ON THE RELATIONSHIP BETWEEN STOCK PRICES AND THE QUANTITY OF MONEY

by

MICHAEL MARTINOFF

B.A., University of British Columbia, 1969

A Thesis Submitted in Partial Fulfilment of

the Requirements for the Degree of

MASTER OF BUSINESS ADMINISTRATION

in the Faculty

of

Commerce and Business Administration

We accept this as conforming to the
required standards

THE UNIVERSITY OF BRITISH COLUMBIA

September, 1970

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree tha permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Commerce

The University of British Columbia
Vancouver 8, Canada

Date September 22, 1970

ABSTRACT

The old Quantity Theory of the Value of Money can be expressed as the "Equation of Exchange," $MV \equiv PT$, in which M is the quantity of money, V is the velocity of circulation of money, P is the price level, and T is the total number of transactions during the period under consideration. The major shortcoming of the old Quantity Theory was that velocity (V) was taken to be numerically constant, which it is not.

The new Quantity Theory is a theory of the demand for money as an asset, productive capital yielding a stream of income in the form of convenience, security, and so on. According to this theory, people hold portfolios containing money, bonds, equities, and other assets, and they adjust their portfolios so that they obtain the maximum returns therefrom. The demand for money can be expressed in terms of the demand for other assets (in real terms), the behaviour of the general price level, people's utility preferences, and their total wealth. Given a function describing total income, an equation describing the velocity of circulation of money can be written as the quotient of the income function divided by the demand for money function. This is the difference between the new and old Quantity Theories: under the old, the velocity of money was considered to be a numerical constant; under the new it is described as a function of income and the demand for money.

In accordance with the above theory, when a monetary disturbance is introduced by the central bank, people will want to adjust their

portfolios in such a way as to compensate for the disturbance. The initial impact of the monetary disturbance is in the markets for the most liquid assets: the financial markets. This idea was tested by correlation analysis on Canadian data of money supply and stock prices and variants thereof for the years 1924 - 1967.

Even after the influence of trend had been removed from the data, statistical support was found for the above theory, but only after the influence of random variation had been reduced by six-month moving averaging. However, the evidence--a significant correlation of .259 between percent change in money and percent change in stock prices--suggests that monetary change accounts for only about 6.7 percent of the variation in stock prices. But this conclusion must be tempered by the realisation that variable lags of the same nature as those that exist between monetary change and change in the level of business activity can be expected to exist between monetary change and change in the level of stock prices. Thus it can be argued that the results of correlation analysis tend to understate the actual impact of monetary change on stock prices.

TABLE OF CONTENTS

CHAPTER		Page
I.	Introduction	1
II.	The Quantity Theory of the Value of Money	3
III.	Data, Statistical Tests, and Results Thereof	16
IV.	Analysis of the Results	20
V.	Conclusions	25
	Bibliography	26
	Appendix: The Computer Programme Used	27

CHAPTER I

INTRODUCTION

A competent economist wrote:

> Both monetary change and stock prices lead business cycle turning points, and both series can, therefore, be classified as leading indicators of economic activity. But since monetary changes have a longer lead over business cycle turning points than do stock prices, it follows that monetary change leads stock prices. It was an awareness of these simple leading relationships that was responsible for sparking the investigations...which have turned up additional evidence bearing on the pervasive influence of monetary change.[1]

Sprinkel examined data of stock prices and monetary growth in the United States. For money he used currency plus demand deposits, because this definition yielded better results than did any other. Sprinkel said that a positive relationship exists between stock prices and changes in monetary growth, and he presented evidence in support of his claim; he did not perform statistical tests.

The purpose of this paper is to see if there is a relationship between stock prices and the quantity of money. A positive relationship between stock prices and changes in monetary growth--confirmation of Sprinkel's work--would be expected.

---

[1]Beryl W. Sprinkel, Money and Stock Prices (Homewood, Ill.: Richard D. Irwin, Inc., 1964), p. 115.

Since the Bank of Canada controls the quantity of money in Canada, the quantity of money is taken to be exogenously determined. Thus interest is focused on two areas: firstly, *a priori* reasons why stock prices should respond to changes in the quantity of money; and secondly, empirical evidence of such a relationship. Empirical evidence cannot, of course, provide proof, which is possible only through logic; however, it is assuring to find empirical support for one's *a priori* reasoning.

In Chapter II the Quantity Theory of the Value of Money is discussed. Both the old Quantity Theory and the new are described, and the deficiencies of the old are seen. The theory of how monetary disturbance affects first the financial markets and later the markets for goods and services is described.

In Chapter III the statistical tests performed and the results thereof are presented.

In Chapter IV the results are analysed.

Chapter V contains the conclusions.

CHAPTER II

THE QUANTITY THEORY OF THE VALUE OF MONEY

In this chapter both the old Quantity Theory and the new are described, and the deficiencies of the old are seen. The theory of how monetary disturbance affects first the financial markets and later the markets for goods and services is described.

