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MONEY AND STOCK PRICES

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# MONEY AND STOCK PRICES

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MONEY AND STOCK PRICES

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ABSTRACT

MONEY AND STOCK PRICES

by Steven J. Cross

This study was conducted to examine the issues and controversy surrounding the relationship between the money supply and stock prices. The specific issue addressed in this study was whether current stock price changes were significantly related to past or future changes in the money supply.

The investigation began with an examination of the theoretical framework for such a relationship. This was followed by a review of the related empirical studies. Finally, additional empirical evidence was presented.

The examination of the theoretical framework included the stock valuation model, the quantity theory of money, the rational expectations hypothesis, and the efficient market hypothesis.

The empirical portion of this study employed multiple regression analysis and correlation analysis to examine the relationship between current stock price changes and past and future changes in the money supply for the period 1960-82 and the subperiods 1960-72 and 1978-82. The money supply measures were M1 and M2, revised and seasonally adjusted. The stock price measure was the Standard and

Poor's Composite 500-Stock Index. Percentage changes in both series were examined for both monthly and quarterly data. Additionally, a Chow test was conducted to test for structural differences in the relationship between the periods 1960-72 and 1973-82.

The results of the empirical portion of the study indicate that the nature of the relationship can best be described as one where current changes in stock prices are related to past money supply changes. However, future changes in the money supply, at least as measured by monthly M2, also appear to be significantly related to current stock prices when the 1973-82 and 1960-82 periods are examined. The findings also indicate that there appears to be a structural difference in the relationship between the money supply and stock prices between the periods 1960-72 and 1973-82.

Moreover, the findings indicate that several factors, such as differences in the periods examined, differences in measures of money supply, differences in data bases employed, differences in methodologies, etc. may account for differences in the findings and conclusions of previous studies.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDIXES

# CHAPTER 1

## INTRODUCTION

There are few, if any, areas of economics or finance which have generated so much interest and controversy in recent years as the relationship between money and stock prices. Although much has been written and there has been much debate over the past three decades, the issue is not, as yet, settled. In 1977, Tanner and Trapani conducted a study "to reexamine these apparent contradictions in the capital market literature."[1] In 1981, Leonard and Kehr described this relationship as "an issue of continuing controversy."[2] Even more recently, Davidson and Froyen stated that the purpose of their research was "to provide further evidence on the timing of the relationship between monetary policy changes and stock returns."[3]

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[1]J. Ernest Tanner and John M. Trapani, "Can the Quantity Theory Be Used to Predict Stock Prices--Or Is the Stock Market Efficient?," Southern Economic Journal 44 (October 1973):261-70.

[2]David C. Leonard and James B. Kehr, "Stock Market Returns and Monetary Aggregates: Recent Evidence on the Issue of Causality," Review of Business and Economic Research 17 (Fall 1981):40-50.

[3]Lawrence S. Davidson and Richard T. Froyen, "Monetary Policy and Stock Returns: Are Stock Markets Efficient?," Federal Reserve Bank of St. Louis Review 64 (March 1982):3-12.

This study does not purport to present conclusive evidence that will ultimately resolve the issue. The emphasis of this study is pedagogical rather than empirical. It seeks to provide a better understanding of this controversial issue through an examination of the theoretical background, a review of the previous empirical studies, and the presentation of additional empirical evidence.

The study is organized in six chapters. Chapter one presents the statement of the problem, purpose of the study, significance of the study, delimitations of the study, definition of terms, hypotheses, and basic assumptions. Chapter two examines the theoretical background, and chapter three presents a review of empirical studies related to this issue. Chapter four describes the research procedures and methodology employed in this study. Chapter five is a presentation of the findings of this research. Chapter six provides a summary and the conclusions and implications of the study.

## Significance of the Study

As demonstrated in the introduction of this paper, a great deal of controversy exists in the literature as to the nature of the relationship between money supply and stock prices. This paper examines the issue of whether current stock price changes are related to current, past, or future changes in the money supply. It would seem, at

first, that this would be a rather straightforward proposition. The controversy surrounding this relationship relates to the timing of stock price changes relative to money supply changes. The significance of this relationship lies in its implications on the basic theories which form the foundation of economic and financial analysis.

The work of Friedman and Schwartz (1963)[1] stimulated research in this area and is often used to support the proposition that changes in the money supply lead changes in stock prices. Friedman and Schwartz found that money supply changes precede changes in overall economic activity which led them to conclude that this was evidence in support of the quantity theory of money. In their work, they traced a mechanism whereby changes in the money supply would lead to changes in securities prices.

One of the earliest and most famous empirical studies of the specific relationship between money and stock prices was conducted by Sprinkel.[2] He concluded that changes in the money supply lead changes in stock prices. Sprinkel felt this evidence supported the quantity theory of money.

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[1]Milton Friedman and Anna J. Schwartz, "Money and Business Cycles," Review of Economics and Statistics 45 (February 1963):32-64.

[2]Beryl W. Sprinkel, Money and Markets: A Monetarist View (Homewood, Ill.: Richard D. Irwin, 1971).

Sprinkel's work was followed by studies by Palmer,[1] Keran,[2] Reilly and Lewis,[3] Homa and Jaffee,[4] Hamburger and Kochin,[5] and others. These works confirmed the results of Sprinkel and concluded that changes in money supply lead to changes in stock prices. Although not without their critics (Miller[6]), these early studies resulted in a general consensus of opinion in support of the quantity theory and a lagged relationship between changes in money and changes in stock prices.

Later studies conducted by Pesando (1974),[7] Cooper

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[1]Michael Palmer, "Money Supply, Portfolio Adjustments and Stock Prices," Financial Analysts Journal 26 (July-August 1970):19-22.

[2]Michael W. Keran, "Expectations, Money, and the Stock Market," Federal Reserve Bank of St. Louis Review 53 January 1971):16-31.

[3]F. K. Reilly and J. E. Lewis, "Monetary Variables and Stock Prices," March 1971, Working Papers No. 38. School of Business, University of Kansas, Lawrence.

[4]Kenneth E. Homa and Dwight M. Jaffee, "The Supply of Money and Common Stock Prices," Journal of Finance 26 (December 1971):1045-66.

[5]Michael J. Hamburger, Jr., and Levis A. Kochin, "Money and Stock Prices: The Channels of Influence," Journal of Finance 27 (May 1972):231-49.

[6]Merton H. Miller, "Money and Stock Prices: The Channels of Influence, Discussion," Journal of Finance 27 (May 1972):294-98.

[7]James E. Pesando, "The Supply of Money and Common Stock Prices: Further Observations on the Econometric Evidence," Journal of Finance 29 (June 1974):900-921.

(1974),[1] Rozeff (1974),[2] Auerbach (1976),[3] Kraft and Kraft (1979),[4] Rogalski and Vinso (1977),[5] Tanner and Trapani (1977),[6] Leonard and Kehr (1981),[7] Davidson and Froyen (1982),[8] and others began to question the conclusions of the earlier studies. These later writers felt that a relationship in which stock prices lagged money supply changes was inconsistent with the growing body of literature on rational expectations theory and the efficient market hypothesis. They reasoned that, in a world where markets quickly incorporate all relevant past and current information and where investors base their actions on

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[1]Richard V. L. Cooper, "Efficient Capital Markets and the Quantity Theory of Money," Journal of Finance 19 (June 1974):887-908.

[2]Michael S. Rozeff, "Money and Stock Prices: Market Efficiency and the Lag in Effect of Monetary Policy," Journal of Financial Economics 1 (1974):245-302.

[3]Robert D. Auerbach, "Money and Stock Prices," Federal Reserve Bank of Kansas City Monthly Review (September 1976):3-11.

[4]John Kraft and Arthur Kraft, "Determinants of Common Stock Prices: A Time Series Analysis," Journal of Finance 32 (May 1977):417-25.

[5]Richard J. Rogalski and Joseph D. Vinso, "Stock Returns, Money Supply and the Direction of Causality," Journal of Finance 32 (September 1977):1017-30.

[6]Tanner and Trapani, "Can Quantity Theory Predict Stock Prices."

[7]Leonard and Kehr, "Returns and Aggregates."

[8]Davidson and Froyen, "Monetary Policy and Stock Returns."

predictions of the future, stock prices could not lag money supply. Most of these later writers interpreted their empirical findings as indicating that stock price changes were related to future money supply changes and not past money supply changes. Some went so far as to say this meant that stock prices caused money supply changes.[1] More recent studies purported to show that the relationship was one where stock prices were related only to current money supply changes and not to either future or past money supply changes.

The criticisms which were brought against both the early writers and the later writers related to their assumptions, methodology, interpretation of findings, and conclusions drawn from their studies as they related to these apparently conflicting theories. However, at the center of the controversy was the question of whether current stock price changes were related to current, past, or future changes in the money supply.

## Statement of the Problem

This study seeks to examine the issues pertaining to the relationship between the money supply and stock prices. More specifically, it will examine the issue of whether there exists a significant relationship between

[1]Rogalski and Vinso, "Stock Returns, Money Supply and the Direction of Causality."

past, future, or current changes in the money supply and current changes in stock prices and the implications of such a relationship.

## Purposes of the Study

The specific purposes of this study are:

1. To identify and analyze the theoretical foundations of the relationship between the money supply and stock prices

2. To identify and analyze the empirical literature concerning the relationship between the money supply and stock prices

3. To develop additional empirical evidence relating to the relationship between the money supply and stock prices

## Delimitations of the Study

The following delimitations apply to this study:

1. The examination of the theoretical background is confined to the stock valuation model, the quantity theory of money, the rational expectations hypothesis, and the efficient market hypothesis

2. The review of related empirical studies is confined to selected studies published between 1964 and 1982

3. The empirical study is confined to the period 1960-82 and the sub-periods 1960-72 and 1973-82

4. The empirical study is further confined to an examination of the significance of current and three period leads and lags for monthly and quarterly periods

These delimitations are necessary to ensure the feasibility of the empirical study. All findings, conclusions, and implications of this study must be interpreted in light of these delimitations. The reason for the first

delimitation is that the data base is limited to this period. This data base, provided by the Federal Reserve Bank, provides the only up-to-date, accurate measures of the money supply figures which have been revised to conform to the present definitions of the money supply. The reason for the second delimitation is that this structure is broad enough to include the significant leads or lags which have been identified by previous researchers. This is documented in the section "review of empirical studies."

## Definition of Terms

The following definitions apply to this study:

### Money Supply

The following are current definitions of the money supply as specified by the Federal Reserve Board.

> M1: Averages of daily figures for (1) currency outside the Treasury, Federal Reserve Banks, and the vaults of commercial banks; (2) travelers checks of nonbank issuers; (3) demand deposits at all commercial banks other than those due to domestic banks, the U.S. government, and foreign banks and official institutions less cash items in the process of collection and Federal Reserve float; and (4) negotiable order of withdrawal (NOW) and automatic transfer service (ATS) accounts at banks and thrift institutions, credit union share draft (CUSD) accounts, and demand deposits at mutual savings banks.
>
> M2: M1 plus money market deposit accounts (MMDAs), savings and small-denomination time deposits at all depository institutions, overnight repurchase agreements at commercial banks, overnight Eurodollars held by U.S. residents other than banks at Caribbean branches of member banks, and balances of money market mutual funds (general purpose and broker/dealer).

M3: M2 plus large-denomination time deposits at all depository institutions and term RPs at commercial banks and savings and loan associations and balances of institution-only money market mutual funds.

L: M3 plus liquid assets such as term Eurodollars held by U.S. residents other than banks, bankers acceptances, commercial paper, Treasury bills and other liquid Treasury securities, and U.S. savings bonds.

## Stock Prices

Stock prices are measured by the Standard and Poor's 500 Stock Index (S&P 500). The S&P 500 is a market value-weighted index of five hundred selected stocks. Each stock is weighted to the market value of outstanding shares. The index provides an arithmetic average of common stock prices. The index is currently composed of four hundred industrials, twenty transportations, forty public utilities, and forty financial stocks. The base period values for the S&P 500 are the averages for the period 1941-43. The value of the base is ten, which represents the approximate average price of a stock at that time.

## Hypotheses

The following hypotheses will be examined in the empirical section of this study:

1. A significant relationship exists between past changes in the money supply and current changes in stock prices

2. A significant relationship exists between future changes in the money supply and current changes in stock prices

The examination of these hypotheses will be restricted by the delimitations and basic assumptions specified in this study.

## Basic Assumptions

The following basic assumptions will apply to the empirical section of this study:

1. The procedures and methodology employed in this study will be adequate to provide valid findings concerning the hypotheses examined

2. The period under study is sufficient to provide valid findings concerning the hypotheses examined

These basic assumptions are necessary to ensure the feasibility of the empirical study. All findings, conclusions, and implications related to the empirical section of this study must be interpreted in light of these basic assumptions as well as the other delimitations specified in this study.

# CHAPTER 2

## THEORETICAL BACKGROUND

The purpose of this chapter is to examine the major theories which relate to the issue of the relationship between the money supply and stock prices. These theories provide the theoretical framework for the previous studies which will be reviewed in the next chapter. An examination of the theoretical background of these previous studies should provide a better understanding of these studies and the issues and controversy surrounding the relationship between the money supply and stock prices.

This chapter is divided into four sections: (1) stock valuation model, (2) quantity theory of money, (3) rational expectations hypothesis, and (4) efficient market hypothesis. Each section will provide a presentation of the basic theory and its implications relative to the issues examined in this study.

### Stock Valuation Model

Several models and equations are used for the determination of the value of an individual stock. Other models are given for the determination of the value of a portfolio of stocks. This section will deal primarily with the determination of the price of a single stock for two

reasons. First, all portfolios of stocks are composed of individual stocks and the return on the portfolio is simply the weighted average of the returns of the individual stocks which form the portfolios.[1] Secondly, although the factors which influence a particular stock are substantial and differ considerably across stocks held in a portfolio, they do not require explicit consideration in a study concerned with aggregate stock prices.

Keran points out this fact in his study.

> This article is concerned with the factors which affect . . . the average stock price of all firms. While there is obviously a substantial overlap, there are a number of factors that are important in the individual case but tend to average out in the aggregate, such as the quality of management, the ratio of debt to equity, and the time horizon of the individual investor. As long as these basic factors are unchanged on average, they would not be expected to cause changes in the aggregate stock price index.[2]

Therefore, from the standard formula for the determination of a single stock, we can proceed to develop a model which is useful in explaining the intrinsic value of an aggregate of all stocks. From this model, we can identify the basic factors which influence overall stock prices. Finally, this study will employ, as a surrogate for aggregate stock prices the Standard and Poor's 500 Index of common stock

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[1]Jack Clark Francis and Stephen H. Archer, Portfolio Analysis, 2nd ed. (Englewood Cliffs, N.J.: Prentice-Hall, 1979), pp. 25-26.

[2]Keran, "Expectations, Money, Stock Market," p. 18.

prices.

> Conceptually, the price an individual is willing to pay for an equity share is equal to the discount to present value of both expected future dividends and the discount to present value of the expected stock price at the time of the sale.[1]

Therefore, the formula for stock price can be written as:

$$SP_t = \frac{D^*_{t+1}}{(1+r)} + \frac{D^*_{t+2}}{(1+r)^2} + \ldots + \frac{D^*_{t+n}}{(1+r)^n} + \frac{SP^*}{(1+r)^n}$$

In the formula above, $SP_t$ is the present value of the stock; SP * is the expected stock price at the time of sale; D* is the expected dividend; and r is the required or expected rate of return. An increase in expected dividends will increase the value of the stock as will an increase in the expected future sale price (a capital gain). An increase in the interest rate will lower the price of the stock.

Moving from the individual investor to the aggregate investor requires moving from a finite time horizon to an infinite time horizon. This requires modifying the formula above to represent the value of a stock as the discounted present value of all future dividends and capital gains. Therefore, the formula is:

$$SP_t = \frac{(D^*+\Delta SP^*)_{t+1}}{(1+r)} + \frac{(D^*+\Delta SP^*)_{t+2}}{(1+r)^2} + \ldots.$$

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[1] Ibid., p. 17.

All symbols are the same as in the previous formula except for $\Delta SP^*$, which represents the expected capital gain $(SP_{t+i} - SP_{t+i-1})$.

It can be assumed that all expected dividends and all expected capital gains are based upon expected corporate earnings.[1] If k represents the dividend payout ratio (dividends/earnings) then (1-k) is the retained earnings ratio (retained earnings/earnings). Therefore, by modifying the previous formula we get:

$$SP_t = \frac{[kE^*+(1-k)E^*]_{t+1}}{(1+r)} + \frac{[kE+(1-k)E^*]_{t+2}}{(1+r)^2} + \ldots.$$

In the formula above, all symbols are the same as previous formulas except for $E^*$, which represents expected corporate earnings.

The formula above can, therefore, be simplified to:

$$SP_t = \frac{\sum_{i=1}^{\infty} E^*_{t+i}}{(1+r)^i}$$

The formula above is an obvious simplification of the complex process of stock price valuation; however, this simplification is useful for the purposes of this paper. This formula makes the implicit assumption that all returns to stockholders, whether they be in the form of dividends or capital gains, come from corporate earnings, whether they

[1] Ibid., p. 18.

are paid out or retained in the firm.

Other modifications could be made to the last formula to explicitly account for such factors as inflation, taxes, etc. For example, taxes on capital gains usually differ from taxes on dividends. Therefore, a shift in either the tax rate or the dividend payout ratio may cause the expected value to change. Likewise, a change in the inflation rate or expected inflation may affect both the required rate of return and expected earnings.

However, these factors are implicitly accounted for in the model since it is formulated in terms of "expected" earnings and the "expected" rate of return. A change in expectations would cause a change to be reflected in the factors explicit in the model. Also, the formula is specified in terms of nominal, rather than real values.

Therefore, this stock price model provides a point of departure in analyzing the effects of certain variables (such as the money supply) on stock prices.

Different studies have identified different factors as the determinants of stock prices. All such models, however, are some form of modification of the above model. As to the basic determinants of expected corporate earnings and the expected rate of return, we could include various factors either directly or indirectly in the model.

The main questions to be answered are: what are the basic determinants of stock prices and how do they affect

stock prices? The monetarists would say that money would be the main factor to be considered. Keynesians might look to such factors as government spending, investment, etc. Rational expectationists would stress the importance of future expectations upon stock prices. Proponents of the efficient market hypothesis would stress that factors affecting the price of stocks would be efficiently incorporated into stock prices.

As the purpose of this paper is to examine the relationship between the money supply and stock prices, the money supply will be the factor explicitly considered. However, this does not imply that money is the only factor or the only important factor related to stock prices. Nor does consideration of the money supply imply a causal relationship. It is simply the focus of this present study, which is limited to an examination of the possible relationship between stock prices and the money supply.

## Quantity Theory of Money

The quantity theory of money is:

> one of the oldest definitely postulated economic theories; its first explicit formulation is attributed to John Locke (1632-1704). With some qualifications and additions it became one of the basic tenets of the "Classical School."[1]

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[1]Harold S. Sloan and Arnold J. Zurcher, Dictionary of Economics, 5th ed. (New York: Barnes and Noble Books, 1970), pp. 363-64.

> However, the success of the Keynesian revolution led to its rejection by perhaps most professional economists. Only recently has it experienced a revival so that it once again commands the adherence of most professional economists.[1]

> Nonetheless, the quantity theory has been a continual bone of contention. . . . Both its acceptance and its rejection have been grounded basically on judgments about empirical regularities."[2]

Any explanation of the quantity theory must begin with the "equation of exchange." This equation is in effect a tautology, not a theory.

> The tautology embodied in the quantity equation [equation of exchange] is a useful device for clarifying the variables stressed in the quantity theory. The quantity equation has taken different forms, according as quantity theorists have stressed different variables.[3]

Three such versions will be examined.

The transactions version ("transactions equation") of the equation of exchange is given as:

$$MV = PT$$

"M" represents the stock of money; "V" is the velocity of money (i.e., the average number of times each unit of money is exchanged); "P" is a measure of the average price of goods, services, and securities exchanged; and "T" is the aggregate of these goods, services, or securities

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[1]Milton Friedman, Milton Friedman's Monetary Framework, ed. Robert J. Gordon (Chicago: University of Chicago Press, 1970), p. 1.

[2]Ibid. [3]Ibid., p. 4.

exchanged during the period. The right side of the equation is equivalent to the nominal value of economic transactions occurring in the economy since it represents the total volume of goods and services exchanged multiplied by the average price of each. The left side of the equation is an equivalent measure since the total number of dollars in the economy multiplied by the average number of times each changes hands (is spent) also represents the nominal value of economic transactions. However, this version, popularized by Irving Fisher, is not without flaws. Although it explicitly takes into account the velocity of circulation of money, it does not take into account the velocity of circulation of goods. For example, a good which is purchased and resold several times is counted several times by this equation. Intermediate goods (those which are purchased for resale or as inputs in the production of other goods) are likewise double counted. This makes the equation undesirable for certain purposes, such as the measurement of national income.[1]

A second version, the "income form" of the quantity equation, has certain advantages over the transactions version.

> The ambiguities of the concepts of "transactions" and the "general price level"--particularly those arising from the mixture of current and capital

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[1]Ibid., pp. 4-5.

> transactions--were never fully resolved. The more recent development of national or social accounting has stressed income transactions rather than gross transactions and has explicitly and satisfactorily dealt with the conceptual and statistical problems of distinguishing between changes in prices and changes in quantities. As a result, the quantity equation has more recently tended to be expressed in terms of income rather than transactions.[1]

The income form can be expressed as:

$$MV = Py$$

"M" represents the stock of money (as before). "V" now represents the average number of times that the money stock is used in making income transactions (i.e., payments for final goods and services), rather than all transactions. "P" is the price index implicit in estimating national income at constant prices; "y" is equal to national income in constant (i.e., adjusted for inflation) prices. It follows, therefore, that the right side of the equation represents nominal national income, and the left-hand side is its equivalent. Therefore, the basic difference between the transactions equation and the income equation is that the former includes the value of all items exchanged each time they are exchanged, and the latter equation counts only final goods and services produced and counts these only once. Although the income version has certain advantages over the transactions version, it has the disadvantage that it completely neglects both the ratio of

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[1]Ibid., p. 7.

intermediate transactions to final transactions and transactions in existing capital assets.[1]

A third version of the equation of exchange, the "Cambridge equation," can be expressed as:

$$M = kPy$$

In this equation "M," "P," and "y" are the same as in the income equation; "k" is the ratio of money stock to income. "k" is numerically equal to the reciprocal of "V" in the income version. As all three versions can be used to express the basis of the quantity theory, the differences in each are due to their differences in emphasis in the variables employed.

> The transactions approach leads to stress being placed on such variables as payment practices, the financial and economic arrangements for effecting transactions, and the speed of communication and transportation as it affects the time required to make a payment--essentially, that is, to emphasis on the mechanical aspects of the payments process. The cash-balances approach [Cambridge equation], on the other hand, leads to stress being placed on variables affecting the usefulness of money as an asset: the costs and returns from holding money instead of other assets, the uncertainty of the future, and so on--essentially, that is, to emphasis on the role of cash in a portfolio.[2]

If the equation of exchange is a tautology, then there seems to be no basis for controversy. Indeed, if it is true by definition, there seems to be not even the basis of a theory. It becomes a theory, however, when we begin to make assumptions concerning the variables in the model.

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[1]Ibid. [2]Ibid., p. 10.

> As it stands, the quantity equation is not a theory, but we can convert it into a theory by postulating that people choose to hold a constant fraction (1/V*) of their nominal income (PQ) in the form of money (M):
>
> $$M = \frac{PQ}{V^*}$$
>
> As written [this equation] appears merely to be a transformation of [MV = PQ] that divides both sides . . . by "V." The definition becomes a theory when we assume that the fraction of income that people desire to hold in the form of money (1/V*) is a constant."[1]

Different versions of the quantity theory arise when we begin to impose further assumptions to the equation.

