8-1971

An Exposition of a Keynesian Theory of Investment

Hyman P. Minsky Ph.D.

Preliminary: Not to be
quoted without permission.

"An Exposition of a Keynesian Theory of Investment"

by

Hyman P. Minsky

Professor of Economics

Washington University

St. Louis, Mo. 63130

U.S.A.

August 1971

Introductory Remarks

The standard IS-LM macro-economic model has as one of its building blocks a negatively sloped relation between investment and the interest rate (Hicks 1937). The validity of this investment function has been questioned by Haavelmo. Derivations have been suggested by Lerner, Clower and Witte which recognize that unsophisticated references to the properties of a well-behaved production function are not sufficient grounds for deriving this standard investment function. Foley and Sidrauski have recently presented a sophisticated version of the IS-LM apparatus which is less clearly dependent upon an assumption that such a negatively sloped investment function exists. Jorgenson in his various writings derives investment as the result of a time consuming process by which units go from an initial to a desired stock of capital; the desired stock is inversely related to the interest rate.

These various formulations of investment theory are deficient as representations or critiques of Keynesian ideas (Keynes 1936, 1937). They never come to grips with the Keynes' view as to the essential financial and speculative character of private asset holding and investment in a modern capitalist economy. In this view assets are held because they are expected to generate cash flows. These cash flows can take either the form of annuities - dated receipts of cash - or of payment for title to the asset. The annuities for financial assets are stated in the contract, the annuities for real assets depend upon the results of the asset being used in production.

The standard production function related model of real assets and investment only considers the cash that an asset or an investment will

generate as it is used in production. That such an asset might also be sold - or hypothecated - to generate cash is ignored. Whereas bankers may be concerned about the liquidity of their assets, in standard theory an ordinary business firm investing in real capital presumably is not. A sloganeering way of looking at Keynesian theory is to assert that all units are like banks, i.e. a bank has to stand ready to pay cash as deposits are withdrawn; an ordinary firm or household has to be prepared to pay cash due to its liabilities even though its available cash receipts vary due to demand and cost changes.

This banker perspective of Keynesian theory means that it is relevant only to capitalist economies and how relevant it is depends upon the financial sophistication and complexity of the economy. Thus Keynesian economics is the economics of this, a capitalist, economy, it is unlike neo-classical economics which is the economics of an abstract economy. The characteristics and evolution of institutions are embodied in Keynesian model building.

Whereas the cash flow from operations and the cash flow from contract fulfillment are repetitive phenomena so that ideas about frequency distributions can be derived from observations, for many assets - especially durable real capital - obtaining cash flows by sale or hypothecation is a "rare" and "unusual" phenomena which usually occurs in special circumstances. Because of this, ideas about the relevant probabilities are vague and imprecise and subject to sharp changes. The speculative demand for money - the speculative impact upon the pricing of real assets - is related to the use of assets for acquiring cash by sale.

When one develops a new theory, as Keynes did, one has some things in mind that are not explained in a satisfactory manner by the existing or standard theory. These poorly explained observations are an anomaly from the perspective of the standard theory, they are what is expected from the alternative theory. The anomaly of the nineteen thirties for standard economic theory was the great depression and its quite obvious financial attributes (Fisher). Keynes constructed an investment theory of the business cycles and a financial theory of investment. The standard presentations of Keynes, following the lead of Hicks, attenuated the financial and the cyclical traits of Keynesian theory (Ackley), although when Hicks turned to business cycle theory he found it necessary to reintroduce, albeit in an artificial manner, financial characteristics (Hicks, 1950). Duesenberry, Turvey, Leijonhufvud and Brainard-Tobin all reflect attempts to resurrect the financial aspects of Keynesian theory.

It is important to note that on the whole the econometric forecasting models abstract from financial considerations. Even in the most "monetary" of the econometric models - the F.R.B.-M.I.T. model - the liability structure and the variable value placed upon liquidity do not appear. One purpose of the research of which this exposition is a part is to develop an enriched macro-economic model which does a better job of integrating the financial and the real aspects of American Capitalism.[1]

The reference to interest rates in Keynes' original presentation in the General Theory was an inappropriate way of getting at a more basic phenomena: What in a particular situation determines the relative prices of real and financial assets and how are these prices related to

the flow of investment? In his rebuttal to Viner's famous review Keynes clarified his views of the investment process (Keynes, 1937). This rebuttal is the foundation of the views an investment that follow.[2]

The Basic Components

The basic components of a Keynesian model of investment are represented in Diagram I. The Keynesian model postulates that two sets of markets interact in determining investment. The first set consists of those markets in which the prices of the units in the stock of capital goods and financial assets are determined. This is represented in Diagram IA by the P_k function. The second set consists of the markets in which the pace of investment is determined by a combination of financing and supply conditions. This is represented by the I and the N_c functions in Diagram IB.

In Diagram IB, the I function gives the supply price of real investment goods as a function of the rate of output. The N_c function gives the internal financing per unit of investment as a function of the pace of investment (N_c is a rectangular-hyperbola if the flow of internal business funds is independent of investment). For any given pace of investment the vertical difference between the two curves $N_c - P_I$ gives the surplus or deficit of internal funds per unit of investment.

The money and capital market determine on what terms such deficits are to be financed and such surpluses are to be utilized. Thus at a deeper level the Keynesian theory of investment has to include a model of the behavior and evolution of money and capital markets (Minsky, 1957 Q.J.E.). It is by way of the money and capital markets that the financial

flows set up by the current financing of investment feedback to the markets which determine the prices of items in the stock of capital. Whatever changes in financing terms result as investment is financed affects the terms upon which positions in the stock of capital goods and financial assets are financed. This in turn affects the price of units in the stock of capital assets: financial market connections integrate stock and flow prices.

These relations are not necessarily simultaneous and that the sequence of reactions as well as the initiating disequilibrium are not always the same.[3] In particular both the evolution and the instability of financial sectors can affect the terms upon which investment can be financed - and thus its pace - as well as the prices of the stocks of capital goods.

The theory as sketched will abstract from the time consuming nature of the investment process. Presumably the price of capital encompasses the price of a nuclear power plant. The gestation period for a nuclear power plant is at least five years. In the empirical implementations of such a model, the investment flow relates to the investment per period - say per quarter. A decision to pay P_k for a nuclear power plant results in a flow of investment I_t over the next 20 quarters such that (ignoring discounting)

$$\sum_{t=1}^{20} I_t = P_k$$

where each I_t is determined by the technical conditions of producing nuclear power plants.

In implementing this theory for an econometric model, the investment process might well be divided into capital goods ordering and investment flow phases. With that dichotomy in mind it might very well be that the first part of the theory sketched here is more of a theory of investment ordering than a theory of investment flows. The second part, which emphasizes financing and financial repercussions, reflects what happens as investment flows and financing actually take place - perhaps long after the initial decision to invest was made.

In summarizing research which involved the replication with a consistent body of data of a number of alternative econometric formulations of investment, Bischoff remarked that accelerator based models - whether simple or flexible (the flexibility depending upon relative prices of inputs) - did better than the cash flow or security price alternatives. The cash flow or security price models tested by Bischoff are not adequate representations of what is here viewed as the Keynesian theory of investment. We can take Bischoff's tests as missing the point about Keynesian models.

However, we have to face up to the fact that we do not explicitly consider the accelerator in our formulation. Long ago (Minsky, 1957, AER) I examined interrelations between accelerator effects and monetary (financial) behavior. In my formulation the accelerator model gave us ex-ante investment. Ex-post investment resulted from the interaction of monetary (financial) factors and accelerator considerations. That formulation ignored the supply function for investment goods output and the pricing process for stocks of capital goods, which are central to the present exposition.

Investment activity is the result of a combination of productivity and speculative factors. The productivity and scarcity of capital services result in current and expected future cash flows to owners of capital. The accelerator basically is an assertion that if an output greater than current output is to be produced, an increment to the capital stock of a particular size can be expected to yield satisfactory or adequate cash flows. In terms of price theory concept this means that for a given long run average variable cost curve - derived from a "production function" - there exists a minimum average planning total cost curve. This curve defines the sets of product prices and outputs that are expected to result in such adequate cash flows. Thus the cash flows from operations of real assets as used in the text that follows embodies the productivity of investment.

