The Impact of Monetary Volatility on Investment in Classical and Keynesian Models: Theory and Evidence

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ABSTRACT

In the past several decades, monetary policy has gained increased popularity as a means for affecting the direction of the economy. For example, in the early 1980's the Federal Reserve's active intervention in the economy squeezed out the double-digit inflation; however, it also reduced Investment and produced a recession.

Traditional Classical and Keynesian theories of Investment describe different factors which influence firms' investment decisions. These models do not account for the influence of monetary policy, beyond the direct effects of money supply shifts on interest rates.

This paper describes a model for both theories which explains the indirect influence of monetary policy on Investment through its impact on uncertainty. When the central bank pursues an active monetary policy, it generates uncertainty about future interest rates and price levels, which indirectly depresses Investment, regardless of the direction of the policy.

Data from 1967 on are used to examine the impact of monetary volatility. This period reflects increased monetary volatility due to external shocks and increasing activism on the part of the Federal Reserve. Both Investment theories are modelled to include the impact of monetary volatility, measured by percentage changes in M2. The regression results suggest that monetary volatility has a significant negative impact on Investment.

CONTENTS

Chapter 1. Introduction and Statement of the Problem

Since the 1970's, the Federal Reserve has taken on an increased role in influencing the direction of the economy. Some economists regard monetary policy as a useful tool for controlling inflation or stimulating weak demand. The Federal Reserve has only recently taken on this role. When it was created, the Federal Reserve was intended to simply offset seasonal fluctuations in the money supply, and serve as a clearing house for local banks. In the late 1960's and early 1970's, with pressures building due to the prolonged cost of the war in Vietnam, the United States sat on the brink of an inflationary explosion. The spark came from the first OPEC oil embargo. Inflation took off, as soaring gasoline prices pulled the rest of the economy away from the price stability that had prevailed since the second World War.[1]

The strong inflation uprooted interest rates, which had been fixed by law. As interest rates and prices ran rampant, the Federal Reserve decided to shift from its traditional policy of stabilizing interest rates to a new policy of controlling inflation. This shift in priorities changed the fundamental nature of Federal Reserve policy. Suddenly, the Federal Reserve was viewed as an important player in controlling the fate of the economy, rather than as a simple central bank.

As the economy continued to overheat in the first years of the 1980's, the Federal

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[1] From 1960 through 1967, inflation averaged 2.10%; from 1968-1973, 5.50%; and from 1974-1982, 8.14%.

Reserve made a concerted effort to halt price increases by strictly limiting the growth of the money supply. This move reined in the runaway prices, but as the Federal Reserve hit the monetary breaks, the economy slid into a short recession. In 1982, real GNP fell by $82.8 billion, a 2.5% decline. During that year, government expenditures rose $12 billion, and consumption actually increased by $26.5 billion. Net exports only fell $23.1 billion. This leaves almost $100 billion of contraction unaccounted for.

The economic decline resulted from a serious drop in Investment expenditures. Investment fell by $98.2 billion, an 18% decline. The recession was largely the result of this serious drop in Investment spending. Investment decreases are associated with most recessions, both as a proximate cause and as a result. Investment deterioration was clearly the proximate cause in this recession, but Federal Reserve Chairman Paul Volcker's tight monetary policy generally receives the blame. If active monetary policy is accused of producing the recession, and decreased Investment spending directly caused the recession, then active monetary policy must have caused the decrease in investment.

This explanation certainly oversimplifies a complex event in the economy. There were many variables at work influencing the decline in Investment and GNP. However, the most important activity taking place that year on an economic level was clearly the tightening of the money supply to break inflationary pressure.

In this paper, I will examine the link between active monetary policy and investment. The traditional Classical and Keynesian theories of Investment are outlined in Chapter Two. Chapter Three expands the traditional theories of Investment by describing a potential source of investor uncertainty: monetary volatility. When the Federal Reserve shifts monetary aggregates in order to stimulate the economy or control inflation, they alter expectations about future prices and interest rates. Major shifts produce a climate of uncertainty: as the Federal Reserve demonstrates a willingness to shift monetary aggregates, managers will be less confident of their expectations.

Chapter Four describes the data and methodology used to test the Classical and Keynesian theories of investment, after they are adjusted to account explicitly for monetary volatility. Chapter Five presents the results of the regressions used to test the hypothesized link between monetary volatility and Investment. Chapter Six provides an interpretation of the results, and addresses the utility of expanding Investment models to account for monetary volatility as described in Chapter Three.

Chapter 2. Theoretical Models of Investment

Investment expenditures do not constitute the largest portion of our economy in an absolute sense, but they have a tremendous amount of relative importance. Two factors account for this importance. First, Investment expenditures play an important part in the economy today, in terms of increasing aggregate demand. Second, they affect the economy in the future, because Investment expenditures increase future productivity, increasing aggregate supply. Therefore, understanding Investment behavior will provide insight into a critical component of our current and future economic health.

Investment expenditures exhibit the most volatility of any component of GNP. Examine **Table 2.1**. Consumption remains fairly stable over time, shifting slowly and often predictably. Political forces set government expenditures exogenously, and the dominant trend is for expenditures to increase. At any rate, government expenditure changes can be easily predicted, because they occur after lengthy, highly visible debate. Exports and imports may vary considerably with exchange rate changes, but generally they form a smaller portion of our economy than Investment.

Table 2.1 Macroeconomic Data*

Year	Real GNP	I	Change in I	C	G
1979	3192.4	575.2	-1.7 (-0.3%)	2004.4	609.1
1980	3187.1	509.3	-65.9 (-11.5%)	2000.4	620.5
1981	3248.8	545.5	36.2 (7.1%)	2024.2	629.7
1982	3166.0	447.3	-98.2 (-18.0%)	2050.7	641.7
1983	3279.1	504.0	-56.7 (-12.7%)	2146.0	649.0
1984	3501.4	658.4	154.4 (30.6%)	2249.3	677.7
1985	3618.7	637.0	-21.4 (-3.3%)	2354.8	731.2
1986	3717.9	639.6	2.6 (0.4%)	2446.4	761.6
1987	3845.3	669.0	29.4 (4.6%)	2515.8	779.1
1988	4016.9	705.7	36.7 (5.5%)	2606.5	780.5
1989	4117.7	716.9	9.2 (1.3%)	2656.8	798.1
1990	4156.3	689.6	-27.3 (-3.8%)	2682.4	820.5

* figures are billions of 1982$

On the other hand, Investment moves around considerably, making it difficult to predict in the aggregate. During the 1980's, Investment levels varied year-to-year from -18 to

30 percent. Consumption and government expenditure continued to rise at a moderate level over the same period, never varying more or less than five percent. Fluctuations in Investment account for most of the short-term growth or decline of GNP.

In addition to shifting aggregate demand in the short term, Investment plays an important long-term role in the economy. Over time, Investment activity increases the productivity of firms, and expands the production possibility frontier. Investment drives long-term economic growth.

Understanding Investment will allow for a better understanding of the economy. Unfortunately the traditional theories of Investment do not offer sophisticated enough analysis. The Classical theory describes Investment in the loanable funds market, as a function of the interest rate. The Keynesian theory of Investment accounts for the role of uncertainty in measuring profit expectations. Mr. Keynes talks about uncertainty without specifying what causes it. He talked of the "animal passions" and the herd instinct which lead to Investment in spite of uncertainty, but he did not test this hypothesis, nor did he identify the sources of uncertainty. Neither the Classical nor the Keynesian theories of Investment account for the influence of monetary volatility.

2.1 Basic Framework of Investment Theory

A. Profit Maximization and Investment.

Investment theory fundamentally presumes that firms allocate resources for plant and equipment in order to increase their profits. This absolute rule governs all analysis of Investment. Firms will purchase new plant and equipment when they believe that doing so will produce future revenues that exceed the initial cost of the capital. Factors which increase the expected return on capital will increase firms' incentive to invest, and factors which reduce the expected return on capital will reduce firms' incentive to invest. These broad considerations will shape both the Classical and Keynesian theories of investment.

On a microeconomic level, firms seek to maximize their profits. Investment can increase profits for a firm by increasing productivity and reducing costs. If the revenues received from the use of capital exceed the supply price for that capital, then the capital yields prospective profit. The ratio of excess revenues received from the use of a capital good to its supply price gives the rate of return for the capital good. This rate of return is the marginal efficiency of the capital good.

B. Marginal Efficiency of Capital.

The rate of return on a capital good should be understood as its marginal benefit. When firms decide to invest, they decide to make an addition to their capital stock. The return on their investment comes from the increased revenues produced by the addition of more capital to the firm's capital stock, so investment offers a marginal increase in revenues, and potentially, marginal profit.

The marginal return associated with the purchase of a capital good is not a one-time return. The return on the purchase of a capital good reflects the increased revenues the firm will realize from the use of the additional capital, over its lifetime. Therefore, the return on the capital good reflects the marginal increase in revenues over a period of time extending into the future.

C. Rate of Return and Discounting.

The return on the purchase of a capital good can be thought of as a stream of future income. This stream of future income must be assigned some present value. The stream of profits realized by a firm over the life of the capital good must be discounted because the value of a dollar received in the future is less than the value of a dollar held today. The concept of a discount rate explains the ability of firms to translate expected future profits into present value, allowing them to compare the expected profits in the future to the supply price of a capital good in the present, in order to decide whether or not to pursue a particular investment project. Firms will only pursue projects when the present value of expected future returns exceeds the supply price of the capital good, including the cost of financing the good as well as the list price.

The value of a sum of money held today appreciates in the future, because the money could be loaned at interest. Assume that a firm has \$1000 today. If the interest rate is five percent, then that \$1000 will be worth \$1050 next year, and \$1102.50 the year after that, assuming the interest rate stays the same. This process is known as compounding. Discounting means simply reversing the process. If you assume that the firm will receive \$1000 two years from now if it buys a bond today, then the firm will only be willing to pay less than $1000 in order to collect some return (interest). The $1000 two years from now is worth about $907.00 today if the firm expects a five percent return on their money.

It must be understood that future profits have to be discounted to ascertain their present value for making investment decisions. A firm that expects a one-time profit of $1000 two years from now from the use of an additional unit of capital would not be willing to pay more than $907.00 today for that capital good.

The discount equation is:

$$V_p = \frac{r_1}{(1+i)} + \frac{r_2}{(1+i)^2} + \frac{r_3}{(1+i)^3} + \cdots + \frac{r_n}{(1+i)^n} \tag{2.1}$$

where V_p is the present value, r is the expected return, i is the rate of interest or the supply price of capital, and n is the number of years over which the firm expects to receive a return.

When using the discount equation, the firm can assign a value to r, which represents the marginal return the firm expects each year as a result of using the additional unit of capital. This expected return will account for the managers' expectations about future demand for their product, the future price of the product, and other general conditions of the market in the future. When the present value of the marginal returns exceeds the cost of acquiring the new capital (i), the firm will make the investment.

The firm must decide what value to assign to r. This number will, like expected returns, reflect the firm's perception of the future. If the firm has confidence in its information and the forecasted profits, then the firm will assign a lower discount rate, and the profits will have a relatively high present value. If the firm lacks confidence in its information and forecasts, then it will assign a higher discount rate, in order to hedge against poor information. A higher discount rate produces a lower present value for the same expected profits. Small changes in the discount rate can drastically change the present value of expected returns, particularly for longer-term equations. The implication is that when firms have confidence in their forecasts, they will expect better returns for a project than if they lack confidence. Changing the discount rate on expected profits may change a firm's decision to invest.

