life of the capital asset, he will, at some point of time, have to search for a buyer of that asset. The saver knows that in selling the capital good, he may have to disrupt its future production (and therefore reduce its yield) and incur delivery costs, if he must physically dismantle and transport the equipment to the buyer as part of the terms of sale. Moreover, since real capital assets are normally large, indivisible physical units, the saver may be required to search out a buyer of the whole unit in a future period, even if he desires only to increase his consumption in that period by some amount smaller than the expected value of the whole physical asset. The smaller the unit of asset, therefore, the greater its saleability is likely to be. Thus, as Makower and Marschak have shown, sales of large units "not only increase the dispersion of future yields, but also reduce their actuarial values" [**22**, p. 279]. Since the saver is interested in maximizing his store of value, it is clear that if the saver can sell, with a minimum of search costs for a buyer and without disrupting productivity and incurring delivery costs, the title to either the entire asset or to some fraction of the asset as the saver's needs arise, then he will, *ceteris paribus*, be better off. Consequently, the development of placements, i.e., equity and loan securities, have allowed savers to store value over time in small readily saleable asset units, with a minimum of delivery costs and no lost production. This development has, however, further severed the connection between the demand for capital decision (control of the services of the factor) and the portfolio balance decision (ownership of the factor) (cf. **20**, p. 150).

Since savers are interested in titles to wealth only as a store of value, while investors desire the flow of productive services from capital goods, portfolio balance decisions and investment decisions will depend on different price levels. The latter depends on the market demand price relative to the minimum flow supply price of capital goods, while the former depends on the price of securities—and there is no

important direct relationship other than the interest rate mechanism between these different price levels [**16**, p. 249].

Given the stock of capital and its rate of depreciation, for the level of investment to change either the stock demand schedule for capital or the flow supply schedule for investment goods must change.[9] For the saver's portfolio balance decision, however, what is relevant is the comparison of the yield on money to the yield on placements. Accordingly, it is the market price of placements, rather than the market price for capital goods, that is the applicable price level for portfolio decisions.

At any point of time, there is a given stock of securities; therefore, the stock supply schedule of placements (S_p^1) facing the public is perfectly inelastic (Figure 6) (cf. [**25**, pp. 15, 19–20]). Increases in the supply of equity or loan securities will depend primarily on entrepreneurial demands for capital goods and their necessity to externally finance that demand. Business firms can usually finance replacement investment entirely from depreciation allowances. Accordingly, it is only the net change in the stock of capital goods that must find additional financing, and since a portion of this net change may be internally financed by the firm, it is only to the extent that the firm uses external sources of finance that the supply schedule of placements will shift outwards as capital accumulates.[10] Hence the stock supply schedule of securities is likely to shift even less in each time period than the stock supply schedule of capital goods.

Our unit of measurement of the quantity of placements is in terms of the income per period to which the ownership of a placement constitutes an absolutely certain claim (cf. [**30**, p. 21]). The use of a certainty income claim unit of measure means that, for our purposes, we may ignore the differences between types of placements. Each bond, preferred stock, or common share would be measured, for example, as a claim for $1 of certain income in the form of interest or dividends per period. Thus, if ownership of one common share (as usually measured) involved a probability of only 0.5 of a $1 income claim per period, then, using the probability statement as a weighting device, two shares would, in this example, equal one placement unit in our model. Thus, in Figure 6, the quantity of placements is measured in units of certainty dollar income claims.[11] Accordingly, "the rate of interest" is inversely related to the price of placements.

The stock supply of placements available to the general public (savers) at a point in time is equal to all the previously issued placements which exist (a_p) less those

[9] Thus Tobin's assumption that the "value of money in terms of goods is fixed" [**29**, p. 676], is incompatible with changes in the level of investment due to changes in the stock demand for capital.

[10] In 1965, for example, capital consumption allowances plus undistributed corporate profits was approximately 80 per cent of gross private domestic investment in the United States.

[11] Of course, an increase in the probability of receiving an income claim would have the same effect as increases in "short sales" in the securities market. It may be viewed as an increase in effective supply. We shall ignore these problems in the following analysis since their introduction would make the analysis more complicated without altering the major conclusions.

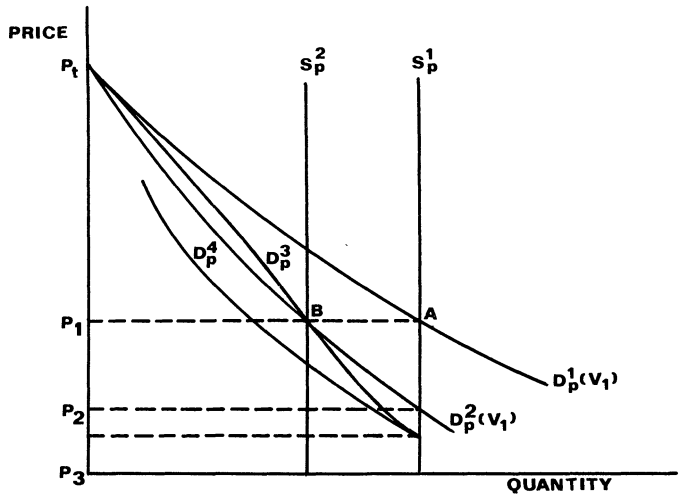

FIGURE 6

placements presently held by the banking system (a_p^b), where this latter quantity will be taken as exogenous to our model. Thus

$$S_p = a_p - a_p^b = a_p^s \tag{9}$$

where S_p is the stock supply of placements offered to the public, and a_p^s is the effective quantity of securities at hand at any point of time.