> We can distinguish two versions of the quantity theory. The "weak version" states that . . . a change in the money supply causes a proportional change in nominal GNP in the same direction. The "strong version" adds the assumption that all or almost all of the adjustment of nominal GNP takes the form of changing prices and none or almost none the form of changing output.[2]

However, there is no shortage of versions of the quantity theory. Several other versions have been proposed. "The more modern theories all predict that the fraction 1/V will decline [i.e., velocity will increase] when there is an increase in the interest rate--the major cost of holding money."[3]

Therefore, with the equation MV = PQ composed of

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[1]Robert J. Gordon, Macroeconomics, 2nd ed. (Boston: Little, Brown and Co., 1981), p. 447.

[2]Ibid. [3]Ibid. p. 457.

four variables, a change in M may be offset by a change in V. Likewise, even if V is a constant, the effects on P and on Q are uncertain as either one or both may change. From the basic equation of exchange, therefore, we cannot say if a change in the money supply will have any effect on nominal income or, if it does have an effect, what the nature of that effect will be. Therefore, the validity of the theory or particular version of the theory is as much or more an empirical question than a theoretical question.

Advocates of the quantity theory are generally referred to as "monetarists." The term is derived from the importance they place upon money in determining prices and real output. Milton Friedman, undoubtedly the most prominent of the monetarists, states:

> The stock of money displays a consistent cyclical behavior which is closely related to the cyclical behavior of the economy at large. This much the factual evidence . . . puts beyond reasonable doubt. That evidence alone is much less decisive about the direction of influence.[1]

Upon further exposition concerning the evidence of his own empirical research, he states:

> Changes in money income and prices have, in every case, been accompanied by a change in the rate of growth of the money stock . . . and there are no comparable disturbances in the rate of growth of the money stock unaccompanied by changes in money income and prices. . . . Hence, if the consistent relation between money and income is not pure

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[1]Friedman and Schwartz, "Money and Business Cycles," p. 48.

> coincidence, it must reflect an influence running from money to business.[1]

Friedman then presents the mechanism of the influence of money on the economy. This transmission mechanism involves stock prices, which is the subject of this present study. He begins by assuming an increase in the money supply brought about, for example, by the Federal Reserve's purchase of securities.

> Although the initial sellers of the securities . . . were willing sellers, this does not mean that they want to hold the proceeds in money indefinitely. . . . [They] will therefore seek to readjust their portfolios. . . . It seems plausible that . . . [these] holders of redundant balances will turn first to securities comparable to those they have sold. . . . But as they seek to purchase these they will tend to bid up the prices of those issues. Hence they, and also other holders not involved in the initial central bank open-market transactions, will look further afield . . . to other categories of securities . . . [such as] equities.[2]

Friedman relates this mechanism to the business cycle.

> The cyclical counterpart to our assumed initial shock is the rise in the rate of growth of the money stock that generally occurs early in contraction. On the basis of the sketch so far, we should expect it to have its first impact on the financial markets, and there, first on bonds, and later on equities and only still later on actual flows of payments for real resources. This is of course the actual pattern.[3]

This pattern was confirmed in later studies by Sprinkel, Keran, and others who observed that money supply changes led to changes in stock prices. However, later

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[1]Ibid., p. 50. [2]Ibid., p. 60. Ibid., p. 61.

studies by Rozeff seemed to indicate that stock price changes preceded money supply changes. These findings even led some writers to conclude that money supply changes do not cause stock prices and that just the opposite was true.[1] Therefore, the timing of money supply changes relative to stock price changes has led some to question the quantity theory as presented by Friedman.

## Rational Expectations Hypothesis

The rational expectations hypothesis is attributed to Muth in 1961[2] and was later revived by Lucas in 1972,[3] Sargent and Wallace in 1975,[4] and Barro in 1976.[5] Formally the hypothesis can be stated as:

$$P^*_{t+i,t} = E_t(P_{t+i})$$

where P is the variable being forecast; $P^*_{t+i}$ is the prediction of the price level for the time t+i, formed at

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[1]Kraft and Kraft, "Determinants," p. 422.

[2]J. F. Muth, "Rational Expectations and the Theory of Price Movements," Econometrica 29 (1961),:315-35.

[3]Robert E. Lucas, "Expectations and the Neutrality of Money," Journal of Economic Theory 4 (April 1972): 103-124.

[4]Thomas J. Sargent and Neil Wallace, "Rational Expectations, the Optimal Monetary Instrument and the Optimal Money Supply Rule," Journal of Political Economy 83 (April 1975):241-54.

[5]R. J. Barro, "Rational Expectations and the Role of Monetary Policy," Journal of Monetary Economics 2 (1976):1-33.

time t; and $E_t$ is the statistical expectation conditioned on information available at time t, the time the forecast is made. The rational expectations hypothesis requires that the prediction made by the forecaster be consistent with the prediction generated by the model. Any error in prediction must be random for the hypothesis to hold.[1]

Several objections have been raised concerning this hypothesis. The basic objections to the hypothesis are that "it requires the knowledge of not only the structure of the model but also all relevant coefficients and parameters" and that "the computation of such expectations is simply not feasible for the typical individual."[2]

Therefore, the rational expectations model is not only difficult to test but virtually impossible for the average investor to use. Since the hypothesis requires only that investors do what they would naturally do, that is to base their actions on their expectations formed on the basis of all available information, it is as difficult to disprove as it is to put to any great use.

> Rational expectations refers to an assumption about expectations behavior which is increasingly used by economists. Many dynamic economic models depend in large part on assumptions about how

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[1]Stephen J. Turnovsky, "Rational Expectations and the Theory of Macroeconomic Policy: An Exposition of Some of the Issues," Journal of Economic Education 15 (Winter 1984):56.

[2]Ibid., p. 58.

> economic agents form forecasts of the future levels of important variables.[1]

The hypothesis that expectations are formed "rationally" simply means that people form their expectations on the basis of all availabie information.

> Expectations are rational if no information available at the time the forecast is made that would be expected to improve its accuracy is ignored. Under this assumption, then, investors' expectations embody all that is knowable from available information about the future behavior of those variables believed relevant in determining the value of stocks.[2]

The assumption that people base their actions on expectations of the future is perfectly reasonable. The further assumption that they incorporate all available information in forming these expectations and that they then draw rational conclusions based upon this information is also reasonable.

> If someone knew for certain that the government was going to slow monetary growth, and that this would boost stock market prices, he would be needlessly wasting the chance to make a profit if he did not take advantage of his knowledge.[3]

However, this does not imply that all investors will, therefore, react in the same manner. Nor does it

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[1] Encyclopedia of Economics, 1981, s.v. "Rational Expectations" (Guilford, Conn.: DPG Reference Publishing, 1981).

[2] Neil G. Berkman, "A Primer on Random Walks in the Stock Market," New England Economic Review (Boston: Federal Reserve Bank, 1978):37.

[3] Gordon, Macroeconomics, p. 243.

imply that all investors will form the same expectations from the same set of information.

> Expectations are rational if in the process of their formation, the forecaster uses all the current information he believes to be relevant for predicting the future course of the variable at hand. . . . Idiosyncratic notions concerning the "true" causal links in the system will lead one forecaster to stress one sort of information, while others trying to predict the same variable will prefer information of some other kind.[1]

Differences in opinion as to the relevance of certain information may cause individuals to use different data in forming expectations or to weigh the same data differently. For example, in an attempt to forecast nominal GNP, a "Keynesian" might prefer information on the components of aggregate demand, while a "monetarist" might want to study money supply data.[2]

In regard to the stock market, the same information considered equally important by investors may result in differing reactions.

> Those who see tighter money as precipitating a fall in the stock market reason that tighter money means higher interest rates (lower bond prices); this will make bonds relatively more attractive than stocks, resulting in lower stock prices as well. On the other hand, others see tighter money as signaling an upturn in stock prices on the logic that inflation has been bad for stock prices. . . . The same divergence of views exists for the implications of easier money.[3]

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[1]Berkman, "Random Walks," p. 37. [2]Ibid.

[3]Lawrence S. Ritter and William L. Silber, Money 4th ed. (New York: Basic Books, 1981), pp. 197-98.

Therefore, two individuals with the same set of data might form differing sets of expectations, both of which would be rational.

Additionally, individuals may not all have access to the same information. Some may not have the resources to acquire all the information which they might consider to be useful in forming expectations concerning the future. Information gathering and processing can have costs which in some cases may be prohibitive. For an individual to form expectations rationally, he would acquire additional data only up to the point where the marginal cost of the additional data is equal to the marginal value he places upon such data. As individuals have different opinions as to the relative worth of certain data, it is logical to assume that different individuals will use different data and may, therefore, form differing expectations. The fact that "insider trading" is closely regulated attests to the fact that different investors have access to different sets of information.

It should be clear from the preceding discussion that "rational expectations theory" does not imply that economic events will cause a predictable reaction in the price of stocks. Not only do expectations of the implications of economic policy differ across individuals, some individuals do not base their forecasts on such matters. Some stock market analysts prefer to use the market itself

as its own predictor. Such analysts, who feel that the key to forecasting the market lies in an examination of the movements in the market itself, are referred to as "chartists." A number of sophisticated techniques such as "filter rules" or the "Dow Theory" are employed in their analyses.[1]

Therefore, rational expectations theory does not imply that the market will respond in a predictable manner to an economic event or the expectation of that event. It does imply that individuals will form rational forecasts of the future based upon all available information and that these expectations will determine their current actions. Differing conclusions have been drawn concerning the implications of the rational expectations hypothesis upon markets. Some authors say that since expectations concerning the future are formed primarily on the basis of past and current events, this past information is useful in forming expectations concerning future events. "The 'adaptive expectations hypothesis' . . . asserts that in forming expectations about the future, decision-making units are strongly influenced by current and recent past experience."[2] Keran's study showed how past data (such as money supply changes) could be used to explain current stock prices.

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[1]Berkman, "Random Walks," p. 41.

[2]Keran, "Expectations, Money, Stock Market," p. 19.

Keran felt this was consistent with rational expectations. He felt that past and current changes in the money supply would lead investors to change their expectations concerning the basic determinants of stock prices over time, and that "since these formation periods are quite long, fundamental changes in expectations occur slowly."[1]

Other studies were critical of Keran's work. These studies, such as the one by Rozeff,[2] claimed that the findings that past data is significantly related to stock prices was inconsistent with rational expectations in that expectations would be forward-looking; and, therefore, current stock prices would reflect the influence of future, not past, data. Therefore, current stock prices would be related to future money supply and not related to past money supply if expectations of the future were accurate and if markets were efficient.

Therefore, Rozeff's interpretation of the rational expectation hypothesis, which he saw to be consistent with the efficient market hypothesis, was inconsistent with Keran's view of how expectations were formed--which he found to be consistent with the quantity theory of money. Since interpretations concerning the effects of rational expectations upon the timing of economic events differ,

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[1]Ibid., p. 16.

[2]Rozeff, "Money and Stock Prices," p. 290.

this theory is even more difficult to prove by empirical tests than would seem apparent from the previous discussion.

## Efficient Market Hypothesis

Copeland and Weston suggest that "in order to describe 'efficient capital markets' it is useful, first of all, to contrast them with 'perfect capital markets.'"[1] They give four conditions necessary for perfect capital markets.

1. Markets are frictionless, i.e., there are no transactions costs or taxes, all assets are perfectly divisible and marketable, and there are no constraining regulations

2. There is perfect competition in product and securities markets. In product markets this means that all producers supply goods and services at minimum average cost, and in securities markets it means that all participants are price takers

3. Markets are informationally efficient, i.e., information is costless, and it is received simultaneously by all individuals

4. All individuals are rational expected utility maximizers[2]

Samuelson includes two other criteria not listed above. His definition also requires that "all participants and potential participants in the market have the same time

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[1]Thomas E. Copeland and J. Fred Weston, Financial Theory and Corporate Policy 2nd ed. (Reading, Mass.: Addison-Wesley Publishing Co., 1983), p. 286.

[2]Ibid.

horizons and homogeneous expectations with regard to prices."[1] It has been shown in the discussion of the "rational expectations theory" that it is reasonable to assume all individuals do not have the same set of "homogeneous" expectations.

The criteria for perfect markets is such that no observable example can be presented. However, in order to measure the degree to which a condition is true, it is necessary to establish standards by which the proposition can be measured. The standards listed above provide a bench mark upon which efficiency can be based. It is obvious, therefore, that capital markets, such as the stock market, are not perfectly efficient. The efficiency of markets in the real world, therefore, is not a question of efficiency or inefficiency, but rather a question of the degree of efficiency which exists.

Because the criteria for perfect markets (conceptually, perfectly efficient markets) is so restrictive, a separate definition is used for efficiency. In this definition of efficiency all but one of the criteria for perfect markets are eliminated, and the one remaining is significantly relaxed. This criteria centers on informational efficiency. "In an 'efficient capital market,'

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[1]James H. Lorie and Mary T. Hamilton, The Stock Market: Theory and Evidence (Homewood, Ill.: Richard D. Irwin, 1973), p. 80.

prices fully and instantaneously reflect all available relevant information."[1] This does not, however, serve as a proper definition, because the term "relevant" is ambiguous. What is considered relevant to one investor may be considered less relevant by another and irrelevant by a third investor. A condition which cannot be defined cannot be tested. Therefore, to facilitate testing, Fama has defined capital market efficiency in three terms.

"Weak-form" efficiency requires that no investor be able to earn excess returns by developing trading rules based upon historical prices or returns of the security market itself. "Semistrong-form" efficiency requires that no investor be able to earn excess returns from trading rules which are based upon publicly available information. "Strong-form" efficiency requires that no investor be able to earn excess returns using any information whatsoever, publicly available or not publicly available.[2]

These definitions have clarified the previous definition by identifying what is "relevant" information. However, they do not specify what is an "excess" return. Additionally, and more importantly, they specify that "no investor" may earn any excess return.

The obvious and generally accepted definition of

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[1]Copeland, Theory and Policy, p. 286.

[2]Ibid., p. 287.

"excess" returns is "above average returns." Market efficiency using this definition would, therefore, require that no one can "consistently" earn returns above the average market return based upon the particular category of information identified. It also follows by these definitions that if any investor consistently earns returns which are above the weighted average return of all stocks on the market, and if he does so with the aid of information from any source, the strong-form of market efficiency is violated. The existence of investors or analysts who can thus perform is thereby precluded.

However, there is sufficient reason to believe that some investors do consistently outperform the average investor in the market. In real markets, it is reasonable to assume that many, if not most, investors will earn an average return and that many will earn below average returns. The definition of "average" would, therefore, require that at least some investors are able to earn returns in excess of the average of all investors. The existence of even one investor who uses information to achieve such an "excess" or above average return violates the condition for market efficiency in its "strong-form." The existence of even one investor who consistently earns above average market returns by the use of data which is "publicly available" violates the "semi-strong form." And the existence of even one investor earning above average returns from

studying the market itself would violate even the "weak-form" of efficiency. Surely at least one investor will have achieved a return which is above the average of all investors by any and all of the definitions cited above.

This discussion makes two points. First, these definitions are not without obvious flaw. Secondly, the real existence of such above average investors is evidence that capital markets are not "efficient."

Therefore, it is impossible to say that markets are "efficient" or "inefficient" in any form or by any definition which has been proposed. Efficiency is not a question of presence or absence but one of degree. Therefore, tests presuming to prove markets are "efficient" cannot do so. However, they may present evidence of the degree of "efficiency" or "inefficiency." That is all that can be said.

All tests of the efficient market hypothesis suffer not only from the deficiencies in the definitions of "efficiency" but also from the methodology employed to test for efficiency. All major studies attempting to prove the hypothesis that markets are efficient admit that markets are not efficient in the strong-form. This is a logical observation and one which could be easily proven from case studies. However, these researchers overlook the cases of financial analysts who have consistently earned above average or "excess" returns through either sophisticated methods of tracking stock movements or by the study of

economic or financial data. These cases, which would disprove the weak-form and semistrong-forms respectively, are written off as "anecdotal" records. They would also reason that on average the users of these methods would earn only average returns. But it is a tautology that the average investor earns an average return. Also, the criteria stated above require that "no" investor be able to use these methods profitably.

How then do empirical studies test for market efficiency? The strong-form is never tested because "all information" cannot be incorporated into a model. The tests of the weak-form use past data on the market itself. The weak-form, which should be the easiest to prove, states that no individual can earn "excess" returns by "technical analysis" of the market. When researchers make the leap from this statement to the inference that movements in the market cannot be explained or tracked from such data, they fall into a trap. Most researchers who seek to disprove the proposition that past data can be used to explain movements in markets base their conclusion on "trading rule tests." "The goal of a trading rule test is to determine if a particular bit of information can be used to earn profits greater than could be earned without the information."[1]

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[1]Berkman, "Random Walks," p. 41.

"Filter rules," a technique used by technical analysts to track stock movements, have been demonstrated to have some merit.

> A stock is purchased if its price increases by x percent and held until its price declines by x percent from a subsequent high, at which time the trader simultaneously sells and goes short, covering his position when the price increases by x percent from a subsequent low. Price movements at less than x percent are ignored. For filters ranging in size from 0.5 to 1.5 percent, this rule has been shown to generate greater profits than are earned if the stock is simply purchased at the beginning of the sample period and sold at the end.[1]

Therefore, it has been proven that such analysis is useful in tracking stock movements. However, this does not imply that such rules can be used to earn excess profits. The reason that profits are no greater than those of a buy-and-hold strategy, whose profits are determined by the average movement in the stock, is simply due to the substantial transactions costs involved with numerous trades. Therefore, it is not the lack of tracking ability of the past information which saves the weak-form of market efficiency but the very inefficiencies (i.e., transactions costs) inherent in the market itself. However, the fact that analysis of past data can be used to track or explain future movements is disregarded.

One last and pertinent example should be sufficient

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[1]Ibid.

to prove this point. Berkman employs a model based solely on past data, including the money supply, to explain movements in stock prices.

> A notable feature of this [model] is that the universe of relevant information has been intentionally restricted to include only past changes in money, government spending and profits. . . . A computer simulation of the model was performed using quarterly data for the United States for the 1948-1977 period to estimate the structural relationships involved. These estimated relationships were then used to generate 25-quarter ahead profit forecasts beginning in the first quarter of 1955, updated after each quarter. . . . The model generates a surprisingly realistic-looking stock price series. Indeed, the simulated data track turning points in the actual data quite closely.[1]

Therefore, it is shown that models using past data can describe the movements in stock prices. This is not, however, inconsistent with rational expectations of efficient markets.

> [By this model] one could produce "rational" corporate profit forecasts and infer the "efficient market" level of stock prices implied by the . . . model at a particular point in time.[2]

Finally, then, we can identify the source of the confusion and controversy concerning the nature of the relationship between stock prices and the money supply. "The common error of interpreting the . . . model as causing stock prices rather than as simply describing their behavior is the source of the misconceptions."[3] Economists

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[1]Ibid., p. 46. [2]Ibid., p. 45. [3]Ibid., p. 36.

cannot determine causation beyond a reasonable doubt. Nor can they form forecasts which will provide consistent excess profits. All that economists can do is to look at the actual historical data and to form hypotheses concerning the nature of the relationship.

The quantity theory says that money has a significant effect upon the economy. Rational expectations simply says that people will base their expectations upon all relevant information (including past data which is used to form current expectations); the efficient market hypothesis simply states that securities are correctly priced. The historical relationship between money and stock prices, which can be observed, is not inconsistent with a proper interpretation of any of these hypotheses. Nor are these hypotheses necessarily inconsistent with one another when properly interpreted.

> The efficient market hypothesis thus emerges not as a radical alternative approach to the problem of stock price determination, but rather as a formalization and rationalization of the implicit axioms of asset valuation that have guided stock price models from the beginning.[1]

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[1] Ibid., p. 47.

# CHAPTER 3

## REVIEW OF EMPIRICAL STUDIES

The purpose of this chapter is to provide a review of the major empirical studies pertaining to the relationship between money supply and stock prices. As the specific purpose of this study is to examine the relationship, a review of the literature is central to this purpose. This review of the empirical studies should provide a better understanding of the issues and controversy surrounding this topic.

This chapter is divided into two sections: Early Studies (1964-72) and Later Studies (1974-82). Each of these sections is further divided into individual empirical studies. Each study is examined in regard to the assumptions, methodology, conclusions, and implications of the study as they relate to the issue of the relationship between money supply and stock prices.

The reason for the division between the two periods relates to the findings and conclusions of the studies. The early studies generally found that changes in the money supply lead changes in stock prices and concluded that this was evidence in favor of the quantity theory of money. The later studies generally purported to show evidence that

changes in the money supply lagged changes in stock prices and concluded that this finding supported the rational expectations and efficient market hypotheses.

Both the early studies and later studies were questioned by subsequent studies in regard to their assumptions, methodologies, findings, and conclusions. Their conflicting findings and interpretations of findings have not as yet been resolved. Therefore, this study does not presume to provide a resolution to the controversy, nor is it expected that this study will escape the attacks made on similar studies. The purpose of this study is to provide a better understanding of the issues relating to the relationship between money supply and stock prices. Therefore, this examination and review of the previous studies is undertaken in respect to this purpose.

## Early Studies (1964-72)

### Beryl W. Sprinkel (1964)[1]

It is generally recognized that Sprinkel's work was the first major empirical study to concentrate on the direct relationship between money and stock prices (although some earlier writers, e.g. Friedman and Schwartz, had discussed the topic in the context of monetary theory).

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

Some authors go so far as to give Sprinkel credit for "discovering" the relationship.[1]

> The purpose of this book is to develop a new and practical technique for improving the art of investment timing of common stock purchases and sales. . . . It is the basic thesis of this exposition that economic and stock price changes have a common "cause," changes in money, which directly influence the demand for assets such as common stocks.[2]

> Both monetary change and stock prices lead business cycle turning points. . . . But since monetary changes have a longer lead . . . it follows that monetary changes lead stock prices. It was an awareness of [this] . . . that was responsible for sparking the investigations, reported in this book, which have turned up additional evidence bearing on the pervasive influence of monetary change.[3]

Sprinkel examined the relationship between changes in the money supply and common stock prices for the period 1918 to 1963. The method he employed was graphical analysis. The measure of the level of stock prices was the Standard and Poor's index of 425 industrial stock prices. For the money supply, M1 was used. Seasonally adjusted figures were used to remove the seasonal factor. To remove the secular trend, rates of change (i.e., percentage changes) were computed for the current month over the last month. Next, a six-month moving average was computed by averaging the monthly growth rates for the past six months.

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[1]Kraft and Kraft, "Determinants," p. 447.

[2]Sprinkel, Money and Stock Prices, p. vii.

[3]Ibid., p. 115.

Finally, each of the six-month moving average figures were converted to average annual rates of change by multiplying by twelve. The purpose of using moving averages was to "remove much of the erratic movement" even though this practice has the admitted drawback of "reducing the sensitivity" of the data.[1]

From his analysis, Sprinkel concludes that "changes in monetary growth lead changes in stock prices by an average of about fifteen months prior to a bear market and about two months prior to bull markets."[2] Sprinkel offers one caution concerning the use of "average" leads:

> However, the data indicate only the average lead of changes in monetary growth prior to a change in stock prices. Although averages may be useful statistical summaries for some purposes, they may be very misleading in other cases.[3]

He offers an additional warning concerning the stability of such leads. "The leads may change in the future . . . [and] substantial variation in the future lead time would seriously limit the usefulness of the liquidity aid to timing investment changes."[4] Nevertheless, he proceeds to make the statement that "both theoretical and empirical evidence strongly suggest that future liquidity changes will provide some useful guidelines to future investment timing decisions."[5]

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[1]Ibid., p. 179. [2]Ibid., p. 119. [3]Ibid.
[4]Ibid. [5]Ibid., p. 120.