Though he was not the first to write about the old Quantity Theory of the Value of Money, Fisher[1] expressed the idea of the old Quantity Theory in his "Equation of Exchange," $MV \equiv PT$, in which, during a given period of time, M is the quantity of money (cash plus demand deposits), V is the velocity of money, which is the average rate of turnover of money in its exchange for goods and services, P is the average of the prices struck in all transactions in the economy, and T is the number of transactions. This equation is written as an identity because it is true by definition. However, before the identity can be applied to the real world to yield practical results it must be reformulated as an hypothesis explaining a relationship between dependent and independent variables, for example:

$$V = \frac{PT}{M} \quad \text{or} \quad P = \frac{MV}{T} .$$

---

[1] Irving Fisher, The Purchasing Power of Money, The Controversy over the Quantity Theory of Money, Studies in Economics, ed. by Edwin Dean (Boston: D.C. Heath and Company, 1965), p. 9-28.

The former formula can be considered a definition of velocity; the latter, a theory about prices. It is in this latter form that the Quantity Theory was usually considered.

It may be argued that M, V, and T are the independent variables for the following reasons: M is determined by the monetary authorities; T is determined by the level of real production in the economy, because all exchanges are really exchanges of real goods and services--money is only an intermediary; V is determined by institutional factors, such as the frequency of payment of wages.

Therefore P turns out to be the dependent variable, as would be expected from the microeconomic theory of perfect competition, according to which prices always adjust to equate quantity supplied to quantity demanded, and thus clear the market.

Thus there are three independent variables: M, V, and T. A change in M or V produces a proportional change in P; a change in T produces an inversely proportional change in P. If M drops 50 percent overnight, then the next morning all prices will drop 50 percent, and all factors of production will remain fully employed.

However, it doesn't appear to work that way. Prices are not that flexible; markets are not that perfect. Changes in M produce changes in V and T as well as in P. For example, as the rate of expansion of M declines, V tends to increase because the interest rate has tended to rise, causing firms to try to reduce their holdings of cash. Factors other than M are at work as well. For example, it has been found that as real incomes rise people tend to hold more than proportionately greater amounts of money; consequently V has shown a long-term secular decline.[2]

Thus is can be seen that although the old Quantity Theory is necessarily basically sound, (because it is based on an identity, $MV \equiv PT$) in this basic form it is insufficiently comprehensive to be able to be applied to the real world to yield practical results. This shortcoming was remedied in the new Quantity Theory.[3]

The new Quantity Theory is a theory of the demand for money. Here money is treated as an asset, productive capital yielding a stream of "income."

In the context of this theory, total wealth includes all sources of consumable services, even the productive capacity of human beings. "Income" here is a net concept; that is, an allowance must have been made for maintaining productive capacity intact. Income may also be considered to be the level of consumption of services that could be maintained indefinitely. Wealth is equal to income divided by the rate of interest.

Various forms of wealth are available to the wealth-holder. These forms of wealth differ from each other not only in their market

---

[2]See Milton Friedman, The Demand for Money: Some Theoretical and Empirical Results, in his The Optimum Quantity of Money and Other Essays (Chicago: Aldine Publishing Company, 1970), pp. 111-139.

[3]See Milton Friedman, The Quantity Theory of Money: A Restatement, Ibid., pp. 51-67.

prices, but also in the forms and sizes of the income streams they yield. Wealth may be held as:

1) money, claims that are generally accepted in payment of debts at a fixed nominal value;
2) bonds, claims to time streams of payments that are fixed in nominal units;
3) equities, shares in the returns of enterprises;
4) physical non-human goods, such as consumer durables; and
5) human capital.

Each of these forms of wealth yields a return. Money yields a return--a service--in the form of convenience and security. The real value of this return depends, of course, on the quantity of real goods and services that a given amount of money can buy; that is, it depends on the general price level. This is true of other forms of wealth as well; the price level affects the real value of their yields.

The real return from holding wealth in the form of a bond depends on three things: the periodic (coupon) payment, fixed in nominal amount; the change in the price of the bond over time; and, as above, the price level.

Equities are similar to bonds; that is, the real value of their yield is based on the same considerations, except that the periodic payment is not fixed in nominal amount; indeed, to the extent that the return on an equity rises with the price level, an equity may be considered to yield an income stream of constant real value.

Physical capital goods yield a return in kind. The nominal value of this yield, like the yield on equities, depends on the price level.

So also does human capital yield a return in kind. In a non-slave society it is not possible to specify market prices of human capital, and obstacles exist to investment and disinvestment in human capital. However, direct investment in a human can take place under some circumstances; for instance, a man can invest in himself through education.

Thus far six considerations have been introduced; the price level and the real values of the rates of return on the five forms of wealth. Two more considerations remain to be introduced.

The quantity of each form of wealth in a wealth holder's portfolio will be influenced by his utility preferences (he will want to maximise expected utility) and by his total wealth. Recall that total wealth may be considered to be equal to total income divided by the interest rate, where income is considered to be the return to all forms of wealth, including the non-monetary returns arising from the holding of money, physical capital goods, and human capital.

Eight considerations have been introduced; these considerations determine the quantity of each form of wealth that a wealth holder will hold in his portfolio. Thus the quantity of money which wealth holders will hold can be expressed as a function of the seven other considerations:

Demand for money = f
- real return on bonds
- real return on equities
- real return on physical capital goods
- real return on human capital
- behaviour of the general price level
- utility preferences
- total wealth

simplified,

$$M = f(X) \quad .$$

Observe that although the above matters were introduced in the context of the individual wealth holder as a person, analogous considerations apply to business enterprises as wealth holders; the latter are concerned with the cost of productive services, the cost of substitute productive services, and the value of the product yielded by productive services.