D. Expectations and Uncertainty.

Mr. Keynes added a particularly important point to this construction. Firms base investment decisions upon expectations about the future. They base these expectations upon guesswork about the future of various relevant variables. Varying levels of uncertainty plague this guesswork. Firms can only know for certain the present supply price of a capital good. The rate of return on the capital good is an expected rate of return, based upon expectations about future market conditions: future prices, demand for the firm's product, input costs, cyclical conditions, and other important variables, such as government policies. Information on these variables will be based upon forecasts of the future, so managers must use very poor information in their decisionmaking, counting upon speculation, not fact.

Managers have no way of knowing the future values for these variables, so they must forecast them. The forecasts generally come from conditions at the present, the activity of other firms, the public mood, and visceral guesses. When managers have confidence, they will be more willing to act on their expectations; when they lack confidence, they will cut back. The inherent uncertainty involved in investment decisionmaking produces the tremendous volatility of aggregate Investment, and much of the volatility in the economy.

This paper will focus on factors influencing investment. Factors which influence investment decisions will either influence a manager's expectations, his uncertainty, or the supply price of capital. Expectations are projected values for future variables. Uncertainty is the condition of doubting the possibility of predicting the future with any accuracy; it deals with a lack of confidence in the expectations generated. A fundamental underlying assumption in this paper is that factors which influence the uncertainty of managers have just as much impact on investment decisions as factors which influence their expectations. Factors which increase uncertainty will decrease investment; factors which reduce uncertainty will encourage investment.

In summary, Investment requires firms to estimate future profits from a capital project, and then discount them to determine the price they will pay for capital goods. Discounting matters a great deal, because it relates to the interest rate firms will be willing to pay to borrow funds in order to finance capital projects.

2.2 Classical Theory of Investment

A. Assumptions.

In order to understand the Classical theory of investment, certain microeconomic principles which govern behavior in Classical theory must be kept in mind. Firms make investment and production decisions. Firms aim primarily at maximizing profits. They will always try to equalize marginal costs and marginal benefits when making decisions. Individuals seek to maximize their utility. When they make decisions, individuals strive to increase their happiness, now and in the future.

The interaction between economic players takes place in markets. Markets govern every economic relation, from labor and other inputs, to the trade of goods and services. Supply and demand interact to produce an equilibrium. In the macroeconomy, aggregate supply and aggregate demand produce an equilibrium level for prices and output, at full employment. Whenever external shocks shift the aggregate supply or demand, the price and output will adjust to the new equilibrium point, returning to full employment.

B. Say's Law and Money: Savings, Investment, and Interest.

According to Say's law, supply creates its own demand. In order for products to be produced, inputs have to be purchased; the purchase of inputs creates the demand for the products. Nothing will be produced without some demand, and what is demanded will be supplied. This model works well until the introduction of money.

The introduction of money complicates this simple conception, because when people have money they may hoard or save it. This causes a problem, because the removal of resources from the demand side causes a surplus of goods to be produced. The Classical model addresses this potential discrepancy with the Classical Theory of Interest, which defines the Classical Investment model. Remember that this is not the Classical theory of Investment, it is the Classical theory of Interest. Investment does not stand alone, it interacts with Savings. The interaction of Savings and intended Investment determines the interest rate and the resulting levels of actual Savings and Investment.

C. The Classical Theory of Interest.

The Classical Theory of Interest provides that Savings and Investment are both functions of the interest rate. People may save, but in order to save, they must forego some amount of present consumption. Because people maximize utility, they will only forego present consumption (utility) if they will receive some compensation, that is, an increase in future consumption. This compensation is interest.

Similarly, business firms will often want to expand their production when doing so will increase their profitability. In order to expand in the long term, firms must invest in new capital. In order to borrow money, firms must offer some compensation, interest payments. Firms will be willing to borrow money only when they believe that the return on their investment will exceed the interest they must pay to borrow funds.

Firms fund some investment through the use of retained earnings, but the vast majority comes from borrowing money. Even when firms finance investment through retained earnings, the interest rate will affect their decision. Instead of using retained earnings for investment, firms could choose to save them, receiving interest compensation. By choosing to invest, the firm forgoes the amount of interest they could have received by saving.

Therefore, the interest rate will govern the amount they choose to invest, financed either through borrowing or retained earnings.

When individuals choose to save, they release resources from producing goods for current consumption. Saving equals the supply of resources that can be used to produce producer goods. The resources that would have been used to produce that amount of consumer goods can instead be committed to the production of plant and equipment for firms. Investment equals the demand for investible resources, for the use of resources to produce producer goods.

D. Loanable Funds Market.

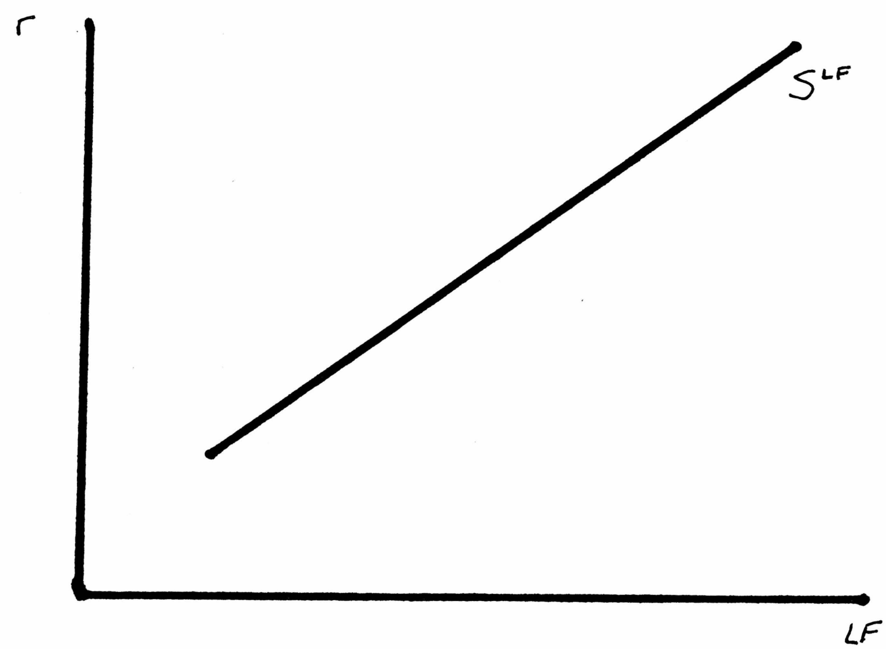
Investment and Savings interact in a market setting, just like other aspects of the Classical system. The market for Savings and Investment is called the loanable funds market. In the loanable funds market, the interest rate equilibrates Savings and Investment, the Supply and Demand for loanable funds.

Firms can finance investment in a number of ways: the use of retained earnings, borrowing money from banks, and the sale of stock are some common means. This analysis will assume that firms finance investment through a fourth means, the sale of bonds. This clearly simplifies the problem, but the principles that will be derived have enough breadth to extend beyond the loanable funds market. The loanable funds market is characterized by the interaction of the supply (Savings) and demand (Investment and Government Deficit Financing).

Supply of Loanable Funds. The funds that individuals and firms save make up the supply of loanable funds. Saving represents the act of foregoing present consumption for increased future consumption. In order for individuals to choose to save money, they must receive some benefit. This is the role of interest.

Slope. Higher interest rates provide a greater reward to savers, therefore higher interest rates encourage greater saving. This positive relationship between interest rates and levels of savings produces an upward-sloping supply curve.

Figure 2.1 Supply of Loanable Funds



The supply of loanable funds is a direct function of the rate of interest. Personal saving, retained earnings of firms, and government saving provide the supply of loanable funds. At higher interest rate levels, the quantity supplied of loanable funds will increase. Government saving is largely exogenous, determined by political demands. To some extent, particularly on a state and local level, interest rate levels affect government saving. This happens when government spending is financed by bond issues which the public votes on directly, since people react more sensitively to the interest rate.

Position. Several exogenous factors will influence the position of the supply curve. These include such matters as wealth, expectations about bond returns, public attitudes toward risk, and government savings. Three main factors influence the position of the Supply of Loanable Funds curve: government policies, expectations, and relative interest rates.

The government can encourage Saving by tax policies and regulations. When the government taxes interest income heavily, it discourages Saving. When the government is lenient toward interest income, or when the government taxes consumption, it encourages people to save. Additionally, if the government taxes more than it spends, then the government can add to savings exogenously, although this has not happened on a federal level in a few decades.

Expectations play an important role in determining the level of Saving. When people expect inflation, they have less incentive to save, because they expect the purchasing power of the dollars they will receive in the future to be eroded by increased prices. When people expect price stability, they have more incentive to save for the future, because they expect to realize significant benefits from their interest payments. When the government runs expanding deficits and takes on massive debt, this may produce inflationary fears, reducing the incentive to save. Of course, people who believe the government will raise taxes to reduce the debt may save more in anticipation of higher taxes.[2]

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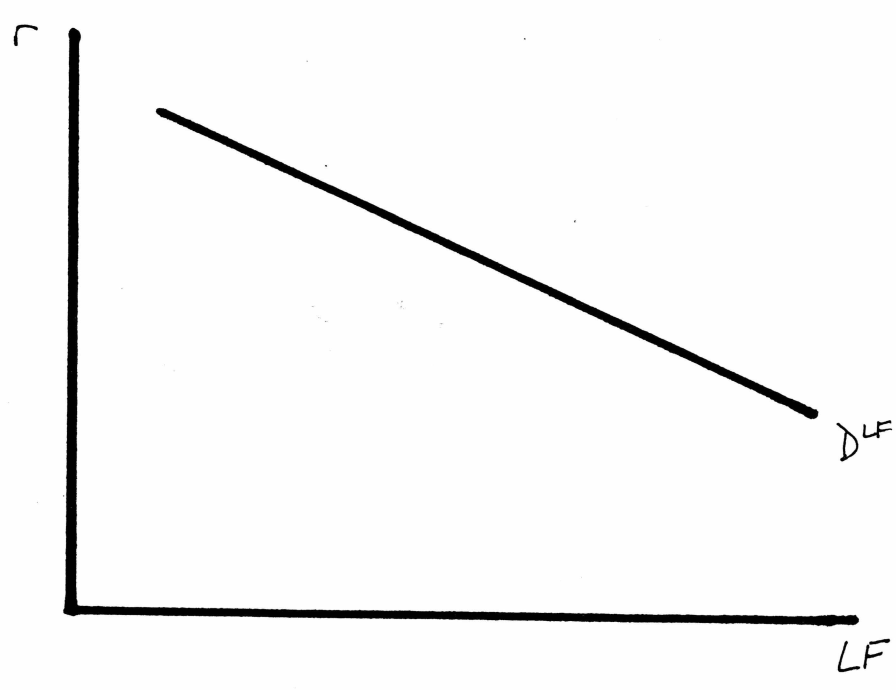
[2] This is Robert Barro's idea, which he called "Ricardian equivalence".

Relative interest rates will influence the supply of loanable funds. As domestic interest rates rise relative to foreign interest rates, more money will shift from foreign financial markets to domestic markets. In recent years, international capital markets have become more tightly integrated, and international capital flows more pronounced.

Demand for Loanable Funds. Two groups demand loanable funds: the government and business firms. Government demand for loanable funds is an exogenously fixed amount. The amount of deficit spending and the percentage of deficit spending financed through the sale of bonds determine government demand. Given the present condition of our government, this is a significant amount, and will be into the fairly distant future.

Firms' demand for loanable funds stems from their desire to invest. Investment is the purchase of new plant and equipment to increase the productive capacity of the firm (by replacing or adding to the firm's capital stock). **Figure 2.2** illustrates the demand for loanable funds:

Figure 2.2 Demand for Loanable Funds



Slope. Firms determine the slope of the demand for loanable funds curve. Government demand for loanable funds is established exogenously, by political factors. While governments may respond to the interest rate over time in setting deficit levels, government demand for loanable funds is considered fixed, independent of the interest rate. Government demand affects the position but not the slope of the demand curve.