As to the mechanism of "causality," Sprinkel offers the propositions embodied in the quantity theory discussed earlier. He points out in regard to the question of causality that there can be no "final answer to the question."[1] After conceding the point, he makes the statement "In any event, so long as changes in monetary growth continue to lead stock prices, one need not be convinced that the relationship is causal."[2]

Admittedly, Sprinkel's research was an effort to support the monetarist viewpoint and was based upon a presupposed relationship. This may explain both his failure to investigate other possible relationships (such as stock prices leading monetary changes) and his rather unsophisticated methodology, both of which were taken to task by later writers. However, major studies contradicting these results were not to appear for almost a decade with several other research studies supporting his results in that interval.

This study would present four basic criticisms of Sprinkel's work: (1) His research is based upon strong presuppositions (i.e., that money causes stock price changes and that the relationship is one where money supply changes precede stock price changes). (2) Graphical analysis is not subject to statistical tests of hypotheses and does not

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[1]Ibid., p. 126. [2]Ibid., p. 127.

quantify the relationship. (3) The stability of the relationship over such a long time period is subject to question, and some structural change is likely to occur. (4) The long leads are almost certain to give conflicting buy/sell signals during the course of this time period.

Nevertheless, Sprinkel does issue some "caveats" in his work, perhaps anticipating these criticisms. Also, his work was a major pioneering effort which was a great stimulus to future research. For this reason alone, his work deserves praise.

Michael Palmer (1970)[1]

The purpose of Palmer's study was to "explore the relationship of movements in the nation's money supply to fluctuations in common stock prices."[2] His study was based upon the quantity theory of money which he states "regards changes in the stock of money as the major causal factor producing immediate changes in aggregate monetary demand and eventual fluctuations in total output and/or price levels."[3] His findings support the quantity theory viewpoint that money influences stock prices.

> This investigation suggests that primary changes (defined as a trend occurring over a period of months) in the nation's money stock may motivate the private sector to adjust its wealth portfolios

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[1]Palmer, "Money Supply, Portfolio Adjustments and Stock Prices," pp. 19-22.

[2]Ibid., p. 19. [3]Ibid.

> in such a manner as to yield predictable movements in the prices of corporate securities.[1]

He explains the mechanism as one where Federal Reserve System actions affecting the money supply cause portfolio disequilibrium and the resulting "liquidity effect" is then transmitted to stock prices having a positive effect.

The period under study is January 1959 through August 1969. The money supply figure used is seasonally adjusted M1. The stock price measure is the Standard and Poor's 425 Industrial Stock Price Index. Both figures are monthly data which are first converted to percentage changes "in an attempt to minimize secular growth factors," then transformed to annual rates and, finally, converted to six-month moving averages "in an effort to smooth out the time series."[2]

The method employed is graphical analysis. He later states that his observations were "confirmed by the use of regression analysis."[3] However, he presents no model nor does he provide any statistical results other than the "R" value of .443. In fact, this whole reference to "regression analysis" is relegated to a short footnote at the end of the article. His findings, which "support a distinct relationship between changes in the nation's money supply and movements of common stock prices," are all based

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[1]Ibid. [2]Ibid., p. 20. [3]Ibid., p. 22.

upon visual observations.[1] This observed "close relationship" is one where the money supply leads "by a few months at most."[2] However, once again in a footnote, he comments that "unfortunately, due to the shift in the lead period, statistical methods did not determine a specific lead period."[3] He does make the visual observation that "generally, the relationship becomes better the longer the trend in the money supply continues."[4]

Palmer draws several conclusions from his results: (1) A close relationship exists between changes in the money supply and common stock prices. (2) The lead is in favor of the money supply. (3) The predictive value of the explanatory model appears to be good. (4) A one percent change in the rate of growth of the money supply is associated with a change of approximately ten percent in stock prices. (5) There appears to be sufficient time for the investor to gauge the future course of the market.[5]

Palmer's study is very similar to that of Sprinkel with two major differences. Palmer studies a more recent time period (1959-69) and attempts to augment his analysis by the use of regression analysis. Therefore, due to their obvious similarity, the major criticisms of the two studies are the same. Two additional criticisms seem evident.

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[1]Ibid., p. 20. [2]Ibid. [3]Ibid., p. 22.
[4]Ibid., p. 20. [5]Ibid., pp. 20,22.

Palmer refers to the use of regression analysis but presents neither the model employed nor the resulting statistics (with the exception of the value of "$R^2$"). These statistical results would have lent more weight to his results and exclusion of these appears suspect. In addition, Palmer draws strong and quantified conclusions from a method of analysis which does not lend itself readily to such conclusions.

One point which may be of merit is the finding of the "close relationship between the turning points of the two series." This point is in conflict with Sprinkel's results and might possibly indicate a structural change where, perhaps, markets are becoming more efficient. This point, however, was not fully developed by Palmer.

Michael W. Keran (1971)[1]

Keran combines expectations theory with monetary theory to explain stock prices. He begins with the basic stock price equation, which views stock price as the discounted present value of expected future dividends and future stock price. In this model, he introduces expectations explicitly into the equation. Next, he proceeds to identify the major factors determining stock price as expected earnings and the long-term interest rate. He then

[1]Keran, "Expectations, Money, Stock Market," pp. 16-31.

develops a rather long and complicated set of equations to identify the expected values of these stock price determinants.

The method used to identify expected values for variables is the "adaptive expectations hypothesis." "This hypothesis asserts that in forming expectations about the future, decision-making units are strongly influenced by current and recent past experience."[1]

He next develops his final equation to explain the level of stock prices in what he terms a "semi-reduced form" equation, which incorporates as independent variables current and lagged values of percentage change in the real money stock, real economic growth, inflation, and expected real earnings. His equation explains ninety-eight percent of the variation in the level of the Standard and Poor's 500 Stock Index for the period of first quarter 1956 through second quarter 1970.

His equation showed that the percentage change in real money (that is, nominal money supply divided by a price index) was statistically significant for the current and two past quarters in explaining stock prices. Keran concluded:

> A one percent acceleration in real money will lead to a 1.31 point increase in the stock price index. This indicates a significant, but relatively small, direct influence on stock prices.[2]

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[1]Ibid., p. 19. [2]Ibid., p. 26.

He went on to state:

> There are, however, important indirect influences of money on stock prices which clearly exceed the direct influence. Money . . . has an important influence on real output, prices and earnings. Through this process, changes in money are the dominant factor, both direct and indirect, influencing stock prices."[1]

The major contribution of Keran's work is that he explicitly attempts to incorporate expectations into the stock price formula. However, a major weakness is his methodology in so doing. His model implies that investors base expectations of future values solely on past values. This assumption is in conflict with the "efficient market hypothesis," which implies that current stock prices would already incorporate any information found in past values of independent variables. In addition, there is no indication that Keran tested a model which involved future values for these variables.

A second criticism involves the structural equations used to determine the form for these "expected" variables. Several of these equations exhibit extremely low Durbin-Watson statistics indicative of the presence of severe autoregression. This would tend to make his prior structural equations dubious in regard to their significance.

Another problem is his use of levels rather than

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[1]Ibid.

percentage changes or some other method, such as first differences, which would have adjusted for the trend factor common in time-series data.

Beryl W. Sprinkel (1971)[1]

This work is very similar to Sprinkel's 1964 book, which has been previously discussed. However, there are several reasons why it should also be discussed. First, it extends the time period of Sprinkel's previous study (1918-1963) through 1970. Secondly, it cites several previous studies which tend to support the conclusions drawn here. Thirdly, changes have been made in the estimated lead of money supply over stock prices. And, fourthly, it reaffirms the basic earlier findings after seven years of additional studies and examination.

Sprinkel states the purpose of his work as follows:

> To explain the increasingly popular monetarist theory of aggregate demand and to relate changes in money to such important economic variables as business cycles, inflation, economic growth, and stock and bond prices.

He goes further to state that there is "practical application" of these findings to the "prediction of economic and financial trends and to the formulation of profitable investment policies."[2]

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[1]Sprinkel, "Money and Markets."

[2]Ibid., p. vii.

Milton Friedman, the most prominent monetarist, grants unqualified praise to Sprinkel's study referring to it as "a sophisticated analysis of monetary relations that embodies results at the very frontier of scientific research."[1] Friedman also implies that this study has valuable application to investment strategy.

Sprinkel cites several previous works which validate his results, including those of Keran[2] and Palmer[3] among others. In regard to these efforts, Sprinkel remarks: "Now that the attention of economists and investment analysts is focusing on this relation, research efforts will undoubtedly improve.

Additional study did not change the conclusions of his earlier study materially. In fact, the major purpose of this work seems to merely reaffirm and restate these findings. However, Sprinkel does change the results regarding the length of the average lead of money supply over stock prices. "Changes in monetary growth lead changes in stock prices by an average of about nine months prior to bull markets."[5] This shortening of the lead preceding bull markets from fifteen to nine months represents a substantial change, but no comment or explanation is evident for this result other than perhaps the implied result of an

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[1]Ibid., p. xxiii. [2]Ibid., p. 119.

[3]Ibid., p. 228. [4]Ibid. [5]Ibid., p. 221.

extension of the study period.

The methodology remains unchanged from the previous study and is, therefore, subject to the same basic criticisms. The significance of this work lies in its influence on research, and perhaps markets, and in its reaffirmation that, at this time, the pervasive belief was in a strong direct and indirect influence of money on stock price and on the widely accepted lead of changes in the money supply over stock prices.

F. K. Reilly and J. E. Lewis (1971)[1]

Reilly and Lewis use graphical analysis and regression analysis to examine the relationship between money and stock prices over the period 1960-70. They were one of the first to use econometric techniques to verify the graphical analysis. The earlier studies of Sprinkel (1964) and Palmer (1970) relied on graphical analysis to draw their conclusions. As noted earlier, although Palmer mentions that his results were "confirmed by the use of regression analysis," he does not specify his model and reports no details of his findings other than the $R^2$ values.

This study contains several similarities with studies of the same period. Reilly and Lewis use revised

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[1]Reilly and Lewis, "Variables and Stock Prices."

[2]Ibid., p. 22.

monthly data for percentage changes in the money supply, which is "smoothed" by the use of moving averages. Also, they use percentage changes in stock prices rather than levels of stock prices. Much has been made recently of the use of levels rather than percentage changes in stock prices. Discussions of later studies will show that these criticisms are more related to statistical problems rather than theoretical issues. Some authorities prefer percentage changes to levels because percentage changes more closely reflect stock returns than do levels. The major benefits to the use of percentage changes, however, relate to methodology. The use of percentage changes for both series reduces the effects of the trend component and reduces autoregressiveness inherent in time-series data. However, the use of moving averages may reintroduce some of this trend component and autoregressiveness which was previously reduced. Moreover, by converting both series to percentage changes for the same time periods, both series will be in equivalent and comparable forms.

A major difference in this and previous as well as later studies was that they used regression analysis to analyze the relationship between current changes in stock prices and current and five-lagged periods of changes in the money supply. By this method, Reilly and Lewis are able to isolate the specific relationship between money and stock prices.

Most other authors state that their purpose is to examine this relationship, but then proceed to incorporate several other variables into their models. Much of the focus of their papers, therefore, is upon these other variables, not the money supply. In their statistical results, they report figures which pertain to the "significance" and "explanatory power" of their models and, therefore, conclude that the money supply is significant, that there is a significant lead or lag, and that the money supply "explains" a very high degree of the variation in stock prices. These conclusions cannot be drawn from such models by the use of the "F" and "$R^2$" statistics because these measures refer to the significance and explanatory power of the total model including several variables. It is possible to eliminate one or more of these variables or to add one or more variables to the model and still show a "significant" relationship with "high" explanatory power. Therefore, such models do not isolate this relationship and conclusions such as those mentioned cannot be drawn for this reason. It is possible, of course, to use the "t" statistic for the coefficient of the monetary variable to indicate its significance; but, as the money supply is only one component of these multivariable models, it is still not possible to isolate the contribution of any one of these variables, such as the money supply, to the significance and explanatory power of the complete model.

Another point that should be made at this time concerns the "predictive" power of models. The $R^2$ statistic measures "explanatory" power not "predictive" power. This statistic simply measures how much of the variation in the dependent variable is "tracked" by the independent variables in the model over the sample period. It does not imply that the same model will be able to forecast the changes in the dependent variable in some ex-ante period.

In spite of this, Rogalski and Vinso in a later criticism of this work, impose such an implication on Reilly and Lewis's findings.

> The conclusion which must follow from such findings is that if one can forecast changes in money supply, one can determine at least in part future prices and returns of stocks. Such a conclusion contradicts a body of knowledge recently developed which demonstrates that the stock market is efficient.[1]

Rozeff states that Reilly and Lewis "implicitly reject the EM [efficient market hypothesis] model."[2] Rozeff, Rogalski and Vinso, and certain other later writers, in an effort to find fault with these early studies, as well as to justify their own studies, sometimes impose conclusions on these earlier studies which their authors do not make. (It should be noted, however, that several early writers did purport that their findings could be used to develop

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[1]Rogalski and Vinso, "Stock Returns, Money Supply and Direction of Causality," p. 1018.

[2]Rozeff, "Money and Stock Prices," p. 290.

profitable trading rules. In this regard, these writers may be subject to legitimate criticism.)

To further clarify this point, it must be noted that the early studies were concerned with the specific nature of the relationship between money and stock prices. They then drew implications from their findings which were supportive of the quantity theory of money. The major focus of later studies was on the efficient market hypothesis. This was not the focus of the earlier studies.

This is evident when the findings and conclusions of Reilly and Lewis's study are examined. Their results were that the first two lagged money variables were statistically significant. They also found that the model explains about eleven percent of the variation in stock prices.[1] These results are consistent with their graphical analysis. From this, they conclude that the relationship between stock prices and past money supply is significant but weak. These results are consistent with the quantity theory of money and with Sprinkel's results; however, it appears that the lag between stock prices and money supply has become shorter during this period. Their graphical analysis shows that "major and sustained declines in the growth rate of the money supply are followed by stock price

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[1]Reilly and Lewis, "Variables and Stock Prices," p. 66.

declines." However, they warn that "false signals are possible."[1]

Most of the criticisms, which can be made of this paper, have already been mentioned in the previous discussion of similar studies. One final point is that they attribute the relatively low $R^2$ value to the occasional failure of stock prices to respond to changes in monetary growth. There are a number of factors that could cause stock price movements unrelated to the money supply. The "random walk" nature of stock prices is such that no model with limited variables should be expected to capture all of its movements.

Kenneth E. Homa and Dwight M. Jaffee (1971)[2]

The stated objective of this paper is as follows:

> To develop and estimate a relationship between the supply of money and an index of common stock prices, and then to evaluate the usefulness of this relationship as a forecasting tool in the implementation of investment strategies.[3]

Homa and Jaffee's work is similar to Keran's in that both use regression analysis, both recognize the importance of incorporating expectations, and both use current and lagged values of changes in the money supply in explaining and

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[1] Ibid., p. 20.

[2] Homa and Jaffee, "Supply of Money and Common Stock Prices," p. 1045-1066.

[3] Ibid., p. 1045.

predicting stock prices. In addition, both use quarterly data, both use the level of stock prices rather than the change or percentage change in stock prices, and both cover similar periods of time. Therefore, it is not surprising that both give somewhat similar results and fall prey to the same criticisms.

Homa and Jaffee make one radical departure from most previous and subsequent studies. They estimate and predict stock prices using only values of the level of the money supply and percentage changes in the money supply, current and past. This dramatically illustrates the importance of money on stock prices. "The importance of the money supply as a determinant of stock prices may be derived both from the structural link of the stock market with monetary conditions and from the role that the money supply plays as a general indicator of economic expectations."[1] They present logical arguments based upon the relationship of money to the determinants of stock prices in the basic stock price formula for such a structure of the model. However, they do present the disclaimer that, "the omission of other economic variables from the relationship should not, however, be taken as a presumption that the money supply is the only important determinant of aggregate stock prices."[2] The equation and results are

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[1]Ibid., pp. 1045-46. [2]Ibid., p. 1046.

reproduced below:

$$SP = -26.77 + .61\ M + 3.14\ G + 1.46\ G_{-1} + .87\ U_{-1}$$
$$(1.11)\quad (4.13)\quad (3.16)\quad (1.46)$$

$$R^2 = .968 \qquad S_e = 3.70 \qquad D.W. = 2.14$$

SP is the current level of the Standard and Poor's 500 Stock Index. M is the current level of the money supply as measured by M1. G is the growth rate in the money supply given as a percentage change from the previous quarter, and $G_{-1}$ is the figure lagged one quarter. Several points are worth noting. First, the .87 figure is the coefficient of serial correlation, which implies that 87 percent of the previous period's error would recur if this factor were not included in the equation. This figure was incorporated into the model due to the evidence of high serial correlation in the error terms of the equation. However, the inclusion of this factor may be indicative of the exclusion of a variable which has a systematic influence on both variables.[1] Other methods of adjusting for such a possible trend, discussed earlier, may be intuitively more desirable.

Secondly, the value of the lagged growth rate is not statistically significant; yet, this important point is not sufficiently addressed. Homa and Jaffee do state that

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[1]Pesando, "Supply of Money and Common Stock Prices," pp. 900-921.

through "experimentation" they found this structure to produce the "best fit."[1]

Thirdly, the use of levels, rather than percentage changes in stock prices, may have been responsible for some of the empirical problems such as autoregressive disturbances. Other authorities choose to criticize the use of levels on the basis that they do not reflect stock returns. However, studies comparing percentage changes in stock price (which amount to stock returns excluding dividends) to stock returns inclusive of dividends show no material difference in results. Therefore, the criticism of the use of levels is primarily empirical rather than theoretical.

Finally, although Homa and Jaffee claim to show that their model outperforms both a forecast based on naive extrapolation and a buy-and-hold strategy, an investor who could predict the money supply accurately would outperform all other strategies (using their model). "This implies that at least some current predictive information on the future movements of the money supply is a necessary input for the successful use of the money supply-stock market relationship."[2] Nevertheless, no attempt was made

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[1]Homa and Jaffee, "Supply of Money and Common Stock Prices," p. 1049.

[2]Ibid., p.1065.

to examine the relationship between current stock prices and future changes in the money supply.

Michael J. Hamburger and Levis A. Kochin (1972)[1]

Hamburger and Kochin recognize the wide agreement among economists that changes in the quantity of money have important influences on the movement in equity prices, but maintain that the channels of influence are in dispute. They, therefore, state that the purpose of their paper is to "contribute to the understanding of this relationship" and to address "a number of limitations contained in earlier studies."[2]

They begin with a theoretical exposition on the effects of money on stock prices which addressed the "liquidity effect," the "earnings effect," and the "risk premium" which are related to the basic stock price formula. A major contribution of this paper is the introduction of the effect of the variability of money on risk and, therefore, on stock prices. Increased variability of money should be associated with higher risk premiums and, therefore, higher stock prices. Also, this study brings up the implications of the efficient market hypothesis to the money-stock price relationship. Hamburger and Kochin state

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[1]Hamburger and Kochin, "Money and Stock Prices," pp. 231-49.

[2]Ibid., p. 231.

that stock prices will lag money supply changes only if these changes are unpredictable.

> The questions we seek to answer are: 1) how much of the variance in stock prices can be explained by using only current and lagged values of money and 2) what is the relative importance of variations in the growth rate of money for the bond and equity markets?[1]

The regression equations used were in the following form:

$$\Delta X_t = a + b_1 \Delta M_t + b_2 \Delta M_{t-1} + \cdots + b_{n+1} \Delta M_{t-n}$$

$M_t$ is the growth rate in M1 and $X_t$ is one of four security market variables including the Standard and Poor's Stock Price Index (which is the one of concern to this present paper). The lag distributions are fitted to a fifth degree polynomial with no end point constraints, and n, the total length of the lag, is taken as nine quarters. the data are quarterly observations for three overlapping periods: 1956-I to 1970-II, 1953-I to 1960-IV, and 1961-I to 1970-IV.[2] The results show current and one- and two-quarter lags to be significant with "$R^2$" values of .26, .31, and .29 respectively for the three periods. Hamburger and Kochin conclude from these results that there is no evidence for an indirect effect of money on stock prices (i.e., working through interest rates) but evidence that changes in money have a direct impact on stock prices.[3]

An additional equation is estimated to address the

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[1]Ibid., p. 241. [2]Ibid. [3]Ibid., p. 242.

second question stated on the preceding page. The results indicated that "the higher the level of variability in the money supply, the lower the level of stock prices."[1] Hamburger and Kochin state that "this effect . . . has not been suggested in any previously published work."[2] Indeed, this result has implications for future research.

Several criticisms could be made of this study. One involves the lack of any effort to examine the significance of future changes in the money supply upon current stock prices. This is somewhat surprising in light of the specific mention of "efficient markets" in the article.[3] Hamburger and Kochin explain this by attributing it to the unpredictability of money supply changes. This reasoning also applies to the use of and apparent significance of lagged money supply variables.

Another possible criticism involves the application of polynomial lag distributions. This point is addressed by Miller and Pesando and will be discussed later.

A final weakness is their admission that "it is doubtful that the evidence will provide final answers to the question of how money influences the stock market or how the effects of money should be measured."[4] This study poses good questions but provides few clear answers.

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[1]Ibid., p. 245. [2]Ibid. [3]Ibid., p. 233.

[4]Ibid., p. 246.

Merton H. Miller (1972)[1]

This work is a discussion of the paper by Hamburger and Kochin; however, it also discusses the paper by Keran, upon which much of the Hamburger and Kochin paper was based. It is a highly critical review of these papers (as was its purpose) discussing several points of logical, theoretical, and, primarily, empirical questions.

The paper begins with a criticism of the structural equations used to form the "expected values" of certain variables. "The lags underlying the supposed 'expectation' have been estimated by a procedure that appears to be entirely arbitrary, to put the matter in the most charitable way."[2] Miller criticizes the arbitrary use of the lagged coefficients constrained by a six-order polynomial of the Almon variety where the only defense of its use is that this treatment is "conventional" and where no prior evidence of the shape of the lag structure is given. Miller refers to this experimentation practice as "mechanical mining" of the data.[3] He goes further to point out that "estimating a lag structure by sifting through the data with a high-order polynomial may simply be generating a close tracking of the random patterns in the particular sample."[4] Miller suggests that their so called

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[1]Miller, "Money and Stock Prices, Discussion," pp. 294-298.

[2]Ibid., p. 294. [3]Ibid. [4]Ibid., p. 295.

"significant" lags may be "merely cloud pictures traced out by the high-order polynomials they insist on using."[1]

A second criticism (which again refers to both Hamburger and Kochin's and Keran's works), which Miller makes, deals with the incorporation of structural equations which exhibit Durbin-Watson statistics of .74 and .67 by the estimates of Keran and Hamburger and Kochin respectively. This makes the structural equations upon which "expected" values of variables are identified subject to autoregressive disturbances in the error terms, thus bringing into question their significance. Also, it may indicate specification errors in the models. Additionally, since the lags and their associated constraints use up 18 degrees of freedom out of a sample of only 58 observations (a lag structure that Miller terms as "positively Baroque"), Miller confesses his inability to even find a table with values of up to K=19 to check the Durbin-Watson statistics.[2]

A third criticism presented by Miller involves the use of levels.

> With both the stock price and earnings variables entering in level form . . . significant coefficients on current or lagged earnings could arise merely from the common upward trend in both.[3]

Miller suggests the use of rates of change rather than

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[1]Ibid., p. 298. [2]Ibid., p. 296. [3]Ibid., p. 295.

levels for two reasons: (1) it may reduce or eliminate the trend factor and (2) stock returns are more relevant to investment strategy than stock levels. The former argument is a good one, but the latter argument is more a matter of choice as investment strategy could be based on either levels or percentage changes in levels (e.g., the use of stock price index futures and options, etc.); and changes in stock prices are logically tied to levels (i.e., a higher stock price level would represent a positive stock price change.).