Let us assume that wages are fixed and as a result the minimum supply price of the investment good is $P_I(o)$. If $P_k > P_I(o)$ then investment is taking place at a rate so that $P_I = P_k$ after allowing, as in the text, for financing discounts. Any entrepreneur purchasing an investment good at $P_k = P_I > P_I(o)$ expects to "earn" extra-ordinary quasi-rents for a long enough time so that when $P_I = P_I(o)$, the extra-costs will have been written off. Thus expectations with respect to future cash flows are imbedded in P_k. The higher P_k for a given $P_I(o)$ the larger and the longer the expected duration of premium quasi-rents. Because the capital stock is increasing due to investment, the higher P_k the greater the capital stock that is assumed to be necessary for quasi-rents to be at their normal or adequate level. Thus the excess of P_k over the minimum normal supply price of investment output is a measure of the difference between the existing and the target capital stock.

Accelerator ideas can thus be read into the pricing of capital assets. However, the strong Keynesian view is that in an economy with cyclical experience and capitalist organization speculative elements dominate productivity consideration in determining the price of investment. By concentrating on how elements other than expected cash flows affect the price of real assets in our uncertain world, the speculative aspects of the investment decision are brought into focus.

To summarize: In market investment relations estimated over periods characterized by rather steady economic growth variables which are interpreted as embodying accelerator conceptions turn out to have a large explanatory weight. In our present formulation productivity concepts are embodied in the cash flows from operations that capital assets earn, especially in the cash flows anticipated as investment decisions are being made. However, the speculative element is introduced into the pricing of assets by way of the contingent cash flows by way of "sale". At times the weight of the two sources of value for assets changes so that speculation dominates. This is so even though for long periods the regularity of investment, output and cash flows from operations are such that measures which can be interpreted as reflecting accelerator relations seem to dominate in what happens.

In Bischoff's research the cash flow model, which is poorly specified from the perspectives of this paper, does very well in explaining investment over the data period. It does quite poorly in explaining investment in 1969 and 1970. However, as I have emphasized (Minsky, 1970) a run of success such as was enjoyed in the 1960's will trigger a euphoric investment boom. During this boom debt financing of investment will expand rapidly, i.e. the investment - gross profit after taxes relation will

change. Whereas the 1969-70 period illustrates the weakness of a narrowly construed cash flow formulation, it is evidence that a financial theory of investment, which allows for liability structures - actual and desired - has a large measure of plausibility.

The Pricing of the Capital Stock

The left hand portion of Diagram I, Diagram IA, asserts that for a given capital stock, the price per unit of capital is a function of the money supply. This assertion rests upon an argument about how assets are valued in the face of uncertainty and in the light of the existence of complex financial structures.

Underlying Diagram IA is the view that all assets - real and financial - are equivalent in that they are expected to generate cash flows. These cash flows fall into two classes. The first class of cash flows result as assets do their thing - are used in production processes if they are real assets or as contract conditions are satisfied for financial assets. This first class will be called cash flows from operations for real assets and cash flow from contract fulfillment for financial assets. The second class of cash flows result as assets are sold or pledged.

The non-Keynesian theory of asset valuation concentrates only on the first class of cash flows. In this view the cash flows that a set of real assets collected in a firm will generate are the future cash flow from operations as given by total revenue minus out of pocket costs (the out of pocket costs are the variable costs of "cost curves analysis" with

Keynesian user costs excluded from the variable costs). Obviously for a firm these cash flows from operations will be conditional upon the state of the economy, the product and factor markets, and the management of the firm.

The current fashion is to argue that assets with different probability distributions should be valued not in terms of their expected values but in terms of their expected utilities - where the transformation between income and utility reflects the units attitude toward risk (Arrow).

Even though Keynes was skeptical of the validity of the Benthemite calculus when applied to incomes, the expected utility hypothesis is a useful expository device for Keynesian ideas if it is accepted that 1) the probabilities set on various alternatives are subjective and thus subject to sharp changes if appropriate triggering events take place and 2) the curvature of the transformations between income or cash flows and utility - the aversion or attraction to risk of the various actors - is itself an endogenously determined relation and will undergo both slow and sharp changes depending upon what happens.

The expected utility hypothesis yields for each distribution of expected incomes an expected utility. There also exists an income with certainty that will yield utility equal to the expected utility. We can call this income the certainty equivalent income. The conclusion on asset price formation has been that assets will exchange at the same ratio as their certainty equivalent incomes. Given that a dollar yields a utility with certainty, this certainty equivalent approach to asset valuation yields the absolute price of various assets.

Note that this argument holds for both real and financial assets. For debts the cash flows are given by the face of the contract and the probability judgments have to be made with respect to the likelihood that the contract will not be fulfilled and the cash flow that will take place in this event.

The above valuation theory has to be modified by taking into account the second way in which an asset can generate cash - by being sold or hypothecated. Assets differ greatly in the ease with which they can be marketed or pledged. In conventional money market analysis the marketability of an asset is sometimes treated by alluding to the breadth, depth and resiliance of its market. The same factors apply to real assets - except that the weight normally attained to the circumstances under which they will have to be sold or pledged is slight and typically the sales market is expected to be narrow, shallow and non-resiliant.

The likelihood that cash will have to be raised by selling or pledging assets depends upon the cash position and the cash payment commitments of a unit. These cash payment commitments are embodied in the liability structure of firms. At any date the liability structure of a firm is determined by market conditions which ruled when the firm financed asset acquisitions and refinanced its positions in assets.

Cash payment commitments include both the repayment of principal as well as the payment of interest.[4] If control over assets is financed by liabilities which are of shorter life than the asset, then the cash required by the liability contract over its life may well exceed the cash the assets will generate over these periods. In such circumstances the

cash needs due to the liability will have to be met by the issuance of a new liability. Such refinancing of positions by sale of liabilities is a characteristic bankers behavior: commercial banks, bill dealers and finance companies normally engage in such refinancing. At the time of its failure, the Penn-Central railway had short term liabilities outstanding which had to be "turned over" for the railway to remain "liquid". When this became impossible, the railway went bankrupt.

In Diagram II the short run cost conditions of a firm are sketched. The given plant defines the marginal and average variable cost (net of Keynesian user costs) for given wage rates. The other average cost curves reflect the payment commitments as embodied in liabilities; the curves for three alternative balance sheets are sketched. Given an expected price P, the differences P - ACL_1 and P - ACL_2 indicate the fall in output price that would lead to the cash flow from operations falling short of the cash needs as given by the liability structure.

The third average cost curve ACL_3 reflects a situation in which the cash flow from operations is insufficient to meet the cash needs of the liabilities. Often, but not always, this situation arises when the principal amount of some liabilities fall due. If the expected cash flows from operations (P - AVC) are large enough and if financial market conditions are orderly a rolling over of liabilities will usually be feasible. If expected cash flows are "too small" relative to payment commitments or if market conditions are disorderly, such refinancing might be expensive if not impossible.

If the payment commitments are large relative to the cash flow from operations, the alternative to refinancing is the sale - or the mortgaging - of assets. The various real and financial assets are saleable to the

extent that they can be transferred cheaply to easily located buyers and that they are expected to generate desired cash flows for these buyers. If an asset is a special purpose asset imbedded in a production process then it has only a limited ability to generate cash by sale.

Thus the valuation of assets in a capitalist economy can be structured as a two stage process. One stage estimates the value of the cash the asset can generate as the owning unit operates it in the current and expected economy; the second stage estimates the value of the cash it can generate by "sale", under pressure, at any date. The market value is some weighted average of these two values.

If assets are equivalent with respect to the cash flows they are expected to generate from use or contract, then assets with a poor secondary market will sell at a discount relative to assets with a good secondary market.

The weight attached to the likelihood that assets will have to be sold to raise cash can change rapidly and thus affect the relative prices of real capital assets with restricted secondary markets to that of readily marketable financial assets. For real and financial assets therefore the market price reflects both productivity and contract concepts as embedded in the expected cash flow from operations and contract fulfillment, and speculative aspects which reflect views as to the likelihood of circumstances arising in which a forced sale of such assets is necessary.

The Role of Money

The special Keynesian argument is not that assets are valuable because they will yield cash in the future either in use or by contract fulfillment or as they are sold, but rather that with perhaps a few exceptions the price of real and non-monetary financial assets are non-decreasing functions of the money supply.[5] That is $dPk/dM > 0$; and it is also assumed that $d^2Pk/dM^2 < 0$.

The special liquidity trap assumption of which much has been made is that circumstances can be such that $\lim_{M\to\infty} P_k < \overset{*}{P}_k$. Once this is associated with the proposition $I = 0$ if $P_I < \overset{*}{P}_I$, $\text{Max } P_I = \overset{*}{P}_k$ and $\overset{*}{P}_k < \overset{*}{P}_I$, then increases in the money supply cannot increase investment. If this assumption is combined with the proposition that money affects income only as it affects investment, then monetary changes are not available as a policy instrument.