The flow supply of placements offered to the public per unit of time is given by

$$s_p = f_3(p_k, I_n, g, h, p_p) \tag{10}$$

where g is the fraction of the cost of net investment output (I_n) that is externally financed, h is that fraction of long-term external finance that is provided by the banking system, and p_p is the market price of placements. If g and h are taken as exogenous, while the cost of net investment is defined as $p_k(s_k - d_k)$, then (10) may be specified as

$$s_p = \frac{(1-\bar{h})(\bar{g})[p_k(s_k-d_k)]}{p_p}. \tag{11}$$

Given any level of net investment that must be financed via a new placement issue to the public, the quantity of placements (measured in income claim units) that must be sold to fund this level of investment declines as the market placement price increases; i.e., the flow supply curve with respect to p_p is a rectangular hyperbola.

The market supply of placements is obtained by summing equations (9) and (11):

$$S_p + s_p = a_p^s + \frac{(1-\bar{h})(\bar{g})[p_k(s_k-d_k)]}{p_p}. \tag{12}$$

Since both $\bar{g}$ and $\bar{h}$ are likely to be less than unity, while $d_k > 0$, placement flow supply is normally considered to be much less important than flow supply considerations in the capital goods market, i.e., $(s_p/S_p) \ll (s_k/S_k)$. Indeed, s_p is normally such a "trifling element" in the block of existing placements, that as a first approximation it is often assumed that the short-run supply of placements is completely dominated by its stock characteristics. In essence, the supply is then predetermined and can be represented by the vertical curve in Figure 6. Specifically if $(1-\bar{h})(\bar{g})[p_k(s_k-d_k)]$ is negligible (e.g., if $h=1$, or $g=0$, or $[p_k(s_k-d_k)] \approx 0$), then

$$S_p + s_p = a_p^s \,. \tag{13}$$

The fact that the net investment term $p_k(s_k-d_k)$ appears in the market placement supply equation (12) does indicate, however, that the total supply of placements available to the public is not completely independent of the demand for capital goods. Though the excess flow demand for capital (s_k-d_k) may, therefore, react on the price of placements (and the price of placements on the demand for capital via the rate of interest), the existence of g and h as exogenous variables suggests that capital goods demand and the supply of placements are independent "at least in the sense that any degree, positive or negative, of the one is compatible in appropriate circumstances with any degree, positive or negative of the other" [**16**, p. 145]. Consequently, for certain aspects of single-period analysis that are discussed in this section, supply aspects of placements will be treated as a stock concept. From p. 312 on, however, the flow supply of placements will be added to the analysis to obtain generalizations on the rate of capital accumulation under various hypotheses about the concurrent actions of the banking system and the magnitudes of g and h.

The demand for placements by the public requires savers to decide how much of their wealth to keep in the form of obligations of firms or titles to capital and how much in the form of bank deposits (money) (cf. [**24**, pp. 233–4]). It is at this point that the portfolio balance decision becomes relevant. For if we assume that savers expect the future price of consumption goods to be the same as the present price (or at least no higher than their carrying cost so that savers do not store their wealth in inventories of consumer goods), then money and placements are the only forms in which savers will want to store wealth. The disposition of savers to store value between money and securities will depend upon the expected return on each. At any instant, of course, the current return on securities is inversely related to the current placement price level. The expected returns on securities, however, depends on the expected future price level of securities. For if a change in security prices is expected, then a capital gain or loss will be anticipated. The return on money, on the other hand, is the convenience yield of being able to meet obligations when they come due, and this will be related to the expected volume of transactions between income payment periods—the transactions and finance motives [**3**]—plus the ability to make purchases of securities if their future price is expected to

fall at a per annum rate which exceeds the rate of interest [**20**, p. 202].

Because these expectations of future placement prices are uncertain, the individual will attempt to manage his store of wealth in the most efficient way while being subject to two types of risks: (1) an income risk, and (2) a capital risk [**14**, p. 240]. If the individual keeps all his wealth in the form of money, he loses future income but keeps his real wealth intact. If he holds securities, he gains future income but risks loss of real wealth. In an uncertain world, both risks are vexatious and an individual will divide his wealth at the margin into money and securities depending on his disposition to bear income risks and capital risks (cf. [**4**, p. 83; **27**]). At each security price level, and for each possible portfolio division, individuals will appraise the probability of these risks differently and the wealth holding public will divide itself into two groups—the bulls, who demand securities, and the bears, who sell them. Consequently, the savers' demand schedule for securities (e.g., D_p^1 in Figure 6) can be derived, given the public's expectations about the future, their present portfolio situation, and their aversion to income risks and capital risks. This demand function includes a Wicksteedian reservation demand by the bulls.

The public demands placements solely as a store of value so that the market demand function is entirely a stock demand, i.e.,

$$D_p = f_4(p_p, \bar{R}, \lambda, \beta, \gamma, e, V) \tag{14}$$

where D_p is the market demand for placements at a point of time, p_p is the market price of placements, $\bar{R}$ is the "certain" income claim per placement ($\bar{R} = \$1$ because of our unit measure of placements), λ is a set of expectations about the rate of change of future placement prices, β and γ represent the public's aversion to income risk and capital risk respectively, e represents the number of savers and the distribution of savings among them, and V is the magnitude of the public's total store of value at any point of time. V is defined as the total money balances held by savers as a store of value (M_2) plus the total market value of placements held by the public. We will follow the normal practice of assuming e is unchanged in our model (cf. [**1**, p. 191; **31**, p. 156]).