A fourth criticism Miller makes concerning these studies (one which could be made of several others also) is the representation of so called "predicted values."

> [Keran] uses the term, "predicted," . . . to mean simply the computed regression values for the past sample interval over which the equation was fitted. This misleading use of "predicted" is a common one and a fine example of what . . . has [been] called "the cruel tricks that statisticians play on economists."[1]

Many subsequent studies use the term "expected" or "anticipated" in the same manner and are subject to this quite simple and obvious criticism. Yet this practice persists with no end in sight.

A fifth major criticism given by Miller is the failure to consider the "efficient market hypothesis" explicitly in these studies (although it is sometimes

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[1] Ibid.

referred to). This hypothesis "implies, among other things, that future stock price movements cannot be forecast from past movements in money."[1] An additional point relates to the use of levels rather than percentage changes. This point has been discussed earlier.

The purpose of Miller's paper was to provide a discussion and criticism of the empirical studies cited. The criticisms of Miller concerning these earlier studies is admittedly strong. However, in all fairness, some of the criticisms involve points which are debatable, and some may simply involve a lack of explanation on the part of the writers. Also, Miller neither develops an alternate structure nor offers additional empirical evidence to support his criticisms. Nonetheless, these criticisms point out certain methodological problems which should be addressed in future studies.

## Recent Studies (1974-82)

### James E. Pesando (1974)[2]

The purpose of Pesando's paper is, as he states, "to evaluate the potential contribution of the Keran, Hamburger-Kochin, and Homa-Jaffee models to the problem

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[1] Ibid., p. 298.

[2] Pesando, "Supply of Money and Common Stock Prices," pp. 900-921.

of forecasting the level of common stock prices."[1] Pesando begins with an examination of the models citing several methodological problems. Next, he tests the models for structural stability, sensitivity to possible specification error, and forecasting ability.

Like many others, Pesando initially questions the supposedly remarkable ability of these models to explain, and, therefore, presumedly to predict, stock prices as evidenced by their high "$R^2$" values. These may be statistical illusions based upon the Almon technique employing rather high-order polynomial lags.

> The explanatory power of these equations may thus reflect the ability of these extraordinarily flexible lag structures to track the observed pattern of stock prices in the sample period rather than to capture a stable structural relationship.[2]

Specifically, the frequent sign reversals of the lag weights for corporate earnings are perhaps indicative of structural instability and neither Keran nor Hamburger and Kochin present any possible explanation.[3]

In regard to the Homa and Jaffee model, which purports to explain 96 percent of the level of stock prices using the nominal money supply as the only explanatory variable, Pesando points out that a simple time trend is able to explain 93 percent of the variation of stock prices

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[1]Ibid., p. 909. [2]Ibid., p. 912. [3]Ibid.

during the same sample period.[1] Homa and Jaffee are also criticized for the incorporation of the pronounced serial correlation into their model, which, like the Almon lag technique, is methodologically acceptable but raises serious questions as to the structure and significance of their model. Thus, the particular model structures described above may give good statistical values for tracking past events but may identify no stable structural relationship and, therefore, have little or no use as predictive tools (which both are purported to be).

To test the sensitivity of the Keran and Hamburger and Kochin models to possible specification error, Pesando reestimates the equations using "relatively straightforward" alternate specifications of the expectations proxies for which there are "little theoretical grounds for preferring one specification to another."[2] The results show sign changes for major variables and indicate an increase in serial correlation of the error terms.[3]

Finally, Pesando uses the models of Keran and Hamburger and Kochin to generate ex post forecasts (forecasts based on the observed values of the exogenous variables) for the period 1970-III to 1972-II. The results indicate that "neither model possesses any real forecasting

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[1]Ibid. [2]Ibid., p. 913. [3]Ibid., p. 914.

power."[1] Further results indicate that "neither model outperforms . . . a naive no-change extrapolation."[2] Furthermore, when predicted percentage changes in stock prices are estimated and compared with actual figures, the results are equally dismal. Likewise, the Homa and Jaffee model does not perform adequately as a forecasting tool--not even outperforming a naive no-change extrapolation.[3]

In summary, Pesando states:

> In view of the inherent volatility of common stock prices one cannot help but view with suspicion the remarkable ability of [these models] . . . to explain the behavior of stock prices during the 1956-70 period. . . . Out-of-sample forecasting experiments . . . confirm the suspicions.[4]

Pesando cites the "efficient market hypothesis" to point out that lagged variables should not be used to explain future stock prices. He then points out that "the market has not been successful in anticipating [even contemporary values of the exogenous variables] in the past."[5] Pesando concludes with the statement: "One should not place undue confidence in the quantitative estimates of the impact of fluctuations in the money supply on common stock prices."[6]

However, like Miller, Pesando offers no alternative model nor does he provide specific suggestions as to how these previous models might be improved. Neither does he

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[1]Ibid. [2]Ibid. [3]Ibid., p. 919.

[4]Ibid., p. 920. [5]Ibid. [6]Ibid., p. 921.

provide any empirical evidence to support an alternative model.

Richard V. L. Cooper (1974)[1]

Cooper's article is a major contribution to the literature for a number of reasons. It represents perhaps the first effort to incorporate the efficient market hypothesis with the quantity theory of money in a model. Additionally, it reconciles the two "apparently contradicted" hypotheses and shows that they are in fact complementary. Thirdly, he purports to show specific empirical evidence that changes in the money supply actually lead, rather than lag, changes in stock prices. And, fourthly, he provides an explanation of the apparently contradictory results of his and earlier studies.

> The hypothesis developed here [referred to as the SQ-EM model] is a combination of the simple quantity theory [SQ] model and the efficient markets [EM] model. The SQ-EM model suggests that the money supply may be an important factor in determining the market rate of return [consistent with the SQ model] but that returns may actually lead money changes [consistent with the EM model].[2]

Cooper uses both regression analysis and spectral analysis, a technique not used in previous studies, for the period 1947-70 to confirm his findings. The regression model is shown on the following page:

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[1]Cooper, "Capital Markets and Quantity Theory," pp. 887-908.

[2]Ibid., p. 887.

$$r_t = \sum_{i=-6}^{12} a_i m_{t-i}$$

In this model, "r" represents returns for the Standard and Poor's 500 stocks (adjusted for the dividends), and "m" stands for the percentage change in the money supply. The values of -6 through 12 represents lags where negative values represent leads (i.e., negative lags). Cooper found that only leads of two and three months were significant and only one lag of eight months was significant. Cooper discounts the significance of the eight-month lag by simply stating that it is probably "spurious." Interestingly, he found the current money supply change to be insignificant, a finding which he considered slightly weakened the results. Replicating the estimation for current, three leads, and two lags found only the two-month lead significant. (All significance levels were for the 90 percent confidence level.) The $R^2$ value for the first equation was .169. These results seem to indicate that money supply changes lag rather than lead stock returns and that the lead is one of two to three months. Also, money supply changes account for a small but significant variation in stock returns.

Extending the research to spectral analysis seems to confirm these regression results. These results show that money supply changes "lag returns by about one to

three months."[1] Interestingly, he found that for the lower frequencies (corresponding to longer-term movements in money changes) the results show money lagging returns significantly by about one to three months; however, for higher frequencies (corresponding to shorter-term fluctuations in money supply), money actually leads stock returns slightly.

An important point is made by Cooper concerning "causation," which is the subject of several later articles and which explains the apparently inconsistent results found by these later studies. "Returns may lead changes even though the causation runs from money to returns."[2]

> Causality between two series cannot be determined by a simple comparison between them. Instead, the choice between a particular hypothesis and several competing hypotheses is the result of a comparison of the implications of each and how well these implications conform to actual events.[3]

Another major finding is given to further reconcile the earlier studies to the later studies. The results of spectral analysis indicate that "money changes lead stock prices . . . even though they lag stock returns [i.e., changes in stock prices]. . . . This shows the importance of considering returns rather than prices in the model."[4]

Another important point which relates to subsequent

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[1]Ibid., p. 899. [2]Ibid., p. 890.

[3]Ibid., p. 906. [4]Ibid., p. 905.

studies regards the use of so called "anticipated" versus "unanticipated" money supply changes.

> Since it is unlikely that money supply changes can be fully anticipated, one would expect stock returns to be affected by the unanticipated component of money changes as well as by the anticipated component.[1]

This shows the appropriateness of using actual money supply figures in testing the lead/lag relationship as the actual money supply change incorporates both expected and unexpected components. Additionally, it has been previously pointed out that the methods of generating "predicted" or "expected" or "anticipated" future values are highly questionable. (See the discussion of Miller.)

A further explanation for the possible lead of stock returns over money supply changes is given by Cooper.

> [Since] money lags returns by about one to three months . . . [and] future money supply changes can be forecast ahead one to three months with a reasonable degree of accuracy . . . [this] is quite compatible with the lead of returns over money. This evidence lends additional support to the SQ-EM model.[2]

Cooper concludes by stating:

> The most plausible explanation of the relation between money supply changes and stock returns seems to be a combination of the efficient markets model and the quantity theory of money. That is, anticipations about future money supply changes are incorporated into current stock returns.[3]

The major criticism of Cooper is his confidence in the

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[1]Ibid., p. 890. [2]Ibid., p. 902. [3]Ibid., p. 907.

results of spectral analysis. By his own admission, these results are not conclusive.

> However, . . . there is some difficulty in interpreting the phase spectrum. . . . For example, for a phase shift of one-quarter cycle for a frequency corresponding to eight months, the phase may be interpreted as money lagging returns by two months, or lagging by ten months . . . or even leading by six months."[1]

He goes on to say that a priori information must be used to interpret the results and that these interpretations are consistent with differing models. Even though he criticizes regression analysis in favor of spectral analysis, his own results show his regression analysis gives more conclusive results and, indeed, these results are used to interpret the results of spectral analysis. Moreover, spectral analysis does not lend itself to hypothesis testing.[2] This may be another example of what was referred to earlier as the "cruel tricks that statisticians play on economists."

Michael S. Rozeff (1974)[3]

The purpose of Rozeff's paper is to "examine stock market efficiency with respect to money supply data by testing 1) regression models of stock returns on monetary variables and 2) trading rules based on money supply data."[4]

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[1]Ibid., pp. 898-99.

[2]Rozeff, "Money and Stock Prices," p. 297.

[3]Ibid., pp. 245-302. [4]Ibid., p. 245.

The conclusions of this study are that "no meaningful lag in the effect of monetary policy on the stock market and . . . no profitable security trading rules using past values of the money supply exist."[1] Rozeff finds this evidence consistent with the efficient market model. He goes further to state that not only do current stock returns incorporate all information in past money supply data but that they "appear to anticipate future changes in the money supply."[2]

Rozeff provides an explanation of the basic theoretical framework for such a relationship and a critical analysis of previous studies. His findings and conclusions are similar to those of Cooper, previously discussed. Additionally, he brings forward certain points which are of interest to this present study.

One such observation is the lack of accurate, timely, and publicly available information concerning the money supply in earlier periods.

> From approximately 1916-39, no money supply series was published at all; from about 1939-43, publication was with a lengthly and irregular lag of about six months; from 1943-46, data was published in the FRB with a three month lag."[3]

This point is not developed in the earlier studies (such as Sprinkel's), which tested the relationship over such periods. This provides one possible explanation for

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[1]Ibid. [2]Ibid. [3]Ibid., p. 266.

evidence that markets were not efficient in these early time periods. Even in later periods, there was a considerable "publication lag." "Prior to 1967, money data was published 1-2 months after its occurrence . . .; since 1967, weekly data has greatly reduced this publication lag."[1] Rozeff develops a model which specifically incorporates this publication lag and the results for the period 1948-70 "are entirely consistent with the efficient market model."[2] He also points out that trading rules based on prior money supply figures would not prove profitable.

A related issue is that of revised versus unrevised data. Rozeff points out that revised data "may better measure" the data base and "be more closely related" to returns. This is not in conflict with the quantity theory, nor is it in conflict with the strong form of the efficient market hypotheses, which would assume perfect knowledge of all relevant information.

> According to the [quantity theory] model, portfolio adjustments depend upon the actual money supply figures whether investors receive the number in published form or not. In this case there is no possible conflict with the [efficient markets] model since the hypothesis being tested is whether monetary variables have any relation at all to stock returns.[3]

Another point relates to the use of regression analysis, the method used by most all other recent writers.

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[1]Ibid., p. 300. [2]Ibid., p. 266. [3]Ibid., p. 263.

"Powerful regression techniques . . . would have been unavailable and/or very costly to operate much before 1960."[1] This points to the fact that trading rules based on this technique would have been unavailable, and therefore obviously not profitable, to investors until recent years. Also, this is an aspect of technological innovation (i.e., advances in computer technology, telecommunications, etc.) as it relates to market efficiency, which has been conspicuously absent in the literature.

Another issue is that of the existence of a trend or some common factor which might cause both series to move in some related fashion. This argument is a major impediment to attempts to prove causation. However, it is not a major impediment to attempts to quantify such a relationship nor to efforts to develop predictive models. "An efficient market does not underutilize information and would not fail to use at least the predictive information inherent in the autoregressiveness of . . . series."[2] One method of removing trend is the use of first differences.

> This use of first differences is a method of removing trend from the time series to obtain the unanticipated components. . . . However . . . this has the major failing that successive prediction errors are correlated since first differences of monetary growth are strongly autocorrelated. This implies failure to use all the information in the time series."[3]

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[1]Ibid., p. 253. [2]Ibid., p. 262. [3]Ibid.

This problem is a common one to many other attempts to "filter" or "pre-whiten" data. In removing either "trends" or "irregular variations," we tend to remove information which would logically be utilized by investors and which is a part of relationships between variables. The seeking of statistically "antiseptic" results changes the variables under investigation to the point that they may no longer coincide with the variables purportedly examined and often produces more ill effects than good. It may be that, in some cases, "the cure is worse than the illness."

An interesting finding is made when Rozeff "splits" the data into subperiods. Using lagged M1 growth rates to explain stock returns for the subperiods 1948-60 and 1960-70, Rozeff found the lagged variables in the prior period significant while those in the later period were not. To this result he remarks, "this difference in behavior over the subperiods is noticeable and raises the question of whether the stock market was inefficient with respect to monetary data prior to 1960."[1] Extending the periods back to 1916 and experimenting with different subperiods, he still finds lagged M1 variables significant for the 1918-60 period. Rozeff rationalizes these findings by a reference to possible "statistical variability" and

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[1]Ibid., p. 266.

further remarks that the relatively low "$R^2$" (.10 and .056 respectively) would result in no profitable trading rules. These remarks concerning his findings of lagged money supply variables significantly related to current stock prices may be indicative of Rozeff's desire to prove market efficiency even over periods where this may not be the case.

A final point is that of causation. Rozeff discusses the Granger-Sims definition and test of causality, which "reasons that past Y should not influence current X if X causes Y solely."[1] Rozeff makes a good point when he poses the question:

> But what if X causes Y and forecasts of future X are reflected in current Y? If the forecasts are accurate on average, current Y will be related to future terms in X even though X is causing Y. The test for unidirectional causality will fail.[2]

Rozeff, therefore, concludes that markets are efficient and, therefore, changes in the money supply lag rather than lead stock returns. This negative lag occurs because stock returns anticipate monetary change.[3] So strong is his conclusion, however, that he appears unwilling to accept the possibility of inefficient markets in past periods even in light of his own evidence. Due to their similarities, additional discussion of this article is included in the discussion of Rogalski and Vinso.

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[1]Ibid., p. 275. [2]Ibid. [3]Ibid., p. 247.

Robert D. Auerbach (1976)[1]

Auerbach explores the relationship between money and stock prices in two parts: (1) a review and commentary on previous articles and (2) additional empirical evidence on this relationship. He notes that recently doubts have arisen concerning the results of earlier studies based upon both theoretical and methodological grounds.

The theoretical grounds relate to the supposition that the quantity theory implies that money supply changes should lead stock prices and the omission of consideration of rational expectations and the efficient market hypotheses. In his opinion, these deficiencies caused earlier studies to consider only lagged values of the money supply.

Specific methodological criticisms relate to Sprinkel's use of graphical and visual analysis and his use of average leads and lags. "Visual inspection of the data, as Sprinkel has done, is less exact than other statistical methods."[2] In regard to the use of averages, Auerbach points out:

> As a matter of arithmetic, it is always possible to compute an average time lag between turning points in two series which do not have synchronous turning points. However it is not the existence of such a lag but rather the stability of the lag which supports the view that the two series are related.[3]

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[1]Auerbach, "Money and Stock Prices," pp. 3-11.

[2]Ibid., p. 4. [3]Ibid.

Auerbach also criticized Keran and Homa and Jaffee for their failure to adjust for trends in the variables. This point has been discussed previously regarding the use of levels rather than percentage changes or first differences. To illustrate his point, he constructed an artificial series having no economic significance by adding a series of random numbers to a simple trend variable (an annual rate of 2.5 percent) and regressed this against quarterly levels of stock prices. By this method he explained 86 percent of the variation in the Standard and Poor's index for the period 1959-74.[1]

Auerbach's review of Cooper is complimentary of his approach, which tested the significance of future leads but was critical of his interpretation of the spectral analysis results. Also, he makes the statement that Cooper's finding that current money supply changes are not significant is contradictory of the efficient market hypothesis.[2] Auerbach found this relationship to be significant, which contradicted Cooper's result.

The empirical research of Auerbach concerns the lead-lag relation between money and stock prices. Variables are the stock yield, defined as the percentage change in the S&P 500 index adjusted for dividends, and the money supply, defined as the rate of change in M1. The data was

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[1]Ibid., p. 6. [2]Ibid., p. 7.

monthly data for the period 1947-70. The trend and cyclical components of each variable were removed by the use of "an autoregressive filter," although Auerbach is not specific in regard to this point. He merely refers us to a footnote in another article, which is "forthcoming." He then applies correlation analysis to the variables to determine the degree of association.

Cross correlations were computed between the current stock yield and the current money supply change. Next, cross correlations were computed between the current stock yield and the money variable for each of the sixty prior monthly periods to test whether stock yields lag money changes. Finally, the variables were reversed and cross correlations were computed between the current money variable and the stock yield in each of the prior sixty months to test whether stock yields lead money changes.

The results were as follows:

> The cross correlations between the current stock yield and sixty prior values of the money variable were not statistically significant. Only the synchronous cross correlation was statistically significant at a value of .18. When the variables were reversed to test whether stock yields lead money, the synchronous cross correlation was equal to .18 [and significant], as expected. Cross correlations between the current money variable and stock yields in each of the previous two months also were found to be statistically significant. Specifically, stock yields one and two months in the past had significant cross correlations with the current percentage change in money of .12 and .20 respectively. Taken together, the current stock yield and the two prior stock yields serve to "explain" about 8.7 percent of the variation in the current percentage

change in money.[1]

A chi-square test was then employed to test for significance in groups. The correlation between the current money variable and the current, one-month lagged, and two-month lagged values for stock yields

> taken as a group of three or as a group of two with the synchronous cross correlations deleted, were significant at the 99.5 percent level. All other lagged coefficients taken in groups of three for successive cumulative tests were not significantly different from zero at the 95 percent level of confidence.[2]

Auerbach draws three conclusions from these results:

> 1. Rates of change of the money supply are not related to future stock yields
>
> 2. Stock yields are related to synchronous and future rates of change in the money supply
>
> 3. The relation between stock yields and synchronous and future rates of change in the money supply is weak, with stock yields associated with only about 9 percent of the variation in the money supply[3]

Auerbach concludes from these results that "the public tends to anticipate some money supply changes and discounts this information into stock prices one or two months before the money supply changes."[4]

One criticism of his work involves the use of simple correlation analysis. The reasoning he gives for this method is to bypass the statistical problems involved in regression analysis. It may have helped to bolster his findings if he conducted a regression analysis and compared

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[1]Ibid., pp. 9-10. [2]Ibid., p. 10. [3]Ibid. [4]Ibid.

the results. If regression analysis gives stronger evidence, then the deletion of such a technique to avoid possible problems is hard to justify.

A second criticism involves his reasoning concerning the elimination of the trend and cyclical factors from the series. In an efficient market, investors would indeed take these factors into account as well as other factors in forming expectations concerning money supply changes.

A third criticism relates to his use of a "filter" to "pre-whiten" the data. This method has been criticized in previous discussions. The use of such a filter changes the data used in such a way that there is no reason to believe that the results of his study truly measure the relationship between "actual" changes in money and stock variables. This procedure alone may be sufficient to account for the discrepancies in his findings and those of other studies. Moreover, he never specifies the particular "filter" technique he employs.

Finally, he offers an "alternative explanation" to the one mentioned above. He suggests that this relationship could be explained by actions of the central bank. If the central bank uses stock yields as an indicator of business cycle fluctuations, they might act on the money supply in some predictable fashion thereby creating this relationship whereby stock yields precede money supply

changes. Moreover, if the public uses stock yields as a predictor of business cycles in the same manner as the central bank, it follows that "the public would be able to forecast monetary changes, and this explanation would not differ from the first explanation."[1] However, the consistency and predictability of FED actions is questionable.

John Kraft and Arthur Kraft (1977)[2]

The stated purpose of this paper is "to test the causal relationship between several determinants of stock prices and stock prices."[3] The determinants used are the money supply, the rate of change in the money supply, the corporate interest rate, and a measure of risk. The measure of stock prices is the Standard and Poor's 500 index, which was defined both as levels and as percentage changes in levels. The measure for the money supply was M1. The data is monthly for the period 1955-74.

The test for unidirectional causality employed is the method employed by Sims who states it as follows:

> Regress Y on past values of X . . . then if causality runs from X to Y only, future values of X in the regression should have coefficients which are insignificantly different from zero as a group.[4]

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[1] Ibid.

[2] Kraft and Kraft, "Determinants," pp. 417-425.

[3] Ibid., p. 417. [4] Ibid., p. 420.

Their results indicate that

> future values of the stock price measures are not significant in explaining M1 or M1%. . . . Thus, there is no significant causality running from either the money supply (M1), [or] percentage changes in the money supply (M1%) . . . to either the level or percentage change in stock prices. This result implies that the money supply [and] changes in the money supply do not lead movements in stock prices, and is consistent with the hypothesis that capital markets are efficient.[1]

They extend this conclusion further when they state that

> unidirectional causality exists from the stock price measures to M1 [and] M1% . . . which indicates that stock price measures have a causal influence on monetary actions. . . . The implication being that stock price measures lead rather than lag monetary actions . . . which supports . . . evidence on efficient markets and the quantity theory.[2]

Their analysis contains several weaknesses not stressed in the paper. For example, their data indicate that the relationship between current stock price levels and money supply levels for the past six months is significant at the .05 level. The results are the same when different filters are used. This conflicts with their statements concerning evidence for stock prices leading money supply changes.

Another weakness is their refusal to consider the possibility that future money supply variables may affect current stock prices. They do, however, address the issue in a footnote: "Rozeff concludes that the Sims test for unidirectional causality is inappropriate when applied to a

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[1]Ibid., p. 422. [2]Ibid.

reverse-causation-with-accurate-anticipations model. Sims, on the other hand, finds the existence of such a model to be implausible. Evidence for or against such a model is inconclusive."[1] Therefore, they summarily dismiss the issue. Such a possibility would, however, render their conclusions concerning causality invalid if it were true and questionable if it is a reasonable possibility.