A number of reasons can be advanced for the view that the price of real capital is a rising function of the quantity of money.

(1) Money is an asset whose value for settling contracted debts is fixed. All money and all real assets - as well as all inherited financial assets - are in some portfolio (Keynes, 1937). An increase in the quantity of money, other assets fixed, will lead to a rise in the money price of other assets inasmuch as the money price of money is fixed.

(2) Moneyness also characterizes those assets whose contractual cash payments are virtually certain and which have good secondary markets; government debt is such an asset. The greater the proportion of such safe assets available for portfolios, the higher the price of the risky assets - as long as the expected cash flows per dollar of the risky

assets is greater than that of the certain asset.[6]

(3) Furthermore, the greater the amount of money in a representative portfolio the smaller the chance that a decline in receipts will force the representative unit to sell assets for cash. If the price that can be realized by sale tends to be depressed the greater the rate of sales, the greater the amount of money in portfolios the smaller the likelihood that assets will have to be sold to raise cash and therefore the higher their market price.

(4) Even if the sectors holding real capital and having balance sheet payment commitments are not holding reserves of money, the larger the amount of money in existence the easier it will be for such units to raise money by selling assets or additional liabilities. For example, if the money supply is large because banks own a large amount of treasury debt, loan demand by business, even if it arises due to transitory shortfalls of cash from operations, can be more easily satisfied than if the money supply was smaller. Basically, the larger the money supply, the easier it is to make portfolio adjustments that accommodate needs for cash.

(5) Note that a decrease in the rate of increase in the money supply is an immediate signal to units with debts that at some future date "standby", "covering" or "emergency" financing may be harder to arrange and more costly.

The same reasons indicate that if we ignore the role, if any, of excessive increases in the money supply as guaranteeing future inflation, $\frac{dPk}{dM} > 0$ and $\frac{d^2Pk}{dM^2} < 0$.

If we assume that the $P_k = P_k(M)$ function is a useful construct it is necessary to determine what phenomena shift the function and affect its shape.

Underlying this function are the existing stock of real capital and the existing set of financial institution. Accumulation will tend to shift the P_k function downward. We can assume that there exists a balanced growth of the money supply, financial layering, cash flows from financial assets and real capital, labor force and output which would leave the price of a representative unit of capital unchanged as accumulation takes place.

Financial layering influences the price of real capital in two ways. With a given stock of money and real capital, the greater the financial layering the greater the flexibility and reliability of financing: financial layering and sophistication creates both specialized and generalized money substitutes. Financial intermediaries make available secure assets for the portfolios of both ultimate and intermediate units. This allows a greater degree of tailor-making of portfolios to individual attitudes toward uncertainty and to institutional constraints. In addition, the greater the financial layering the larger the number of alternative sources available to finance ultimate positions in real assets. These reasons indicate that the greater the financial layering the higher the price of assets.

However, the greater the financial layering the greater the number of payments both on principal and income account that have to be made: each layer sets up payments to and from financial institutions. With a fixed amount of money this indicates that money will have to turn over

more rapidly transactions velocity and that there will be more portfolios that want a "money buffer" the greater the extent of layering. Furthermore, financial intermediaries are organizations that typically make positions in one set of assets by emitting liabilities or selling other assets. The dangers of market disruption in refinancing markets increases as layering increases. This indicates that the greater the financial layering, the greater the "implicit" yield on money - which tends to lower the price of real assets.

More fundamentally, the $P_k = P_k(M)$ function embodies the preference systems and views as to expected cash flows from operations.

If we take the Friedman-Savage view of the preference system, then for some range of incomes a representative unit is a risk averter and for another range of possible incomes he is a risk seeker. Risk seeking reflects the lure of a bonanza. An option which includes a chance of a very large increase in income will sell at a premium over an option which does not include such a chance even if both have the same expected income. In respect to a bonanza, the distinction between "holding period" and asset life is important. Great fortunes are made by capital gains, not by saving out of income as defined by the National Income Accounts.

Asset prices can rise and fall rapidly when a "market" modifies its views about the cash flows assets can be expected to generate. If a "long-shot" innovation begins to yield substantial and apparently secure quasi-rents, the underlying assets as collected in the innovating firm will be revalued upward sharply. If assets have been valued on a consensus that business cycles are "inevitable" and a new era is proclaimed

(and the proclamation is believed) then the value of real assets will increase. Symmetrically if business cycles reappear after a formal proclamation of their demise, the value of real assets will decrease.

With invariant preference systems, if "bonanzas" appear in goodly numbers and views that business cycles are now "obsolete" become dominant, then the price of a representative unit of real capital will rise: the $P_k = P_k(M)$ function shifts upward. To put the above succinctly, successful functioning of an economy tends to raise the price of units in the stock of capital.

Preference systems are creations of society, not genetic characteristics. The representative aversion to or delight in risk of a population is a result of the population's history. If the population is replete with risk seekers who succeeded, if those who played it safe lost out, then even if there is no change in the expected payoffs, the preferences systems will change so that "risk" assets rise in price relative to "safe" assets. A major element affecting the price of real capital, for a given portfolio structure, are the views as to the likelihood of the need arising to use the asset to raise cash and the costs that may be assessed if this contingency is realized. If fears of illiquidity decrease the value of real assets will rise.

Conversely, the experience of financial difficulty and disorderly markets for financial assets - such mild events as the crunch of 1966 and the liquidity squeeze of 1970 - may lead to a sharp fall in the value of real assets.

For firms, if we consider the debt structures as generating cash payments and the real assets as generating the cash to meet these payments, financial developments during a boom time tend to increase cash payments relative to cash receipts. Even as success breeds preference systems and views as to the future of the economy which lower the weight to emergencies in which assets will have to be sold or pledged under disadvantageous conditions, the objective conditions change so that the likelihood increase that operations will generate insufficient cash to service debts - that cash needs will have to be met by recourse to asset sale or borrowing.

Thus, the price of capital as a function of the money supply shifts. These shifts are not random: success of the economy raises, failure lowers the function. In particular, success can lead to an investment boom and a financial crises or stringency can lead to a stagnation of investment and incomes.

If $P_k = P_k(M)$ is interpreted as the liquidity preference function, then a basic proposition of Keynesian investment theory is that the liquidity preference function shifts.

The Stock Market

An objection to writing $P_k = P_k(M)$ for real capital is that there is no clear market price for used items of many types of capital. One reason for this is that the transaction costs - the cost of searching for a purchaser and of dismantling, transporting and setting up such items - can be so great that it is not feasible to market such items individually.

In the current (1971) taut financial environment, firms under financial pressures or with profit problems are in fact divesting themselves of operating divisions and units. These divestures are a way of selling real capital to raise cash to retire pressing debts. The special property of these transactions is that whereas it is often not feasible to raise cash by selling real assets individually, it often is feasible to do so by selling capital goods collected in operating "bundles".

Often the process by which such divestures take place involves the sale of the "stock" in a wholly or predominantly owned subsidiary. For our purposes, such organization properties - that operating units are often organized as separate corporations - is not significant.

On a regular basis corporations are valued in the stock market. While in general capital goods may not be traded regularly, common stock (shares) are. From the market value of the stock and the balance sheet of the corporation, a valuation can be placed upon the combination of the firm's real capital and the firm's special market and management traits. The stock market therefore provides an index, with considerable noise, of the value of the capital goods as collected in corporations in the economy: the implicit price of capital is a function of the explicit price of common stock modified by the items mentioned earlier (Turvey).

Stock market valuations do enter into various investment functions primarily as an element in the cost of capital, where cost of capital is defined as financing terms. A high price to common stocks is presumed to lower the cost of capital. This increases, in a production function, the desired amount of capital for any output (wages, etc., unchanged).

This is supposed to tend to increase investment. In this formulation, the lower cost of capital by way of stock market valuation may be offset by a higher cost due to other financing terms. Within the models that use stock market valuations as an input in determining the cost of capital, there is no precise way in which the valuation of capital goods can be treated separately from the terms on which debts are available to finance control over the existing stock of capital as well as investment.

Ultimately, the test of whether it is better to use stock market information as a measure of the implicit price being placed upon the economy's stock of real capital or as one element in the determination of financing terms will depend upon how well theories based upon these different formulations do in explaining what happens (Brainard-Tobin, Turvey, Bischoff).