The slope of the demand curve, then, is determined by firms' sensitivity to the interest rate. At any given time, a firm will have a set of prospective investment projects with different levels of expected return. The firm can compare the expected level of return to the market interest rate; when a firm expects a product to yield a profit net of interest, then the firm would sell bonds to acquire the funds to pursue it. At higher levels of interest, the firm will have less projects that would be expected to yield a profit net of interest. As a result higher interest rate levels will lower firms' demand for loanable funds, creating a downward sloping demand curve. The demand curve is negatively sloped: as interest rates rise, the demand for loanable funds drops, as the interest rate falls, the quantity demanded increases. The demand for loanable funds represents both the level of government borrowing to finance deficits, and the level of business investment expenditures.

Classical theory asserts that the interest rate determines the quantity of Investment desired by firms, and that firms are especially sensitive to changes in the interest rate. Therefore, the demand curve should be relatively elastic with respect to interest rate changes. The theoretical explanation for this is simple. The expected returns on investment projects are subject to a high degree of uncertainty due to a large number of variables influencing the firm's future, such as expected price and demand for the firm's product, input costs, and cyclical movements. Changes in the interest rate affect the firm's discount equation; small changes in the discount rate can produce large changes in the present value of the expected marginal returns. Therefore, when the interest rate changes, the number of profitable projects will decline quickly.

Position. Several factors influence the position of the demand curve. My discussion will include three of those factors: government dissaving, profit expectations, and monetary volatility.

Government dissaving increases the demand for loanable funds. While interest rates constrain some state and local spending (when the voters decide bond issues for particular projects) the vast majority of government dissaving is exogenous, determined by political decisions made in legislatures and government agencies. As government dissaving increases the demand for loanable funds, it will drive up the interest rate that firms must pay to borrow funds. This phenomenon is referred to as "crowding out".

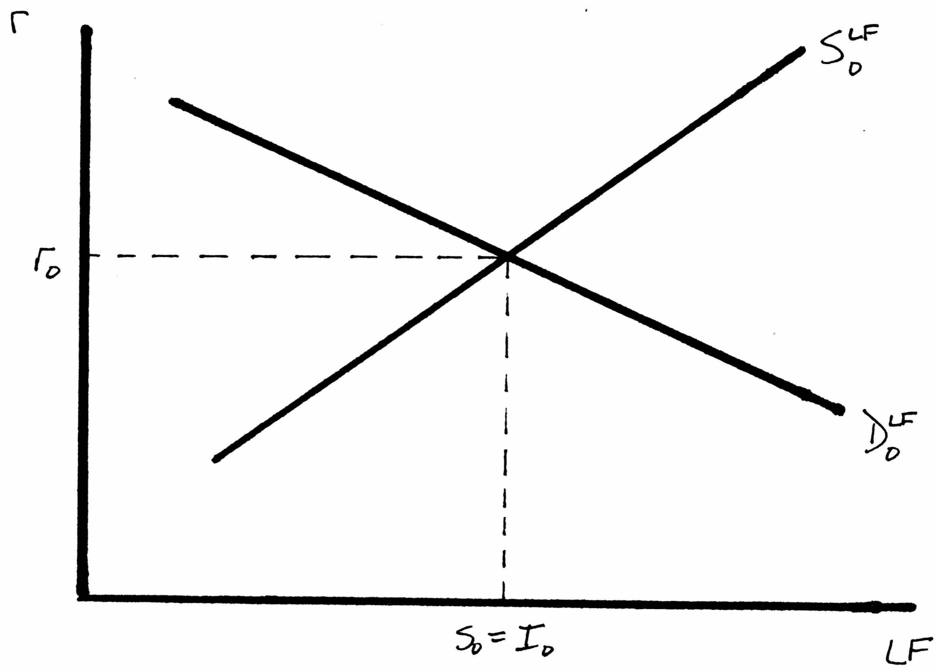
Business expectations about the future profitability of investment expenditures also affect the position of the demand for loanable funds. Firms base the decision to invest on one fundamental principle, the desire to make money. Business firms will invest only when they expect to make a profit. My discussion will focus on two factors as influencing the expected profitability of investments: gross profits after taxes, and inventory levels.

Equilibrium. The loanable funds market captures the interaction between the supply and demand curves. The interaction between these two curves produces an interest rate and such that the quantity supplied and quantity demanded of loanable funds will be equal

(Savings = Investment).

The interest rate and quantity of loanable funds will tend toward equilibrium. If the interest rate is above the equilibrium point, then there will be a surplus of loanable funds. Individuals who want to save will bid the interest rate down until they can find a borrower. If the interest rate is below equilibrium, then there will be a shortage of loanable funds. Firms will bid up the interest rate in order to encourage more savings. The loanable funds market in equilibrium is shown in **Figure 2.3**.

Figure 2.3 Loanable Funds Market

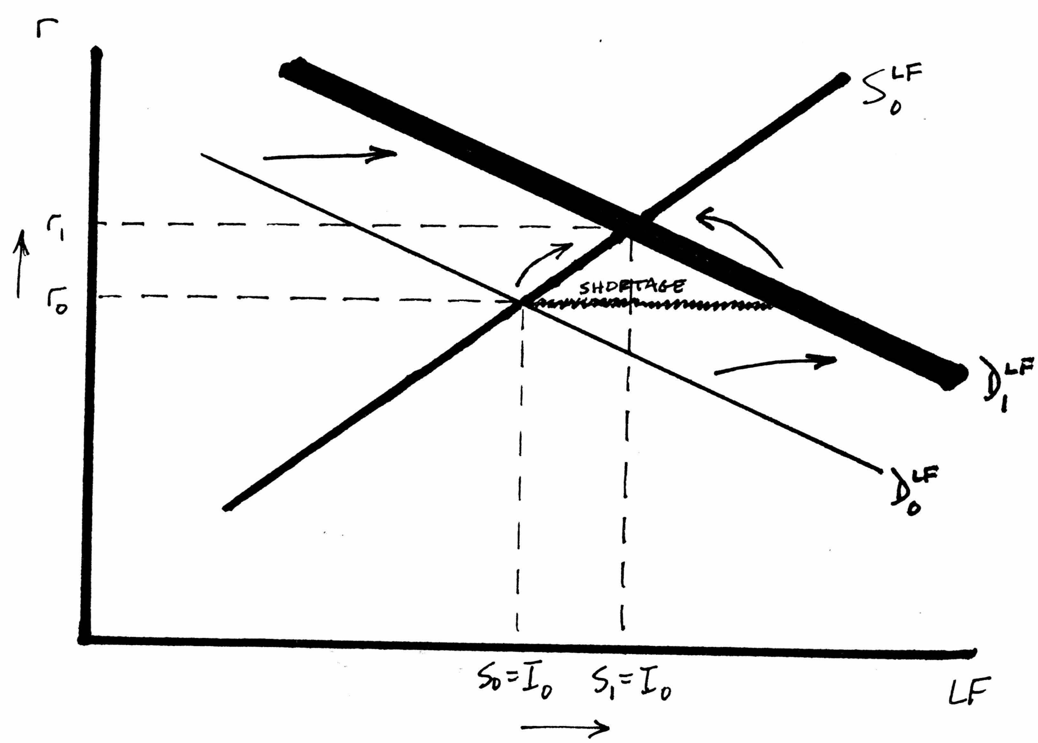


The discussion becomes moderately more complicated when the model includes international savers and investors, particularly when economists add exchange rates to the model. Exchange rates will influence decisionmaking by drawing savings to or from domestic markets, and by creating export demand for products. Additionally, the opening of the economy intensifies the effects of monetary policy and adds to investor uncertainty.

Opening the economy and including exchange rate effects enhances the impact of monetary policy movements. Additionally, the policies of other countries' central banks will influence the loanable funds market in our own country.

When there disequilibrium occurs, due to a shift in one of the curves, the market adjusts the interest rate and the quantity of Savings and Investment. Consider the exogenous shift in the demand for loanable funds depicted in **Figure 2.4**. For instance, if the government implemented an Investment tax credit, the demand for loanable funds would increase at every interest rate, shifting the curve out to the right:

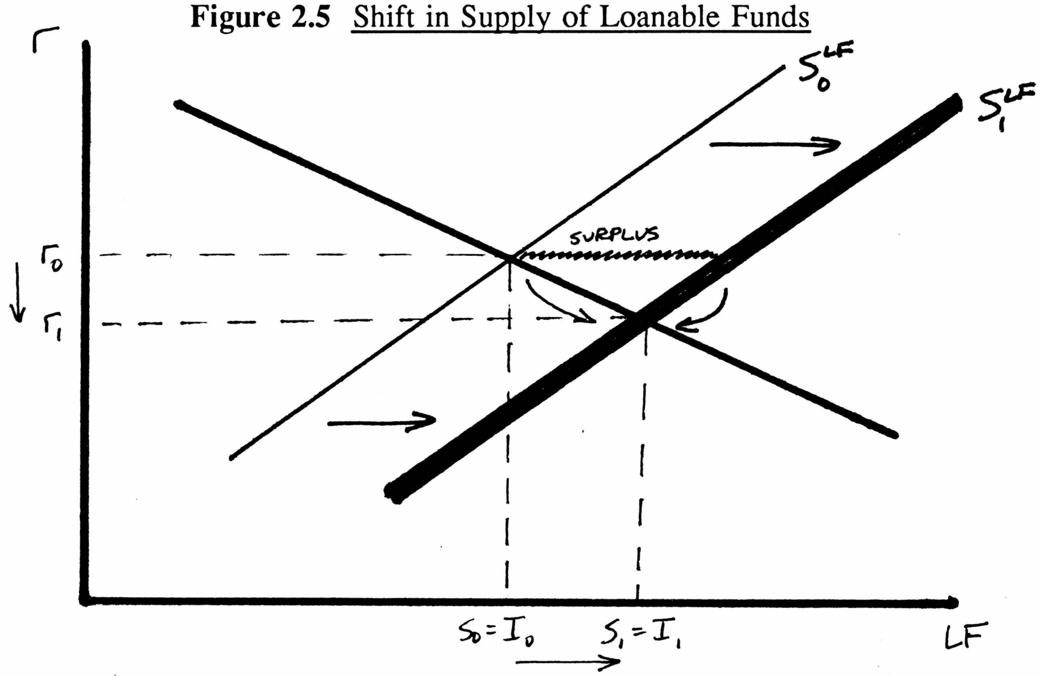
Figure 2.4 Shift in Demand for Loanable Funds



At the initial interest rate, there will be a shortage of loanable funds. Firms will have to bid up the interest rate in order to increase the quantity of loanable funds supplied. The interest rate will increase until the market achieves a new equilibrium, with a higher interest rate and quantity of loanable funds.

A shift in the supply of loanable funds will have the same basic effect. **Figure 2.5**, depicts the result of an exogenous increase in the supply of loanable funds. Assume that the federal government enacts a national sales tax, discouraging consumption, increasing the desire to save:

Figure 2.5 Shift in Supply of Loanable Funds



As the quantity of loanable funds increases at every interest rate, there will be a surplus of loanable funds. Savers will bid the interest rate down to encourage firms to borrow more money. The interest rate will fall and loanable funds will increase as the curves settle in to the new equilibrium.

Exogenous factors may influence one or both curves in the loanable funds market. After exogenous shifts in either curve, investors and savers will bid the interest rate up or down until a new equilibrium is established. As the interest rate changes, the quantity of loanable funds will shift into a new equilibrium value.

2.3 Keynesian Theory of Investment

A. Volatility.

Mr. Keynes challenged Classical theory, because it appeared to have failed given the duration and strength of the Great Depression. He believed that one of the main problems with Classical theory was its failure to adequately describe investment. He considered Investment to be a major part of economic theory, the prime mover in changes in income. He pictured Investment as a highly volatile portion of GNP, a view generally borne out by empirical study. It is not the size of investment, but its volatility that makes it so significant for changes in the economy.