Given β, γ, and V, for any given expectation λ_1, the market demand curve —e.g., $D_p^1(V_1)$ in Figure 6—will be downward sloping; i.e., $f'_{4p_p} < 0$, since as the price declines the expected capital gain from purchasing a placement increases, while the (income) opportunity cost of holding money balances as a store of value increases. Hence the public will want to substitute placements for money holdings as the price of securities declines. The demand curve in Figure 6 is depicted as intersecting the price axis at p_t, indicating that at that "high" price the quantity of placements demanded equals zero as the risk of capital loss becomes so great, while the opportunity cost of holding money is negligible. This is the traditional Keynesian liquidity trap, where every member of the public is a complete "bear" since that price "leaves more to fear than to hope, and offers, at the same time, a

running yield which is only sufficient to offset a very small measure of fear" [**20**, p. 202].

If, for example, individuals should increase their desire to avoid capital risks (and/or increase their estimate of the probability of a capital loss in the future), that is, if they should become more bearish at any placement price level (e.g., γ increases), then the savers' demand schedule for securities should shift downward from $D_p^1(V_1)$ to $D_p^2(V_1)$ in Figure 6; i.e. $f'_{4\gamma} < 0$. This implies that the public wishes to hold less of its wealth in the forms of titles to capital and more in the form of currency or bank deposits.[12] If the supply of placements is constant and if V is unchanged, then the price of securities will fall from p_1 to p_2. Since the total value of placements declines as p_p falls, V will decline, reducing the demand for placements, i.e., $f'_{4V} > 0$. In Figure 6, however, the shift from $D_p^1(V_1)$ to $D_p^2(V_1)$ was due only to an increase in bearishness, with V unchanged at V_1. The resulting market demand curve when both the change in bearishness and the change in V are accounted for will be D_p^3 in Figure 6. At any price below p_1, $\Delta V < 0$ and therefore the quantity of placements demanded will be less than the quantity demand on the unchanged V demand curve, $D_p^2(V_1)$, while at any price above p_1, the demand quantities will be greater. The horizontal difference between D_p^3 and D_p^2 at any price will depend on the magnitude of the marginal propensity (j) to demand placements when V changes because of a change in the market price of placements, given the expectations about future security prices. The magnitude of j is a measure of a wealth effect, due to changes in placement prices, on the demand for placements (cf. [**1**, p. 191]). If $j=0$, then D_p^3 and D_p^2 would coincide. The often mentioned "locked-in" effect due to a security price fall implies that $j \approx 0$, at least for prices below the initial price p_1. In any case, the market price declines (from p_1 to p_3) and the expected real return on loan and equity securities will have risen until in equilibrium the actual portfolio mix of households (which is, by hypothesis, unchanged) is the desired one. (Of course, this will raise the rate of interest and therefore lower the demand for capital goods—in the traditional Keynesian manner). It is the flexibility of the market price of placements that permits each household unit to hold as many placements as it desires and to alter its portfolio as often as it desires, while in the aggregate the public holds exactly the quantity of placements and money that is made available to it.

This decline in the price of placements can be offset by the commercial banks or the Monetary Authority purchasing securities and simultaneously creating bank deposits for households. In this latter case, the price of securities will not fall as

[12] This increase in bearishness may result from the fact that rapidly fluctuating stock prices may increase the public's uncertainty about the future and therefore increase their expectation of capital risk. On the other hand, steadily increasing stock prices may reduce the public's expectation of capital loss and therefore increase their bullishness. Thus, changes in portfolio balance decisions may be the result of the rapidity and the trend in changing security prices, rather than their current effective yield (cf. [**11**, p. 252]).

much as in the former (and it may remain unchanged or even rise) as banks reduce the effective supply of securities available to the public (i.e. a_p^b increases), while households increase their holdings of money and decrease their holdings of placements (cf. [**16**, p. 142]). If the banking system adopts this latter course, then the ultimate effect of the rate of interest and therefore on the demand for capital goods will be different than if the stock of money was kept constant. For example, in Figure 6, we can assume that after the market price has declined to p_3, the banks buy securities on the open market, shifting S_p to the left. If the banks could purchase all the placements at the market price of p_3, then there would be no change in V (only a change in the composition of the public's portfolio holdings); and the public would be moved up a demand curve based on a constant $V(D_p^4$ in Figure 6). Open market purchases, however, involve bidding up the price of placements and thus altering the magnitude of V at each price. Accordingly, the public will move up the varying $V(D_p^3)$ curve, and the supply schedule must be shifted to the S_p^2 line to restore p_1. Comparing points A and B on Figure 6, we note that, mutatis mutandis, the actual portfolio holdings of the public have shifted from placements towards money as the banking system has satisfied the bearish sentiment of the public and prevented the rate of interest from rising. Although the public has shifted out of titles to capital goods, the community need not alter its holdings of real capital goods at all.

In summary, in an economy where the major form of money is bank deposits, portfolio decisions in combination with the operations of the banking system will determine what proportion of the community's total of real wealth is owned by households and what proportion is owned or looked after by the banking system (cf. [**14**, pp. 237–8]). Portfolio decisions, except to the extent that they affect the rate of interest via the usual liquidity preference relationships, will have no direct effect on the demand for investment goods. Thus portfolio balance can affect the rate of accumulation only via the interest rate or some other impact via ϕ or E on the demand for capital goods. It is to this question of the impact of portfolio decisions on the demand for capital via ϕ or E to which we now turn.