Notice that if income (Y = PT) is given, then dividing Y by M yields an equation describing the velocity of money in terms of the determinants of the demand for money:

$$* \quad \frac{Y}{M} = \frac{Y}{f(X)} = v(X) \quad .$$

Thus the "Equation of Exchange" in which the old Quantity Theory was cast can be seen to be a limited application of equation *, a limited application in which the velocity of money was considered to be if not constant at least numerically stable.

At this point the same question that arose with respect to the old Quantity Theory again arises: how can this theory be applied to the real world to yield practical results?

The stability and importance of the demand function for money and the independence of the factors affecting demand for and supply of money must be considered. Of what use if the new Quantity Theory if the demand for money is a highly unstable function, or if the factors affecting demand for and supply of money are interrelated?

Consider the latter point first. Under a fractional reserve banking system the total amount of money in circulation is equal to the monetary base (in a fiat money system, the liabilities of the central bank; sold, under a pure gold standard) plus the demand deposits created by the banking system through fractional reserve operation. Thus if the reserve ratio is r, and the monetary base is Z, then the total amount of money in circulation is equal to Z/r. The legal reserve ratio is prescribed. However, because reserves required as legal reserves cannot be used as operating reserves, banks keep actual reserves in excess of legal reserves. Consequently the actual reserve ratio is somewhat larger than the legal reserve ratio, and the amount of money actually in circulation is somewhat smaller than the amount which would be in circulation if the banks were to keep only reserves legally required.

The amount of excess reserves to be kept is in the banks' discretion. Thus it can be seen that even if the central bank holds the monetary base constant, the money supply can vary in accordance with the bank's inclinations to hold excess reserves. During an upswing in business activity, when the demand for money increases, and interest rates rise, banks should be inclined to reduce their excess reserves, due to the higher opportunity cost of holding them. This policy will cause the effective money supply to rise (in response to an increase in the demand for money) even if the central bank holds the monetary base constant.

Notice that a monetary base of Z can be expanded into a money supply of Z/r only if all Z of the monetary base is put into the banking system. But currency is part of the monetary base, and people tend to want to hold currency, because of its liquidity. Furthermore, the ratio of currency to deposits that they will hold varies according to their inclinations. It can be seen that by varying their holdings of currency the people can cause the money supply to vary even if the central bank holds the monetary base constant.

The same process, *mutatis mutandis*, can cause monetary contraction, in response to a decrease in the demand for money, or to an increase in the banks' demand for excess reserves, or to an increase in the people's demand for currency. Indeed, the great depression was caused not really by the Fed's contracting the monetary base, but rather by the banks' reducing the money supply by trying to increase their excess reserves and by the people's contracting the money supply by increasing their currency holdings.[4]

---

[4] Milton Friedman, *The Great Contraction 1929 - 1933* (Princeton, New Jersey: Princeton University Press, 1965), p. 46.

> The onset of the [first] banking crisis is clearly marked in all three proximate determinants but particularly in the deposit ratios. From a peak of 11.9 in October 1930, the ratio of deposits to currency declined sharply--a decline that was to carry the ratio, with only minor interruptions along the way, to a low of 4.4 in March 1933. The deposit-reserve ratio likewise began a decline that was to carry it from a level of 12.9 in October 1930--the all-time high was 13.4 in April 1929--to a level of 8.4 in March 1933. These declines brought the deposit-currency ratio back to its level in 1912. They thus wiped out the whole of the much heralded spread in the use of deposits and 'economy' in reserves achieved under the Reserve System.[5]

It can be seen that the supply of money can vary in response to the demand for it; however, should the central bank not want the money supply to vary, it can, through open market operations, cause the monetary base to vary in such a way as to offset other changes such as changes in the deposit-currency and deposit-reserve ratios which would otherwise cause the money supply to vary, as described above. Thus possible variations in the deposit-reserve ratio and in the deposit-currency ratio present no obstacle to the application of the new Quantity Theory.

Consider now the former point. Of what use is the new Quantity Theory if the demand for money is a highly unstable function? Very little. But the demand for money has been shown empirically to be highly stable; Friedman mentions several studies.[6]

> One cannot read Lerner's description of the effects of monetary reform in the Confederacy in 1864 without recognizing that at least on occasion the supply of money can be a largely autonomous factor and the demand for money highly stable even under

---

[5] Ibid.

[6] See Friedman, Optimum Quantity, pp. 64-65.

> extraordinarily unstable circumstances. After three years of war, after widespread destruction and military reverses, in the face of impending defeat, a monetary reform that succeeded in reducing the stock of money halted and reversed for some months a rise in prices that had been going on at the rate of 10 per cent a month most of the war! It would be hard to construct a better controlled experiment to demonstrate the critical importance of the supply of money.[7]

In summary thus far, the new Quantity Theory is a theory of the demand for money as a productive asset. The demand for money has been found empirically to be highly stable.[8] An equation describing the velocity of money can be derived from the demand for money. This is the difference between the new Quantity Theory and the old: under the old the velocity of money was considered to be stable, a numerical constant; under the new it is considered to be a stable <u>function</u>. The old Quantity Theory was unduly simple.