Mr. Keynes believed that the volatility of Investment stemmed from the psychological precariousness of managers' investment decisions. In determining expectations, managers will estimate future values for relevant variables. They then assign weights to their estimates, based on the level of confidence they have, their "usual practice being to take the existing situation and to project it into the future, modified only to the extent that we have more or less definite reasons for expecting a change."[3] Investor confidence relies on the certainty managers have about their predictions. In situations where uncertainty dominates, "animal spirits" will move managers to invest or hold back. Mr. Keynes described two variables as the primary determinants of investment expenditure: interest rate levels and profit expectations.

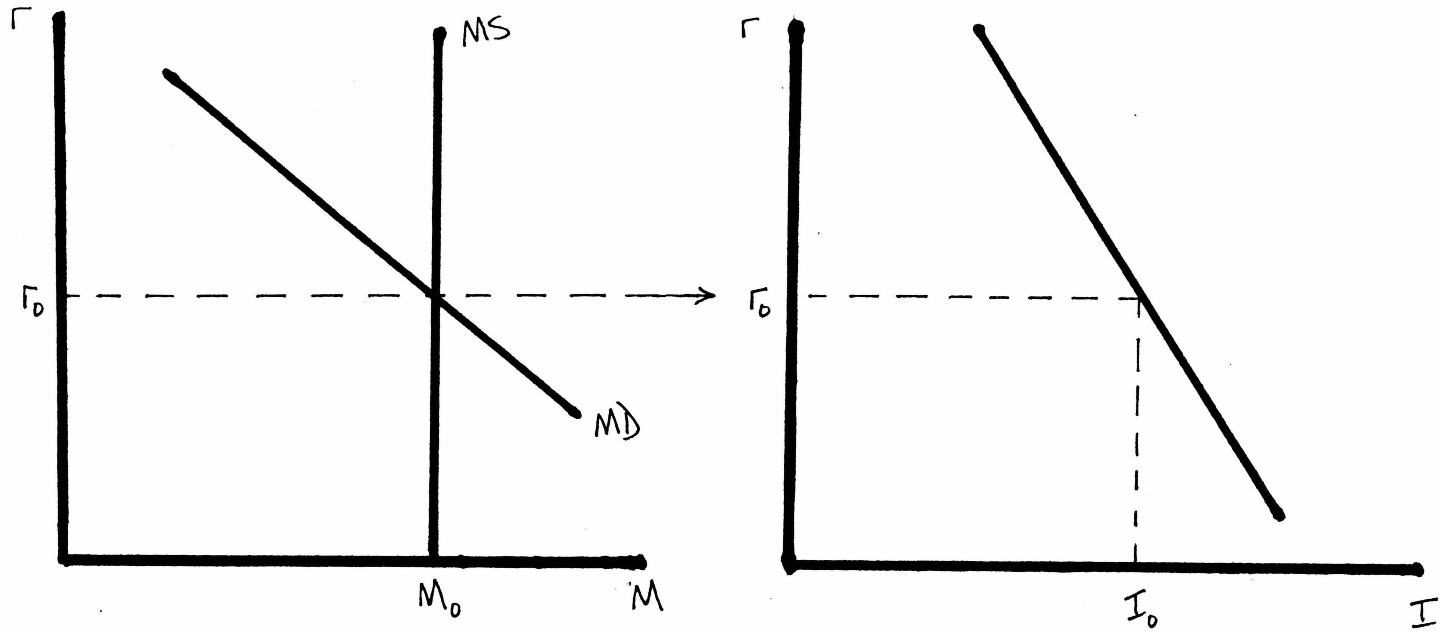
B. Interest Rate.

Mr. Keynes's explanation of the relationship between interest rate levels and Investment expenditure was essentially the same as the Classical view. The level of Investment varies inversely with the interest rate, because at higher interest rates, fewer projects will seem to be profitable.

In the Keynesian model, though, the interest rate is determined exogenously, in the money market. The interaction of the money supply, which the central bank determines, and the demand for money, which consists of demand for security, transaction, and speculation, determine the rate of interest. Managers then take the rate of interest as a given in their investment decisionmaking. The following graphs demonstrate the relationship of the money market and the Investment curve:

[3] Keynes, J. M., The General Theory, p. 148.

Figure 2.4 Money Market and Investment Curve



C. Profit Expectations.

Mr. Keynes stepped beyond the Classical view to include a second variable affecting Investment expenditures. He described firms' profit expectations as central to the decision-making process. This is an important point, because it broadens the analysis considerably. In Classical theory, firms base the decision to invest upon expected returns on the specific investment project. For Mr. Keynes, firms also base the decision to invest on the expected return on the marginal increase in capital. He then goes beyond this analysis of the investment project at hand to assert that managers also consider their future profitability.

Accurately predicting the general profitability of the firm requires knowledge about future product demand, potential changes in consumer tastes, the overall future health of the economy, as well as future costs, including inflation. Needless to say, firms have a difficult time getting accurate predictions on these issues, meaning that managers must guess about profit expectations in the future based on other guesses about the future. Managers lack accurate information about the future, and this dearth of information forces managers to be cautious in determining what investment projects are worth pursuing. As uncertainty increases, managers become unable to make rational decisions. Under conditions of high uncertainty, equations and forecasts become meaningless, and managers have to rely on gut reactions, Mr. Keynes's "animal spirits", instead of any semblance of rational analysis.

D. Uncertainty.

Firms must therefore make investment decisions with a high level of uncertainty. Generally, Mr. Keynes explained that they use two techniques:

1. Managers tend to extrapolate past trends into the future, ignoring possible future changes unless they have some specific knowledge about a prospective change (such as an expected tax policy change). This is fairly reasonable, but not a particularly accurate predictor. Additionally, using recent past data will tend to perpetuate shocks.

2. Managers may even be afraid to make their own predictions and will rely instead upon the prevailing trends in their industry and in the popular channels, conforming to

"convention...assuming that the existing state of affairs will continue indefinitely".[4] This may involve hiring experts, calling in consultants, or reading industry magazines. Unfortunately, the investment "experts" will be encouraged to anticipate short-run changes, because the market is organized to reward short-run investments and speculation.[5] This makes the expert predictions difficult to use for long-term investment decisions made by managers.

Based upon these flimsy foundations, decisions made in such a manner would be subject to sudden and serious changes. At any change of hopes or fears, investment decisions are liable to fluctuate wildly, and this effect will tend to spread rapidly. Conventional valuations are "liable to change violently as the result of a sudden fluctuation of opinion due to factors which do not really make much difference to the prospective yield; since there will be no strong roots of convention to hold it steady."[6]

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[4] Keynes, p. 152.

[5] Ibid, pp. 154-5.

[6] Ibid, p. 154.

Chapter 3. Expanding the Models

3.1 The influence of monetary volatility

A. Definition of Monetary Volatility.

Monetary volatility is the amount of change that takes place between time periods. Monetary volatility primarily occurs as a function of Federal Reserve policies. When the Federal Reserve tries to stimulate the economy, it uses policies which increase the money supply and decrease interest rates. When the Federal Reserve tries to reduce inflation, it uses policies which decrease the money supply.

Both models of Investment consider Investment in very general terms. Many small, specific exogenous variables influence actual investment decisionmaking. Monetary policy significantly impacts the state of the economy, and it is highly visible. Specifically, monetary policy directly impacts interest rates and currency values, as well indirectly impacting employment, inflation, growth, and income. Managers realize that these impacts will affect their future profits, including the future profitability of investment projects. As a result, they should take into account the actions of the central bank when making investment decisions.

B. Effect on Investment Decisions.

Monetary policy should affect investment decisions directly and indirectly. The direct effect of monetary policy is to change interest rates. Directly altering interest rates will cause a movement along the demand for loanable funds or Investment curve. Indirectly, monetary policy will affect the attitudes and uncertainty of managers. This indirect effect will cause the supply and demand for loanable funds and Investment curves to shift. Two additional concerns determine the affects of monetary policy on investment decisionmaking: the effect of the lag associated with monetary policy, and the effect of the secrecy of Federal Reserve policy.

Interest Effects. In the short term, the decisions of the central bank will alter the interest rate, directly affecting the investment options of managers.

Chilling Effect. In the long run, the willingness of the central bank to intervene in the economy will have a subtle chilling effect. If managers believe that the Federal Reserve is willing to meddle with the economy, then it will reduce their confidence in the future. A constant monetary policy, focused on stable monetary growth, will increase the confidence of investors, because it will reduce their uncertainty. If managers do not know what the central bank will do, then they will face greater levels of uncertainty. If managers can be confident that the central bank will pursue a stable level of monetary growth, they will face less uncertainty.

Lagged Effects. Monetary policy suffers from a lagged effect on the economy. The decisions of the central bank may take several months to change the course of the economy. This gives managers and investors a cushion period to assess the actions of the central bank, and to react accordingly.

Secrecy. When the central bank operates in secrecy, as it generally must when attempting to influence the economy, the effects will be intensified. To successfully change monetary aggregates and interest rates, the central bank must hide its plans. Otherwise, firms and individuals will compensate for the central bank's activity and thwart its designs. This secrecy increases the levels of uncertainty by reducing the information available to decisionmakers. They can only know that the central bank will be acting to some degree to alter the shape of the economy. Even if managers can guess the direction of the central bank's policy, they cannot know the degree, nor can they anticipate future policy decisions.

The international nature of modern capital markets intensifies the effects of monetary policy on investment decisions. Modern international capital flows rapidly, and the markets are sensitive to changes in business conditions and interest rates. In the short term, investors will send their money to the highest interest return. In the long term, investors will send their money to the best return. If currency values and interest rates are volatile, then investors will be reluctant to invest in a particular nation, favoring stable currency countries. High volatility may inspire greater levels of speculation, but it will harm serious long term investment.

The direction of policies is really not as important as their size. The Federal Reserve will pursue policies in different directions based upon their expectations for the economy, so firms cannot forecast very far into the future to determine Federal Reserve policies. However, if the Federal Reserve makes large changes in the money supply, then firms will anticipate high volatility, and will be less likely to take risks on marginal investment projects. If the Federal Reserve makes small changes in the money supply, then firms will have a better ability to anticipate future prices and interest rates. Firms will invest more if they feel more certain about expected returns. Stable monetary growth encourages investment, and volatile monetary growth discourages investment. To make this idea more formal and more explicit, I will consider it in the framework of the two models.

3.2 Classical Model

In the Classical model, investment decisions hinge primarily on interest rates. In this world, investment decisions will be altered to the extent that interest rates will be uncertain. Firms may invest less if they expect high fluctuation in interest rates over the life of their investment projects. Additionally, firms base investment decisions, expected rates of return, and to the extent that these are uncertain, they will reduce the incentive to invest. The net effect of this influence will be a shift in the demand for loanable funds. The Classical model assumes stable prices and wages. If the central bank plays around with these levels, it will tend to shift the Investment curve down to the left, reducing Investment at each level of interest.

The interest effects of monetary policy occur on the supply side. When the Federal Reserve acts to increase the money supply, by open market operations, or by altering reserve requirements and the discount rate, it influences the supply of loanable funds. As the Federal Reserve buys bonds, for instance, it puts more cash into the hands of savers and banks. Some of this will be spent on consumption, but some will also be saved.

The indirect effect of monetary policy will shift the supply and demand for loanable funds. Saving and Investment are both intertemporal activities. Both involve expectations about the future. To the extent that monetary volatility forces managers to overestimate in discounting expected returns, it shifts the demand curve back; to the extent that it produces inflationary fears among savers, it shifts the supply curve backward.