Security Price Levels and Second Hand Placements, and the Rate of Investment

At any point of time, firms will have a demand for a stock of capital that will depend on the discounted expected flow of future income resulting from the utilization of the services of capital, relative to the acquisition cost of these services. Thus, for alternative acquisition costs, there will be different quantities of capital demanded. Given the stock of capital and its depreciation rate, there will be a market price based on market demand. As we have already pointed out, if this market price exceeds the minimum flow supply price of capital, new capital goods will appear on the market; i.e., gross investment will be positive. Given the rate of depreciation and the market demand price above the minimum flow supply price, the annual rate of capital accumulation will be more rapid, as the supply conditions

in the capital goods industry are more elastic.

Each planning period, therefore, the firm will decide, on the basis of a present value calculation based on (a) its profit expectations, (b) the rate of interest, and (c) the current market price of capital assets, whether its current stock of capital is optimal. If the firm believes it has too much capital then it may sell some of its stock. If it has too little it may either (a) buy second hand capital or (b) order new investment goods. Of course, if the market price for capital goods is below the minimum flow supply price, no new investment goods will be produced. If above, new capital goods will be produced. All this has been discussed above.

Entrepreneurs, however, may have an alternative market—the organized securities market dealing in second hand titles to capital goods—that can sometimes be used to gain control of the future services of capital. As Keynes pointed out, because of the absence of any precise knowledge of the prospective yield of any long-lived assets, the daily reevaluations of equities on the organized exchanges are based on a tacitly agreed upon convention, i.e., the existing market value of equities are "uniquely *correct* in relation to our existing knowledge" and the market value "will only change in proportion to changes in this knowledge" [**20**, p. 152]. Thus, a saver who holds equities as a store of value "need not lose his sleep merely because he has not any notion what his investment will be worth ten years hence" [**20**, p. 153]. It is not surprising therefore that (a) since equity-holding savers are typically individuals who do not manage or have any knowledge (or even interest) in the long-run prospective yield of the capital assets that they legally own, and (b) since market valuations are a result of a convention established on "the mass psychology of a large number of ignorant individuals" [**20**, p. 154], the price of equities at any point of time need bear little relationship to entrepreneurial views of future profit opportunities.

Thus, if the price of equities is depressed (because, perhaps, households have increased their preference for money vis-a-vis titles to capital goods due to a pessimistic view of the future price of equities or a change in risk preference—i.e., either λ, β, or γ have changed), it may be possible to buy titles to capital goods at a price below the flow supply price of capital (e.g., market value is less than replacement value). Then individual firms can obtain control of the flow of services from the existing capital stock more cheaply by stock takeovers (mergers, amalgamations, etc.) than by purchasing either second hand assets directly or buying newly produced equipment.[13] Since this will reduce the number of independent demanders of capital goods (E in equation (1)), it may retard the rate of capital formation for the society by reducing the demand in the capital goods market (cf. [**20**, p. 151]).

[13] This is particularly likely to occur if poor management of a firm has caused savers to have a pessimistic view about its future earning ability. Thus, a stock takeover by an efficient management may improve the "productivity" of the capital goods of the firm that has been swallowed up. (Also control of the first firm's assets may come without even buying a majority of the outstanding stock.)

Alternatively, if equity prices are high relative to the market demand price for capital (so that market value exceeds replacement value) because households' view of the future indicates little risk of capital loss and a high probability of large capital gains if equities are purchased now, then entrepreneurs will always find it cheaper to buy new equipment than attempt to gain control over the flow of services from existing capital via the purchases of second hand equities. Moreover, as Keynes indicated, when equity prices are high "there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated off on the stock exchange at an immediate profit" [**20**, p. 151]. Thus, potential entrepreneurial investors may find their ability to finance the demand for capital goods easier (increasing E in equation (1)) in a period of high equity prices either because households wish to reduce their holdings of idle balances, or the high prices of common stocks relative to their dividend yields imply that firms can retain profits—that is withhold cash balances from households (cf. [**17**, p. 195])—or that banks are willing to provide additional bank deposits to a previously unsatisfied fringe of entrepreneurial borrowers as investment is undertaken. Accordingly, although there may be no direct relationship between portfolio balance decisions that depend upon household expectations of the future price of securities[14] and the capital demand decisions of firms that depend upon future expected profitability of capital services and the rate of interest, there may be some interaction via either financing ability or the ability to take over second hand real assets via merger. The actual rate of production of new investment goods will always depend upon (a) the existence of a discrepancy between the market demand price of capital and the minimum flow supply price of capital and (b) the supply elasticity of the capital goods industries. Thus, though there may be a link between the security market and the market for capital goods, there is also "many a slip twixt the cup and the lip."

Keynes used "the term *speculation* for the activity of forecasting the psychology of the [placement] market, and the term *enterprise* for the activity of forecasting the prospective yield of assets over their whole life" [**20**, p. 158]. Placement market activity is, for the most part, independent of both investment activity and the rate at which new securities are being floated; i.e., $\bar{g}(1-\bar{h})[p_k(s_k-d_k)]$ is likely to be exceedingly small relative to the total number of transactions occurring in the securities market. Organized placement market activity, based as it is primarily on second hand transactions and not new issues, depends almost entirely on people's views about how rich they are likely to be in the future; i.e., $\Delta\lambda$ is likely to be much more important than s_p in affecting security prices. As Keynes noted, the value of equities will often appear quite absurd to "a rational observer from the outside" [**17**, p. 360], for "the vast majority of those who are concerned with the

[14] If the future price of consumer durables is expected to increase, then households may increase their purchases of durables until the marginal carrying costs of the additional goods equal the expected decline in the commodity purchasing power of money.

buying and selling of securities know almost nothing whatever about what they are doing" [**17**, p. 361], while the professional speculator is normally interested only in taking advantage of the expected misguided views of the crowd [**20**, pp. 154–8].