Two final comments can be made concerning empirical methodology. One concerns the use of filters to "pre-whiten" data. Kraft and Kraft make use of a filter to remove serial correlation from the data. The use of such a method reduces variation inherent in the data (and, therefore, some information) and possibly results in low explanatory powers of the models in the case of Kraft and Kraft.[2] Moreover, the selection of a particular filter is often based on an "ad hoc" approach. Kraft and Kraft admit that "in actually attempting to estimate (discover?) a filter the process is more art than science and may best be labeled a sophisticated attempt at producing a naive result."[3] Since the use of a filter and the particular version of a filter may substantially affect the results and conclusions, such filters should be used cautiously. Additional comments on the use of filters will be made in later discussions.

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[1]Ibid., p. 421. [2]Ibid. [3]Ibid., p. 420.

The final comment concerns the choice of levels, percentage changes in levels, or rates of return.

> While much is made of using the level of stock prices, the percentage rate of change of stock prices, or the rate of return, there is little difference in their influence on our results. . . . Admittedly the level of stock prices is a poor choice since it reflects neither changes in asset value nor the rate of return. If, however, one defines the rate of return for period "t" as the dividend yield for period "t" plus the percentage change in prices, then the only difference between returns and the percentage change in stock prices is the mean associated with the dividend yield. Despite the claims of Pesando and Cooper [and others], the use of levels or percentages made little empirical difference.[1]

In addition, other writers have pointed out that the variation in stock prices so dominates the variation in dividends that use of percentage changes as a proxy for stock returns is acceptable from both a conceptual and an empirical standpoint. The main argument against the use of levels is related to empirical concerns rather than theoretical concerns.

Richard J. Rogalski and Joseph D. Vinso (1977)[2]

The purpose of this article is to "investigate the relationship between money supply and stock prices to ascertain whether dependence can be established and in which direction the causality is manifested."[3] "To investigate

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[1]Ibid.

[2]Rogalski and Vinso, "Stock Returns," pp. 1017-30.

[3]Ibid., p. 1019.

the causal relationship between stock returns and money supply, one must determine the existence and direction of causality between unexplained variations in both series."[1]

Rogalski and Vinso use the definition of causality due to Granger, which "is based on the time series notion of predictability." They state that this definition is generally accepted and suitable for empirical testing. The definition is stated as:

> Given a set of variables, variable X causes variable Y if present values of Y can be predicted more accurately by using only past values of X than by using all or any combination of other variables in the information set that includes X and Y.[2]

The series X and Y are first transformed by a filtering procedure into white noise series and these resulting residuals are then cross correlated. "If the cross correlation coefficients at particular lags are inferred to be significantly different from zero, one may proceed to build an appropriate model to describe the relationship."[3] The note that the process of transforming data may make use of a number of alternate methods which will result in

> two variables, X and Y, which have been suitably transformed . . . so that x and y are related in the same manner as X and Y. . . . This transformation may consist, for example, of simple differencing, percentage changes, or trend removal.[4]

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[1]Ibid. [2]Ibid. [3]Ibid. [4]Ibid.

Next, they conduct what they refer to as "a practical statistical test for causality." They compute the cross correlation function between x and y after prefiltering each series by an ARMA model. Next, they employ a chi-square test to determine if the series are independent. They note "if causality runs from x to y, future lags of x should have coefficients insignificantly different from zero as a group. . . . In a similar fashion, one can determine if causality runs from y to x."[1]

Another point in regard to the test for causality relates to the use of the F-test.

> Causality testing based on regression analysis (the usual F-test) is asymptotically equivalent to testing based on cross correlation analysis (the $X^2$ test). Which procedure to use becomes one of individual preference."[2]

The money supply measure used is M1. The stock price measures used were the Standard and Poor's 500 Stock Index (S&P 500), Fisher's Link Relative Series (FIS), the Dow Jones Industrial Average (DJIA), and the New York Stock Exchange Index (NYSE). Percentage changes (excluding dividends) were calculated based on monthly closing prices over the period 1963-74.

They note that the American Stock Exchange Index (AMEX) is ignored because it is an equally weighted index. They also note that the FIS series, contrary to the other

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[1]Ibid., p. 1020. [2]Ibid., p. 1021.

indexes, does not correspond to a random walk model and, therefore, a low order moving average model must be identified and employed. The NYSE index was not available prior to 1962. The DJIA index is very narrowly based. It would seem, therefore, that the best measure of stock prices of those commonly available and used would be the S&P 500 index for a number of reasons.

Rogalski and Vinso measure the correlations between the unexplained variations (white noise) of money and stock prices and conclude that a "bi-directional" theory of causality is appropriate. They reached this conclusion based upon the results which showed that "some of the estimated cross correlations are significant for future lags." They go further to state that these results "are consistent with the hypothesis that stock returns . . . perhaps influence money supply in some complicated fashion . . .[and that] changes in the money supply cause . . . changes in stock returns."[1]

These conclusions are somewhat surprising and difficult to reconcile. Several points need to be made at this time. One of the purposes of this paper, as previously stated, was to determine the direction of causality. As the results were inconclusive, Rogalski and Vinso are amenable to stating that it goes in both directions.

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[1]Ibid., p. 1025.

This conclusion may be explained due to the fact that their intent was to find causality even if the evidence was not strongly in favor of such a conclusion. This is not particularly surprising, however, when viewed in light of their earlier statement.

> The fact that future lags of the independent variable have coefficients as a whole insignificantly different from zero only shows that unidirectional causality is possible . . . bidirectional causality may be important despite the insignificant X's.[1]

They go further to conclude that "changes in returns may actually lead money changes."[2] They view their evidence as consistent with the "strict form of the efficient market hypothesis."[3] These conclusions are inconsistent with their findings of significant lagged values of the money supply.

In addition to these obvious criticisms, several methodological weaknesses need to be mentioned. Part of their evidence is based upon "forecasted" values for the variables.

> The cross correlation function was estimated between the resulting residuals of the money supply growth forecast series and each of the stock index series for the last half of the observations.[4]

They state that only one of the correlations was significant, a future lag at five months. This they consider to be conclusive proof. However, closer examination of the

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[1]Ibid., p. 1021. [2]Ibid., p. 1027. [3]Ibid.

[4]Ibid.

actual data reveals that for both the NYSE and the S&P 500 indexes, comparing correlations at corresponding lead/lag points, the correlations for lagged values are larger than those for leading variables in a majority of the cases. This further shows how Rogalski and Vinso draw strong conclusions from weak empirical results. Unfortunately, although severe attempts have been employed to purportedly remove bias from the data, it appears that the same cannot be said of the authors.

They do give several reasons why similar studies may give conflicting results which, while they do not strengthen their conclusions, are worthy of mention as they pertain to these studies in general. One obvious reason is the time period studied. This point was discussed earlier (see discussion of Rozeff). A change in the time period can have effects on results for a number of reasons. There may be structural changes from one time period to another. In defense of their chosen time period, they point out:

> Besides assuring complete data series, this time period [1963-74] avoids the market equilibrium problem i.e., prior to 1960 equilibrium relationships between securities markets may have been affected by the accord between the Treasury and the Federal Reserve. Such a time period is considered adequate as several episodes in the business cycle have occurred over that period. In fact, results using this time period would be of even more contemporary interest than results which purport to study market structures no longer current.[1]

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[1] Ibid., p. 1023.

Another problem Rogalski and Vinso point out is the failure to consider the publication lag.

> Stock returns may show a lag relation with changes in the rate of growth of money stock if there is a lag in publication; that is, stock returns at a point in time reflect information available at that time.[1]

As they point out,

> the question of information lag has not been adequately treated. To examine the relationship of money supply and stock returns, it is important to use data gathered over precisely the same span of time. For example, Rozeff recognizes the problem of publication lag, but still uses money supply data generated at intervals somewhat different from that of the stock index. Most other authors ignor the information lag.[2]

The publication/information lag is a matter of fact.

> Because it takes the Federal Reserve nearly a month to gather all of the information, the Federal Reserve estimates what the final figure might be and publishes it as a preliminary estimate. Then one month later the Federal Reserve publishes the actual value.[3]

Another reason for an information lag is not mentioned by Rogalski and Vinso. Once the "actual" value for the money supply is published, these figures are later revised. In fact, several revisions can occur over some period of time in an effort to correct the figures for previous errors and omissions. As they conclude, this information lag alone is sufficient to expect some lag in stock price changes.

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[1]Ibid., p. 1018. [2]Ibid., p. 1019.

[3]Ibid., p. 1025.

> Therefore, the significant correlation of lag zero may indicate the incorporation of the estimated or preliminary value of money supply into stock returns and the significant correlation of lag 1 may indicate the incorporation of the information of the actual value of the previous month's money supply as soon as it is published.[1]

As mentioned previously, subsequent revisions in the data, which are common and frequent, may result in stock prices lagging money supply changes by even longer periods.

What is presented by Rogalski and Vinso as support for their assumption that stock prices lead money supply instead provides evidence that money supply leads stock prices and gives a plausible explanation as to why this is so. It is usually the case that the Federal Reserve, which is responsible for gathering the data, is unable to accurately measure the money supply even for the current period, much less forecast money supply into the future. Moreover, the FED is presumably in control of the money supply. If the FED cannot forecast money supply accurately even for the current period, how can others who are not privy to this information, do not gather this information, and do not control the money supply, be expected to consistently and accurately predict the money supply? However, this is what would be the case if the stricter or stronger forms of the efficient market hypothesis were, in fact, true. This fact alone is enough to imply that markets are not perfectly

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[1]Ibid.

efficient. However, Rogalski and Vinso contend that their results support the "stricter view of efficiency."[1] This point is also neglected or ignored by many other writers who seek to prove the theory of market efficiency in the strictest sense in spite of logical and empirical evidence to the contrary.

The empirical evidence for stronger forms of the efficient market hypothesis is somewhat weak. As previously stated, Rogalski and Vinso calculated cross correlations between the residuals of money supply and stock prices for each of four different stock indexes and of these twenty-five past, current, and future residuals found only one to be statistically significant. As this was a future residual, they immediately concluded that this was evidence that stock prices are related to future money supply and lead money supply. Rozeff's own results found "significant future lags one, two, and four and significant past lags zero, eight, and twelve."[2] From this Rozeff concludes that "stock returns are unrelated to the lagged values of the money variable but are related to future values."[3] This he concludes in spite of the fact that he finds as many significant lagged values for money as lead values.

Furthermore, Rozeff states, "all relationships of

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[1]Ibid., p. 1027. [2]Ibid., p. 1026.

[3]Rozeff, "Money and Stock Prices," p. 300.

stock returns to monetary variables are significantly improved when current stock returns are related to future monetary data.[1] He then concludes that this is evidence for the efficient market hypothesis. It is not difficult to raise the explanatory power of a model by merely including additional variables, even if these variables are, by themselves, not significant. Therefore, his conclusion is not warranted. This methodology borders on the "kitchen sink model" approach.

Finally, two methodological points are brought out which relate to this and several other studies. Rogalski and Vinso point out that predictive models require continual updating to incorporate new data as it occurs or is known. This necessitates continuous reestimation of the forecasting equation. This should reduce the forecasting error of such models considerably. However, in the case of Rogalski and Vinso, for a six-year period (seventy-two months), this would require producing up to seventy-two separate forecasting models. This, understandably, they did not do and this explains why such models are perhaps not used to a greater degree. This is an element of "information cost."

The second point relates to the use of filters. They point out that "the sign of the estimated cross

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[1] Ibid.

correlation coefficients will be affected by the form of the moving average process used to filter the growth forecast series."[1] This illustrates that filters, when used, should be used with caution and their effects should be noted. This was referred to earlier as a "sophisticated attempt at producing a naive result."

Additionally, it must be remembered that many of these studies test the relationship between actual stock prices in the current period and future values of "expected" money supply--which is merely the result of a regression equation which many times has a poor fit--and "unexpected" money supply--which is merely the residual of the estimated equation. This does not measure the relationship between actual stock prices and actual money supply. Therefore, this and similar studies appear to be examples of attempts to prove a preconceived relationship in spite of weak or inconclusive results. However, one positive contribution of the Rogalski and Vinso paper deserves mention. They suggest that the study of "velocity [of money] effects" might prove "an interesting avenue for future research" to which I would heartily agree.

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[1]Rogalski and Vinso, "Stock Returns," p. 1027.

J. Ernest Tanner and John M. Trapani (1977)[1]

Tanner and Trapani begin by stating the basic elements of the quantity theory of money and the efficient market hypothesis. (These have been presented in an earlier section of this study--Theoretical Background.) They next make the statement concerning earlier studies that the advocates of the quantity theory of money "find significant evidence supporting the view that investor profits can be increased by a careful analysis of monetary growth trends." Next they proceed to make the statement that the advocates of the efficient market hypothesis find that "analyzing monetary growth trends will not materially affect the earnings of an investor." From this they identify the purpose of their paper as being "to reexamine these apparent contradictions in the capital markets literature."[2] Their conclusion is that this reexamination "confirms that both are true--that markets are efficient and that monetary growth trends do affect stock prices."[3]

No argument can be made concerning their conclusions that markets are efficient and that money exerts an influence on stock prices if they are qualified such that they do not imply that these theories hold in their strongest form. The strongest form of the quantity theory which

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[1]Tanner and Trapani, "Can Quantity Theory Predict Stock Prices," pp. 261-70.

[2]Ibid., p. 261. [3]Ibid.

could be posed would state that money is the only variable which influences economic activity and markets. No model could be developed to prove this form as it would require that all possible variables be incorporated. The strongest form of the efficient market hypothesis implies full and perfect knowledge on the part of investors and likewise cannot be tested by a model. Tanner and Trapani, therefore, prescribe to the following convention:

> We call the test of the efficient markets hypothesis which uses only past [stock] prices or only lagged values of the forecast variable in making forecasts a "weak" test because other relevant information which may also forecast the variable are not taken into account. The "strong" test would take all other information into account. "Intermediate tests" would take a subset of this other relevant information into account. The strongest tests that we make, or that can be made in actual fact, must necessarily be part of the set we call "intermediate" strength tests."[1]

Therefore, it logically follows that it is not possible to prove the strongest form of the efficient market hypothesis. This illustrates the point that all models and studies which claim to "prove" such theories or hypotheses should be qualified to state that the findings show evidence in support of the theory in some specified form. Stronger statements than these should not be made. Quite often, unfortunately, this is not done.

These problems concerning the conclusions drawn

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[1]Ibid., p. 267.

from such studies are exacerbated by methodological flaws in these studies. The proponents of the efficient market hypothesis state that "only the 'unexpected' monetary changes matter and the 'predicted' monetary changes would not be statistically significant in explaining current stock prices."[1] This necessitates definition of and identification of the "expected" and the "unexpected" components of the money supply.

To this end, Tanner and Trapani employ three separate regression models to predict future money supply. The residuals of these equations are identified as the "unpredicted" component of money supply. The first model uses past money supply; the second model adds the federal deficit and GNP to the first model; the third model adds the monetary base to the second model.

Even though Tanner and Trapani use three separate, and increasingly complex, models to identify the "predicted" component of the money supply, the highest $R^2$ for any model is .452. This would indicate that the major portion of any future money supply changes will be identified as "unpredicted" (and implicitly "unpredictable"). It could also be interpreted that the models selected and estimated are not specified correctly. For example, Sorensen uses a predictive model which explains 94 percent of the money

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[1]Ibid.

supply.[1] This illustrates the problem of "specification error" which is inherent in most such models which are used to identify the "expected" and "unexpected" components of the money supply. Since their analysis is based upon a questionable model, it, therefore, follows that their results and conclusions will also be questionable.

Another specification problem relates to the fact that these studies clearly do not measure expectations. "Because the equations were estimated over the entire sample period, the estimated parameters use information from periods not available when the original expectations were formed."[2] The obvious implication is that: "If the subsequent structure were not known to the participants when the expectations were formed, much of what we call 'expected' money supply would actually be 'unexpected.'"[3] This means that the conclusions of this study are suspect. The reason given for not reestimating the equations over time is simply that "this would require as many "prediction' regressions as there are observations on the expected money supply."[4] Therefore, these studies do not measure what

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[1]Eric H. Sorensen, "Rational Expectations and the Impact of Money upon Stock Prices," Journal of Financial and Quantitative Analysis 17 (December 1982):649-662.

[2]Tanner and Trapani, "Can Quantity Theory Predict Stock Prices," p. 266.

[3]Ibid., p. 267. [4]Ibid., p. 266.

they purport to measure and their conclusions concerning the significance of future money variables cannot be assumed to be accurate. Nowhere in the study do they test, or even develop a model to test, the relationship between actual money supply and stock prices.

Even Tanner and Trapani admit the weakness of their model.

> We were never able to develop the right framework to forecast money change which would consistently "beat" the market . . . [investors] appear to use far more information than simply that contained in past monetary growth rates."[1]

It does appear that investors will pay little attention to such models. It also seems apparent that the money supply is not the only factor influencing stock prices. Many studies have shown that other factors are far more imporant in stock price determination. It is perhaps fortunate for investors that they do not pay much attention to such models.

Tanner and Trapani make the point that "the stock market does not like uncertainty." This brings up the point that investors may be more influenced by variability in economic variables than by the levels of the variables themselves. Since these studies involve the use of residuals, they may be measuring, at least to some degree, the effects of variability or uncertainty rather than the pure

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[1]Ibid., p. 269.

effects of money supply itself, which is what these studies purport to show. This is both an obvious weakness of these studies and an interesting topic for future research.

David C. Leonard and James B. Kehr (1981)[1]

The purpose of this paper was to "examine the recent relationship between unanticipated changes in several monthly monetary aggregates and stock returns."[2] To accomplish this they used the method employed by several previous studies. "In order to eliminate or at least reduce the impact of expectations, it is necessary to remove all information which is contained in the past history of the data."[3]

> In order to measure the unanticipated changes in a series, it is necessary that the covariances are stationary. This property is achieved by differencing or by taking a percentage change of a series. Since market returns are expressed on the latter basis, consistency is maintained by performing the same linear transformation on each of the monetary aggregates.[4]

The money variables were then estimated by a model to determine the residuals. These residuals were found to conform to white-noise. The market return series was found to conform to a random walk model.[5] Cross correlations between the market return and each monetary residual were then computed and tested for significance.

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[1]Leonard and Kehr, "Returns and Aggregates," pp. 40-50.

[2]Ibid., p. 48. [3]Ibid., p. 44. [4]Ibid. [5]Ibid., p. 45.

The results were as follows:

> Interestingly, the money supply findings do not indicate a significant spike for any of the future lags. . . . Two significant spikes are observed in the past lags of money supply with the current market return.[1]

These findings are indeed "interesting." Additional findings are even more interesting. "The independence null hypothesis is rejected for all three monetary aggregates [including the money supply] when their current and twelve past lags are examined."[2] They further find "absence of dependence between the current market return and future monetary residuals."[3]

These results were surprising to the authors because they were inconsistent with stock returns leading changes in money supply. In fact, they provide evidence that money supply changes actually lead stock prices.

Recall from previous discussions that the critics of the earlier studies finding past money changes significantly related to current stock returns said that this could not be the case if the efficient market hypothesis were true. These critics then employed sophisticated techniques to try to prove this hypothesis. In spite of weak, and often contradictory results, they drew strong conclusions that all elements of past money supply were insignificant and that future money supply changes were

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[1]Ibid. [2]Ibid., p. 46 [3]Ibid.

significant. The critics then proceeded to conclude that the early studies were wrong and that the efficient market hypothesis--which they perceived as being in conflict with money changes leading stock prices-- was vindicated.

To test their results further, Leonard and Kehr added future values of the monetary variables to the current and past values to see if these future values would improve the relationship. "Results . . . indicate that in all regressions the addition of future values did not result in a significant improvement in the goodness-of-fit."[1]

Recall also that some earlier studies concerning causation claimed that just the opposite was the case. They concluded that stock returns led money supply changes and that this meant, therefore, that stock price changes cause money supply changes. For example, Kraft and Kraft concluded:

> Unidirectional causality exists from the stock price measures to M1 and M1%. . . . the implication being that stock price measures lead rather than lag monetary actions . . . which supports . . . evidence on efficient markets.[2]

(The weaknesses in the Kraft and Kraft paper were discussed earlier; so, Leonard and Kehr's findings are not as surprising as they might seem.)

However, Leonard and Kehr conclude that with

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[1]Ibid., p. 47.

[2]Kraft and Kraft, "Determinants, " p. 422.

dependence between current stock returns and current and past money variables, "in conjunction with the absence of dependence between the current market return and future monetary residuals, the evidence is not inconsistent with unidirectional causality from money to stock returns."[1] Leonard and Kehr also note: "Our findings conflict with those recently reported by Rogalski and Vinso."[2]

What is most surprising are the conclusions they draw from their findings. Leonard and Kehr found past M1 residuals at one month lag and seven month lags to be statistically significant. They found no future money residuals significant. However, in spite of this, they "explain away" these significant findings. "Since this study employs revised data (an adjustment of actual figures released) and the contemporaneous correlation is approximately zero, our findings suggest that the negative spike at lag one reflects the market's immediate response to the preliminary estimate."[3]

This may be one possible explanation, but other writers (as previously discussed) point to the fact that the use of actual data better reflects the true effects of money on stock prices. The fact remains that actual money leads stock prices. However, this does not imply that the efficient market hypothesis, in a weaker form, is invalid.

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[1]Leonard and kehr, "Stock Market Returns," p. 46.

[2]Ibid., p. 49. [3]Ibid., p. 46.

The publication lag, therefore, is consistent with efficient markets with publication lags. As to the other significant lag at seven months, Leonard and Kehr simply write this off as possibly being "spurious."[1]

Other contradictory statements are also evidenced in the paper. Recall that the residuals were defined as the "unpredicted" changes in the money supply. Recall also that these studies, seeking to test the efficient market hypothesis, explicitly state that such future residuals will be statistically significant if they are "unpredicted" and that the "predicted" future money changes will be statistically insignificant. Since Leonard and Kehr find that no "unpredicted" money changes were significant, their logical conclusion should be that the market has fully predicted all future money supply changes and, therefore, can accurately predict the money supply. However, they state that their results indicate the "absence of this ability [to predict future money supply changes]."

This statement by Leonard and Kehr could only have one explanation. Recall that they "explained away" the significance of the one month lagged money residual as a response to the release of the money supply figure. Therefore, faced with evidence that the market fully predicts all future money supply figures (i.e., no significant

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[1]Ibid.

"unpredicted" future money residuals) and having previously "explained away" the lag by stating that the market does not fully predict these changes, they make the contradictory statement that the market cannot predict money changes. Although they could possibly defend one statement, they cannot possibly defend both--since these are opposite statements.

The obvious conclusion to be drawn from the empirical evidence presented in this paper is that future money changes are not statistically significant and that past money supply changes are statistically significant in relation to current market returns. Sadly, Leonard and Kehr refuse to draw such a conclusion--presumably because it conflicts with their preconceived notions concerning the efficient market hypothesis. As with other studies of this nature, evidence contrary to the theory to be proved is either "explained away," simply ignored, or attributed to methodological imperfections or statistical abberations. However, when the findings coincide with the theory to which they adhere, the methodology is defended and the results are presented as"proof" that their theories are the only interpretations which can be made. The proper approach, of course, would be to accept the empirical evidence and then to draw logical inferences from the results.

Lawrence S. Davidson and Richard T. Froyen (1982)[1]

Davidson and Froyen make the statement: "The purpose of this article is to provide further evidence on the timing of the relationship between monetary policy changes and stock returns." However, it can be clearly seen that their tests do not measure what they purport to measure in their statement of the purpose of the article by examining the methodology they employ. Their methodology shows that they are merely making a test of the efficient market hypothesis combined with rational expectation theory. The implication is that their regression models have the ability to prove or disprove these theories based upon the timing of the money-stock price relationship.