Of what use is the new Quantity Theory? It can be used to provide a means of relating monetary change, change in stock prices, and change in the level of business activity.[9]

Consider an economy in which real wealth and real GNP remain, for the sake of simplicity, constant, but in which the money supply has been expanding at an annual rate of 5 percent for some time, producing a continuous increase in the price level at an annual rate of 5 percent. The people have fully adjusted to this annual rate of price increase, and expect it to continue.

---

[7] <u>Ibid</u>., p. 64.

[8] <u>Ibid</u>., pp. 64-65.

[9] <u>Ibid</u>., pp. 229-235.

The people hold real wealth in various forms: money, bonds, equities, physical capital goods, and human capital. Notice that it is real wealth that matters; the people's nominal money holdings, for example, increase at an annual rate of 5 percent, but the real value of these money holdings--the amount of real goods and services which can be received in exchange for these money holdings--remains constant, since the price level is increasing at an annual rate of 5 percent.

Suppose now that the central bank does not make its regular purchase of bonds, which would have enabled the money supply to continue to grow; it has introduced a monetary disturbance which, it will be seen, will travel through the financial markets and eventually cause readjustment in the market for real goods and services.

It is assumed that the people already held the desired proportions of real assets in their portfolios. Had the central bank made its regular purchase of bonds, the nominal value of the total stock of bonds in the hands of the people would have continued to rise at an annual rate of 5 percent, and the real values of both the total stock of bonds and the total stock of money would have remained constant. However, now it is the nominal value of the money stock which remains constant; because of the 5 percent annual rate of increase in the price level, the real value of the stock of money has begun to fall at an annual rate of 5 percent. Thus the actual proportions of real wealth which the people hold in their portfolios become different from the desired proportions. The people will take action to restore equality between actual and desired real amounts of assets in their portfolios;

they will sell bonds--driving down the prices of bonds--and buy money in order to reduce the relative amount of real bonds held and to increase the relative amount of real money held. But they are not selling their bonds to the central bank (because it isn't buying); consequently the money supply is not growing. They are able to approach the desired ratio of the real value of their money holdings to the real value of their holdings of other assets only by selling some of their other assets. After bonds, equities are most readily marketable, so they are sold as well as bonds. Disinvesting in other assets, such as physical capital goods, is not as easy as disinvesting in bonds and equities, so these bear most of the burden of adjustment.

As the nominal value of the money supply continues to remain constant--and thus the real value of the money supply continues to fall--the adjustment process which began in the financial markets spreads to the markets for other assets. The prices of, for example, physical capital goods begin to fall. At this point the prices of the final goods and services provided by the physical capital goods (and human capital) are seen to be too high in relation to the prices of the capital which is their source, and so the demand for these final goods and services falls. Workers who choose to price their services above the market become unemployed. But now the monetary disturbance is beginning to affect the final prices of goods and services. In time price rigidities (which in this hypothetical economy meant annual price increases of 5 percent) are overcome, and the rate of increase inthe price level drops to zero. Now a new equilibrium is reached in which real and nominal values of assets are equivalent.

To the extent that prices of all assets in the economy did not adjust quickly to the decline in the real value of the money stock, the burden of adjustment was borne excessively by the more liquid assets. As the prices of the less liquid assets and of final goods and services were brought into line, a recovery in the prices of the more liquid assets was enabled.

> ...we should expect it [monetary disturbance] to have its first impact on the financial markets, and there, first on bonds, and only later on equities, and only still later on actual flows of payments for real resources. This is of course the actual pattern. The financial markets tend to revive well before the trough. Historically, railroad bond prices have risen very early in the process. Equity markets start to recover later but still generally before the business trough. Actual expenditures on purchases of goods and services rise still later.[10]

In summary, then, this is what happened in the economy under consideration:

1) The economy was in equilibrium; actual holdings of real assets were equal to desired holdings.

2) A monetary disturbance was introduced; the real value of the stock of money began to decline.

3) In order to maintain the desired ratio of real money to other real wealth people began to sell liquid assets, driving down their prices.

4) In time the process of adjustment spread to the markets for less liquid assets, and recovery in the financial markets was enabled, as the economy approached a new equilibrium.

---

[10] Ibid., pp. 231-232.

Of course in practice, given that neither the Bank of Canada nor the Fed has pursued a policy of constant monetary expansion, equilibrium has not been reached; rather, the economy has been required to adjust to disturbance after disturbance.

Now it is possible to state the hypothesis to be tested in this paper: that, on the basis of the above new Quantity Theory, a statistically testable relationship exists between the behaviour of the money supply and the behaviour of stock prices. More specifically, a positive correlation between money and stock prices, and between stock prices and changes in monetary growth, would be expected.

CHAPTER III

DATA, STATISTICAL TESTS, AND RESULTS THEREOF

In this chapter the statistical tests performed are briefly described, and the results thereof are presented. More detailed analysis follows in Chapter IV.

Data describing stock prices and seasonally adjusted cash and demand deposits in Canada for the years 1924-1967 were collected.[1] Correlation analyses on several pairs of variables, listed in Table I and described below and further explained in Chapter IV, were run; lags of up to +120 to -120 months[2] were introduced, in order to see if better results could be obtained in this way than without lags. Since a lag exists between the beginning of a monetary disturbance and the beginning

---

[1]Money supply was considered to be cash plus demand deposits. The Dominion Bureau of Statistics index of total common stock prices was used for Stock prices. Data on cash, demand deposits, and stock prices were taken from the Dominion Bureau of Statistics *Statistical Summary Supplements*. Periodically there were discontinuities in the series; at each of these points an adjustment ratio was calculated and the data were adjusted accordingly. The adjustment ratio was calculated in this fashion: at a point at which the two discontinuous parts of the series overlapped the datum for the new part and the datum for the earlier part were observed and the ratio new datum'old datum was calculated. The earlier data were then multiplied by this ratio.