If savers should take a rosier view of the future and therefore accept a lower present return on a store of equity wealth for the promise (hope? expectation?) of higher future returns than the entrepreneurial view of the perspective yield of a capital asset, then stock prices can rise almost without limit (as long as bullishness persists) and without directly altering the demand for capital goods except by making finance more readily available to investors. In the limiting case, where investors see no new profitable opportunities while savers maintain their rosy view of future placement prices, placement prices can increase, the rate of interest will decline, while the demand for capital will remain virtually unchanged.

If, on the other hand, savers should require a higher present return on equities, perhaps because the future looks worse to them than it does to the entrepreneurs, then security prices will fall while the flow of new capital goods will not be affected except if (a) the price of titles to capital falls below the flow supply price of capital, (b) firms find their ability to obtain finance reduced as individuals increase their preference for money in their portfolios, and the supply of money remains unaltered so that entrepreneurial demands for capital are aborted by higher interest charges and/or credit rationing (reducing E in equation (1)), and (c) the decrease in security prices colors entrepreneurial views about future profit yields of capital goods (reducing ϕ in equation (1)).

The only unequivocal link between portfolio balance behavior and the demand for capital goods by investors is via the usual Keynesian interest rate mechanism. Nevertheless, the introduction of an exogenous money creating banking system allows investors to make investment decisions that can be incompatible with the public's portfolio preferences at the current rate of interest. If the investors can obtain finance, then the market price of placements will be the adjusting mechanism that will bring the savers' portfolio balance decisions into harmony with the investment projects undertaken. In a monetary economy, it is finance that provides the energy fuel that permits the investment tail to wag the portfolio balance dog.

Finance and Capital Accumulation

It is now possible to use our model to suggest the mechanism that relates the path of capital accumulation to the supply of money. At this stage we can no longer ignore the flow supply aspects of placements.

Assume initially a stationary state economy. The market price for capital goods is p_s. New capital goods (financed internally via the business sector's depreciation reserves) are merely replacing capital as it wears out in each period of time. Assuming no change in λ, the demand and supply curves for placements are fixed and can be represented as D_p^1 and S_p in Figure 7a. The price of placements is unchanged

at a price of p_1 as the placement market clears in each period for as many periods as the economy remains in the stationary state. Now let us postulate an increase in the demand for capital by investors due to an exogenous improvement in profit expectations at the beginning of period t. This will lead to an increase in the demand for capital goods, provided the additional demand can be financed (cf. [**17**, p. 149]) (for as we always teach in courses in microeconomics, demand for any commodity implies *want plus the ability to pay*). Thus there will be an increase in net investment, $\Delta(s_k - d_k) > 0$.

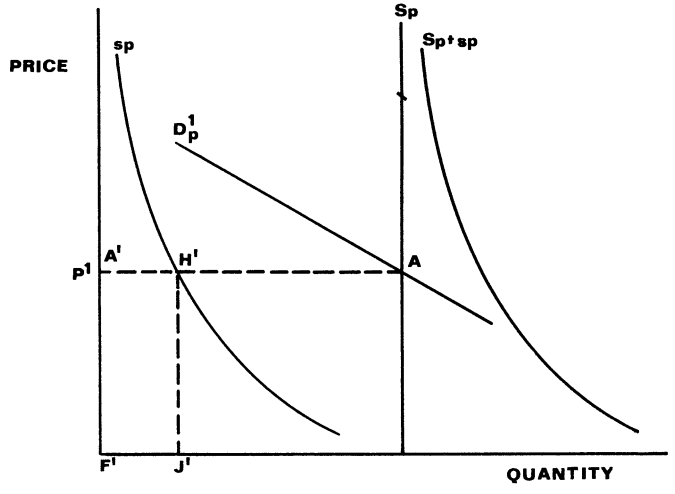

FIGURE 7a

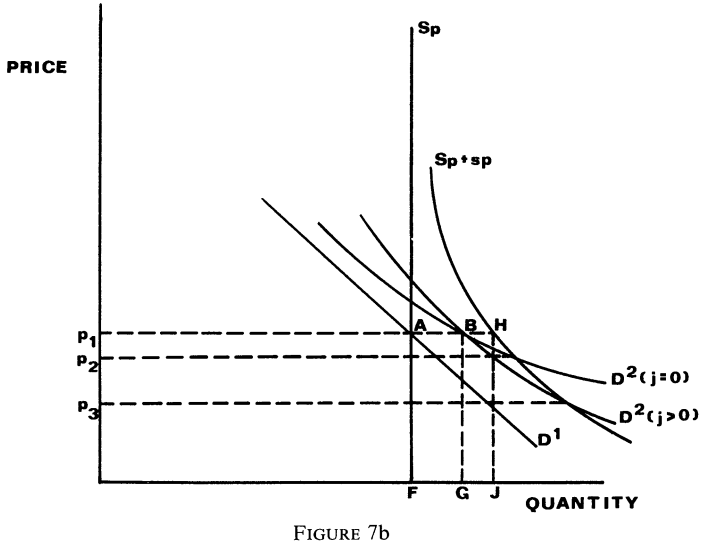

FIGURE 7b

Since the previous level of capital demand was being adequately financed, there must have been sufficient transaction cash balances in the system to maintain the initial level of consumption and gross investment transactions. With the improved profit expectations, however, there will be an additional demand for money to finance the additional demand for capital even at the initial income level [**3**]. Thus some firms will, *ceteris paribus*, require additional cash balances to buy net investment goods. They may engage an investment banker (or a promoter) who, after convincing himself of the correctness of the investors expectations, will borrow funds from a commercial bank on a short-term loan to finance the increased demand for investment goods. (Of course, particularly in the case of financing increments in working capital, the firms may borrow directly from the banks.)