The Supply of Investment

Investment is a part of output. The amount of investment goods produced is decided by investment goods producers. Given the capital stock specialized to the production of investment goods there is a rate of production of investment goods such that a further increase will result in rising costs per unit. Thus there is a rising portion of the supply curve for investment goods. If we assume the investment goods industries are sufficiently competitive this rising supply curve is a summation of marginal cost curves.

In addition there is a horizontal or virtually horizontal portion to the supply curve for investment goods. This "horizontal" portion is at the minimum point of an average cost curve for each producing unit.

This average cost curve contains variable and user costs. Fundamentally Keynesian user costs are the present value of future quasi-rents that will be sacrificed if capital goods are used in current production. Keynesian user costs integrates the costs of utilizing inventories and durable capital equipment. Inventories or durable capital goods will be used only if the present return is at least equal to the present value of foregone expected future returns. The returns to stocks are essentially rents, except that technical conditions can lead to a reservation price.

In Diagram III, the supply curve of investment goods as discussed in the text is illustrated by the curves labeled I. The dotted line labeled I' is the supply curve if user costs were ignored. The effect of a decline in wages can be examined with the aid of Diagram III.

Wages are a parameter of shift in both the I and I' curves. A decline in wages that is assumed to be transitory will shift both curves downward by the same amount. User costs will not decline as long as the future expected rents do not change. Under these circumstances the offer price will have a larger mark up on labor costs after wages fall than before. The higher price of investment goods relative to wages can be presumed to induce a substitution against capital in the choice of production techniques.

On the other hand declining wages may also be taken to signal that a return to the former price level is not to be expected - or at best it will take place at some date so far in the future that it can be ignored. Under these circumstances the quasi-rents that determine current

user costs are either smaller or in the more distant future. This means that user costs will decline. As a result the supply price of investment may fall by a greater percentage than wages.

Thus depending upon how a decline in money wages is interpreted the supply curve of investment may fall by a smaller, larger or equal percentage as wages. It follows that as far as substitution effects are concerned falling wages may be unfavorable, favorable or neutral with respect to inducing investment.

In Diagram III, if investment produced is I_1, we assume that current period quasi-rents are sufficiently large so that the reservation effects of user costs are of minor importance. Current quasi-rents are $(P_1 - P_1')I_1$ and these quasi-rents are presumably sufficient to satisfy the internal funds requirements of a representative firm producing investment goods.

If output is I_1', quasi-rents equal to $(P_1 - P_1')I_1'$ are being earned. If these cash flows are sufficient to meet the pressing needs for cash or if firms earning such smaller cash flows can still receive adequate financing to sustain the reservation rents then P_1 will be maintained. If a large enough number of firms find $(P_1 - P_1')I_1$ insufficient to meet cash commitments, then firms will violate the user cost constraint in an effort to achieve larger cash flows through volume output. (Note that bankruptcy eases cash commitments due liabilities and thus allows user cost to act as a reservation price, bankruptcy restores orderly conditions so beloved of olisopolists).

If the need for cash forces prices to P_1' then the representative firm is not generating positive quasi-rents: sufficient funds are not

being generated internally to meet payment commitments embodied in the liability structure. Under these circumstances illiquidity will be prevalent.

User costs explain why excess capacity is associated with positive cash flows to capital owners even in highly competitive industries. They also help explain why the economy can operate at levels in between boom and zero gross profits to firms. Without the reservation pricing of the services of capital goods the unreliability of cash flows from operations would stand as a barrier to debt financing of durable capital.

Of course the argument with respect to user cost is of general validity: the supply curve for consumption goods looks just like that for investment goods.[7]

Thus there are two parameters of shift for the investment (and consumption) supply function. One parameter is the wage rate. A fall in wages may increase, decrease or not affect the pace of investment, depending upon what happens to user costs.

The second parameter of shift is user cost. A fall in user cost lowers, an increase raises the supply curve. Note that as user costs are present valuations of future returns a rise in interest rates lowers and a fall in interest rates raises user costs. The situation where present cash needs dominate foregone future rents discussed earlier can be interpreted as the reaction when effective interest rates become very high to the affected unit.

On the whole the supply curve of investment goods can be considered to be more "stable" than the $P_k(M)$ function which sets the price of capital goods. The parameters of shift, wage changes and the pressing

needs for cash which dominate normal user costs are the result of prior system functioning. Shifts in the investment supply function tend to be induced. We can approximate system behavior by assuming that the $P_k(M)$ function of Diagram IA shifts with reference to a stable I function.

Note that if the need for cash results in a fall of the supply curve of investment goods from I to I', the need for cash will also tend to increase the weight attached to the forced sale price in valuing real assets. Such as increase in the importance attached to liquidity will lower the P_k function.

Ex-ante and Ex-post Investment: The Flow of Internal Funds

Let us assume that the flow of corporate internal funds, N_c - gross profits after taxes of the Flow of Funds accounts is a close approximation to the relevant concept - is invariant with respect to the pace of investment. Then for any period we have that

$$N_c = \hat{N}_c$$

a constant. This means that internal funds will pay for N_c out of the total investment bill $P_I I$. On a per unit basis the contribution of internal funds to the financing of investment can be designated by the rectangular hyperbola

$$P_I I = \hat{N}_c.$$

Let us assume that P_{I_1} in Diagram IV is the ex-ante demand price for investment goods. This means that given the structure of financing by the owners of the stock of capital, the price per unit of real capital is $P_k = P_{I_1}$. If there were no financing of investment constraints this implies that an investment of I_1 will take place.

The total investment bill will be P_{I_1}. I_1 of which $\hat{N}_c$ will be internal funds. External financing requirements will be $(P_{I_1} - \hat{N}_c/I_1)I_1$. Let us further assume that if I_1' of investment were financed then with $\hat{N}_c/I_1'$ of internal funds per unit of investment the various balance sheet relations for financing the flow would be consistent with the way in which the "stock" is financed. Investment in excess of I_1' implies a greater dependence upon debt for the increment of investment than is true for the stock of capital. The negatively sloped function P_I' indicates how the demand price for investment goods declines as the financing terms become progressively more constraining.

In Diagram IV the equilibrium is achieved with realized investment of I_2, a supply price of investment goods of P_{I_2} with $\hat{N}_c/I_2$ of internal financing per unit of investment put into place. As a result of financing constraints ex-post investment is less than ex-ante investment.

Interrelations Between Financing Investment and the Price of Capital Assets

The equilibrium of Diagram IV is partial even for the investment model. The external financing terms for investment are the prices at which various liabilities with specified cash flow attributes can be sold by the investing units. These financing terms can be such that increments to real capital assets are valued as the stock of capital assets. This means that I_1 of investment in Diagram IV will take place. Alternatively the financing terms may be such that beyond some rate further increments to capital are valued at less than units in the stock. If this is true the demand for investment goods will be negatively sloped. The P_I' curve of Diagram IV reflects such an effective financing constraint.

At any moment of time the stock of private real capital is owned by some units. These asset positions are financed by liabilities. For equivalent contract terms such as maturity and collateral clauses, the liabilities of a unit which finances its ownership of the stock of capital and those liabilities which finances purchases from the flow of investment output must sell at equivalent prices.[8] Thus a constraining change in financing terms, as illustrated by the curve P_I', will feedback and affect either the price of the stock of capital or the price of the stock of outstanding debts of the firm under examination.

Over time as debts financing ownership of the stock must conform to the terms ruling in the market for financial instruments the effect will be upon the price of capital P_k. Initially however the losses may accrue mainly to the owners of the inherited stock of private liabilities.

For purposes of our discussion the liability structure of units holding the real stock of capital can be broken into three parts: equity, bank debt and other debt. For the existing stock of capital the value of equity is the value of the capital goods minus bank and other debt. The stock market valuation is the only way in which the equity investment in a firm can be measured.

The financing techniques for investment are internal funds - gross profits after taxes net of dividends - and external funds. The external funds are divided into bank and other external financing. The other external financing consists of new equity issues and net other debt financing. By adding new equity financing and internal funds a breakdown of corporate financing of investment into equity, bank debt and other debt financing is possible.

The class other debt is heterogeneous containing many different types of liabilities. However, the technique of considering all debts as setting up cash flow commitments should enable us to deal with this heterogeneous class.

For every pace of investment there exists at least one way in which the investment can be financed so that no change will occur in the financing conditions for holding the stock of real capital. Presumably if investment flow and stock holdings are financed in the same way then no changes in the financing condition of the stock be induced by the need to finance the flow. If we assume that the money stock is related to bank financing of positions in the stock of capital, if internal funds are the only way in which equity financing can occur, then we have that

$$\frac{I}{K} = \frac{\Delta M}{M} = \frac{N_c}{E} = \frac{\Delta \text{other debt}}{\text{other debt}}.$$

That is if K, M, E and other debt all grow at the same rate then there will be no changes in the terms upon which positions in the stock of assets will be financed as a result of the investment process.