[2]Each test was run initially with lags of +24 to -24 months; it was thought that longer lags were *a priori* unreasonable. However, in those tests in which trend was an influence--explained further in this chapter and in the following chapter--the highest correlations appeared at the longest lags. Consequently, these tests were re-run with progressively longer lags, up to 120 months.

of a reaction in the level of business activity, a lag might also be expected to exist between the beginning of a monetary disturbance and the beginning of a reaction in the stock market.

Test #1 was quite straightforward: money vs. stock prices. The correlation results of test #1 were high throughout the whole range of lags of +120 to -120 months; this is the results of comparing what are essentially two trends.

The idea behind test #2 was to eliminate the trends in both money and stock prices by constructing exponential trend lines, measuring percent deviations of the actual data from the trends, and correlating these deviations. For the purposes of test #2 it was assumed that money supply grew at a constant annual rate μ per time period t, as:

$$M(t) = M_o \theta^{\mu t} .$$

It was assumed that stock prices grew similarly. For the purposes of the test μ was calculated, as was θ, the corresponding parameter for stock prices. Then the series of data describing exponential growth--at the above calculated rates--in stock prices and in money were calculated; that is, the trend lines were constructed. Then each datum was divided by the corresponding trend datum, from which result 1.0 was subtracted, yielding the percent deviation from trend. These are the data that were correlated in that test.

TABLE I

Test	Best Correlation(s)	Lag of latter Variable Over Former	Result Significant at Better Than the ____ Level
#1 Stock prices vs. money	.957 .965	-118 mo. +120 mo.	.005 .005
#2 Percent deviation from trend of exponentially normalised stock prices vs. similarly treated money	.811	-112 mo.	.005
#3 Stock prices vs. first differences in log. money	Not significantly different from zero		
#4 Stock prices vs. 6-month moving averages of first differences in log. money	Not significantly different from zero		
#5 First differences in log. stock prices vs. first differences in log. money	Not significantly different from zero		
#6 6-month moving averages of first differences in log. stock prices vs. 6-month moving averages of first differences in log. money	.259	-2 mo.	.005

First differences in the natural logarithms of the data of a series are equivalent to percent changes in those data. These were used in several combinations in the remaining tests.

Because of erratic fluctuations in the money series, Sprinkel recommends, "...computing a current annualized rate of change for each month but averaging the most recent six months' rates. The resulting series removes most short-run erratic movements but retains fair sensitivity to average recent developments."[3]

Annualizing having no effect on correlation, six-month moving averages of natural logarithms of both series were tried in test #6. In contrast to tests #1 and to some extent #2, the correlation results of test #6 did not remain high throughout, but fell rapidly and decidedly on both sides of the peak.

---

[3] Sprinkel, Op. Cit., p. 45.

CHAPTER IV

ANALYSIS OF THE RESULTS

Given that it is desired to see whether or not a relationship exists between money and stock prices, one might ask, "Which are the relevant variables to be correlated: the level of stock prices, or change in stock prices vs. the level of the money supply, or change in the money supply, or perhaps change in change in the money supply?"

Observe first that the "level" of the money supply and the "level" of stock prices are not necessarily comparable magnitudes; the former is a quantity of wealth; the latter, an average of prices. These are not the same dimensions. But what does it matter what the dimensions are? What is being sought is a statistically sound relationship.

A time series can be considered to contain four elements: a trend, plus cyclical, seasonal, and random fluctuations. Thus, given a time series, the choice of which variation thereupon is to be statistically tested depends on which element of the time series is to be examined. Since the data used in these tests are seasonally adjusted, seasonal variation is taken to be eliminated.

Thus the results of test #1, the test of stock prices vs. money, contain the influence of the remaining three elements: trend, cyclical variation, and random variation. That the correlation results are high throughout the range of lags of -120 months to +120 months suggests that the influence of trend on these results is very powerful.

Of what use is the information that both money supply and stock prices exhibit rising trends? Not much. Suppose the money supply has been rising for some time and is expected to continue to rise at an annual rate of x percent, where x percent is greater than the annual rate of increase necessary to satisfy people's increasing demand to hold real money. Then the price level will have been rising at an annual rate of y percent, and it expected to continue to rise at that rate. Consequently, the nominal interest rate will be equal to the real interest rate plus y percentage points, in order that the rise in the price level be discounted by the market. The price of a bond which retained interest and paid compound interest thereon would rise at the nominal interest rate compounded, as would, in the absence of discriminatory taxation, an equity of equal risk which retained all its earnings. Here there is no opportunity for profit beyond a normal rate of return on investment.