Accordingly, if the entire increase in the cost of investment is borrowed on short-term credit from the banks, then, *ceteris paribus*, the quantity of money is increased:

$$\Delta M = \Delta C \,, \tag{15}$$

where ΔC is the increase in cost (market value) of the output of the investment goods industries when net investment increases ($\Delta I_n > 0$).

These newly created funds will be used by the firms to make payments that ultimately become income to owners of factors engaged in the capital goods industry. There will be, therefore, an increase in the money balances of households pari passu with the growth in investment expenditures; hence the real wealth of the community (but not that part directly owned by the household sector) and savers' money balances increase simultaneously.[15] Some households that were previously in portfolio balance now find their real income and their money holdings have increased. They will, of course, increase their planned consumption expenditures and consequently hold some of the additional money for transactions purposes. The remainder becomes household savings and the households must decide in what form to store wealth. (This process continues over other households as the multiplier—and income velocity—process works itself out.) Accordingly, at the end of the process, some of the new money has been absorbed permanently into active balances (ΔM_1) and the remainder is idle balances (ΔM_2). This increase in M_2 increases V and induces a rightward shift in the placement demand curve in Figure 7b from D^1. The magnitude of the wealth effect on the demand for placements when the idle balances of savers is exogenously altered is measured by m, the marginal propensity to demand placements as M_2 changes. If $m = 1$, which is the usual assumption underlying the traditional speculative demand curve for money (cf. [**1**, 195–6]), then, given λ, the demand curve for placements will be shifted out from point A to point B at the p_1 price. This shift from point A to B is indicative of

[15] For simplicity of exposition, we will, at this point, ignore the possibility of retained profits by the capital producing firms. To the extent that some profits are retained, internal finance in the business sector is possible.

an increase in demand at p_1 that is just sufficient to absorb a volume of new placements (at a price of p_1 per unit) so that purchases equal ΔM_2; i.e., $FABG = \Delta M_2$ in Figure 7b. At any price below p_1, the total value of the public's initial holdings of placements will decline and hence there is another wealth effect on the demand for placements such that if $j > 0$, the shift in the placement demand curve will not be sufficient to purchase ΔM_2 worth of additional placements even if $m = 1$. Similarly if $j > 0$ at any price level above p_1, the demand for additional placements will exceed ΔM_2. If, on the other hand, $j = 0$—i.e., a change in the total market value of the public's initial stock of placements does not, in itself, affect the demand for placements, so there is no second wealth effect—then, at any price, the increase in demand will involve additional purchases that just equal ΔM_2. The curves $D^2(j=0)$ and $D^2(j>0)$ in Figure 7b represent these two possible cases. The $D^2(j=0)$ curve will have a rectangular hyperbolic relationship with respect to D^1.

The number of placements that must be floated to completely fund any given increase in the cost of investment (ΔC) varies inversely with the market price of placements. If, for example, $g = 1$ and $h = 0$, then, given ΔC, the flow supply curve of placements is the rectangular hyperbola s_p in Figure 7a where $F'A'H'J' = \Delta C$. The total market supply curve in the period can be represented by $S_p + s_p$ in Figure 7a. By placing the market supply curve $S_p + s_p$ onto Figure 7b we can readily see what will happen to the market price of securities. Since $\Delta M_2 < \Delta M = \Delta C$, therefore $FABG (= \Delta M_2)$ must be less than $FAHJ (= \Delta C)$. Consequently the new market supply curve, at the p_1 market price, must lie to the right of the new market demand curve. If $j = 0$, then the new market demand curve is hyperbolically related to the downward sloping D^1 curve. Since the new supply curve has the same rectangular hyperbola relationship to the vertical S_p curve, the new intersection must occur at some lower market price, p_2. Of course, if $j > 0$ then the intersection will occur at even a lower market price, p_3. The revenue from the sale of new placements at the market clearing price will be sufficient to pay off the outstanding short-term bank loans.

Thus if householders do not alter their expectations about the future price level of placements, and if their feelings about income and capital risk have not altered, and if the commercial banks or the Monetary Authority does not purchase some of the additional securities, then the rate of return on securities must rise (security prices fall) in order to induce households to alter the relative portfolio holdings from money towards securities.

In summary, given the expectation of the community, if the rate of return on securities is to be kept constant or reduced as the level of economic activity expands with an increase in net investment, and if all the titles to the increment in net investment are to be held by the public (rather than the banks), then the quantity of money will, in general, have to increase by an amount that exceeds the increased cost of investment; i.e., ΔM must be $> \Delta C$.

The rate of increase in M in each period which would be necessary to keep the

rate of interest constant, when net investment is increasing and expectations about the rate of change of future placement prices is unchanged, will depend upon (1) the magnitudes of g and h, (2) the marginal propensity to increase M_1 as transactions increase, and (3) m – the marginal propensity to buy placements with changes in M_2. If $g=1$, $h=0$, $m=1$, and if M_1 is always proportional to commodity transactions, while the latter is proportional to real output (so that, for example, there is no change in the degree of industrial integration), and if the capital-output ratio is a constant, then the required proportionate increase in the money supply that will keep the rate of interest unchanged is equal to the proportionate increase in capital goods that is forthcoming. If all these conditions are fulfilled, then the demand for placements will increase at the same pace as the supply of placements. If these conditions are not met,—unless there are exactly offsetting influences—the rate of increase in M, which will leave interest rates unaltered, will not be equal to the rate of growth of capital goods.[16]

Since in our example above, $\Delta I_t > 0$, the equilibrium level of economic activity in period t will be greater than in $t-1$, and the economy will depart from the stationary state. The funds that were obtained by floating the new issue in period t are used to retire the short-term bank loan and, therefore, are available at the banks to finance the same level of net investment in the $t+1$ period as in the t period.