However, as previously shown, such studies do not measure the actual relationship between money and stock prices, and their methodology is flawed by the use of regression models which simply incorporate past variables to estimate the value of the dependent variable which is then labeled the "expected" future variable and the resulting regression residual is labeled the "unexpected" portion of the future variable. The methodology, definitions, and assumptions of such studies are so flawed that their conclusions have little meaning.

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[1]Davidson and Froyen, "Monetary Policy and Stock Returns," pp. 3-12.

To their credit, Davidson and Froyen recognize this problem and employ several innovative techniques to examine this relationship. "Past studies generally have divided money growth into anticipated and unanticipated components in a mechanical or ad hoc fashion."[1] They cite Rozeff's study which "assumes that anticipated money growth in a given month depends on money growth in the past three months" as an example of the methodology employed in such previous studies.[2] In addition to using these previous methods, they employ "monetary policy reaction functions," which is a theoretically more acceptable test of reactions to unanticipated monetary changes than these earlier models. "This enables us to determine whether the efficient market findings are robust across differing aggregates and decompositions of monetary policy into anticipated and unanticipated components."[3]

Another innovation they employ is to also test stock market reactions to changes in the federal funds rate. Finally, they

> extend the time period in earlier studies through 1977. This allows us to examine the monetary policy/stock return relationship in both a period of low stable inflation (1954-65) and one of higher and more variable inflation and money growth (1966-77).[4]

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[1]Ibid., p. 3. [2]Ibid. [3]Ibid.

[4]Ibid., p. 4.

Their results show that by regressing "unanticipated" changes in money supply on "unanticipated" stock returns, "as a whole, these results offer no clear rejection of stock market efficiency."[1] This is based on their observation that "all three models explain more of the variance of equity returns when current or future money growth is included in the regressions." However, it is not difficult to enter more variables and, therefore, increase the "$R^2$" of a model.

Several other points must be made upon a closer examination of the data. In the tables, they mix the current values in with the future values when these are added, thereby making it impossible to tell how many future lags are significant. Also, for the period 1954-65, when lags of money growth alone are measured, one model "shows a statistically significant effect of the 16 lags of money growth." Additionally, the other two models show four past lags and two past lags respectively to be significant. To go further, in every case except one where future and current lags are added and shown to be significant, past lags are also shown to be significant. The one exception to this is the model which exhibits "a high degree of autocorrelation" and, therefore, which "should be interpreted with caution."[2]

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[1]Ibid., p. 7. [2]Ibid.

Additional evidence is presented when the monetary policy reaction function proposed by Froyen[1] is used.

> This function, which we assume is used to forecast future growth rates of the monetary base, relates the latter to past values of the Federal Reserve's assumed goal variables; the unemployment rate, inflation rate, balance of payments and the outstanding government debt held by the public. The estimated function is used to predict the level of the monetary base.[2]

When this model was tested, it indicated as many significant lags in the effect of the monetary base as the current and future values combined.[3] The results from this model contrasted sharply with those of Rozeff's model and may explain some of the earlier conclusions made by Rozeff in his paper.

> For the proxy constructed on the basis of the estimated monetary policy reaction function . . ., future unanticipated monetary base growth has no significant effect on current stock returns.[4]

This finding may explain why some earlier studies showed "unexpected" future money changes important.

Even more powerful evidence for the significance of lagged money supply variables is given when the effects of changes in the federal funds rate are examined. These results, using monthly data for the period 1971-I through

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[1]Richard T. Froyen, "A Test of the Endogeneity of Monetary Policy," Journal of Econometrics (July 1974): 175-88.

[2]Davidson and Froyen, "Monetary Policy and Stock Prices," p. 8.

[3]Ibid. [4]Ibid.

1976-VI, show that both past unanticipated and past anticipated changes in the federal funds rate taken separately or together have a significant effect upon stock prices. Moreover, no significant leads were shown to exist. This indicates that "lagged values of both anticipated and unanticipated monetary policy as measured by the federal funds rate have significant effects on stock returns."[1]

Davidson and Froyen show how this might occur. "This accords with the conventional expectation that a tightening of monetary policy . . . lowers stock prices and, hence, stock returns."[2] The results show that "for our 1971-76 sample period, months when the federal funds rate fell were followed by periods of rising stock returns." They also found that "increases in that rate tended to lower stock returns over a six to nine month period."[3] It logically follows that if the Federal Reserve is attempting to tighten monetary policy, they might also act to lower the money supply or at least to lower the rate of growth in the money supply. This follows from logical consistency. Davidson and Froyen admit that "this evidence supports the view that stock returns lag monetary policy."[4]

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[1]Ibid., p. 10. [2]Ibid. [3]Ibid., p. 12.

[4]Ibid., p. 10.

# CHAPTER 4

## RESEARCH PROCEDURES AND METHODOLOGY

This chapter explains the procedures and methodology employed in the empirical section of this study. The use of the particular data, procedures for treating the data, and methods of analyzing the data are discussed and explained at some length in the previous sections of this study. Therefore, to reduce redundance, these procedures and methods are stated in this section with limited discussion.

### Procedures for Collecting Data

Data for the money supply was supplied by the Banking Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System, Washington, D.C. This data represents the latest revised historical data incorporating all definitional changes, bench mark revisions, and seasonal revisions as of 1983. The data is monthly M1 and M2, seasonally adjusted, for the period 1959-83. The data for 1959 and 1983 were necessary to calculate the three-month and three-quarter leads and lags for the study period 1960-82.

Data for stock prices were monthly figures for the Standard and Poor's 500 Composite Stock Index (S&P 500)

collected from various issues of the Federal Reserve Bulletin from 1960 through 1982.

Monthly and quarterly data were chosen on the basis that annual data is too broad to identify a short lag structure, and weekly data is too erratic and contains too much "noise."[1] Additionally, the data base for money supply employed in this study gives weekly figures for 1975-83.

## Procedures for Treating Data

Where quarterly data is used, the quarterly figures were calculated as the arithmetic average of the monthly figures for that quarter. Levels of both M1 and M2 and the S&P 500 were then converted to monthly and quarterly percentage changes. This was done to eliminate the effect of trend.[2] Another reason for this procedure is to convert the data into units which are comparable and independent of the levels of the figures. A third reason is that percentage changes in stock prices are considered more intuitively appealing as they may be used as a surrogate for returns.[3]

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[1]Tom Herman and Alan Murray, "M1 Mania Irks Fed, but Monetary Data Still Rattle Markets," Wall Street Journal 24 January 1984, p. 1.

[2]Friedman and Schwartz, "Money and Stock Prices," pp. 35-36.

[3]Kraft and Kraft, "Determinants," p. 418.

## Methods for Analyzing Data

The general form of the regression models employed in this study is:

$$\%SP = f(\%M_1, \%M_2, \ldots \%M_n)$$

%SP represents either the monthly or quarterly percentage change in the S&P 500, and the %M's represent either monthly or quarterly percentage changes in either M1 or M2 for either positive or negative lags (i.e., leads) of from 0 to 3 periods.

The following statistics were calculated for these regression equations: "$R^2$," which is a measure of the degree of variation in the dependent variable which is "explained" by the independent variables in the model; "F," which is a test for the significance of the independent variables as a group; "t," which is a test for the significance of an individual independent variable; and D-W (Durbin-Watson), which is a test for the presence of autocorrelation in the error terms. These statistics are presented with each equation in the tables in the next chapter with the "t" statistics given in parentheses under each coefficient.

## Multiple Regression Analysis

The first method of analysis was multiple regression.[1] Multiple regression is generally accepted and

[1]Jan Kmenta, Elements of Econometrics (New York: Macmillan Publishing Co., 1971).

recognized as a valid method of analyzing such data and is the method employed by the majority of the previous related studies. The regressions were performed using the SPSS (Statistical Package for the Social Sciences) computer program.[1] Eight separate regressions were conducted for each time period under study (1960-82, 1960-72, and 1973-82) resulting in twenty-four regression equations. The results of these regressions are given in Tables 1 through 6 in the next chapter.

Next, all regressions were repeated eliminating the current changes in the money supply. This was done to test the significance of "pure" leads and lags, which do not incorporate the current period, and to test the significance of the current period variable. Also, this was done to avoid possible criticism that the significance of the lag or lead may be due to the inclusion of the current variable. This resulted in twenty-four additional regression equations for a total of forty-eight regressions. The results of these additional regressions are given in Tables 7 through 12 in the next chapter.

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[1]Marija J. Norusis, SPSS Introductory Guide, eds. Norman H. Nie and C. Hadlai Hull (New York: McGraw-Hill Book Co., 1982).

Correlation Analysis

Correlation analysis[1] was conducted to provide additional empirical evidence and to confirm the regression results. Some authors suggest that correlation analysis is superior to regression analysis in that it avoids some statistical problems inherent in multiple regression.[2] Additionally, this method of analysis was employed by several of the previous related studies.

Correlation coefficients between stock price variable and the money supply variables used in the previous analysis were calculated and tested for significance. The results of these tests are presented in Tables 13 through 15 in the next chapter.

Chow Test

A Chow test[3] was conducted to test whether there is evidence of a structural change in the relationship between money supply and stock prices over the period of this study. The test was conducted to determine whether there is a structural difference in the relationship between money and stock prices between the two sub-periods 1960-72

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[1] Ibid., pp. 58-62.

[2] Auerbach, "Money and Stock Prices," p. 9.

[3] M. Dutta, Econometric Methods (Cincinnati: South-Western Publishing Co., 1975), pp. 173-177.

and 1973-82. None of the previously cited studies employed such a test. The results of this test are reported in Table 16 in the next chapter.

# CHAPTER 5

## PRESENTATION OF FINDINGS

This chapter presents the findings of the empirical portion of this study. Although the primary focus of this study is on the examination of the issues and controversy surrounding the relationship between money supply and stock prices rather than the presentation of additional empirical evidence, it is hoped that this presentation will contribute to the stated purpose of this study, which is to provide a clearer understanding of these issues. No single study should be viewed as providing conclusive evidence to resolve this controversy, and this study is no exception. Therefore, an attempt is made to present these findings objectively, with the ultimate interpretation of these findings to be left to the discretion of the reader. The findings of this study are presented in Tables 1 through 16.

### Results of Multiple Regression Analysis

The findings of the multiple regression analysis are presented in Tables 1 through 12. Tables 1 through 6 give the results of the regressions of the money variables including the current and three period lags (past values) and current and three period leads (future values) against the stock price variable. Tables 7 through 12 give the

Table 1

S&P 500 vs. M1 and M2
Monthly % Change
1960-72

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$$SP = -0.010 - 0.704\ M1_t + 2.763\ M1_{t-1} + 0.972\ M1_{t-2} + 0.851\ M1_{t-3}$$

(-2.30)* (-0.94) (3.77)** (1.33) (1.14)

$R^2 = 0.13$ $F = 5.807^{**}$ D.W. = 1.59

$$SP = -0.001 + 0.208\ M1_t + 0.076\ M1_{t+1} + 1.020\ M1_{t+2} - 0.000\ M1_{t+3}$$

(-0.25) (0.26) (0.10) (1.32) (-0.00)

$R^2 = 0.01$ $F = 0.572$ D.W. = 1.55

$$SP = -0.019 - 2.493\ M2_t + 5.725\ M2_{t-1} - 0.430\ M2_{t-2} + 0.841\ M2_{t-3}$$

(-2.95)** (-1.87) (3.64)** (-0.27) (0.63)

$R^2 = 0.15$ $F = 6.740^{**}$ D.W. = 1.62

$$SP = -0.011 + 2.158\ M2_t - 0.847\ M2_{t+1} + 0.604\ M2_{t+2} + 0.375\ M2_{t+3}$$

(-1.52) (1.52) (-0.51) (0.37) (0.28)

$R^2 = 0.04$ $F = 1.473$ D.W. = 1.65

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** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 2

S&P 500 vs. M1 and M2
Quarterly % Change
1960-72

---

$SP = -0.035 - 2.237\ M1_t + 1.583\ M1_{t-1} + 1.656\ M1_{t-2} + 2.464\ M1_{t-3}$

(-1.70) (-1.57) (0.90) (0.95) (1.74)

$R^2 = 0.25$ $F = 3.918^{**}$ D.W. = 1.24

$SP = 0.015 + 0.195\ M1_t - 1.638\ M1_{t+1} - 0.591\ M1_{t+2} + 1.354\ M1_{t+3}$

(0.59) (0.12) (-0.85) (-0.31) (0.82)

$R^2 = 0.05$ $F = 0.622$ D.W. = 1.18

$SP = -0.059 - 3.491\ M2_t + 3.728\ M2_{t-1} - 0.071\ M2_{t-2} + 3.234\ M2_{t-3}$

(-2.62)* (-2.46)* (1.81) (-0.03) (2.25)*

$R^2 = 0.38$ $F = 7.273^{**}$ D.W. = 1.40

$SP = 0.023 + 2.488\ M2_t - 3.213\ M2_{t+1} - 0.404\ M2_{t+2} + 0.282\ M2_{t+3}$

(0.84) (1.44) (-1.36) (-0.18) (0.18)

$R^2 = 0.09$ $F = 1.150$ D.W. = 1.31

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 3

S&P 500 vs. M1 and M2
Monthly % Change
1973-82

$$SP = -0.020 + 0.156\ M1_t - 0.710\ M1_{t-1} + 3.191\ M1_{t-2} + 1.116\ M1_{t-3}$$
$$(-2.64)^{**} \quad (0.22) \quad (-0.96) \quad (4.30)^{**} \quad (1.55)$$

$R^2 = 0.19$ $F = 6.805^{**}$ D.W. = 1.58

$$SP = -0.002 - 0.579\ M1_t + 0.337\ M1_{t+1} + 0.340\ M1_{t+2} + 0.304\ M1_{t+3}$$
$$(-0.26) \quad (-0.74) \quad (0.41) \quad (0.42) \quad (0.39)$$

$R^2 = 0.01$ $F = 0.331$ D.W. = 1.55

$$SP = -0.041 + 0.897\ M2_t - 2.425\ M2_{t-1} + 5.724\ M2_{t-2} + 1.363\ M2_{t-3}$$
$$(-3.57)^{**} \quad (0.67) \quad (-1.53) \quad (3.61)^{**} \quad (1.03)$$

$R^2 = 0.20$ $F = 7.206^{**}$ D.W. = 1.65

$$SP = -0.021 - 0.849\ M2_t + 2.569\ M2_{t+1} + 1.393\ M2_{t+2} - 0.360\ M2_{t+3}$$
$$(-1.78) \quad (-0.61) \quad (1.74) \quad (0.95) \quad (-0.29)$$

$R^2 = 0.08$ $F = 2.488^{*}$ D.W. = 1.63

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 4

S&P 500 vs. M1 and M2
Quarterly % Change
1973-82

---

$SP = -0.050 - 1.445\ M1_t + 0.750\ M1_{t-1} + 1.296\ M1_{t-2} + 3.071\ M1_{t-3}$

(-1.58) (-1.42) (0.72) (1.24) (2.90)**

$R^2 = 0.27$ F = 3.173* D.W. = 1.39

$SP = 0.061 - 0.733\ M1_t - 0.737\ M1_{t+1} - 1.050\ M1_{t+2} - 0.611\ M1_{t+3}$

(1.97) (-0.64) (-0.63) (-0.91) (-0.54)

$R^2 = 0.08$ F = 0.747 D.W. = 1.42

$SP = -0.063 - 2.607\ M2_t + 0.196\ M2_{t-1} + 3.202\ M2_{t-2} + 2.438\ M2_{t-3}$

(-1.91) (-2.46)* (0.15) (2.54)* (2.05)*

$R^2 = 0.36$ F = 5.007** D.W. = 1.60

$SP = 0.049 - 0.313\ M2_t + 0.209\ M2_{t+1} - 0.338\ M2_{t+2} - 1.420\ M2_{t+3}$

(1.69) (-0.23) (0.14) (-0.23) (-1.04)

$R^2 = 0.08$ F = 0.721 D.W. = 1.40

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 5

S&P 500 vs. M1 and M2
Monthly % Change
1960-82

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$SP = -0.011 - 0.630\ M1_t + 0.602\ M1_{t-1} + 2.003\ M1_{t-2} + 1.106\ M1_{t-3}$

$(-2.83)^{**}\quad (-1.27)\quad (1.17)\quad (3.88)^{**}\quad (2.22)^{*}$

$R^2 = 0.11 \qquad F = 8.224^{**} \qquad D.W. = 1.61$

$SP = -0.000 - 0.313\ M1_t + 0.110\ M1_{t+1} + 0.619\ M1_{t+2} + 0.123\ M1_{t+3}$

$(-0.07)\quad (-0.60)\quad (0.20)\quad (1.14)\quad (0.24)$

$R^2 = 0.01 \qquad F = 0.536 \qquad D.W. = 1.53$

$SP = -0.025 - 0.974\ M2_t + 0.736\ M2_{t-1} + 2.861\ M2_{t-2} + 1.333\ M2_{t-3}$

$(-4.09)^{**}\quad (-1.04)\quad (0.66)\quad (2.55)^{*}\quad (1.44)$

$R^2 = 0.11 \qquad F = 8.725^{**} \qquad D.W. = 1.65$

$SP = -0.013 - 0.037\ M2_t + 1.426\ M2_{t+1} + 1.351\ M2_{t+2} - 0.504\ M2_{t+3}$

$(-2.14)^{*}\quad (-0.04)\quad (1.35)\quad (1.28)\quad (-0.58)$

$R^2 = 0.04 \qquad F = 2.951^{*} \qquad D.W. = 1.60$

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 6

S&P 500 vs. M1 and M2
Quarterly % Change
1960-82

---

$SP = -0.036 - 1.704\ M1_t + 0.827\ M1_{t-1} + 1.307\ M1_{t-2} + 2.781\ M1_{t-3}$

$(-2.28)^*\quad (-2.31)^*\quad (1.07)\quad (1.69)\quad (3.74)^{**}$

$R^2 = 0.25\qquad F = 7.139^{**}\qquad D.W. = 1.30$

$SP = 0.036 - 0.475\ M1_t - 0.770\ M1_{t+1} - 0.736\ M1_{t+2} + 0.025\ M1_{t+3}$

$(2.04)^*\quad (-0.57)\quad (-0.88)\quad (-0.84)\quad (0.03)$

$R^2 = 0.04\qquad F = 0.859\qquad D.W. = 1.28$

$SP = -0.057 - 2.568\ M2_t + 0.754\ M2_{t-1} + 2.679\ M2_{t-2} + 2.279\ M2_{t-3}$

$(-3.20)^{**}\quad (-3.36)^{**}\quad (0.80)\quad (2.81)^{**}\quad (2.77)^{**}$

$R^2 = 0.35\qquad F = 11.768^{**}\qquad D.W. = 1.56$

$SP = 0.041 + 0.239\ M2_t - 0.493\ M2_{t+1} - 0.526\ M2_{t+2} - 0.831\ M2_{t+3}$

$(2.20)^*\quad (0.25)\quad (-0.44)\quad (-0.48)\quad (-0.90)$

$R^2 = 0.05\qquad F = 1.199\qquad D.W. = 1.35$

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 7

S&P 500 vs. M1 and M2
Monthly % Change
1960-72

$SP_t = -0.011 + 2.680\ M1_{t-1} + 0.855\ M1_{t-2} + 0.663\ M1_{t-3}$
$(-2.71)^{**}\quad (3.68)^{**}\quad (1.19)\quad (0.92)$

$R^2 = 0.13 \qquad F = 7.456^{**} \qquad D.W. = 1.59$

$SP_t = -0.001 + 0.108\ M1_{t+1} + 1.051\ M1_{t+2} + 0.047\ M1_{t+3}$
$(-0.19)\quad (0.14)\quad (1.38)\quad (0.06)$

$R^2 = 0.01 \qquad F = 0.743 \qquad D.W. = 1.53$

$SP_t = -0.022 + 4.189\ M2_{t-1} - 0.854\ M2_{t-2} + 0.774\ M2_{t-3}$
$(-3.51)^{**}\quad (3.10)^{**}\quad (-0.54)\quad (0.58)$

$R^2 = 0.13 \qquad F = 7.700^{**} \qquad D.W. = 1.60$

$SP_t = -0.008 + 0.540\ M2_{t+1} + 0.949\ M2_{t+2} + 0.396\ M2_{t+3}$
$(-1.20)\quad (0.39)\quad (0.58)\quad (0.29)$

$R^2 = 0.02 \qquad F = 1.179 \qquad D.W. = 1.57$

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 8

S&P 500 vs. M1 and M2
Quarterly % Change
1960-72

$$SP_t = -0.048 - 0.030\ M1_{t-1} + 2.239\ M1_{t-2} + 2.322\ M1_{t-3}$$
$$(-2.52)^* \quad (-0.02) \quad (1.29) \quad (1.61)$$

$R^2 = 0.21$ $F = 4.269^{**}$ D.W. = 1.19

$$SP_t = 0.016 - 1.503\ M1_{t+1} - 0.635\ M1_{t+2} + 1.362\ M1_{t+3}$$
$$(0.69) \quad (-0.96) \quad (-0.34) \quad (0.83)$$

$R^2 = 0.05$ $F = 0.842$ D.W. = 1.18

$$SP_t = -0.079 + 0.051\ M2_{t-1} + 1.375\ M2_{t-2} + 3.045\ M2_{t-3}$$
$$(-3.61)^{**} \quad (0.03) \quad (0.66) \quad (2.02)^*$$

$R^2 = 0.30$ $F = 6.949^{**}$ D.W. = 1.39

$$SP_t = 0.039 - 0.732\ M2_{t+1} - 1.143\ M2_{t+2} + 0.213\ M2_{t+3}$$
$$(1.55) \quad (-0.45) \quad (-0.52) \quad (0.14)$$

$R^2 = 0.05$ $F = 0.826$ D.W. = 1.19

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 9

S&P 500 vs. M1 and M2
Monthly % Change
1972-82

$$SP_t = -0.019 - 0.662\ M1_{t-1} + 3.163\ M1_{t-2} + 1.106\ M1_{t-3}$$
$$(-2.90)^{**} \quad (-0.94) \quad (4.34)^{**} \quad (1.54)$$

$R^2 = 0.19$ $F = 9.132^{**}$ D.W. = 1.58

$$SP_t = -0.005 + 0.155\ M1_{t+1} + 0.436\ M1_{t+2} + 0.318\ M1_{t+3}$$
$$(-0.67) \quad (0.20) \quad (0.54) \quad (0.41)$$

$R^2 = 0.01$ $F = 0.260$ D.W. = 1.55

$$SP_t = -0.038 - 1.824\ M2_{t-1} + 5.504\ M2_{t-2} + 1.496\ M2_{t-3}$$
$$(-3.58)^{**} \quad (-1.39) \quad (3.55)^{**} \quad (1.15)$$

$R^2 = 0.20$ $F = 9.502^{**}$ D.W. = 1.63

$$SP_t = -0.024 + 2.102\ M2_{t+1} + 1.554\ M2_{t+2} - 0.478\ M2_{t+3}$$
$$(-2.28)^{*} \quad (1.67) \quad (1.09) \quad (-0.40)$$

$R^2 = 0.08$ $F = 3.209^{*}$ D.W. = 1.64

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 10

S&P 500 vs. M1 and M2
Quarterly % Change
1973-82

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$SP_t = -0.067 + 0.539\ M1_{t-1} + 1.232\ M1_{t-2} + 2.985\ M1_{t-3}$

$(-2.28)^*$ $(0.52)$ $(1.16)$ $(2.79)^{**}$

$R^2 = 0.22$ $F = 3.462^*$ D.W. = 1.40

$SP_t = 0.053 - 0.841\ M1_{t+1} - 1.090\ M1_{t+2} - 0.690\ M1_{t+3}$

$(1.89)$ $(-0.74)$ $(-0.95)$ $(-0.62)$

$R^2 = 0.07$ $F = 0.875$ D.W. = 1.46

$SP_t = -0.079 - 1.076\ M2_{t-1} + 2.939\ M2_{t-2} + 2.124\ M2_{t-3}$

$(-2.27)^*$ $(-0.87)$ $(2.19)^*$ $(1.68)$

$R^2 = 0.25$ $F = 4.082^*$ D.W. = 1.56

$SP_t = 0.046 + 0.098\ M2_{t+1} - 0.380\ M2_{t+2} - 1.471\ M2_{t+3}$

$(1.77)$ $(0.07)$ $(-0.26)$ $(-1.11)$

$R^2 = 0.07$ $F = 0.970$ D.W. = 1.41

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 11

S&P 500 vs. M1 and M2
Monthly % Change
1960-82

---

$SP_t$ = - 0.013 + 0.422 $M1_{t-1}$ + 2.022 $M1_{t-2}$ + 1.060 $M1_{t-3}$

(-3.58)** (0.85) (3.92)** (2.13)*

$R^2$ = 0.10 F = 10.408** D.W. = 1.61

$SP_t$ = - 0.001 + 0.021 $M1_{t+1}$ + 0.628 $M1_{t+2}$ + 0.098 $M1_{t+3}$

(-0.31) (0.04) (1.16) (0.19)

$R^2$ = 0.01 F = 0.598 D.W. = 1.54

$SP_t$ = - 0.026 + 0.083 $M2_{t-1}$ + 2.939 $M2_{t-2}$ + 1.207 $M2_{t-3}$

(-4.62)** (0.09) (2.63)** (1.31)

$R^2$ = 0.11 F = 11.269** D.W. = 1.66

$SP_t$ = - 0.013 + 1.404 $M2_{t+1}$ + 1.354 $M2_{t+2}$ - 0.509 $M2_{t+3}$

(-2.29)* (1.58) (1.29) (-0.59)

$R^2$ = 0.04 F = 3.948** D.W. = 1.60

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 12

S&P 500 vs. M1 and M2
Quarterly % Change
1960-82

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$SP_t = -0.050 + 0.288\ M1_{t-1} + 1.231\ M1_{t-2} + 2.674\ M1_{t-3}$

$(-3.30)^{**}\quad (0.38)\quad (1.55)\quad (3.52)^{**}$

$R^2 = 0.20 \qquad F = 7.373^{**} \qquad D.W. = 1.28$

$SP_t = 0.032 - 0.919\ M1_{t+1} - 0.757\ M1_{t+2} - 0.008\ M1_{t+3}$

$(1.98)\quad (-1.11)\quad (-0.87)\quad (-0.01)$

$R^2 = 0.03 \qquad F = 1.046 \qquad D.W. = 1.31$

$SP_t = -0.073 - 0.915\ M2_{t-1} + 2.672\ M2_{t-2} + 2.197\ M2_{t-3}$

$(-4.01)^{**}\quad (-1.07)\quad (2.65)^{**}\quad (2.53)^{*}$

$R^2 = 0.27 \qquad F = 10.692^{**} \qquad D.W. = 1.52$

$SP_t = 0.042 - 0.350\ M2_{t+1} - 0.517\ M2_{t+2} - 0.830\ M2_{t+3}$

$(2.50)^{*}\quad (-0.37)\quad (-0.47)\quad (-0.91)$

$R^2 = 0.05 \qquad F = 1.596 \qquad D.W. = 1.33$

---

** Significant at 1% confidence level.

* Significant at 5% confidence level.

results of the regressions when the current money variable is omitted. These findings indicate that the inclusion or omission of the current money variable did not change the findings concerning the significance of leads or lags as a group.