Note that if $I/K \neq \Delta Y/Y$ then the neutral rate of growth of the money supply with respect to income, $\Delta M/M = \Delta Y/Y$, is not equal to the neutral rate of growth of the money supply with respect to financing investment $\Delta M/M = I/K$.

Furthermore if there is a third component to balance sheets which consists of outside government debts then financing neutrality will require that $\Delta G/G = \Delta M/M = I/K$, i.e. the government deficit must be such that government debt grows at the same rate as capital.

The concept of monetary neutrality becomes amorphous and vague as the domain of relevant observations is expanded. For example the evolution of the financial structure involves a substitution of other financial assets for money and for direct liabilities in portfolios. Some concept of evolutionary neutrality is needed once such observations are recognized (Minsky, 1957, QJE).

Presumably no change will occur in the price of liabilities relative to the price of real capital if the cash flow commitments by the incremental liabilities are to the cash flow expectations from the incremental capital as the cash flow commitments for the stock of liabilities are to the cash flow expectations from the stock of capital. The negatively sloped portion of the demand for investment function reflects a need to pledge increasing portions of the expected cash flows in order to finance the acquisition of capital goods.

If financial growth is not balanced - if for example $\Delta M/M < N_c/\text{equity} < I/K$ - then there will be a feedback from the financing terms for investment to the financing terms for items in the stock of capital. These will in turn imply changes in the price of items in the stock of capital.

If for instance financing terms for investment are such that $P_I < P_K$, then the feedback from investment financing to the price of capital will operate so as to decrease the gap between them; if initially $P_K - P_I > 0$ then the financial feedback will induce $\dot{P}_K < 0$.

Underlying the prices of the items in the stock of capital goods are the evaluations of uncertainty with respect to the cash flows that operations are expected to generate and the terms upon which positions

in assets can be sold out or refinanced as well as subjective attitudes towards risk. A run of success by the economy changes both the views as to what is likely to occur and the relative aversion-attraction of risk in preference systems. These phenomena will lead to upward shifts in the $P_K(M)$ function of Diagram IA. Such a shift implies increases in the market valuation of common stock. The increment in the value of capital due to such unrealized capital gains is reflected as an increase in the (implicit) equity financing of positions, i.e. the equity to value of capital ratio increases. It follows that for owners of the underlying stock of capital who are simultaneously investors there exists the possibility of hypothecating the stock to finance investment.

In terms of Diagram IV a rise in P_K implies a rise in P_I and an increase in the ex-ante pace of investment. With the increase in the owners equity in the existing stock of capital, the ability of the unit to debt finance investment is improved. Capital gains due to upward shifts in the $P_K(M)$ function tend to make the ability to finance investment elastic at terms equivalent to those at which the stock of investment is held. The negatively sloped portion of the investment demand curve - which was due to financing constraints - tend to evaporate. That is the "increased" protection involved in the larger equity financing of the now revalued stock induces lenders to sustain favorable terms for financing investment.

This latter phenomena - that supply conforms to the demand for financing during an investment boom - is often the result of evolution and change in the financial system. It is evident that the financial

system during a period such as the 1960's in the United States changed rapidly, tended to facilitate the financing of investment and invented new or modified old ways in which positions in the stock can be financed. In terms of the IM diagram of conventional theory, the historic liquidity preference function for a given supply of money is a step function with infinitely elastic segments. These segments represent periods in which a financial innovation such as CD's, commercial paper use by non financial corporations etc. are working their way through the market (Minsky, 1957, 1970).

In terms of conventional quantity theory language a IM curve such as is illustrated in Diagram V indicates that velocity conforms to business cycles. But this is the result of increased financial intermediation. The layering process implies that aggregate payment commitments on financial account increase relative to the underlying income related payment receipts. This means that financial organizations which make position by dealing in assets grow relative to the rest of the economy. Although financial innovation and its associated velocity increases are part of the way in which good times are financed, the very growth of financial intermediation increases the likelihood that a financial feedback will occur that lowers the $P_K(M)$ function by increasing the weight attached to the value of real assets as a source of cash by sale or hypothecation.

In a boom the rise in common stock prices implies a decrease in the ratio of debt to the market value of real capital. This implies that a high debt to internal funds ratio for investment will be acceptable to both bankers and investors as it tends to offset the effects of the

capital gains. A willingness to debt finance investment during booms is evidenced by increases in dividends, not only absolutely but as a ratio of gross profits after taxes, by firms that are engaged in debt-financed investment programs. This is so because a stock market boom lowers the ratio of debt to the market valuation of the firm. If firms have views as to acceptable debt ratios, such an improvement means that increments to capital can be more heavily debt financed.[9]

A prolonged or extended period of good times also changes views as to the cash flows that can be expected from operations. A belief that these cash flows are both larger and more stable than hitherto expected will lead to a willingness to hypothecate a larger share of the expected cash flows.

Thus in terms of what investing units are willing to do, what financing units are willing to accept and the layering of financial commitments an extended period of prosperity culminating in an investment boom generates a financial structure in which the "making of position" by the sale of assets or the creation of additional liabilities becomes increasingly prevalent. In this increasingly active financial environment a triggering event which leads to the sale of assets in a thin market can lead to a sharp increase in the view that real assets may have to be used to raise cash by sale or hypothecation.

This change in subjective probabilities leads to a sharp fall in the $P_K(M)$ function. In Diagram VI the effect of a revaluation downward of asset prices is illustrated. With the configuration of the $\overset{*}{P}_K$ and the I curves no increase in the money supply will increase investment. This configuration illustrates the liquidity trap.

The problem of financial crisis - whether of the magnitude of the great debt-deflation process of 1929-33 or of the minor scale of the crunch of 1966 or the liquidity squeeze of 1970 - is that they occur. Historically - prior to World War II - financial crises were the identifying phenomena of the great depressions of history. These great depressions were associated with stagnation of enterprise, of investment. The debt-deflation process once triggered was easy to describe: Irving Fisher did it admirably. But for Fisher and Keynes the initiation of a debt-deflation was basically unexplained.

The model sketched here makes a debt-deflation process up to the triggering event an endogenous phenomena not in any deterministic sense but in the sense of creating an environment in which the likelihood of such an event taking place increases.

With modern Central Banking and large scale central governments the course of events following a triggering event can and does diverge from the cumulative debt-deflation process. Instead of plunging into a great depression the economy retreats from a boom. Nevertheless following the triggering event for many sectors the desired liability structure will include less debt than the actual liability structure. Even in the absence of a cumulative process there exists the possibility that after a protracted boom and a financial trauma the inherited financial structure will act as a prolonged constraint upon investment.

Whereas in the past the business cycle of experience may have been characterized by boom and bust, currently the business cycle may be characterized by boom and high level stagnation.

Concluding Remarks

The model sketched here makes the debt-deflation process through the triggering event an endogenous phenomena. It is the ever increasing financial layering of a boom that makes the need to raise cash by the sale of assets more likely to occur. Once this takes place the failure of the asset market to be broad, deep or resiliant will lead to a revaluation of asset prices. In this revaluation a much greater weight is placed upon liquidity attributes than hitherto. It is by way of the financial attributes of a decentralized capitalist economy that we can develop a theory of investment that fits into an investment theory of the business cycle.

In the United States there are two popular competing models - the monetarist and the income expenditure - which have been vying for the favor of our recent Princes and which have been used as the theoretical basis for forecasting models. These forecasting models have been conspicuously in error in recent years. On the basis of the failure of forecasting efforts, the validity of the underlying theoretical model can be questioned.

The monetarist and the income-expenditure models are similar in they tend to ignore the complex financial interrelations of the economy. The construction of an empirical model of investment consistent with the theoretical formulation advanced here would emphasize liability structures and the demand, dated and contingent cash flows they entail. A first approximation to a data base for such a model exists in the sectoral balance sheets of the Flow of Funds accounts. An integration of this

data with interest rate and term to maturity data in order to generate estimates of cash flow commitments that are more accurate than a mere detailing of liabilities outstanding is required.