The veracity of Keynes' dictum that "if investment is proceeding at a steady rate, finance ... [is] a revolving fund of a more or less constant amount" [**18**, p. 247] is readily demonstrable. If in $t+1$, $\Delta I = 0$, then the firms have no difficulty in financing the same level of net investment as in the t period via short-term bank borrowing. Again, the increase in capital stock will result in a simultaneous increase in household balances—but, if $\Delta I = 0$, then $\Delta Y = 0$. Consequently, there is no need for households to increase their M_1 holdings and all the increment in their money holdings are initially M_2. If $m=1$, this shifts the demand for placements out sufficiently to absorb, at the current market price, enough new placements to fund the entire short-term borrowing. In such a situation, the planned net debtor position of firms has increased pari passu with the planned net creditor position of households (at the current rate of interest). Obviously, finance is a revolving fund that need not be augmented even if net investment is positive as long as net investment and the rate of economic activity are unchanged from period to period (and expectations are unaltered). Of course, a constant positive level of net investment each period implies a declining rate of capital growth and economic stagnation as the level of economic activity remains unchanged.

If, on the other hand, we posit another improvement in profit expectations in $t+1$, so that there is an additional demand for money to finance an increment in net investment, and if the banks provide these additional balances via short-term credit expansion, then at the higher $t+1$ equilibrium level of output, the additional

[16] Thus, the justification of Tobin's conclusion that in equilibrium "money and capital must grow at the same rate" [**29**, p. 679] requires a host of heroic assumptions which were not specified in his model.

money (net of additional active balances) held as a store of value will not shift the placement demand curve sufficiently, even if $m=1$, to float the entire new issue at the current market price (i.e., $\Delta M_2 < \Delta M = \Delta C$). Consequently, if the rate of interest is to be kept unchanged when $g=1$ and $h=0$, again we note that ΔM must be greater than ΔC.

We might inquire what would have happened in $t+1$ if the banks refused to expand the money supply, i.e., $M_{t+1}=M_t$, as firms attempted to increase their demand for capital goods because of improved profit expectations. (For ease of exposition we ignore the net investment that can be financed from the revolving fund and concentrate only on the increments in net investment and finance.) If additional finance is to be obtained, then some households must be induced to give up some of their portfolio money holdings in exchange for securities. Hence the market price must initially fall (rate of interest must rise) to encourage households to substitute placements for money in their desired portfolios (cf. [**7**, p. 525]). As the additional investment projects are carried out, economic activity increases and additional money is absorbed into active balances, leaving less money permanently available for portfolio balance. Consequently, the demand for securities at any price level is reduced, and, of course, the equilibrium level of output will be lower and the rate of interest higher than if the supply of money had expanded in pace with the additional investment demand.

Every actual increase in the level of investment will, if the money supply is unchanged and $g>0$, increase the quantity of placements and reduce the quantity of money available as a store of value; therefore, placement prices will decline. The greater the increase in net investment demanded per unit of time, the greater the quantity of active balances demanded, and therefore, the greater the reduction in M_2 balances. Thus, the greater the growth in demand for net investment, *ceteris paribus*, the greater the decrease in demand and increase in supply of placements, and therefore, the greater the decline in placement prices (the more rapid the rise in interest rates). This lack of finance will ultimately limit the rate of capital accumulation as another "liquidity trap" restrains expansion[17] since "a heavy demand for investment can exhaust the market and be held up by the lack of financial facilities on reasonable terms. It is, to an important extent, the financial facilities which regulate the *pace* of new investment [at less than full employment] ... too great a press of uncompleted investment decisions is quite capable of exhausting available finance, if the banking system is unwilling to increase the supply of money" [**18**, p. 248].

Thus, in any expansion, as Keynes argued:

> the banks hold the key position in the transition from a lower to a higher scale of activity. If they refuse to relax [i.e., to provide additional finance], the growing congestion of the short term loan market or the new issue market, as the case may be, will inhibit the improve-

[17] For an analysis of this new type of liquidity trap using the Hicksian *IS-LM* model, see [**3**, p. 62].

> ment, no matter how thrifty the public purpose to be out of their future income. On the other hand, there will always be *exactly* enough ex-post saving to take up the ex-post investment and so release the finance which the latter has been previously employing. *The investment market can become congested through a shortage of cash. It can never become congested through a shortage of saving* [or savers not *wanting* to own the titles to the real wealth (at some reduced placement price level) that has been produced]. *This is the most fundamental of my conclusions within this field* [**19**, pp. 668–9, italics mine].

It should be apparent, therefore, that if growth is to be sustained, the money supply must increase as output rises. In an uncertain world, however, where expectations are volatile and unpredictable (rather than the given datum assumed in our model), the relationship between the required increase in the money supply and the increase in real wealth is much too complex to be handled by any simple rule. Money clearly matters in the process of economic growth in a monetary economy, but a simple rule can be no substitute for wise management of the money supply (cf. [**16**, Ch. 15]).