In every case, for both M1 and M2 and for both monthly and quarterly data, past money supply changes, as a group, are significantly related to current changes in stock prices.

Future changes in M1, as a group, are never found to be significantly related to current changes in stock prices. Future changes in M2 are not significant when quarterly data is used. However, when monthly data is used, future changes in M2 are found to be significant for the periods 1973-82 and 1960-82.

Past money supply changes, as a group, are significantly related to current stock price changes. Additionally, in every case, one or more of the individual past money supply variables is significant (with the one exception being quarterly M1 for the period 1960-72). Moreover, the findings are robust across the different time periods studied.

These results appear to show clear and consistent evidence that past changes in the money supply, as a group, are significantly related to current stock price changes.

When future values of money supply changes are examined, the findings are somewhat different. In all cases where M1 is the money variable, there is no significant relationship between current stock price changes and future money supply changes.

When M2 is the money variable, there is no significant relationship between current stock price changes and future money supply changes on a quarterly basis.

When monthly data is examined for the period 1960-72, future changes in M2 are not significantly related to current stock price changes.

However, when monthly data is considered for the periods 1960-82 and 1973-82, there is a significant relationship between current stock price changes and future changes in M2. Although they are significantly related as a group, none of the individual future money variables are ever significantly related to current stock prices. Additionally, even though significance is indicated, the explanatory power in these cases is only 4% in the 1960-82 period and only 8% in the 1973-82 period.

Therefore, a relationship where current stock prices are related to future money supply is indicated only for monthly M2 for the periods 1960-82 and 1973-82 and the relationship appears weak.

When the relationship between money supply and stock prices is measured in terms of the $R^2$ statistic, the

results are consistent with those above. When past values of the money supply are considered, the explanatory power of the regressions range from a low of 10% to a high of 38% with all $R^2$ values significant. When future money supply is related to current stock prices, the $R^2$ statistics range from a low of 1% to a high of 9% with all $R^2$ values insignificant except for monthly values of M2 for the periods 1973-82.

Finally, possible statistical problems related to the use of multiple regression analysis should be addressed at this point.[1] The Durbin-Watson (D.W.) statistics for the regression equations indicate that the only equations in which the assumption of nonautoregression must be rejected at the 1% confidence level for a statistically significant relationship are for quarterly lags of M1 for the periods 1960-72 and 1960-82. Therefore, the significance of the quarterly lags of M1 for these periods must be interpreted with caution, and this finding weakens these results. However, the assumption of nonautoregression is not rejected for any of the other significant relationships.

As to the question of possible multicollinearity in the independent variables, this is not a problem even if we assume multicollinearity to exist. Most time series data will exhibit some degree of multicollinearity. However,

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[1]Kmenta, Econometrics.

the existence of multicollinearity only means that we cannot be certain about the significance of the "t" value for a particular coefficient; it does not affect the interpretation of the "F" value for the significance of leads or lags as a group. Since this study is concerned with the significance of leads or lags as a group rather than individual coefficients, this question is not a problem to this particular study.

In regard to the question of specification errors, the models employed in this study were developed to isolate the specific relationship between changes in the money supply and changes in stock prices within the specified delimitations of this study. Therefore, this question does not appear to be a problem in this particular study. As regards other possible problems such as heteroskedasticity, stochastic explanatory variables, etc., there does not appear to be evidence to suggest that these are problems related to this particular study.

## Results of Correlation Analysis

The findings of the correlation analysis are presented in Tables 13-15. These findings serve to confirm the findings of the multiple regression analysis. Additionally, correlation analysis avoids several of the possible problems related to multiple regression analysis previously mentioned.

Table 13

CORRELATION COEFFICIENTS BETWEEN STOCK PRICES AND MONEY SUPPLY
% S&P 500 vs. % M1 and M2
1960-72

Monthly

| | SP | | SP | | SP | | SP |
|---|---|---|---|---|---|---|---|
| $M1_t$ | .051 | $M1_t$ | .051 | $M2_t$ | .186* | $M2_t$ | .186* |
| $M1_{t-1}$ | .335** | $M1_{t+1}$ | .039 | $M2_{t-1}$ | .360** | $M2_{t+1}$ | .132 |
| $M1_{t-2}$ | .180* | $M1_{t+2}$ | .120 | $M2_{t-2}$ | .263** | $M2_{t+2}$ | .145 |
| $M1_{t-3}$ | .174* | $M1_{t+3}$ | .033 | $M2_{t-3}$ | .259** | $M2_{t+3}$ | .126 |

Quarterly

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $M1_t$ | -.095 | $M1_t$ | -.095 | $M2_t$ | -.012 | $M2_t$ | -.012 |
| $M1_{t-1}$ | .198 | $M1_{t+1}$ | -.189 | $M2_{t-1}$ | .313* | $M2_{t+1}$ | -.202 |
| $M1_{t-2}$ | .406** | $M1_{t+2}$ | -.084 | $M2_{t-2}$ | .486** | $M2_{t+2}$ | -.207 |
| $M1_{t-3}$ | .412** | $M1_{t+3}$ | .085 | $M2_{t-3}$ | .536** | $M2_{t+3}$ | -.124 |

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 14

CORRELATION COEFFICIENTS BETWEEN STOCK PRICES AND MONEY SUPPLY
% S&P 500 vs. % M1 and M2
1973-82

Monthly

| | SP | | SP | | SP | | SP |
|---|---|---|---|---|---|---|---|
| $M1_t$ | -.068 | $M1_t$ | -.068 | $M2_t$ | .077 | $M2_t$ | .077 |
| $M1_{t-1}$ | .005 | $M1_{t+1}$ | .032 | $M2_{t-1}$ | .127 | $M2_{t+1}$ | .259** |
| $M1_{t-2}$ | .404** | $M1_{t+2}$ | .071 | $M2_{t-2}$ | .414** | $M2_{t+2}$ | .225* |
| $M1_{t-3}$ | .242** | $M1_{t+3}$ | .054 | $M2_{t-3}$ | .327** | $M2_{t+3}$ | .072 |

Quarterly

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $M1_t$ | -.153 | $M1_t$ | -.153 | $M2_t$ | -.167 | $M2_t$ | -.167 |
| $M1_{t-1}$ | .111 | $M1_{t+1}$ | -.165 | $M2_{t-1}$ | .093 | $M2_{t+1}$ | -.157 |
| $M1_{t-2}$ | .222 | $M1_{t+2}$ | -.204 | $M2_{t-2}$ | .428** | $M2_{t+2}$ | -.205 |
| $M1_{t-3}$ | .431** | $M1_{t+3}$ | -.152 | $M2_{t-3}$ | .393* | $M2_{t+3}$ | -.270 |

** Significant at 1% confidence level.

* Significant at 5% confidence level.

Table 15

CORRELATION COEFFICIENTS BETWEEN STOCK PRICES AND MONEY SUPPLY
% S&P 500 vs. % M1 and M2
1960-82

Monthly

| | SP | | SP | | SP | | SP |
|---|---|---|---|---|---|---|---|
| $M1_t$ | -.027 | $M1_t$ | -.027 | $M2_t$ | .119* | $M2_t$ | .119* |
| $M1_{t-1}$ | .129* | $M1_{t+1}$ | .025 | $M2_{t-1}$ | .225** | $M2_{t+1}$ | .189** |
| $M1_{t-2}$ | .293** | $M1_{t+2}$ | .080 | $M2_{t-2}$ | .324** | $M2_{t+2}$ | .177** |
| $M1_{t-3}$ | .198** | $M1_{t+3}$ | .034 | $M2_{t-3}$ | .277** | $M2_{t+3}$ | .084 |

Quarterly

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $M1_t$ | -.116 | $M1_t$ | -.116 | $M2_t$ | -.094 | $M2_t$ | -.094 |
| $M1_{t-1}$ | .149 | $M1_{t+1}$ | -.159 | $M2_{t-1}$ | .196 | $M2_{t+1}$ | -.167 |
| $M1_{t-2}$ | .293** | $M1_{t+2}$ | -.145 | $M2_{t-2}$ | .452** | $M2_{t+2}$ | -.203 |
| $M1_{t-3}$ | .414** | $M1_{t+3}$ | -.057 | $M2_{t-3}$ | .455** | $M2_{t+3}$ | -.208* |

** Significant at 1% confidence level.

* Significant at 5% confidence level.

For the period 1960-72, past changes in the money supply were found to be significantly related to current stock prices. Future money supply changes were never found to be significantly related to current stock prices.

For the period 1973-82, past money supply changes were found to be significantly related to current stock price changes. Future values of M1 were not significantly related to current stock prices. Future values of M2 were found not to be significantly related to current stock prices for the quarterly data. For monthly data, however, one month and two month future changes in M2 were found to be significant.

For the period 1960-82, past money supply changes were found to be significant. Future values of M1 were not found to be significant. For quarterly data, future values of M2 were not significant (with the exception of three quarter lead for M2). However, one and two month future changes in M2 were statistically significant.

## Results of Chow Test

The results of the Chow test for structural change between the periods 1960-72 and 1973-82 are presented in Table 16. This test indicates no evidence of a significant structural change using quarterly data. However, the results show evidence of a structural change on the basis of monthly data.

Table 16

RESULTS OF TEST OF STRUCTURAL CHANGE (CHOW TEST)
1960-72 vs. 1973-82

| Regressions Including the Current Money Variables | | | |
|---|---|---|---|
| Monthly | | Quarterly | |
| $M1_{t-i}$ | F = 3.772** | $M1_{t-i}$ | F = 0.285 |
| $M1_{t+i}$ | F = 0.407 | $M1_{t+i}$ | F = 0.514 |
| $M2_{t-i}$ | F = 4.305** | $M2_{t-i}$ | F = 0.575 |
| $M2_{t+i}$ | F = 1.207 | $M2_{t+i}$ | F = 0.554 |
| **Regressions Excluding the Current Money Variables** | | | |
| Monthly | | Quarterly | |
| $M1_{t-i}$ | F = 4.962** | $M1_{t-i}$ | F = 0.490 |
| $M1_{t+i}$ | F = 0.411 | $M1_{t+i}$ | F = 0.600 |
| $M2_{t-i}$ | F = 4.789** | $M2_{t-i}$ | F = 0.281 |
| $M2_{t+i}$ | F = 0.918 | $M2_{t+i}$ | F = 0.291 |

** Significant at 1% confidence level.

* Significant at 5% confidence level.

This finding is consistent with and confirms the findings of the multiple regression analysis and the correlation analysis. There appears to be a structural difference in the relationship between money supply and stock prices between the 1960-72 and 1973-82 periods.

Although these findings appear to indicate that the nature of the relationship between money and stock prices can best be described as one where current changes in stock prices are related to past money supply changes, future money supply changes, at least as measured by monthly M2, also appear to be significantly related to current stock prices for some periods studied.

Moreover, these findings illustrate that differences in the periods examined and differences in the measures of the money supply employed can result in the differences in the findings of studies. This helps to explain to some degree the conflicting findings of the past empirical studies discussed and the controversy surrounding this issue.

# CHAPTER 6

# SUMMARY, CONCLUSIONS, AND IMPLICATIONS

## Summary

The purpose of this study was to examine the issues and controversy surrounding the relationship between money and stock prices. More specifically, the purpose was to examine the issue of whether current changes in stock prices are significantly related to past, future, or current changes in the money supply.

This investigation began with an examination of the theoretical framework for such a relationship. This was followed by a review of the related empirical studies. Finally, additional empirical evidence was presented.

This study found that the controversy in the literature was related to the assumptions, methodology, interpretation of findings, and conclusions drawn from such studies as they related to a growing body of seemingly conflicting theories. However, at the center of the controversy was the issue of whether current stock price changes were related to past or future changes in the money supply.

This study found that what seemed like contradictory theories were really contradictory interpretations of the implications of the theories. The early monetarist

writers reasoned that money supply changes preceded stock price changes because money supply changes caused stock price changes through money's effect on the economy. The increasing popularity of rational expectations theory led later writers to question this conclusion. By this time rational expectations had evolved toward a forward-looking approach. These later writers reasoned that current stock price changes would result from investors' expectations concerning future rather than past events. The incorporation of the efficient market hypothesis with the rational expectations hypothesis led some later writers to flatly reject the idea that money supply changes could precede stock price changes in the same manner that the early monetarist writers had rejected the notion of stock price changes preceding money supply changes.

This led to several studies attempting to find conclusive evidence that their's was the correct approach to the study of this relationship. Various methodologies were employed and much empirical evidence was presented but the controversy continued. Eventually writers began to take a more balanced approach which attempted to reconcile those theories in light of the conflicting findings. However, a full reconciliation has not yet been achieved.

The basic findings of the empirical section of this study were that while the nature of the relationship between money supply and stock prices may best be described

as one where current changes in stock prices are significantly related to past changes in the money supply, future money supply changes, as measured by M2, may be significantly related to current stock price changes for the most recent period of study. There also appears to be some evidence of a significant change in the structure of this relationship over the study period. This change corresponds almost precisely with the changes in the literature. This might explain at least part of the controversy in the literature.

There are ample reasons to explain the conflicting findings of these different studies. Some of these methodological reasons are: (1) the study of different time periods, (2) the use of different data bases, (3) the use of different model structures, (4) the use of different data forms (i.e., levels, percentage changes, first differences, logarithms, etc.), (5) the use of various types of "filters" to pretreat data, (6) the use of preliminary versus revised data, (7) the use of "predicted" and "unpredicted" values versus actual values, (8) the use of different models to estimate these "predicted" and "unpredicted" values, (9) changes in the money supply definitions over time, (10) the use of different lead/lag structures, (11) the use of different methods of analyzing data (i.e., graphical analysis, multiple regression analysis, correlation analysis, spectral analysis, etc.), (12) the

use of different levels of significance, etc.

In the preliminary stages of this study, this writer experimented with some of the methods listed above. The results were that the findings are extremely sensitive to the type of data, procedures, and methodology employed. These differences resulted in several conflicting and contradictory findings. As a result, the data, procedures, and methodology employed in this study are felt to be the most appropriate by this writer. However, different writers may have good reason for employing different methods. Therefore, it is evident that the differences in the findings of these studies are, to a great extent, attributable to the differences in the data, procedures, and methodologies employed in these different studies.

Moreover, the findings of this study are not necessarily in conflict with the theories discussed. These findings do not conflict with the quantity theory which states that changes in the money supply have an effect on economic activity and changes in economic activity have an effect on the determinants of stock prices. Changes in the money supply may cause a "chain reaction" whose effects last for some time. Therefore, past changes in the money supply may continue to have effects on the economy and, therefore, on stock prices, which do not dissipate immediately even when these effects are generally recognized.

In regard to expectations theory, the "adaptive expectations" approach allows for expectations to be based upon current and recent past events.[1] Also, it has been shown that the business cycle lags behind both money supply changes and stock price changes. It may be entirely reasonable to assume that investors place more emphasis upon the business cycle and on interest rates than on money supply. They may even watch for several consecutive changes in the money supply as a better measure of the course of the business cycle and interest rates. Most business cycle models do incorporate past data on the money supply to predict the course of the business cycle.

As to the efficient market hypothesis, it states that no one should be able to earn "supernormal" profits from studying past data. Models using past money supply data as one of several inputs have been able, through regression analysis, to form an equation which will produce figures which coincide closely with actual past data on stock prices as evidenced in a high "$R^2$" value and a "good fit" when these results are presented graphically. However, no one has ever been able to show that an investor would be able to earn "excess" profits in the stock market by using such models to form "trading rules." These models

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[1] Turnovsky, "Rational Expectations and Macroeconomic Theory," p. 55.

can be developed using past historical data to explain the past quite well, but no one has shown that they have been able to "predict" the future course of stock prices any better than a well-informed investor who does not use such a model. Therefore, the relationship in which past money supply changes are related to current stock prices is not in conflict with the efficient market hypothesis.

Moreover, the findings indicate that future changes in M2 may have a significant relationship to current stock price changes for the later period studied (1973-82). This finding is not in conflict with the quantity theory as it merely implies that money supply and stock prices may be related. It may also be viewed as being in agreement with rational expectations theory in that investors may be taking a more forward-looking approach to money supply changes. Also, this finding does not conflict with the efficient market hypothesis in that investors may be incorporating predictions of future changes in M2 into their evaluation of current stock prices.

The previous discussion is not offered as a statement of fact, but rather as a plausible explanation to the reasoning that while the observed relationship between money and stock prices is supportive of the quantity theory, it is not necessarily in conflict with rational expectations or the efficient market hypothesis. A proper

interpretation of these theories would seem to indicate that they may be viewed as complementary rather than contradictory.

"Historical progress occurs when an idea, or thesis, is confronted by an opposing idea, or antithesis. In the battle of ideas, neither one remains intact, but both are synthesized into a third; that is how all general knowledge, as well as history, advances."[1]

It is hoped that this controversy will, by the process of "thesis," "antithesis," and "synthesis," result in the further refinement of accepted economic theory.

## Conclusions

The following conclusions relate to the findings of the empirical section of this study.

1. A significant relationship appears to exist between changes in the money supply and changes in stock prices for the periods 1960-82, 1960-72, and 1973-82

2. Past changes in the money supply appear to be significantly related to current stock prices for the periods 1960-82, 1960-72, and 1973-82

3. Future changes in the money supply do not appear to be significantly related to current stock prices for the 1960-72 period.

4. For the period 1973-82, future money supply changes as measured by monthly M2, appear to be significantly related to current stock prices

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[1]Robert B. Ekelund, Jr., and Robert F. Hebert, A History of Economic Theory and Method (New York: McGraw-Hill Book Co., 1975), p. 171.

5. For the period 1960-82, future changes in the money supply as measured by monthly M2, appear to be significantly related to current stock prices

6. For the period 1973-82, future money supply changes, as measured by M1, do not appear to be significantly related to current stock prices

7. For the period 1960-82, future money supply changes, as measured by M1, do not appear to be significantly related to current stock prices

8. A structural difference appears to exist between the periods 1960-72 and 1973-82 in the relationship between money supply and stock prices as measured by monthly data

9. Past, current, and future changes in the money supply can all be shown to be significantly related to current stock prices when certain measures of the money supply are employed and certain periods are examined

10. Differences in measures of the money supply employed and differences in time periods studied may result in differences in findings and conclusions concerning the relationship between money and stock prices

Although the relationship between money supply and stock prices over the periods of this study may best be described as one where current changes in stock prices are related to past money supply changes, future money supply changes, at least as measured to monthly M2, appear to be significantly related to current stock prices for some periods studied. Therefore, the relationship cannot definitely be described as one where changes in the money supply either lead or lag changes in stock prices. In addition, the evidence on the relationship between money supply and stock prices is not such that any of the particular theories discussed in this regard may be either

definitely proven or disproven.

## Implications

The seemingly conflicting findings of the related empirical studies examined may be explained by differences in the methodologies employed, the time periods studied, the measures of the money supply and stock prices employed, and several other factors discussed in this study. The assumptions, interpretations, and conclusions made concerning these findings further contributed to this controversy. There is no evidence to suggest that a proper interpretation of these findings would be in conflict with a proper interpretation of the implications of the theories discussed in this study as they relate to the relationship between the money supply and stock prices.

Therefore, what seems like contradictory findings may be contradictory interpretations of these findings. Also, the seemingly contradictory theories may simply be contradictory interpretations of the implications of the theories. The empirical findings and theories discussed in this study should, therefore, be viewed as complementary rather than contradictory.

Therefore, a critical examination of the theoretical framework and the related empirical studies as well as the presentation of additional empirical evidence should

lead to a reexamination of the findings and conclusions of these studies and a reformulation of the implications of the theories relating to the relationship between money and stock prices.