The key significance of the contingent need to raise cash by selling assets implies that attention should be paid to the structure of financial assets of the corporate sector. If assets with good, smoothly operating secondary markets become relatively scarce in portfolios, then a need to raise cash will be more likely to entail an attempt to sell or pledge assets with this markets. Sharp price declines - and even episodes of markets not functioning can result. Thus the ratio of "good" or "protected market" assets to the current cash flow requirements due to debts becomes a key indicator of the likelihood that asset prices will decline. Data on this attribute of the economy are available in the flow of funds accounts.

Thus measures of the cash flow from operations available to service debt will generate one aspect of the financial picture. Another aspect is generated when internal funds (cash flow from operations after debt services) are related to investment, either anticipated or realized. The technique of financing investment - whether the ratio of investment to internal funds is high or low - is a key indicator of the stability of investment. Fundamentally it is postulated that a high and increasing ratio of debt financing to investment cannot be sustained.

It seems likely that an equal rate of growth of internal funds and investment cannot be permanently sustained. If sustained for awhile, the temptation to experiment with balance sheets increases, leading to greater rate of increase of investment than internal funds.

A strong stock market is a signal for a higher ratio of debt financing to internal funds in investment. However, with the long lag of investment delivery behind the initiating of investment, a stock market boom may result in an investment backlog. As a result a long lag between a stock market decline and a decline in investment may exist. That is if we use stock market data as the proxy for the implicit price of capital there may be long and variable lags - depending upon the gestation periods of the investment involved - between stock market changes and investment changes.

Fundamentally in a Keynesian model of investment speculative elements are as vital as production function attributes in determining the pace of investment. The $P_k = P_k(M)$ function embodies the speculative elements of the investment process. Current neo-classical based aggregate investment theories ignore speculative phenomena. As a result the dominant academic theory of investment has but little relevance to an economy such as the United States economy of the 1970's.

DIAGRAM I

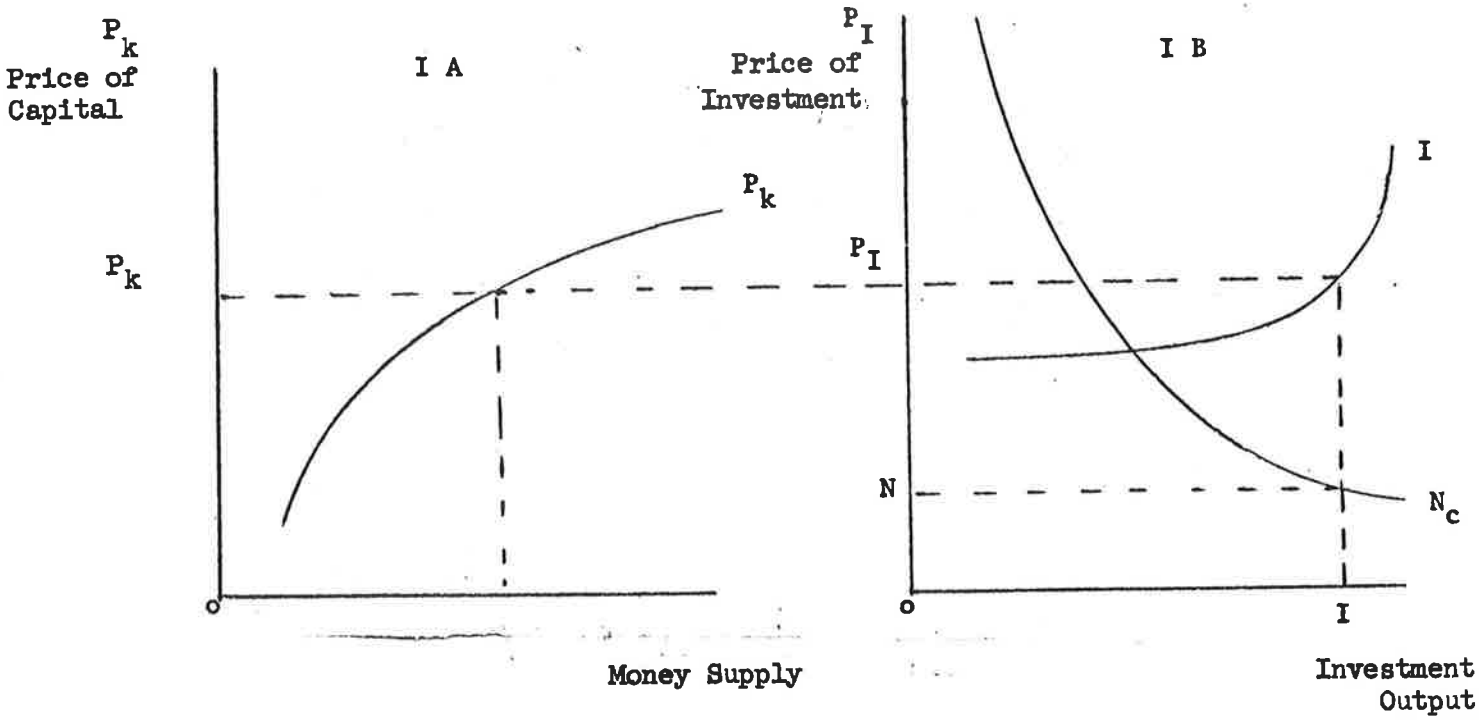
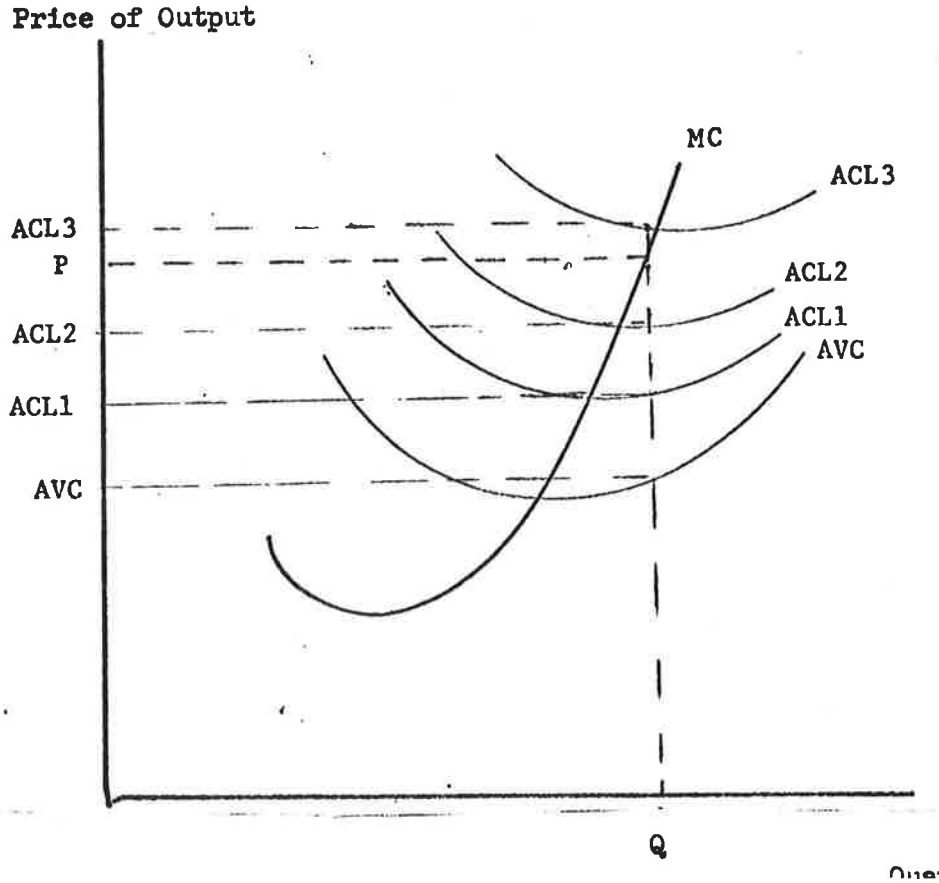