3.3 Keynesian Model

In the Keynesian theory of investment, the interest rate is determined exogenously, in the money market. Federal Reserve activity will alter the interest rate directly by shifting the money supply around. Since the money market determines the interest rate, primarily by the speculative demand for money, active monetary policy will translate into rapid shifts in the interest rate as speculators adjust their demand for money to respond to Federal Reserve Activity. The direct effects will be immediately apparent, since the interest rate is determined independently, then applied to the Investment curve.

In the Keynesian model, there will be an even greater indirect impact than in the Classical model. Mr. Keynes explained that investors deal with high levels of uncertainty, producing a volatile Investment curve. To the extent that variable monetary policy increases investor uncertainty, the volatility of the Investment curve will increase. While stable monetary policy will not remove businesses' uncertainty, it will at least reduce the endogenous component of that uncertainty.

3.4 Predictions

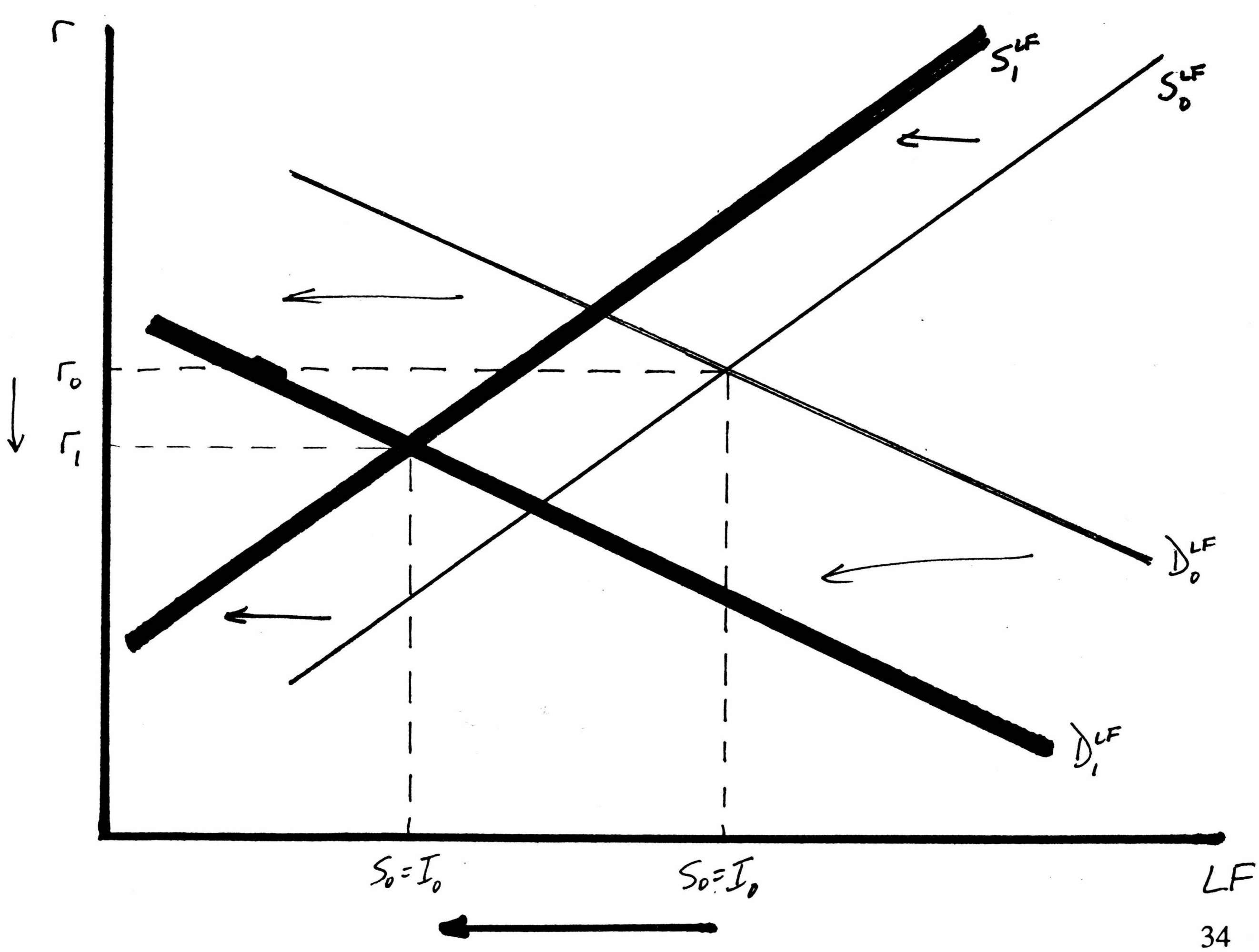
Each of these theories of Investment involves different approaches to the determination of investment. However, both involve the same basic assumptions. Both involve a demand curve for investment. That demand curve is determined in both models by managers who must forecast future returns to an investment project. This involves discounting the expected returns in order to establish some present value. Monetary policy will influence decisionmaking in both models.

A. Classical theory.

In the Classical model, monetary volatility will affect the expectations of savers and investors. If savers feel uncertain about future changes in interest rates and prices, they will demand a higher return before forgoing present consumption. This means that volatility in monetary policy should shift the supply of loanable funds curve back to the left, as savers demand a higher rate of interest for each quantity of funds saved. Consider **Figure 3.1**, where the market for loanable funds begins in equilibrium at $r = I = S$. If monetary volatility increases, ceteris paribus, then the Savings curve will shift until r increases enough to induce increased supply of loanable funds.

An active monetary policy should have an even greater effect on managers. Since they have to discount expected returns on investment projects that may extend many years into the future, a shift in their expectations about future prices and interest rates will drastically alter their assumptions about the level of expected returns. In order to guarantee that the present value of their expected returns will exceed the purchase price of new capital, they will use a high discount rate. This means that they will demand less funds at every interest rate, shifting the demand for loanable funds curve back and to the left, as **Figure 3.1** demonstrates.

Figure 3.1 Predicted Effects of Monetary Volatility, Classical Model



The net effect of volatile monetary policy will have an indeterminate effect on the interest rate, depending on the relative shift of the two curves. I predict that the shift of the demand curve will be stronger than the shift of the supply curve, because managers are more sensitive to uncertainty, given that they have to discount into the future on fixed projects, while savers are fairly liquid.

The important thing to note from **Figure 3.1**, though, is the net effect of monetary volatility on the overall level of Savings and Investment. Since both curves will shift backward, there will be an unequivocal decrease in the quantity of loanable funds saved and invested. Monetary volatility should produce a significant negative impact on Investment.

B. Keynesian theory.

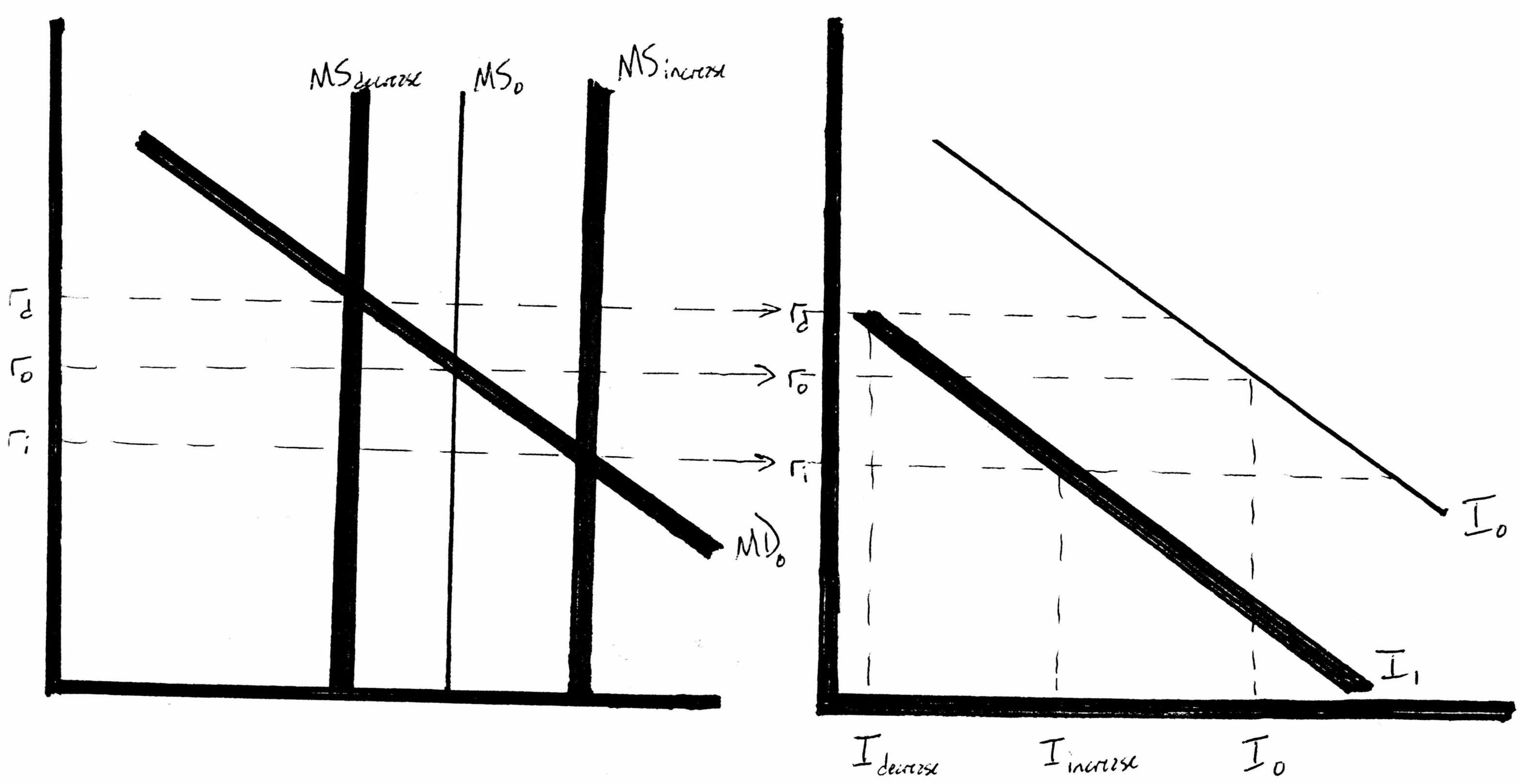
In the Keynesian model, there will not be the dual effect present in the Classical model, since only one curve matters in determining Investment levels. However, uncertainty plays a much larger explicit role in Mr. Keynes's explanation of investment. Therefore, the observed shift in the Investment curve should be even more substantial then the shift in the demand for loanable funds curve in the Classical model.

Initially, the shift in money supply in the money market will affect the interest rate. The effect on the interest rate will depend upon the direction of the money supply shift. A shift in the interest rate will have a direct effect on investment. Expansionary monetary policy will cause interest rate to fall, increasing Investment, and contractionary policy will reduce Investment by increasing the interest rate. There will also be an indirect effect on

Investment. As the Federal Reserve uses monetary policy in either direction, managers will

Since the Federal Reserve policy moves in both directions, with regard to the Keynesian model, I predict that the increase in uncertainty associated with increased monetary volatility should cause a large backward shift in the Investment curve, producing a significant decrease in Investment levels. Therefore, there should be a greater decrease in Investment associated with a contractionary move by the Federal Reserve (decreasing the money supply), and a mitigating effect on the Investment decrease associated with an expansionary move (increasing the money supply). **Figure 3.2** shows the results of both scenarios. Note that each case results in a net decrease. They differ in degree.

Figure 3.2 Predicted Effects of Monetary Volatility, Keynesian Model



Chapter 4. Methodology and Data

The first three chapters set out the Classical and Keynesian theories of Investment. They went on beyond the traditional explanations associated with these theories to consider what causes Investment to be so volatile. Uncertainty plays the primary role in determining the volatility of Investment. What factors cause uncertainty? The third chapter describes monetary volatility and its potential influence on uncertainty. This chapter will outline a framework for testing the hypothetical impact of increased monetary volatility on Investment expenditures.