# APPENDIXES

# APPENDIX A

## STANDARD & POOR'S COMPOSITE 500-STOCK INDEX

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5901 | 55.82 | 6201 | 69.07 | 6501 | 86.12 | 6801 | 95.04 |
| 02 | 54.77 | 02 | 70.22 | 02 | 86.75 | 02 | 90.75 |
| 03 | 56.15 | 03 | 70.29 | 03 | 86.83 | 03 | 89.09 |
| 04 | 57.10 | 04 | 68.05 | 04 | 87.97 | 04 | 95.67 |
| 05 | 57.96 | 05 | 62.99 | 05 | 89.28 | 05 | 97.87 |
| 06 | 57.46 | 06 | 55.63 | 06 | 85.04 | 06 | 100.53 |
| 07 | 59.74 | 07 | 56.97 | 07 | 84.91 | 07 | 100.30 |
| 08 | 59.40 | 08 | 58.52 | 08 | 86.49 | 08 | 98.11 |
| 09 | 57.05 | 09 | 58.00 | 09 | 89.38 | 09 | 101.34 |
| 10 | 57.00 | 10 | 56.17 | 10 | 91.39 | 10 | 103.76 |
| 11 | 57.23 | 11 | 60.04 | 11 | 92.15 | 11 | 105.40 |
| 12 | 59.06 | 12 | 62.64 | 12 | 91.73 | 12 | 106.48 |
| 6001 | 58.03 | 6301 | 65.06 | 6601 | 93.32 | 6901 | 102.04 |
| 02 | 55.78 | 02 | 65.92 | 02 | 92.69 | 02 | 101.46 |
| 03 | 55.02 | 03 | 65.67 | 03 | 88.88 | 03 | 99.30 |
| 04 | 55.73 | 04 | 68.76 | 04 | 91.60 | 04 | 101.26 |
| 05 | 55.22 | 05 | 70.14 | 05 | 86.78 | 05 | 104.62 |
| 06 | 57.26 | 06 | 70.11 | 06 | 86.06 | 06 | 99.14 |
| 07 | 55.84 | 07 | 69.07 | 07 | 85.84 | 07 | 94.71 |
| 08 | 56.51 | 08 | 70.98 | 08 | 80.65 | 08 | 94.18 |
| 09 | 54.81 | 09 | 72.85 | 09 | 77.81 | 09 | 94.51 |
| 10 | 53.73 | 10 | 73.03 | 10 | 77.13 | 10 | 95.52 |
| 11 | 55.47 | 11 | 72.62 | 11 | 80.99 | 11 | 96.21 |
| 12 | 56.80 | 12 | 74.17 | 12 | 81.33 | 12 | 91.11 |
| 6101 | 59.72 | 6401 | 76.45 | 6701 | 84.45 | 7001 | 90.31 |
| 02 | 62.17 | 02 | 77.39 | 02 | 87.36 | 02 | 87.16 |
| 03 | 64.12 | 03 | 78.80 | 03 | 89.42 | 03 | 88.65 |
| 04 | 65.83 | 04 | 79.94 | 04 | 90.96 | 04 | 85.95 |
| 05 | 66.50 | 05 | 80.72 | 05 | 92.59 | 05 | 76.06 |
| 06 | 65.62 | 06 | 80.24 | 06 | 91.43 | 06 | 75.59 |
| 07 | 65.38 | 07 | 83.22 | 07 | 93.01 | 07 | 75.72 |
| 08 | 67.79 | 08 | 82.00 | 08 | 94.49 | 08 | 77.92 |
| 09 | 67.26 | 09 | 83.41 | 09 | 95.81 | 09 | 82.58 |
| 10 | 68.00 | 10 | 84.85 | 10 | 95.66 | 10 | 84.37 |
| 11 | 71.08 | 11 | 85.44 | 11 | 92.66 | 11 | 84.28 |
| 12 | 71.65 | 12 | 83.96 | 12 | 95.30 | 12 | 90.05 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7101 | 93.49 | 7501 | 72.56 | 7901 | 99.70 | 8301 | 145.13 |
| 02 | 97.11 | 02 | 80.10 | 02 | 98.23 | 02 | 146.80 |
| 03 | 99.60 | 03 | 83.78 | 03 | 100.11 | 03 | 151.88 |
| 04 | 103.04 | 04 | 84.72 | 04 | 102.10 | 04 | 157.71 |
| 05 | 101.64 | 05 | 90.10 | 05 | 99.73 | 05 | 164.10 |
| 06 | 99.72 | 06 | 92.40 | 06 | 101.73 | 06 | 166.39 |
| 07 | 99.00 | 07 | 92.49 | 07 | 102.71 | 07 | 166.96 |
| 08 | 97.24 | 08 | 85.71 | 08 | 107.36 | 08 | 162.42 |
| 09 | 99.40 | 09 | 84.62 | 09 | 108.60 | 09 | 167.16 |
| 10 | 97.29 | 10 | 88.57 | 10 | 104.47 | 10 | 167.65 |
| 11 | 92.78 | 11 | 90.07 | 11 | 103.66 | 11 | 165.23 |
| 12 | 99.17 | 12 | 88.74 | 12 | 107.78 | 12 | 164.36 |
| 7201 | 103.30 | 7601 | 96.86 | 8001 | 110.87 | | |
| 02 | 105.24 | 02 | 100.64 | 02 | 115.34 | | |
| 03 | 107.69 | 03 | 101.08 | 03 | 104.69 | | |
| 04 | 108.81 | 04 | 101.93 | 04 | 102.97 | | |
| 05 | 107.65 | 05 | 101.16 | 05 | 107.69 | | |
| 06 | 108.01 | 06 | 101.78 | 06 | 114.55 | | |
| 07 | 107.21 | 07 | 104.20 | 07 | 119.83 | | |
| 08 | 111.01 | 08 | 103.29 | 08 | 123.50 | | |
| 09 | 109.39 | 09 | 105.45 | 09 | 126.49 | | |
| 10 | 109.56 | 10 | 101.89 | 10 | 130.22 | | |
| 11 | 115.05 | 11 | 101.19 | 11 | 135.65 | | |
| 12 | 117.50 | 12 | 104.66 | 12 | 133.48 | | |
| 7301 | 118.42 | 7701 | 103.81 | 8101 | 132.97 | | |
| 02 | 114.16 | 02 | 100.96 | 02 | 128.40 | | |
| 03 | 112.42 | 03 | 100.57 | 03 | 133.19 | | |
| 04 | 110.27 | 04 | 99.05 | 04 | 134.43 | | |
| 05 | 107.22 | 05 | 98.76 | 05 | 131.73 | | |
| 06 | 104.75 | 06 | 99.29 | 06 | 132.28 | | |
| 07 | 105.83 | 07 | 100.19 | 07 | 129.13 | | |
| 08 | 103.80 | 08 | 97.75 | 08 | 129.63 | | |
| 09 | 105.61 | 09 | 96.23 | 09 | 118.27 | | |
| 10 | 109.84 | 10 | 93.78 | 10 | 119.84 | | |
| 11 | 102.03 | 11 | 94.28 | 11 | 122.92 | | |
| 12 | 94.78 | 12 | 93.82 | 12 | 123.79 | | |
| 7401 | 96.11 | 7801 | 90.28 | 8201 | 117.41 | | |
| 02 | 93.45 | 02 | 88.98 | 02 | 114.50 | | |
| 03 | 97.44 | 03 | 88.82 | 03 | 110.84 | | |
| 04 | 92.46 | 04 | 92.71 | 04 | 116.31 | | |
| 05 | 89.67 | 05 | 97.41 | 05 | 116.35 | | |
| 06 | 89.79 | 06 | 97.66 | 06 | 109.70 | | |
| 07 | 82.82 | 07 | 97.19 | 07 | 109.38 | | |
| 08 | 76.03 | 08 | 103.92 | 08 | 109.65 | | |
| 09 | 68.12 | 09 | 103.86 | 09 | 122.43 | | |
| 10 | 69.44 | 10 | 100.58 | 10 | 132.66 | | |
| 11 | 71.74 | 11 | 94.71 | 11 | 138.10 | | |
| 12 | 67.07 | 12 | 96.10 | 12 | 139.37 | | |

# APPENDIX B

## M1 MONEY SUPPLY, SEASONALLY ADJUSTED (BILLIONS OF DOLLARS)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5901 | 139.8 | 6201 | 146.6 | 6501 | 162.3 | 6801 | 184.1 |
| 02 | 140.3 | 02 | 147.0 | 02 | 162.5 | 02 | 186.6 |
| 03 | 140.7 | 03 | 147.3 | 03 | 163.1 | 03 | 187.4 |
| 04 | 140.6 | 04 | 147.8 | 04 | 163.6 | 04 | 188.6 |
| 05 | 141.6 | 05 | 148.2 | 05 | 163.3 | 05 | 190.0 |
| 06 | 142.1 | 06 | 148.0 | 06 | 163.9 | 06 | 191.4 |
| 07 | 142.7 | 07 | 147.9 | 07 | 164.7 | 07 | 192.6 |
| 08 | 142.8 | 08 | 147.9 | 08 | 165.3 | 08 | 193.8 |
| 09 | 142.0 | 09 | 147.7 | 09 | 166.5 | 09 | 194.7 |
| 10 | 141.4 | 10 | 148.1 | 10 | 167.7 | 10 | 196.1 |
| 11 | 141.4 | 11 | 148.7 | 11 | 168.4 | 11 | 198.0 |
| 12 | 141.0 | 12 | 149.2 | 12 | 169.5 | 12 | 199.4 |
| 6001 | 141.0 | 6301 | 149.7 | 6601 | 170.8 | 6901 | 200.7 |
| 02 | 140.9 | 02 | 150.3 | 02 | 171.3 | 02 | 201.4 |
| 03 | 140.8 | 03 | 150.6 | 03 | 172.2 | 03 | 202.1 |
| 04 | 140.6 | 04 | 151.2 | 04 | 173.5 | 04 | 202.8 |
| 05 | 140.7 | 05 | 151.8 | 05 | 173.0 | 05 | 202.9 |
| 06 | 140.7 | 06 | 151.9 | 06 | 173.3 | 06 | 203.4 |
| 07 | 141.3 | 07 | 152.9 | 07 | 172.1 | 07 | 203.7 |
| 08 | 142.4 | 08 | 153.2 | 08 | 172.5 | 08 | 203.8 |
| 09 | 142.3 | 09 | 153.4 | 09 | 173.7 | 09 | 204.2 |
| 10 | 142.0 | 10 | 154.1 | 10 | 172.9 | 10 | 205.0 |
| 11 | 142.0 | 11 | 155.1 | 11 | 173.1 | 11 | 205.6 |
| 12 | 141.8 | 12 | 154.7 | 12 | 173.7 | 12 | 205.8 |
| 6101 | 142.2 | 6401 | 155.3 | 6701 | 173.6 | 7001 | 208.2 |
| 02 | 142.8 | 02 | 155.8 | 02 | 174.8 | 02 | 207.0 |
| 03 | 143.1 | 03 | 156.0 | 03 | 176.6 | 03 | 207.7 |
| 04 | 143.3 | 04 | 156.3 | 04 | 176.0 | 04 | 208.7 |
| 05 | 143.9 | 05 | 156.9 | 05 | 177.5 | 05 | 209.2 |
| 06 | 144.2 | 06 | 157.2 | 06 | 178.9 | 06 | 209.6 |
| 07 | 144.2 | 07 | 158.4 | 07 | 180.0 | 07 | 210.1 |
| 08 | 144.7 | 08 | 159.4 | 08 | 181.6 | 08 | 212.0 |
| 09 | 145.1 | 09 | 160.3 | 09 | 182.6 | 09 | 213.9 |
| 10 | 145.5 | 10 | 160.9 | 10 | 183.6 | 10 | 215.0 |
| 11 | 146.1 | 11 | 161.5 | 11 | 184.2 | 11 | 215.8 |
| 12 | 146.5 | 12 | 161.9 | 12 | 185.1 | 12 | 216.6 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7101 | 217.8 | 7501 | 277.2 | 7901 | 363.9 | 8301 | 485.1 |
| 02 | 219.7 | 02 | 278.1 | 02 | 365.1 | 02 | 491.1 |
| 03 | 221.1 | 03 | 280.2 | 03 | 367.5 | 03 | 496.4 |
| 04 | 222.3 | 04 | 279.8 | 04 | 371.7 | 04 | 497.9 |
| 05 | 224.4 | 05 | 282.5 | 05 | 372.9 | 05 | 506.6 |
| 06 | 225.9 | 06 | 286.2 | 06 | 377.4 | 06 | 510.9 |
| 07 | 227.3 | 07 | 287.0 | 07 | 381.4 | 07 | 514.9 |
| 08 | 228.0 | 08 | 288.2 | 08 | 383.7 | 08 | 517.4 |
| 09 | 228.9 | 09 | 289.2 | 09 | 385.9 | 09 | 518.9 |
| 10 | 229.6 | 10 | 288.8 | 10 | 386.3 | 10 | 521.6 |
| 11 | 230.3 | 11 | 291.3 | 11 | 386.8 | 11 | 523.0 |
| 12 | 230.8 | 12 | 291.2 | 12 | 389.1 | 12 | 525.3 |
| 7201 | 232.6 | 7601 | 292.4 | 8001 | 392.5 | | |
| 02 | 234.8 | 02 | 294.6 | 02 | 395.8 | | |
| 03 | 236.8 | 03 | 296.0 | 03 | 394.7 | | |
| 04 | 238.1 | 04 | 297.9 | 04 | 387.5 | | |
| 05 | 238.4 | 05 | 299.7 | 05 | 388.7 | | |
| 06 | 239.3 | 06 | 299.6 | 06 | 393.8 | | |
| 07 | 241.3 | 07 | 300.8 | 07 | 398.7 | | |
| 08 | 243.5 | 08 | 302.8 | 08 | 406.0 | | |
| 09 | 245.8 | 09 | 303.4 | 09 | 411.8 | | |
| 10 | 247.7 | 10 | 306.6 | 10 | 415.7 | | |
| 11 | 249.1 | 11 | 307.4 | 11 | 417.7 | | |
| 12 | 252.0 | 12 | 310.4 | 12 | 414.9 | | |
| 7301 | 254.3 | 7701 | 313.3 | 8101 | 418.0 | | |
| 02 | 254.9 | 02 | 315.6 | 02 | 420.4 | | |
| 03 | 254.4 | 03 | 317.5 | 03 | 424.2 | | |
| 04 | 255.6 | 04 | 320.0 | 04 | 430.1 | | |
| 05 | 257.8 | 05 | 320.6 | 05 | 428.9 | | |
| 06 | 259.6 | 06 | 322.1 | 06 | 428.7 | | |
| 07 | 260.5 | 07 | 324.5 | 07 | 431.0 | | |
| 08 | 260.8 | 08 | 326.2 | 08 | 433.1 | | |
| 09 | 260.9 | 09 | 328.3 | 09 | 433.6 | | |
| 10 | 262.1 | 10 | 331.1 | 10 | 433.8 | | |
| 11 | 264.0 | 11 | 332.9 | 11 | 436.9 | | |
| 12 | 265.9 | 12 | 335.4 | 12 | 441.9 | | |
| 7401 | 266.9 | 7801 | 339.2 | 8201 | 450.3 | | |
| 02 | 268.3 | 02 | 339.6 | 02 | 448.1 | | |
| 03 | 269.7 | 03 | 340.9 | 03 | 447.9 | | |
| 04 | 270.2 | 04 | 344.3 | 04 | 449.8 | | |
| 05 | 270.7 | 05 | 347.9 | 05 | 451.5 | | |
| 06 | 271.6 | 06 | 349.9 | 06 | 452.3 | | |
| 07 | 272.6 | 07 | 352.0 | 07 | 453.1 | | |
| 08 | 273.1 | 08 | 353.6 | 08 | 457.7 | | |
| 09 | 274.1 | 09 | 357.4 | 09 | 463.5 | | |
| 10 | 275.4 | 10 | 358.2 | 10 | 470.2 | | |
| 11 | 276.8 | 11 | 360.1 | 11 | 476.4 | | |
| 12 | 277.6 | 12 | 363.1 | 12 | 480.5 | | |

# APPENDIX C

## M2 MONEY SUPPLY, SEASONALLY ADJUSTED (BILLIONS OF DOLLARS)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5901 | 286.6 | 6201 | 337.6 | 6501 | 427.8 | 6801 | 525.4 |
| 02 | 287.8 | 02 | 340.3 | 02 | 430.5 | 02 | 530.2 |
| 03 | 289.1 | 03 | 343.0 | 03 | 433.1 | 03 | 532.8 |
| 04 | 290.2 | 04 | 345.6 | 04 | 435.6 | 04 | 535.9 |
| 05 | 292.3 | 05 | 347.6 | 05 | 437.2 | 05 | 539.0 |
| 06 | 294.0 | 06 | 349.2 | 06 | 439.9 | 06 | 542.6 |
| 07 | 295.4 | 07 | 351.0 | 07 | 443.0 | 07 | 546.0 |
| 08 | 296.4 | 08 | 352.9 | 08 | 445.7 | 08 | 549.9 |
| 09 | 296.5 | 09 | 354.7 | 09 | 449.2 | 09 | 553.8 |
| 10 | 296.6 | 10 | 357.3 | 10 | 452.8 | 10 | 558.1 |
| 11 | 297.2 | 11 | 359.9 | 11 | 456.0 | 11 | 562.2 |
| 12 | 297.8 | 12 | 362.7 | 12 | 459.4 | 12 | 566.3 |
| 6001 | 298.3 | 6301 | 365.4 | 6601 | 462.4 | 6901 | 569.3 |
| 02 | 298.6 | 02 | 368.0 | 02 | 464.6 | 02 | 571.7 |
| 03 | 299.3 | 03 | 370.5 | 03 | 467.0 | 03 | 574.0 |
| 04 | 300.1 | 04 | 373.4 | 04 | 469.4 | 04 | 576.0 |
| 05 | 301.0 | 05 | 376.2 | 05 | 470.1 | 05 | 576.7 |
| 06 | 302.2 | 06 | 378.3 | 06 | 471.0 | 06 | 578.5 |
| 07 | 304.3 | 07 | 381.3 | 07 | 471.0 | 07 | 579.9 |
| 08 | 306.9 | 08 | 383.7 | 08 | 472.7 | 08 | 580.6 |
| 09 | 308.2 | 09 | 385.8 | 09 | 475.3 | 09 | 582.3 |
| 10 | 309.6 | 10 | 388.5 | 10 | 476.1 | 10 | 583.9 |
| 11 | 311.0 | 11 | 391.6 | 11 | 477.5 | 11 | 587.0 |
| 12 | 312.3 | 12 | 393.2 | 12 | 480.0 | 12 | 589.5 |
| 6101 | 314.2 | 6401 | 395.5 | 6701 | 481.9 | 7001 | 591.4 |
| 02 | 316.6 | 02 | 397.7 | 02 | 485.0 | 02 | 588.5 |
| 03 | 318.2 | 03 | 399.6 | 03 | 489.4 | 03 | 589.3 |
| 04 | 320.0 | 04 | 401.8 | 04 | 492.2 | 04 | 590.5 |
| 05 | 322.3 | 05 | 404.3 | 05 | 497.2 | 05 | 593.7 |
| 06 | 324.2 | 06 | 406.9 | 06 | 502.0 | 06 | 597.3 |
| 07 | 325.7 | 07 | 410.3 | 07 | 506.6 | 07 | 600.5 |
| 08 | 327.6 | 08 | 413.5 | 08 | 511.1 | 08 | 606.2 |
| 09 | 329.4 | 09 | 416.6 | 09 | 514.8 | 09 | 612.5 |
| 10 | 331.2 | 10 | 419.3 | 10 | 518.6 | 10 | 617.7 |
| 11 | 333.5 | 11 | 422.2 | 11 | 521.2 | 11 | 622.4 |
| 12 | 335.5 | 12 | 424.8 | 12 | 524.3 | 12 | 628.2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7101 | 634.3 | 7501 | 912.3 | 7901 | 1395.8 | 8301 | 2017.5 |
| 02 | 642.6 | 02 | 920.1 | 02 | 1402.5 | 02 | 2054.0 |
| 03 | 651.4 | 03 | 931.4 | 03 | 1411.9 | 03 | 2067.4 |
| 04 | 660.7 | 04 | 941.6 | 04 | 1425.8 | 04 | 2081.8 |
| 05 | 668.9 | 05 | 954.4 | 05 | 1434.7 | 05 | 2102.2 |
| 06 | 675.0 | 06 | 969.4 | 06 | 1448.0 | 06 | 2117.0 |
| 07 | 681.5 | 07 | 981.2 | 07 | 1459.7 | 07 | 2126.6 |
| 08 | 687.6 | 08 | 989.7 | 08 | 1469.7 | 08 | 2135.3 |
| 09 | 694.6 | 09 | 998.5 | 09 | 1481.0 | 09 | 2147.9 |
| 10 | 700.5 | 10 | 1004.7 | 10 | 1486.7 | 10 | 2167.2 |
| 11 | 707.0 | 11 | 1014.8 | 11 | 1489.5 | 11 | 2182.1 |
| 12 | 712.8 | 12 | 1023.3 | 12 | 1498.5 | 12 | 2196.1 |
| 7201 | 719.9 | 7601 | 1034.1 | 8001 | 1508.5 | | |
| 02 | 728.1 | 02 | 1047.8 | 02 | 1521.5 | | |
| 03 | 735.9 | 03 | 1057.0 | 03 | 1526.6 | | |
| 04 | 741.3 | 04 | 1068.4 | 04 | 1522.6 | | |
| 05 | 746.0 | 05 | 1082.0 | 05 | 1532.8 | | |
| 06 | 752.8 | 06 | 1086.2 | 06 | 1551.8 | | |
| 07 | 762.4 | 07 | 1095.2 | 07 | 1572.1 | | |
| 08 | 771.9 | 08 | 1108.7 | 08 | 1588.7 | | |
| 09 | 781.0 | 09 | 1120.5 | 09 | 1603.3 | | |
| 10 | 789.6 | 10 | 1135.6 | 10 | 1615.8 | | |
| 11 | 796.7 | 11 | 1148.5 | 11 | 1629.0 | | |
| 12 | 805.2 | 12 | 1163.6 | 12 | 1632.6 | | |
| 7301 | 813.7 | 7701 | 1177.2 | 8101 | 1640.9 | | |
| 02 | 817.8 | 02 | 1188.4 | 02 | 1653.0 | | |
| 03 | 818.8 | 03 | 1199.4 | 03 | 1669.6 | | |
| 04 | 823.3 | 04 | 1211.4 | 04 | 1690.3 | | |
| 05 | 830.4 | 05 | 1222.0 | 05 | 1697.3 | | |
| 06 | 837.3 | 06 | 1230.2 | 06 | 1705.4 | | |
| 07 | 841.2 | 07 | 1240.6 | 07 | 1716.8 | | |
| 08 | 843.7 | 08 | 1249.9 | 08 | 1733.4 | | |
| 09 | 844.6 | 09 | 1259.5 | 09 | 1744.8 | | |
| 10 | 848.5 | 10 | 1269.2 | 10 | 1758.7 | | |
| 11 | 854.5 | 11 | 1277.8 | 11 | 1776.2 | | |
| 12 | 861.0 | 12 | 1286.7 | 12 | 1796.6 | | |
| 7401 | 865.6 | 7801 | 1296.5 | 8201 | 1814.2 | | |
| 02 | 870.4 | 02 | 1301.5 | 02 | 1818.1 | | |
| 03 | 876.6 | 03 | 1308.4 | 03 | 1827.1 | | |
| 04 | 879.2 | 04 | 1317.3 | 04 | 1839.4 | | |
| 05 | 881.4 | 05 | 1326.6 | 05 | 1854.2 | | |
| 06 | 884.7 | 06 | 1333.3 | 06 | 1865.9 | | |
| 07 | 888.2 | 07 | 1341.2 | 07 | 1878.3 | | |
| 08 | 891.1 | 08 | 1349.2 | 08 | 1897.3 | | |
| 09 | 895.2 | 09 | 1361.9 | 09 | 1914.0 | | |
| 10 | 900.2 | 10 | 1371.2 | 10 | 1928.8 | | |
| 11 | 905.4 | 11 | 1378.7 | 11 | 1945.7 | | |
| 12 | 908.5 | 12 | 1389.1 | 12 | 1965.3 | | |

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