Consider now test #2, the theory of which--the removal of a hypothetical exponential growth trend--was described in Chapter II. The results of this test are much more appealing, because in contrast to those of test #1, the correlations do not remain high over all the lags; rather, they decline quite smoothly from the peak value of .811 (where money leads stock prices by 112 months) to zero in the area around zero lag. This lends the inference that the test reveals more than just the results of correlating two trends. However, why was the lag--112 months--so long? The answer is that in this test deviations were taken about a hypothetical long-run growth trend, though in reality many shorter trends surely existed over the time period tested. Consequently what was examined was a congeries of cyclical influences and trends, and the trends certainly produced their impact in the form of the long lag.

In the remaining four tests, in order to remove the influence of trend from the data, monthly percent differences, that is, first differences in the natural logarithms of the data, were introduced. Tests #3 and #4 produced results not significantly different from zero, as might be expected because the influence of trend was still present, in stock prices. Six-month moving averages were used in test #4 (to no avail) as in test #6 (to some avail) in order to reduce the influence of random fluctuations.

The propriety of the use of six-month moving averages might well be questioned. On the one hand it may be argued that in monthly data there exists a substantial random element, which ought to be removed by six-month moving-averaging, but on the other hand it may be argued that one can moving-average one's way down to a straight line for each series. However, the results of test #6 do not show high correlations over various lags, the result characteristic of the correlation of two somewhat straight lines, that is, two trends; rather, the correlation results of test #6 fell rapidly and decidedly on both sides of the peak. The peak correlation, .259 was obtained with money leading stocks by two months; the adjacent correlations were as in Table II.

TABLE II

Lag (months)	Correlation
-8	.080
-7	.093
-6	.118
-5	.168
-4	.200
-3	.228
-2	.259
-1	.258
0	.248
1	.218
2	.184
3	.165
4	.123
5	.128
6	.117
7	.099
8	.084

In both directions away from the peak the correlations dropped smoothly to zero and remained there.

It will be noted that although the correlation of .259 was found to be significant at better than the .005 level, an r of .259 implies an r^2 of only 6.7; that is, only 6.7 percent of the variation in six-month moving averages of percent changes in stock prices can be accounted for by six-month moving averages of percent changes in money.

Williams writes:

> So rapid can be the velocity of circulation of money in both the stock market and the real estate market that neither stocks nor real estate need ever wait for an increase in the quantity of money in order to rise in price, and no shortage of money need ever keep prices down in these markets.[1]

[1]John Burr Williams, The Theory of Investment Value (New York: Augustus M. Kelley, 1965), p. 49.

Sprinkel admits:

> It must be remembered too that infrequently the stock market experiences a cycle all its own, apparently unrelated to the business cycle. In 1939 and 1940 when war broke out in Europe and for a while went badly for the Allies, the U.S. stock market broke sharply despite strong underlying monetary and economic trends. Again in 1962, the market suffered a sharp break even though a recession did not follow shortly. However, favorable liquidity trends restored most of the losses within several months; and stock prices eventually rose to new highs before liquidity trends became unfavorable.[2]

Thus it seems that money may not be very important to the stock market. However, with reference to the low correlation, .259, obtained above, it should be pointed out that since there exists a variable lag between the beginning of a monetary disturbance and the beginning of a reaction in the level of business activity, a variable lag might also be expected to exist between the beginning of a monetary disturbance and the beginning of a reaction in the stock market. Such a variable lag would preclude the use of correlation analysis as a means of detecting a relationship between money and stock prices; indeed, if it were given that variability exists in the lag, then the correlation of .259 could be considered quite high.

Sprinkel performed no correlation analysis; rather he plotted graphs of stock prices and six-month moving averages of percent changes in money and, fitting trend lines by eye, produced results considerably more encouraging than a correlation of .259.[3]

---

[2] Sprinkel, Op. Cit., p. 116.

[3] Sprinkel, Ibid., p. 5.

CHAPTER V

CONCLUSIONS

The theory of how monetary disturbance ought to affect financial markets was seen in Chapter I. Recall that, according to the theory, monetary disturbance affects the amounts of various assets that wealth-holders wish to hold, causing them to adjust their portfolios, first with respect to their most liquid assets.

Even after the influence of trend had been removed from the data, statistical support was found for the above theory, but only after the influence of random variation had been reduced by six-month moving averaging. However, the evidence--a significant correlation of .259--suggests that monetary change accounts for only about 6.7 percent of the variation in stock prices. But this result must be tempered with the realisation that variable lags of the same nature as those that exist between monetary change and change in the level of business activity can be expected to exist between monetary change and change in the level of stock prices. Thus it can be argued that the discovered results of correlation analysis tends to understate the actual impact of monetary change on stock prices.

BIBLIOGRAPHY

Dean, E. (ed.), The Controversy Over the Quantity Theory of Money. Studies in Economics. Boston: D.C. Heath and Company, 1965.

Friedman, M. The Optimum Quantity of Money and Other Essays. Chicago: Aldine Publishing Company, 1970.

Friedman, M. The Great Contraction 1929-1933. Princeton, New Jersey: Princeton University Press, 1965.

Sprinkel, B. W. Money and Stock Prices. Homewood, Ill.: Richard D. Irwin, Inc., 1964.