4.1 Classical Model

A. Problem of two Equations.

The hypothetical impact of monetary volatility on Investment poses a potential problem for analysis, for it involves two equations, supply and demand, and two endogenous variables, quantity of loanable funds and interest rate. In a normal regression equation, there will be one dependent variable, an one or more independent variables. The problem becomes apparent if you consider a simple situation of supply and demand.[7]

[7] The following discussion of the statistical method involved in simultaneous equations models is instructed by G. S. Maddala, Introduction to Statistics, chapter 9.

A simple demand function can be written as an equation:

$$q = \alpha_0 + \alpha_1 p + s \tag{4.1}$$

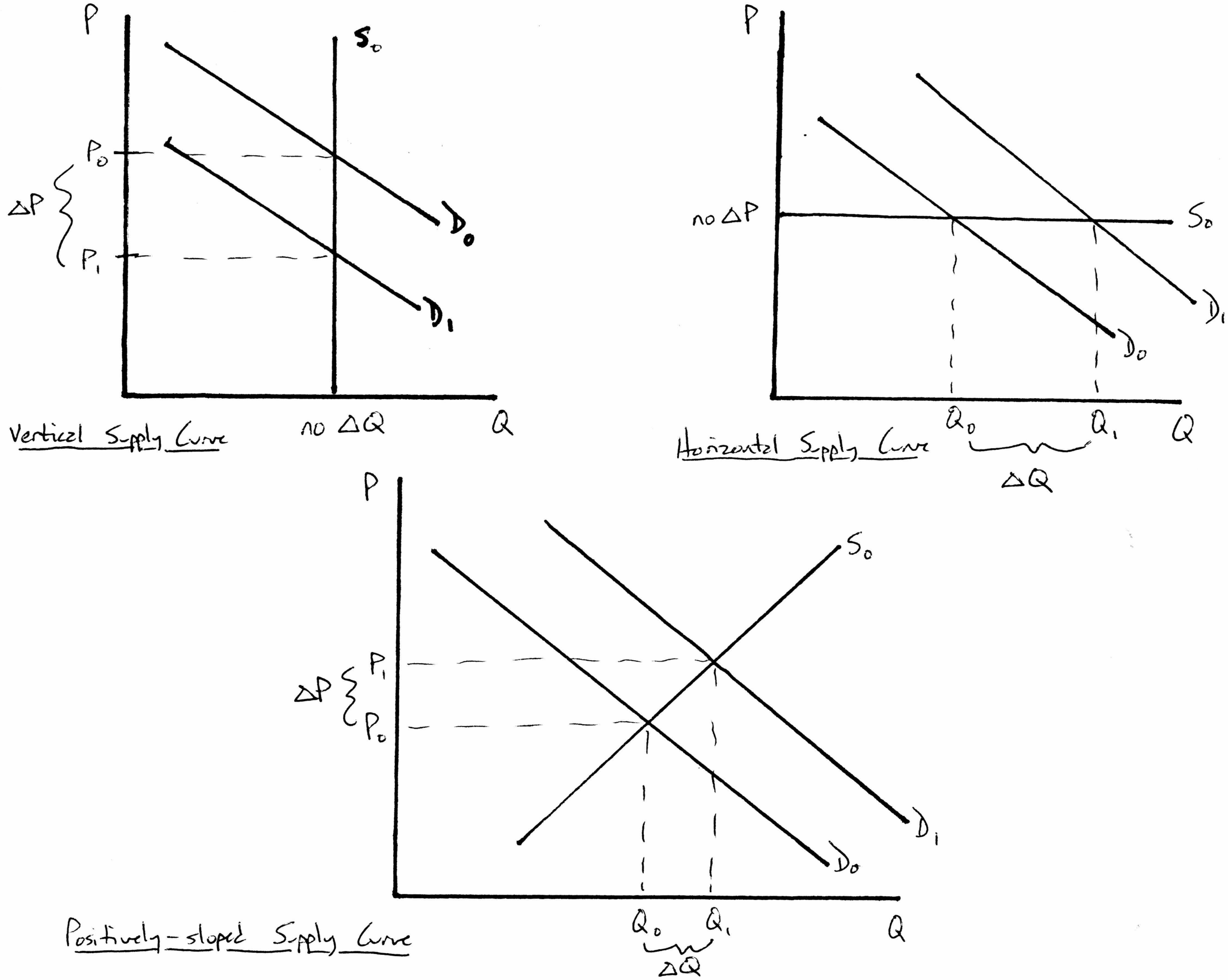
where q is the quantity demanded, p is the price, and s is the disturbance term, denoting random shifts in the curve. If the supply curve is completely vertical, then a shift in demand will alter the price, but not the quantity demanded. If the supply curve is perfectly horizontal then a shift in demand will change the quantity demanded, but not the price. However, in any case where the demand curve is positively sloped, that is, in pretty much every market situation, aside from the extreme perfectly elastic or perfectly inelastic, a shift in the demand curve will alter both the price and the quantity. See Figure 4.1.

This means that the error term, s, is correlated with the independent variable p, which violates one of the assumptions of the regression model. Therefore, the ordinary least squares method produces inconsistent estimates of the parameters.

The demand equation could also be written as:

$$p = \alpha_0' + \alpha_1' q + s \tag{4.2}$$

Figure 4.1 Possible outcomes of Demand shifts



But this still does not escape the problem of correlation between the independent variable and the error term. The demand equation can be written in either way, as in (4.1) or (4.2). If it is written as in (4.1), then it is normalized with respect to q that is, the coefficient of Q is unity. If it is written as (4.2), then it is normalized with respect to p. Since the interaction of supply and demand determine both price and quantity, it should not matter whether the equation is normalized with respect to p or q.

This causes a problem, since the market determines price and quantity simultaneously. We cannot consider the demand function in isolation from the supply function, which causes a problem. To solve the problem, we must consider supply and demand simultaneously. This model is known as a simultaneous equations model.

B. Simultaneous Equations Model

In simultaneous equation models, there are the endogenous variables, determined inside the model, and exogenous variables, those determined outside the model. The endogenous variables are jointly determined, and the exogenous variables are predetermined. Past values of the endogenous variables may be included in the predetermined group. Since the exogenous variables are predetermined, they avoid the problem of correlation with the error term and meet the specifications of the regression model.

Now we need to define both the supply and the demand curves:

$$q_D = \alpha_0 + \alpha_1 p + \alpha_2 y + u_1$$

$$q_S = \beta_0 + \beta_1 p + \beta_2 R + u_2 \tag{4.3}$$

where p is the price, q is the quantity, and the error terms are u. Let us assume that this is the market for cut flowers, so y is income, and R is rainfall. Price and quantity are endogenous, and income and rainfall are exogenous. Since y and R are exogenous, we can regress p and q on y and R by ordinary least squares, although we cannot estimate equations (4.3).

By regressing p and q on y and R, we can discover the parameters for the original supply and demand curves, (4.3). This method is called indirect least squares. It is indirect because we do not apply ordinary least squares to the original equations.

If we solve the original equations (4.3) for p and q, we get:

$$
\begin{aligned}
q &= \frac{\alpha_0 \beta_1 - \alpha_1 \beta_0}{\beta_1 - \alpha_1} + \frac{\alpha_2 \beta_1}{\beta_1 - \alpha_1} y - \frac{\beta_2 \alpha_1}{\beta_1 - \alpha_1} R + \text{an error} \\
p &= \frac{\alpha_0 - \beta_0}{\beta_1 - \alpha_1} + \frac{\alpha_2}{\beta_1 - \alpha_1} y - \frac{\beta_2}{\beta_1 - \alpha_1} R + \text{an error}
\end{aligned}
\tag{4.4}
$$

These are called reduced-form equations. Equations (4.3) are called the structural equations, because they describe the structure of the model. We can write equations (4.4) as:

$$
\begin{aligned}
q &= \pi_1 + \pi_2 y + \pi_3 R + v_1 \\
p &= \pi_4 + \pi_5 y + \pi_6 R + v_2
\end{aligned}
\tag{4.5}
$$

where the v's are the error terms, and

$$
\pi_1 = \frac{\alpha_0 \beta_1 - \alpha_1 \beta_0}{\beta_1 - \alpha_1} \qquad \pi_2 = \frac{\alpha_2 \beta_1}{\beta_1 - \alpha_1}
$$

The pi's are reduced-form parameters. The estimation of the equations (4.5) by ordinary least squares gives consistent estimates of the reduced form parameters. When estimating simultaneous equations, a researcher must be able to identify the parameters, since the sample statistics will be combined into a single equation. This often causes a problem, leading many researchers to adopt a reduced form model.

In these cases, though, identification will not be a problem, because the key variable, the one measuring monetary volatility, appears in both equations. As the theoretical analysis explained earlier, the effect of monetary volatility on the supply and demand for loanable funds curves produces an indeterminate result for the interest rate, but the two curves shift in the same direction with regard to investment. It will not be possible to determine how much of the decrease in Investment occurs due to a supply curve shift, and how much occurs due to a demand curve shift, but this is largely irrelevant, since they both depress Investment levels. The regression must simply be understood to measure the joint impact of the supply and demand curve shifts.

C. Reconfiguring the Equations

The loanable funds market can be dealt with in the same way. However, there is one additional wrinkle. Using the form outlined above, we are left with a regression to determine the influence of various variables on the price. In this study, I am concerned with the quantity of loanable funds (investment), not the price (the interest rate). Therefore, I will make one change.

Instead of describing the quantities of loanable funds supplied and demanded as functions of the interest rate and other variables, I will describe the supply and demand price of loanable funds as a function of the quantity of loanable funds supplied and demanded. Instead of writing the equations as:

$$Q^{S}_{LF} = f(r)$$
$$Q^{D}_{LF} = f(r) \qquad (4.6)$$

I will simply rewrite them as:

$$r^{S} = f(Q_{LF})$$
$$r^{D} = f(Q_{LF}) \qquad (4.7)$$

This may sound a little tricky, but it makes sense. We just have to change our thinking about the curves. Instead of imagining investors and savers determining the quantity of loanable funds they will demand or supply based upon the interest rate, we think of investors and savers determining the levels of interest they will be willing to pay to borrow or be willing to accept to loan the quantity of loanable funds they desire to invest or save. This conception depicts investors and savers as having a quantity of funds they wish to invest or save, then calculating what interest rate they will seek.

This reflects real-world decisionmaking. Firms initially come up with investment projects without regard to the interest rate. Once they figure out how much a project will cost, and what kind of return they expect, then they decide what interest rate they will be willing to pay to borrow the funds that they have previously decided they will need. And when individuals or firms decide to save, they already have the money on hand--firms have the profits, and individuals have their income. Based upon the amount of money they have, the firms and individuals decide how much interest they will demand to save those funds instead of offering them as dividends or spending them on consumption.

So for the Classical model, I will describe two structural equations, for the supply and demand price for loanable funds, and then combine them into one reduced form equation, solving for the quantity of loanable funds as a function of the other variables. This combination can exist, because in equilibrium, the interest rate will be the same for both equations.

4.2 Keynesian Model

The Keynesian model is much simpler, because it only involves one curve, the Investment schedule, and one endogenous variable, Investment expenditures. As a result, it will only be necessary to use simple regression on the Investment equation. Initially, it appears that the Keynesian theory of Investment can not be specified as a reduced form model, since the interest rate is being determined simultaneously with Investment, even though it is being determined in the money market, not the Investment market. However, since the interest rate is endogenous, albeit in a different part of the comprehensive Keynesian system, the simultaneous equations problem presents itself again. To get around the problem, I will lag the interest rate, and assume that firms base their decisions on the interest rate they faced in the last quarter when they determine their investment demand.