Finance, Capital Accumulation, and Public Policy

Our mechanism has emphasized that for increases in capital demand to be effective, firms must be able to obtain additional finance. Thus, for a steady rate of capital accumulation and growth to occur, the banking system and the Monetary Authority must play an essential role by providing the initial funds on terms which investors deem attractive[18] (cf. [**17**, p. 149; **7**]). It is at the level of financing investment projects that the money supply plays an essential role in stimulating economic growth in a monetized market economy, and not at the level of portfolio balances. Keynes wrote a long time ago that "the rate at which the world's wealth has accumulated has been far more variable than habits of thrift have been" [**17**, p. 149]. To this dictum we may add "or habits of portfolio balance." If we can expand Keynes' Treatise analogy, we might note that the Seven Wonders of the World were not built by either habits of thrift or portfolio balance; rather they were the result of the desire for personal capital monuments by kings and other important personages plus these people's ability to obtain finance in order to command the necessary real resources. (Of course, a respected government—or a feared one—has no difficulty in finding a means of finance (cf. [**24**, p. 276, n. 1]).) Once the active decision to increase the real wealth of the world in this form was implemented all that the ancient households could do was to adjust their savings and portfolios in the light of the variables that were left open to them.

Most Keynesian growth models have (erroneously) ignored the monetary

[18] An investment project will appear attractive to entrepreneurs if the expected return to capital less interest charges is large. Thus, profits per unit of capital may, from the investors' view, rise, even if the marginal product of capital is declining, if interest charges to the firm are falling more rapidly than the marginal product. In this sense, interest is merely a transfer of income between entrepreneurs who wish to command resources and savers who have a store of purchasing power.

requirements for growth.[19] Professor Tobin has, at least, attempted to show that monetary factors are of primary importance in growth. Unfortunately, he ties money supply requirements too closely to portfolio balances and not sufficiently to the requirements of finance where it belongs.

In modern money economies with a developed banking system, there is normally a continual fringe of unsatisfied borrowers. Banks often restrict credit in the sense that "the amount lent to any individual ... [is] governed not solely by the security and the rate of interest offered, but also by reference to the borrowers' purposes and his standing with the bank as a valuable or influential client" [**17**, p. 365]. It is this restriction on credit (limiting E in equation (1)) that limits the rate of accumulation as often as a high rate of interest.

The policy implication of this analysis is that since capital accumulation primarily depends upon (1) investors views of the future (ϕ), (2) the ability of firms to obtain finance (E) and the rate of interest (i), and (3) supply conditions in the capital goods industries (s_k), and since (1) and (3) are not normally under public policy control, then the money supply should be controlled so as to make finance as easy as possible until full employment at any point of time is reached.

At full employment the rate of capital accumulation will depend only on its expected profitability (ϕ), and the elasticity of supply of the capital goods industries (s_k). If this should result in a rate of accumulation that exceeds the natural rate of growth in the labor force, then ultimately, in a free market, money and real wages and prices will rise, forcing savers (particularly bondholding rentiers) to reduce real consumption—forced savings—and allowing some further expansion in investment goods industries and a higher level of full employment with a greater labor force participation rate (which implies that there is nothing "natural" about the natural rate of growth of the labor force)[20] [**4**, pp. 170–1; **5**].

The accompanying inflation and its income redistribution will have undesirable social effects. The real income and wealth of bondholding savers will be reduced; this will alter the views as to the probabilities attached to income and capital risks of portfolio holdings, which will feed back onto security price levels. Moreover, entrepreneurs may build inflationary expectations into their future income stream calculations, thereby raising the demand for capital via ϕ [**4**, p. 203]. Finally, the Monetary Authority is unlikely to continue to allow easy financing under such circumstances. In the absence of an integrated monetary, fiscal, and incomes policy for full employment, therefore, the output of the investment goods industries ought ultimately to slow down because of the shortage of finance.

If, on the other hand, the economy is in a position where the demand price for

[19] There are a few exceptions where the importance of money is at least mentioned, e.g. [**24, 29, 32**]. It is interesting to note that the father of modern growth theory, Harrod, had an important article on "The Expansion of Credit in an Advancing Economy" as early as 1934 (reprinted in [**11**]).

[20] Given leisure-income preferences, and the rate of growth of population, the natural rate of growth of the labor force is market determined.

capital brings forth an increase in the stock of capital (where the rate of capital accumulation is still less than the long run rate of growth in the labor force), then unless the capital-labor ratio can decline over time, the threat of surplus labor and depression will tend to appear. In these circumstances, only the socialization or subsidization of investment or other nonconsumption demands, or reductions in the rate of growth of the effective labor force (e.g., a reduction in the work week) can maintain full employment.

In a market-oriented economy, there is no automatic market mechanism which will adjust the rate of capital accumulation to the rate of increase in the effective labor force. The most that can be said is that, given technology, given the distribution of income, given the expectations of entrepreneurs, and given the liquidity preference of the public, there may be an attainable rate of interest which will bring the warranted rate of growth of capital into equality with the natural rate of growth of the labor force (cf. [**11**, pp. 129–69]). If such an optimum rate exists, then the Monetary Authority should orient its policy to obtaining and maintaining this optimum or natural rate of interest.[21] Thus in an economy of steady growth, the supply of money would have to be continually expanded, and as I have shown elsewhere, unless this additional finance is supplied in advance of the actual expansion, the economy may be restrained by almost another "liquidity trap" [**3**, p. 62], this time by virtue of the fact that the shortage of finance may choke off investment, rather than the fear of capital loss precipitating the liquidity crisis.

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