DIAGRAM II



Price of Investment

DIAGRAM III

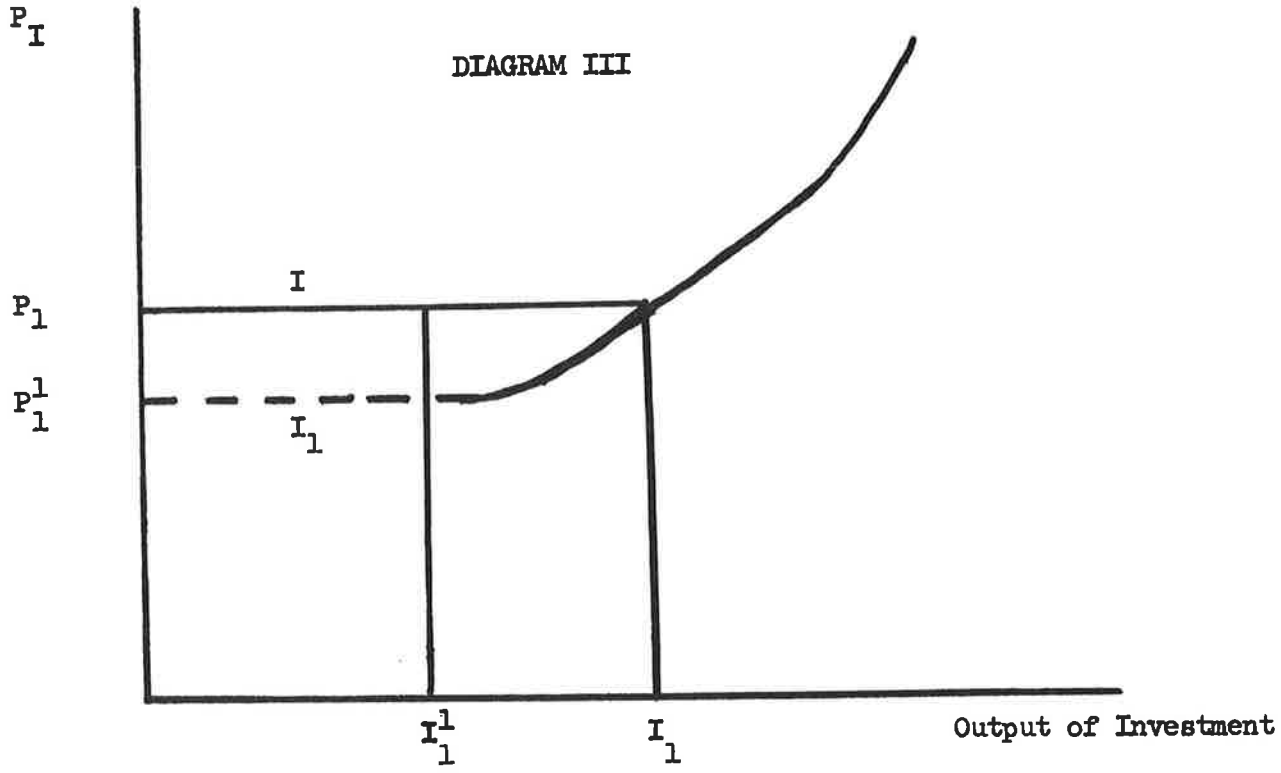


DIAGRAM IV

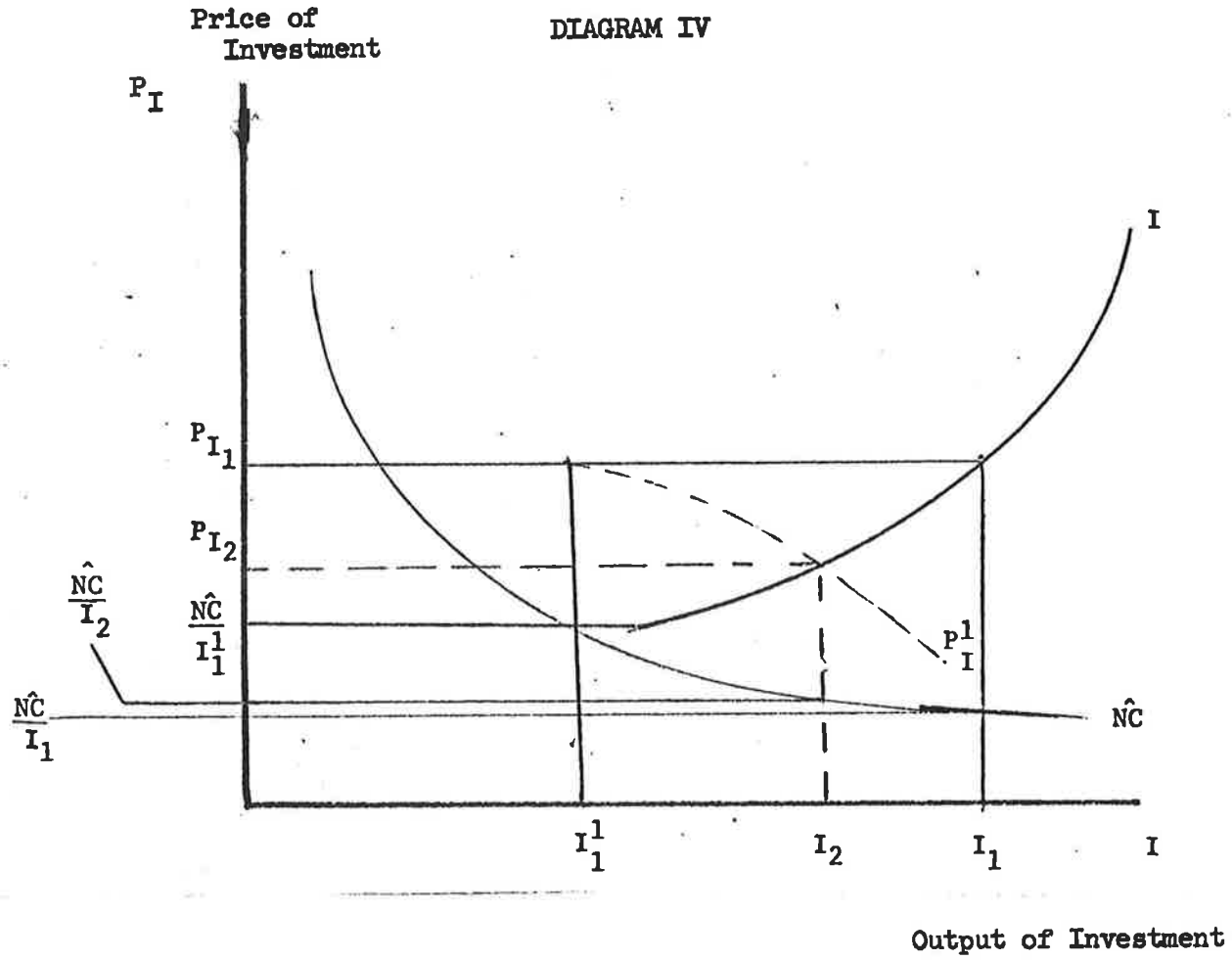


DIAGRAM V

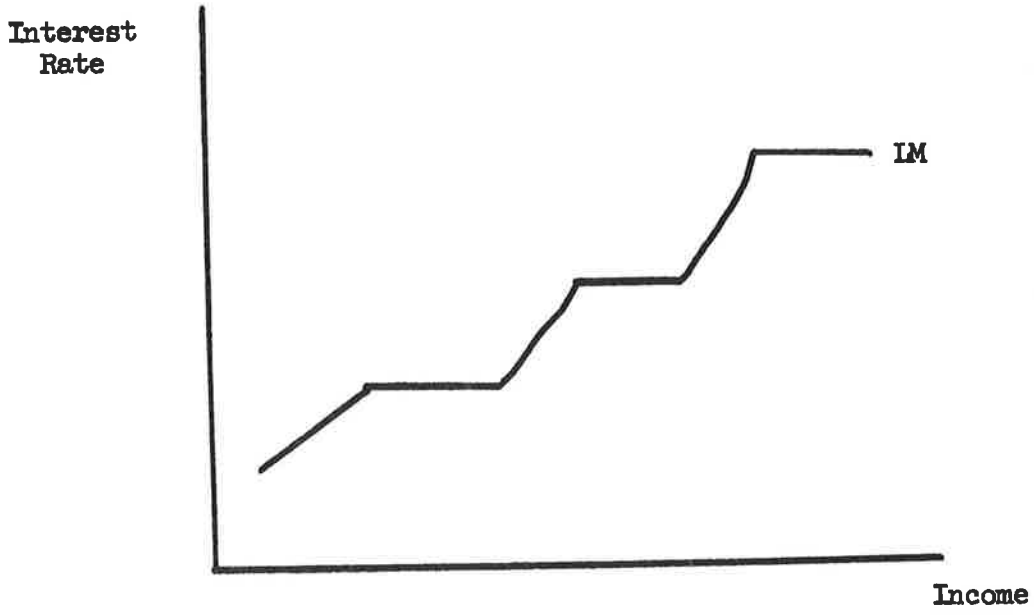
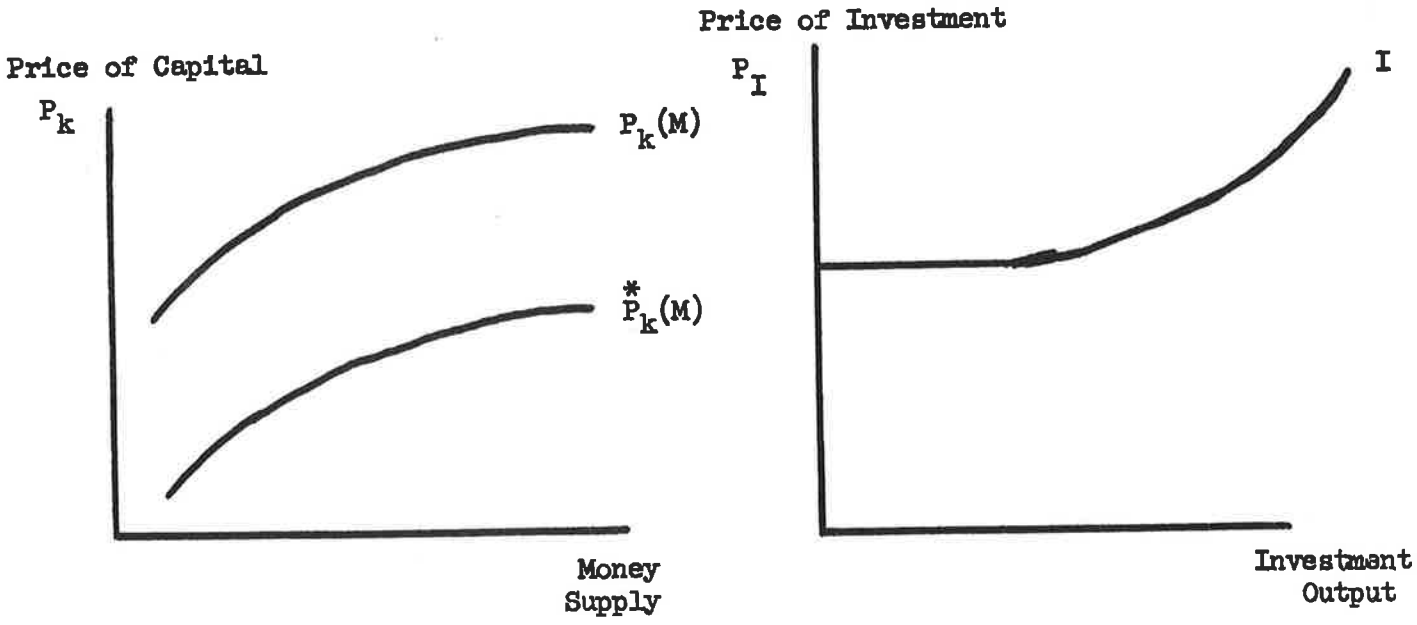


DIAGRAM VI



FOOTNOTES

[1]There is no precise reference to the F.R.B.-M.I.T. model. However, Bischoff has given a straight forward exposition of the F.R.B.-M.I.T.'s investment model, which stands as a basically flexible accelerator - the accelerator adjusting to relative prices of factor inputs.

[2]Prof. J. Robinson in the Preface to the second edition of her "Introduction to the Theory of Employment" argues that Keynes' analysis "... attributed too much importance to the rate of interest as a regulation of the economy" (p. xii). Keynes' restatement of his views in his rebuttal to Viner in 1937 is, I believe, not subject to Prof. Robinson's criticism.

[3]In his Ph. D. research at Washington University (St. Louis), L. Ederington has shown that the yield and dealer spreads are system determined variables. The variation in these spreads is the way market pressures from the financing of investment are transmitted by way of the financing of positions in the stock of capital to the perhaps implicit price of capital assets.

[4]The standard balance sheet by ignoring longer term rental contracts by business understates payment commitments. A restructuring of financial data in terms of payments and receipts is needed.

[5]A chain of substitution among assets is possible so that with a money supply of M_o a financial asset, L_i, is used as if it were money, but with a money supply $M_1 > M_o$, L_i is no longer used in this way. For such an "inferior" money substitute it is possible that $P_{L_i}(M_1) < P_{L_i}(M_o)$.

[6]It is necessary to distinguish between the "stock" and the "flow" impact of government debt - where "government debt" includes not only the statutory debt but also all interest bearing debt which is effectively guaranteed against default by government endorsement - implicit or explicit.

For given stocks of money, private debt and real capital and a given set of expectations about the behavior of the economy the greater the stock of government debt the higher the price of the stock of real capital and private debt. On the other hand, with given stocks of money, government debt, private debt and real capital, a given (exogenously determined rate of growth of the money supply, and a given income level, the greater the rate of increase of the government debt the lower the price (the higher the conventionally measured interest rate) on new issues of private debt and on new investment output. That is as a stock government debt is a complement to real capital and private debt, as a flow they are substitutes.. This ambiguity in the relationship causes a considerable amount of confusion in the analysis of financial markets.

[7]Keynesian user cost is not a planning cost of capital concept - the planned for quasi-rents are larger than the reservation price which enters users cost. For example, if by producing now a firm sacrifices a quasi-rent of 100 sometime in the future, the current user cost is the discounted value of the future expected quasi-rent and this can be smaller than the "planning" rate used in determining factor proportions. This view differs from that of Jorgenson and is somewhat like that of Tobin.