Williams, J. B. The Theory of Investment Value. New York: Augustus M. Kelley, 1965.

```
****WE ARE HAVING MANY HARDWARE PROBLEMS--SORRY****
******************** THIS JOB SUBMITTED THROUGH FRONT DESK READER ******************
$SIGNON WFJW T=200 P=50 COPIES=4
**LAST SIGNON WAS: 21:34:09   09-09-70
 USER "WFJW" SIGNED ON AT  15:01:36 ON 09-11-70
$LIST *SOURCE*
$RUN *WATFOR 5=*SOURCE* 6=*SINK*
$COMPILE
      SUBROUTINE CORLTN(X,Y)
      DIMENSION X(528), Y(528)
      DO 1 K=6,78
      XYSUM = 0.0
      XSUM  = 0.0
      YSUM  = 0.0
      XSQSUM= 0.0
      YSQSUM= 0.0
      DO 2 I=42,488
      J=K+I-42
      XYSUM = XYSUM + X(I)*Y(J)
      XSUM = XSUM + X(I)
      YSUM = YSUM + Y(J)
      XSQSUM=XSQSUM+X(I)*X(I)
2     YSQSUM=YSQSUM+Y(J)*Y(J)
      Z=SQRT((500.0*XSQSUM-XSUM*XSUM)*(500.0*YSQSUM-YSUM*YSUM))
      IF(Z.LT.0.001)GO TO 3
      R=(500.0*XYSUM-XSUM*YSUM)/Z
      N = K-42
      WRITE(6,21) N, R
21    FORMAT(1X, I5, F10.4)
      GO TO 1
3     WRITE(6,22)
22    FORMAT(16HZ LESS THAN .001)
1     CONTINUE
      RETURN
      END
C
      REAL M, LOGM, LOGSA
      DIMENSION C(528), DD(528),               STKAVG(528), M(528),
     1                         CUNAJ(528),DDUNAJ(528),SAUNAJ(528),
     3 LOGM(528), CHLOGM(528), AVCLM(528), DUMF(528),
     4 LOGSA(528), CHLOGS(528), AVCLS(528),DUMF(528)
      DO 500 I=1,528
      READ (5,11) DDUNAJ(I), CUNAJ(I), SAUNAJ(I)
11    FORMAT (F8.1,F8.1,F8.1,F8.3)
500   CONTINUE
C
C
C     INSTRUCTIONS TO ACJUST DATA
C
      A=1.0
      B=1.0
      CC=1.0
      DO 30 I=1,528
      K=529-I
      IF(I.EQ. 28) A=2262.0/2325.0*A
      IF(I.EQ. 39) B=4425.0/5847.0*B
      IF(I.EQ. 74) CC=139.9/326.3*CC
```

```
      IF(I.EQ.135) B=3764.0/3846.0*B
      IF(I.EQ.172) B=3292.0/3150.0*B
      IF(I.EQ.267) A=1069.5/998.8*A
      IF(I.EQ.326) CC=74.5/81.7*CC
      IF(I.EQ.339) A=251.0/248.7*A
      IF(I.EQ.409) CC=75.3/72.2*CC
   31 C(K)=CUNAJ(K)*A
      DD(K)=DDUNAJ(K)*B
   30 STKAVG(K)=SAUNAJ(K)*CC
      DO 12 I=1,528
      M(I)= C(I)+DD(I)
      LOGSA(I)=ALOG(STKAVG(I))
   12 LOGM(I)=ALOG(M(I))
      DO 13  I=1,527
      CHLOGM(I+1)=LOGM(I+1)-LOGM(I)
   13 CHLOGS(I+1)=LOGSA(I+1)-LOGSA(I)
      CHLOGM(1)=0.0
      CHLOGS(1)=0.0
      DUMF(4)=CHLOGM(2)+CHLOGM(3)+CHLOGM(4)+CHLOGM(5)+CHLOGM(6)+CHLOGM(7
     1)
      DUME(4)=CHLOGS(2)+CHLOGS(3)+CHLOGS(4)+CHLOGS(5)+CHLOGS(6)+CHLOGS(7
     1)
      AVCLM(4)=DUMF(4)/6.0
      AVCLS(4)=DUME(4)/6.0
      DO 110 I=4,524
      J=I-2
      DUMF(I+1)=DUMF(I)-CHLOGM(J)+CHLOGM(J+6)
      DUME(I+1)=DUME(I)-CHLOGS(J)+CHLOGS(J+6)
      AVCLS(I+1)=DUME(I+1)/6.0
  110 AVCLM(I+1)=DUMF(I+1)/6.0
      AVCLM(1)=0.0
      AVCLM(2)=0.0
      AVCLM(3)=0.0
      AVCLM(526)=0.0
      AVCLM(527)=0.0
      AVCLM(528)=0.0
      AVCLS(1)=0.0
      AVCLS(2)=0.0
      AVCLS(3)=0.0
      AVCLS(526)=0.0
      AVCLS(527)=0.0
      AVCLS(528)=0.0
C
C
C     NOW WE WILL PRINT OUT ALL THE DATA
C
  201 WRITE(6,41)
   41 FORMAT( //// 1X, 19H 1  UNADJUSTED CASH, /
     11X, 17H 2  ADJUSTED CASH, /
     21X, 30H 3  UNADJUSTED DEMAND DEPOSITS, /
     31X, 28H 4  ADJUSTED DEMAND DEPOSITS, /
     41X, 29H 5  MONEY, FROM ADJUSTED DATA, /
     51X, 13H 6  LOG MONEY,/
     51X, 28H 7  FIRST DIFFERENCES IN (6),/
     61X, 35H 8  SIX-MONTH MOVING AVERAGE OF (7),/
     91X, 29H 9  UNADJUSTED STOCK AVERAGES, /
     11X, 27H10  ADJUSTED STOCK AVERAGES, /
     21X, 23H11  LOG STOCK AVERAGES,/
     31X, 30H12  FIRST DIFFERENCES IN (11),/
     41X, 38H13  SIX-MONTH MOVING AVERAGES OF (12),/)
```