The Investment curve will be described in an equation like the demand for loanable funds. Theoretically, all that happens is that the impact of savings decisions drop out, and the interest rate is determined exogenously. In practical terms, this means that the variables which influence the position of the supply of loanable funds, but not the demand, will be removed. However, the interest rate, which captures all of the movement involved in the Classical supply of loanable funds curve, will be included.

4.3 Data

This section describes the data used to test the hypothesized effect of monetary volatility in both the Classical and the Keynesian models. First the section offers an explanation of how each variable figures in to the Classical and Keynesian models. Then the section offers a description of the sources for the data, and an explanation of how they are measured. The regression for the Keynesian model is estimated using quarterly data from 1967 to the present; the regression for the Classical model is estimated with quarterly data from 1973 to the present, because the data for foreign interest rates were not available until 1973. The Classical model explicitly involves the relative domestic interest rate effect, while the Keynesian model accounts for it in the money market setting of the interest rate. All of the data that were reported monthly were converted to quarterly figures, and all data appear in

1982 dollars.[8] I list all of the original sources for the data, but I downloaded them from CITIBASE: CITIBANK ECONOMIC DATABASE.

A. Dependent Variable:

Business Investment Expenditures: **Inv Exp**

Expenditures for new plant and equipment by business, for all industries, in current dollars, represents demand for Investment. The data come from the U.S. Department of Commerce, Bureau of Economic Analysis, SAAR. The series includes actual expenditures, as well as planned expenditures one and two quarters ahead. Since the data represent current and planned expenditures, they should give a good gauge of the attitude of firms toward the conditions at the present, as well as their expectations for the future. Because the data include planned expenditures, they will be larger than the current QSLF, even if foreign savings were included. The data were provided in 82$, which I am assuming were derived by using the Producer Price Index.

B. Independent Variables:

1. Real Gross Profits after Taxes: **RGPAT**

Corporate profits after taxes, before inventory valuation adjustments and capital

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[8] Where the data were available in 1982 dollars, I used those measures, otherwise I used the GNP deflator to adjust them. When the data originally appeared as monthly figures, I took three-month averages to convert them to quarterly figures.

consumption adjustments, in billions of current dollars, SAAR, from the U.S. Department of Commerce, Bureau of Economic Analysis. As I discussed earlier, firms base their investment decisions on some idea of profit expectations. Past profits certainly provide one of the best indicators for firms. While many other concerns influence profit expectations, past profits represent an excellent and simple single measure. These data were in nominal figures. I used the GNP deflator to adjust them to 1982$.

For the regression, I lagged profits by one quarter. Some lag must be included, because managers do not know their profits until after the quarter ends, and when they make their decisions, they will only have data for past profits. I could have included several lag values, but this would have added too many problems, and distracted the research from its primary goal. Adding in more lagged values would definitely pose a problem with multicollinearity. Further figures do not need to be included, because the point is to get an idea of profit expectation influence; it goes beyond the scope of this paper to examine the relative influence of different GPAT lags.

2. AAA Corporate Bond Rate: **AAA**

The AAA corporate bond rate, average yield in percent per annum, not seasonally adjusted. From the U.S. Department of the treasury Bulletin, originally monthly data. The lagged corporate interest rates will affect managers' expectations about future rates they will face, and savers' expectations about what rates they will be able to command. As lagged rates increase, savings should increase, and Investment should decrease. This should increase interest rates, and the net effect on Investment levels will depend on who reacts more strongly, savers or investors.

This variable is lagged by one quarter. This avoids the problem of simultaneous equations, because a lagged variable is exogenous in the present, its value holds constant no matter what occurs in the model during this time. Additionally, the one quarter lag reflects the consideration of recent rates in deciding what interest rate to accept in the present.

3. Federal Funds (Effective Rate): **FedFund**

From the Board of Governors of the Federal Reserve. The data were originally monthly average of daily figures, in percent per annum. The federal funds rate affects the loaning of money between banks. Lower rates will encourage more interbank lending, and therefore more Investment.

4. Relative Interest Rate: **US/For**

This statistic represents a combination of two variables, the U.S. composite rate - over 10 years (long term), and the weighted average foreign interest rate. The U.S. long term rate comes from the unweighted average of all treasury notes neither due nor callable in less than ten years, including flower bonds. The data were monthly averages of daily figures, yields in percent per annum. The foreign interest rate is the weighted average rate for the G-10 countries and Sweden, form the Board of Governors of the Federal Reserve, selected interest and exchange rates. The data were percent, monthly averages of weekly rates. The data for the foreign rates did not start until 1973, so this measure had to be used in a separate series of regressions beginning at that point.

The relative interest rate variable that I used was a simple ratio of foreign rates to U.S. rates. When the relative rate improves, that is, when foreign interest rates improve relative to U.S. rates, there should be a decrease in the supply of loanable funds in the United States, as foreign savers have less incentive to bring their money here and domestic savers have more incentive to send their money abroad. This variable will be important in the Classical configuration, because it will influence the decision of savers, determining their willingness to save here or abroad. It will also affect the availability of foreign savings being available to domestic investors. The variable will not be included in the Keynesian equation, since it is assumed to be incorporated in the money market determination of the interest rate.

5. Real GNP: **RGNP**

From NIPA, originally in nominal figures, adjusted by use of GNP deflator. RGNP serves two purposes. First, it adjusts them for business cycle fluctuations. This helps to remove some potential serial correlation, particularly with regard to the interest rates used in the models. Second, RGNP will give an indication of positive sentiment about the economy. As RGNP rises, confidence should increase, so there should be a positive correlation between RGNP and Investment. I will lag RGNP one quarter, because that is the data firms will have access to, and it will complement the one-quarter lag applied to some of the other variables.

C. Monetary Volatility Measures.

1. Percentage Change in M2: **%d M2**

Data from the Board of Governors of the Federal Reserve, originally monthly average of daily figures. M2 figures in billions of 1982 dollars. M2 consists of M1 plus overnight repurchase agreements and eurodollars, money market mutual fund balances and deposit accounts, and savings and small time deposits. I converted the data to quarterly figures by finding the mean over each three month period. I chose percentage change in M2 as my measure of monetary aggregate volatility because M2 is more comprehensive than M1, involving short-term time deposits which influence the cash flows of most corporations. The figure is also the generally accepted target figure for Federal Reserve decisions, so it can be regarded as the best estimate of how managers can be expected to view Federal Reserve activity. I used percentage changes to reflect the relative size of monetary shifts, allowing meaningful comparisons over time.

This variable is lagged four quarters. This reflects the long-term lag structure of money supply shifts. When the Federal Reserve acts to change the money supply, its influence is not immediately felt. The effects take at least six months, and generally take nine months to a year to produce an impact. The secrecy of the Federal Reserve intensifies this lag, by hiding Federal Reserve policy directions for several months. I could have included several lags to measure the different effects from different lag times, but that goes beyond the pale of this paper. Lagging the variable four quarters allows for the effect to be measured at a time differential when it should be most influential.

2. Exchange Value of the U.S. Dollar: **EXVUS**

This is the United States - Index of weighted average exchange value of US$ against currencies of other G-10 countries, March 1973 = 100. Weights are 1972-76 average total trade shares of each of the eleven countries. The data come from the Board of Governors of the Federal Reserve System, and were originally monthly averages of daily rates, not seasonally adjusted. I included the exchange rate fluctuations to capture two effects. First, to capture the impact of exchange rates on exports and imports, to the extent that they influence Investment decisions, and second, to capture the relative fluctuations of the US$ as a measure of international monetary volatility.

4.4 Equations

A. Classical Model.

The Classical Model of Investment, including monetary volatility:

$$\text{Inv Exp} = \alpha_0 + \alpha_1 \text{ RGPAT} - \alpha_2 \text{ \%d M2} - \alpha_3 \text{ FedFund} - \alpha_4 \text{ EXVUS} - \alpha_5 \text{ US/For} + \alpha_6 \text{ RGNP} \tag{4.8}$$

where:

Inv Exp	= Business Investment Expenditure, in period t
RGPAT	= Real Gross Corporate Profits after Taxes, in period t-1
%d M2	= Percentage Change in M2, in period t-4
FedFund	= Federal Funds (Effective Rate), in period t
EXVUS	= Exchange Value of US$, in period t
US/For	= Relative Domestic Interest Rate, in period t
RGNP	= Real GNP, in period t

B. Keynesian Model.

I will remove the Federal Funds rate and the relative interest rate, because the money market determination of the interest rate assumes both of these variables. The AAA rate will represent the interest rate coming out of the money market, as it is received by firms.

The Keynesian Model of Investment, including monetary volatility:

$$Inv\ Exp = \alpha_0 + \alpha_1\ RGPAT - \alpha_2\ AAA - \alpha_3\ \%d\ M2 - \alpha_4\ EXVUS + \alpha_5\ RGNP \qquad (4.9)$$

where:

RGPAT	= Real Gross Profits after Taxes, in period t-1
AAA	= AAA Corporate Bond Rate, in period t-1
%d M2	= Percentage change in M2, in period t-4
EXVUS	= Exchange Value of US$, in period t
RGNP	= Real GNP, in period t-1

Chapter 5. Regression Results

5.1 Classical Model

A. General Results. The regression for the Classical model produced promising results. The initial equation estimated for the Classical model had an R-squared (adjusted) of 97.9%, demonstrating a strong goodness-of-fit. There was no problem with multicollinearity in the data. The VIF scores were all 1.8 or lower. The one problem with the equation came from serial correlation.

Serial correlation is a problem that often occurs with the use of time-series data. Serial Correlation exists when the error terms of time-series data are correlated. This causes a problem, because its presence invalidates conventional tests of significance. Serial correlation can be detected by use of the Durbin-Watson score. In a case with six right-hand side variables and 75 observations, if the D-W score falls below 1.77, then the D-W test is inconclusive. If the score falls below 1.49, then there is positive serial correlation. In the initial estimation, the Classical model had a D-W of .70, indicating positive serial correlation.

In order to correct for this problem, I used a Cochrane-Orcutt procedure. The Cochrane-Orcutt procedure basically works to wring the serial correlation out of the data by estimating the level of serial correlation in the data, and then adjusting them by an appropriate amount. I estimated the relationship between the residuals and the lagged residuals, and came up with a positive correlation, which the D-W score had predicted. I then adjusted the data using a Cochrane-Orcutt procedure. After the first Cochrane-Orcutt, the D-W score was 1.20, still indicative of positive serial correlation. I performed the same procedure a second time, adjusting the data even further. After the second attempt, I ran another regression. This time, I came up with a D-W score of 1.74, which falls in the inconclusive zone, but it is close enough to 1.77 (the lower limit for no serial correlation for this equation) that the serial correlation has probably been wrung out.

In the initial regression, the results for the specific data consistently manifested the hypothesized relationships across the board. The only variable which was not statistically significant at .025 was the Federal Funds Rate. However, using the Cochrane-Orcutt procedure to eliminate serial correlation often reduces goodness-of-fit and significance in the regression. The apparent precision of the initial equation was due to the positive serial correlation. While the removal of the serial correlation makes the model appear less accurate, in reality, the appropriateness of the model can only be evaluated once the serial correlation has been purged. **Table 5.1** summarizes the results of the regression performed after the second Cochrane-Orcutt.