[8]Because of the yield spread, new issues are sold at a discount as compared to outstanding issues, however, if they are priced correctly, there is an immediate rise in the price of the new issue. Observed market yields on seasoned issues are not the cost of funds to units selling new issues and the difference between the two (market yield and cost to borrowers) is not constant over time (Ederington).

[9]If existing management is unwilling to increase debt financing of investment, then mergers, take-over-bids, etc. - which are debt financial - will take place so as to "redeploy" financial assets.

REFERENCES

Ackley, G., Macroeconomic Theory, New York, 1961.

Arrow, K. J., Essays in the Theory of Risk-Bearing, Chicago, 1971.

Bischoff, C. W.,"Business Investment in the 1970's: A Comparison of Models", Brookings Paper on Economic Activity I: 1971.

Board of Governors, Federal Reserve System, Flow of Funds Accounts.

Brainard, W. C. and Tobin, J., "Pitfalls in Financial Model Building", A.E.R., May 1968, pp. 99-122.

Clower, R., "An Investigation into the Dynamics of Investment", A.E.R., March 1954, pp. 64-68.

Duesenberry, James S., Business Cycles and Economic Growth, New York, 1958.

Ederington, L., Unpublished Ph. D. research, Washington University (St. Louis).

Fisher, I., "The Debt-Deflation Theory of Great Depressions", Econometrica, October, 1933.

Foley and Sidvauski, "Portfolio Choice Investment and Growth", A.E.R. March, 1970.

Friedman, M. and Savage, L. J., "The Utility Analysis of Choices Involving Risk", J.P.E., August, 1948, pp. 279-304.

Haavelmo, T., A Study in the Theory of Investment, Chicago, 1960.

Hicks, J. R., "Mr. Keynes and the Classics: A Suggested Interpretation", Econometrica, April, 1937.

Hicks, J. R., A Contribution to the Theory of the Trade Cycle (1950).

Jorgenson, D. W., "Capital Theory and Investment Behavior", A.E.R. May, 1963.

Jorgenson, D. W., "The Theory of Investment Behavior" in R. Ferber (ed.) Determinants of Investment Behavior, New York, NBER, 1967, pp. 129-155.

Keynes, J. M., "The General Theory of Employment," Q.J.E., February, 1957.

Keynes, J. M., The General Theory of Employment, Interest and Money, New York, 1936.

Leijonhufvud, A., On Keynesian Economics and the Economics of Keynes, New York, 1968.

Lerner, A. P., The Economics of Control.

Minsky, H. P., "Central Banking and Money Market Changes", Q.J.E., May, 1957.

Minsky, H. P., "Monetary Systems and Acceleration Models", A.E.R., December, 1957.

Minsky, H. P., Financial Instability Revisited, Board of Governors, Federal Reserve System, Washington, D. C. (1970).

Robinson, J., Introduction to the Theory of Employment, 2nd edition, London, 1969.

Tobin, J.,"Comment", A.E.R., May, 1963.

Turvey, R., Interest Rates and Asset Prices, London, 1960.

Viner, J., "Mr. Keynes on the Causes of Unemployment", Q.J.E., November, 1936.

Witte, J. G., "The Microfoundations of the Social Investment Function", J.P.E., October, 1963, pp. 441-456.