```
      WRITE(6,99)
   99 FORMAT(10X,1H1,6X,1H2,6X,1H3,6X,1H4,6X,1H5,6X,1H6,6X,1H7,6X,1H8,
     1       6X,1H9,6X,2H10,5X,2H11,5X,2H12,5X,2H13)
      NYEAR=1923
      DO 43 J=1,44
      NYEAR=NYEAR+1
      WRITE(6,44) NYEAR
   44 FORMAT (// 1X, I4)
      K=J-1
      L=K*12
      DO 43 N=1,12
      I=L+N
      WRITE(6,46)CUNAJ(I),C(I),DDUNAJ(I),DD(I),M(I),LOGM(I),CHLOGM(I),
     1AVCLM(I),SAUNAJ(I),STKAVG(I),LOGSA(I),CHLOGS(I),AVCLS(I)
   46 FORMAT( 6X,  5(F7.1),3(F7.2),2(F7.1),3(F7.2))
   43 CONTINUE
C
C
      WRITE(6,15)
   15 FORMAT (////53HSTOCK PRICES VS MONEY, MONEY LAGGED -36 TO +36 MONT
     2HS//)
      CALL CORLTN(STKAVG,M)
      WRITE(6,16)
   16 FORMAT (//// 64H STOCK PRICES VS FIRST DIFFERENCES IN LOG MONEY, L
     3AGGED AS ABOVE //)
      CALL CORLTN(STKAVG,CHLOGM)
      WRITE(6,17)
   17 FORMAT (//// 93H STOCK PRICES VS SIX-MONTH MOVING AVERAGES OF FIRS
     4T DIFFERENCES IN LOG MONEY, LAGGED AS ABOVE //)
      CALL CORLTN(STKAVG, AVCLM)
      WRITE(6,18)
   18 FORMAT(//// 89H FIRST DIFFERENCES IN LOG STOCK PRICES VS FIRST DIF
     5FERENCES IN LOG MONEY, LAGGED AS ABOVE //)
      CALL CORLTN(CHLOGS,CHLOGM)
      WRITE(6,19)
   19 FORMAT(////111H SIX-MONTH MOVING AVERAGES OF FIRST DIFFERENCES IN
     6LOG STOCK PRICES VS SIMILARLY TREATED MONEY, LAGGED AS ABOVE //)
      CALL CORLTN(AVCLS,AVCLM)
C
C
      STOP
      END
$DATA
END OF FILE
```

```
RES NO. 774812          UNIVERSITY OF B C COMPUTING CENTRE    MTS(AN120)          15:01:34    09-11-70
```

```
USER: WFJW
DEPARTMENT: COMM

**** ON AT  15:01:36
**** OFF AT 15:01:38
**** ELAPSED TIME          1.3    SEC.
**** CPU TIME USED          .385  SEC.
**** STORAGE USED          1.52   PAGE-SEC.
**** CARDS READ          159
**** LINES PRINTED       708
**** PAGES PRINTED        16
**** CARDS PUNCHED         0
**** DRUM READS            0
**** RATE FACTOR           1.0
**** APPROX. COST OF THIS RUN  C$1.15

**** FILE STORAGE        169 PG-HR.    C$.06

**LAST SIGNON WAS: 21:34:09   09-09-70
```

```
MMMMM                   MMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT        SSSSSSSSS
MMMMMM                 MMMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT      SSSSSSSSSSSSS
MMMMMMM               MMMMMMM     TTTTTTTTTTTTTTTTTTTTTTTTT    SSSSSSSSSSSSSSSSS
MMMMMMMM             MMMMMMMM              TTTTT              SSSSSS       SSSSSSS
MMMMMMMMM           MMMMMMMMM              TTTTT             SSSSS           SSSSS
MMMMMMMMMM         MMMMMMMMMM              TTTTT             SSSSS
MMMMM MMMMM       MMMMM MMMMM              TTTTT              SSSSSS
MMMMM  MMMMM     MMMMM  MMMMM              TTTTT               SSSSSSSSSSSSS
MMMMM   MMMMM   MMMMM   MMMMM              TTTTT                 SSSSSSSSSSSSS
MMMMM    MMMMMMMMMMM    MMMMM              TTTTT                   SSSSSSSSSSSSS
MMMMM     MMMMMMMMM     MMMMM              TTTTT                           SSSSSSS
MMMMM      MMMMMMM      MMMMM              TTTTT                             SSSSS
MMMMM       MMMMM       MMMMM              TTTTT                             SSSSS
MMMMM        MMM        MMMMM              TTTTT             SSSSS           SSSSS
MMMMM                   MMMMM              TTTTT             SSSSSSS       SSSSSSS
MMMMM                   MMMMM              TTTTT               SSSSSSSSSSSSSSSSS
MMMMM                   MMMMM              TTTTT                 SSSSSSSSSSSSS
MMMMM                   MMMMM              TTTTT                   SSSSSSSSS
```