Table 5.1 Classical Model Results

Variable	Coefficient	Std Dev	p-value
RGPAT, lag 1	.090	.083	0.139
%d M2, lag 4	-1.587*	.841	0.032
FedFund	.274	.686	0.346
EXVUS	-.054	.187	0.387
US/For, lag 1	-21.340**	10.500	0.023
RGNP, lag 1	.155***	.007	0.000
n = 73	Regression F 78.48	R-sq(adj) 86.6%	Durbin-Watson 1.74

* Significant to .05
** Significant to .025
*** Significant to .01

All t-tests are one-tailed

As expected, real GNP has a positive impact on Investment, significant at the .01 level. An increase in the relative domestic interest rate produced a significant negative impact on investment. The most interesting result, in terms of this study, came with the estimated relationship of monetary volatility on Investment. As predicted, a percentage change in M2 produced a significant negative impact, at a .05 level of confidence. In the adjusted model, gross profits after taxes the Federal Funds rate, and the exchange value of the dollar were statistically insignificant. The regression F reveals that not all of the variables in the regression are unrelated to Investment. Indeed, 86.6% of the variance in Investment can be accounted for by the variance of the variables involved in this Classical model.

B. Interpretation of specific variables

1. Percentage Change in M2. With a p-value of 0.032, the percentage change in M2 bears a statistically significant relationship to Investment. The coefficient is negative, as expected. The coefficient of -1.587 means that for every one percent increase in the rate of change of the money supply, Investment decreases by $1.5 billion. Since the mean for Investment over the range of data was $363.4 billion, the decline in Investment associated with a one percent change in the increase of the monetary supply will be less than one percent. The regression seems to indicate that as changes in the money supply increase in size, Investment decreases. This matches the predicted effect of greater monetary volatility on Investment. The result is statistically significant, although it has low economic significance (e.g. a small coefficient). Estimating the equation with absolute percentage changes produced an inferior equation on every level: goodness-of-fit, significance, multicollinearity, and serial correlation.

2. Relative Interest Rate. The relative domestic interest rate proved to be particularly significant. With a p-value of .023, it is statistically significant to a .025 degree of confidence. More importantly, with a coefficient of -21.34, it appears to have a great deal of economic significance. Recall that the data are a ratio of interest rates, the United States

government securities long-term composite rate divided by a weighted average of foreign interest rates.

Since this number is a ratio with a mean value of 1.086, the coefficient seems extraordinarily large.[9] Realize that the coefficient means that for a 10% increase in the domestic rate, holding the foreign rate constant, there will be a $2.13 billion decrease in Investment. The standard deviation for the relative interest rate is .25. Increasing the ratio by one standard deviation would decrease Investment by $5.335 billion.[10] Since the mean value for Investment is $363.4 billion, the increase in the ratio would only represent about a 1.5% decrease.

3. RGNP. The real GNP has a positive relationship to Investment. With a p-value of 0.000, it is clearly a statistically significant relationship. The relationship is not necessarily direct or causal. Increases in GNP probably produce two changes which in turn influence Investment. Therefore, GNP and Investment will be indirectly related.Specifically, Increases in GNP will increase income, increasing the supply of loanable funds at every interest rate (shifting the supply curve out to the right), and therefore depressing the interest rate and increasing the amount of funds invested. Additionally, GNP increases should generally improve business expectations, encouraging firms to invest by improving their estimates of profitability.

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[9] This value comes from minitab description of the US/For variable.

[10] Assume that the domestic rate and the foreign rate both begin at 10%, for a ratio of 1.00. If the ratio increased by one standard deviation, it would be 1.25 (say the domestic rate increased from 10% to 12.5%, holding the foreign rate constant). An increase in the ratio of .25 would produce a decrease in investment of $5.335 billion (.25 x 21.34 = 5.335).

4. RGPAT, FedFunds, EXVUS. These variables were significant in the original estimation, but after correcting the data to remove the positive serial correlation, they all became statistically insignificant (p-values of .139, .346, and .387, respectively).

5.2 Keynesian Model

A. General Results. The initial Keynesian model also produced strong results. The R-squared (adjusted) was 97.6%, indicating strong goodness-of-fit. The VIF scores were 2.1 or less, which indicates no problem with multicollinearity. However, the Keynesian model suffered the same serious problem with serial correlation in the original data. The Keynesian model initially produced a D-W score of .38, indicating serial correlation.

The first use of the Cochrane-Orcutt procedure resulted in a regression with a D-W score of 1.42, which falls just below the minimal score for an inconclusive test for positive serial correlation. I performed the Cochrane-Orcutt procedure for a second time, with satisfying results. The D-W score for the regression estimated after the second procedure was 1.86, which falls into the range of no serial correlation for a series with 93 observations and five independent variables. **Table 5.2** presents the results from the estimation.

Table 5.2 Results for Keynesian Model

Variable	Coefficient	Std Dev	p-value
RGPAT, lag 1	0.071	0.077	0.180
AAA, lag 1	-0.885	1.830	0.315
%d M2, lag 4	-1.454*	0.805	0.037
EXVUS	0.068	0.198	0.366
RGNP, lag 1	0.141**	0.009	0.000
n = 93	Regression F 52.83	R-sq(adj) 73.8%	Durbin-Watson 1.86

* Significant to .05
** Significant to .01

All t-tests are one-tailed

Real GNP came in with the expected positive coefficient, significant at .01. Percentage change in M2 came in with the expected negative coefficient, significant at a confidence level of .05. Gross profits, the AAA interest rate, and the exchange value were insignificant. However, the model demonstrates strong predictive ability, with a regression F of 52.83 showing that not all of the variables in the model are not correlated to Investment. Indeed, 73.8% of the variance in Investment can be accounted for by the variables used in the model.

B. Interpretation of specific variables

1. Percentage Change in M2. The results for percentage change in M2 were slightly less significant, and the coefficient was a little smaller in the Keynesian model than in the Classical model. This result indicates that the decrease in Investment due to monetary volatility is less dramatic when only one curve is being affected in the model. At the same time, the shift in the Keynesian model is almost as large as the shift in the Classical model, meaning that the shift in the Investment curve in this model almost equals the combined shift of the supply and demand for loanable funds curves in the Classical model. Therefore, the shift in Investment in the Keynesian model appears to be larger than the shift in the demand for loanable funds. This conforms to the greater theoretical emphasis placed upon uncertainty in the Keynesian theory of investment.

2. Real GNP. GNP plays a significant role in influencing investment. The role of GNP in the model appears to serve a general determinant of business confidence. If the GNP rises in one quarter, then managers respond with high investment. The interpretation here is essentially the same as it was for the Classical model.

3. Exchange value of the dollar, AAA interest rate, and profits after taxes. A relationship exists between variations in the exchange rate did not have a significant statistical relationship to changes in Investment. Evidently, the exchange rate does not produce enough net export growth to significantly affect Investment.

The result for the interest rate is the most interesting. In the Classical theory of investment, and in the regression results for the Classical model, the rate of interest plays a significant role in determining Investment. In Keynesian theory, the interest rate does affect

Investment, but it does not play a large role. The Keynesian theory suggests a steep Investment curve, unresponsive to changes in the interest rate. According to Mr. Keynes, a recessionary "crisis" stems not from a change in the interest rate, but a collapse of expectations:

> Now we have been accustomed in explaining the "crisis" to lay stress on the rising tendency of the rate of interest under the influence of the increased demand for money both for trade and speculative purposes. At times this factor may certainly play an aggravating and, occasionally perhaps, an initiating part. But I suggest that a more typical, and often the predominant, explanation of the crisis is, not primarily a rise in the rate of interest, but a sudden collapse in the marginal efficiency of capital.[11]

The Keynesian model bears out Mr. Keynes's explanation. The AAA rate had a p-value of .315, clearly not significantly related to Investment. The regression affirmed the analysis by demonstrating no significant relationship between the rate of interest and fluctuations in Investment.

The results for gross profits after taxes are the most disappointing from a theoretical perspective. RGPAT showed a statistically insignificant relationship to Investment. The statistical significance is important, because the Keynesian model relies heavily upon the notion of profit expectations as a determinant of Investment. There is a potential explanation for this. RGPAT may be a poor proxy for measuring profit expectations. If managers are forward-looking, then this might be true.

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[11] Keynes, p.315.

Chapter 6. Interpretation and Analysis of Results

6.1 Classical Model

Classical theory assumes that money is neutral, that is, that it does not affect real variables, such as Investment and Income. Modern Classical thinkers, including the Monetarists, oppose the use of monetary policy as a means of affecting economic variables. They argue that the effects of monetary policy are large and indiscriminate: they are large in an open economy, because the balance-of-payments curve adds to the impact of monetary shifts, and indiscriminate, because the time lag of monetary policy makes it effect hit after situations have had months to change.

This study suggests that there should be an additional reason for opposing active monetary policy. In addition to the argument that monetary policy is too unwieldy, there is the additional concern that it frightens investors.

This study tends to minimize the effect of international currency value differentials. The exchange value of the dollar did not have a significant relationship to Investment in either of the estimated models. However, the relative interest rate demonstrated a solid impact on Investment decisions. This evidence indicates that exchange fluctuations are not as important as interest rate fluctuations. This supports the Classical view that Investment (and Savings) are sensitive to changes in the interest rate.

Active monetary policy should not be pursued, according to these results. When the monetary policy aims to increase Investment, by increasing the money supply and decreasing interest rates, the policy will be ineffective. It will be ineffective because the increase in uncertainty associated with the willingness of the Federal Reserve to shift monetary aggregates will cause Investment to decrease. When the monetary policy aims to reduce aggregate demand and rein in inflation, it will be doubly bad. First, the tightening of the money supply will raise interest rates and directly decrease Investment. Second, the volatility will increase uncertainty and depress the willingness to invest. The percentage change in M2 and the relative interest rate effects bear this out.

6.2 Keynesian Model

In the Keynesian model, the results were somewhat disappointing for traditional theory. Conventional Keynesian theory posits profit expectations as a major factor in determining Investment. The Keynesian model estimated in this study undermines this argument. The measure for profit expectations did not have a significant influence on Investment; however, the measure for monetary volatility did have a significant effect.

These findings have important implications for the idea of neutral money. Keynesian theory asserts that money is not neutral, that increases in the money supply will increase aggregate demand, and therefore will increase income and prices, since price expectations adjust slowly. The traditional Keynesian notion of non-neutral money assumes that the increase in money supply will simply increase demand. It does not account for the fact that the shift in the money supply will increase monetary volatility and uncertainty, thereby decreasing Investment and shifting aggregate demand back to the left. This means that even if money is non-neutral, the increase in aggregate demand due to an increase in the money supply will be mitigated by the decrease in Investment associated with the volatility effect.

Conclusion.

The results of this study are clear. In both the Classical and Keynesian theories of Investment, the inclusion of monetary volatility offers a theoretically and statistically significant impact. On a theoretical level, there is reason to expect that increased monetary volatility will reduce Investment. On a statistical level, there is evidence that monetary volatility, measured by percentage change in M2, reduces firms' willingness to invest.

Monetary policy has become much more important in the realm of government influence on the economy in the past couple of decades. The Federal Reserve is often asked to fine tune the economy. Leaving aside the question of whether or not the central bank can effectively steer the economy by altering the money supply, it is clear that changes in monetary policy hurt the economy by increasing uncertainty and reducing Investment. In the short term, this reduces aggregate demand, decreasing production and employment. In the long term, this reduces productivity growth and economic expansion by stunting the growth of the nation's capital stock. Perhaps it is time to rethink the wisdom of fiddling with the money supply.

REFERENCES

Abel, Andrew B., and Ben S. Bernanske, Macroeconomics (Addison-Wesley Publishing Company: Reading, Massachusetts, 1991).

Anderson, David R., Statistics for Business and Economics (West Publishing Company: St. Paul, 1990).

CITIBASE: CITIBANK ECONOMIC DATABASE.

Keynes, John M., The General Theory of Employment, Interest, and Money (Harcourt Brace Jovanovich: New York, 1953).

Maddala, G. S., Introduction to Econometrics (Maximillan Publishing Company: New York, 1988).

Peterson, Wallace C., and Paul S. Estenson, Income, Employment, and Economic Growth (W. W. Norton and Company: New York, 1992).