Faculty Working Papers

THE MARKET MODEL: POTENTIAL FOR ERROR

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#606

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Faculty Working Papers

AN ANALYSIS OF FACTORS THAT INFLUENCE AGGREGATE STOCK MARKET VOLATILITY

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#607

Summary:

A prior study indicated that the level of volatility of aggregate stock prices experienced several significant changes during the period 1928-1975. This study identifies several variables that should impact on market volatility and examines the importance of the variables. There is also a separate analysis of the recent impact of institutional trading. The results indicate that the most important variable for the long-run analysis was a change in variability of the market's risk premium. The analysis of the impact of institution indicated a negative relationship, which is completely contrary to the prevailing folklore.

AN ANALYSIS OF FACTORS THAT INFLUENCE AGGREGATE STOCK MARKET VOLATILITY*

John M. Wachowicz, Jr.
Frank K. Reilly**

INTRODUCTION

In a prior study the authors carried out a detailed analysis of aggregate stock price volatility using daily stock price data for the period 1928-1975.[1] The results of this prior study provided strong evidence that aggregate market volatility has not been constant over time, but rather has experienced major changes. Specifically, the twin peaks of the great depression (1931-1933 and 1937-1939) showed the highest levels of volatility while the recent 1973-1975 period showed significantly more volatility than every other three-year period beginning with 1940-1942. It was shown in the prior study that such changes can have a significant impact on individual stocks and the aggregate stock market. Because of the significant changes and the impact that these changes can have on the equity market, it is important to analyze what factors influence the volatility of the market. Therefore, the purpose of this study is to identify which variables should impact on market volatility and test the relative

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[1] John M. Wachowicz, Jr. and Frank K. Reilly, "An Analysis of Changes in Aggregate Stock Market Volatility," paper presented at Midwest Finance Association Meeting, Chicago, Illinois (April, 1979).

importance of the hypothesized variables. In addition to several variables implied by a basic valuation model, we also conduct a separate analysis of the impact of institutional trading on market volatility. This separate analysis is prompted by the pervasive folklore that contends that there is a strong positive relationship between institutional trading and price volatility and such a contention has important policy implications for financial institutions and our capital markets.

The first section contains a brief review of the prior study on changes in market volatility. In the second section we discuss several prior studies that analyzed factors that might influence market volatility. In section three the potential explanatory variables are derived from the valuation model and empirical proxies for these variables are presented. In section four the results from the basic model are presented and discussed. This is followed in section five by an extension where the impact of institutional trading is considered. The final section contains a summary, conclusion, and a discussion of the implications.

PRIOR STUDY ON CHANGES IN MARKET VOLATILITY

The purpose of this prior study was to define, measure, and study changes in the level of aggregate stock market volatility over time. Aggregate market volatility was defined as the <u>ex post</u> variability in market rates of return. It was shown that changes in the level of market volatility could influence the expected market return, the risk/return relationship of all individual securities, and an individual security's "beta."

A review of four prior studies on market volatility indicated agreement that market returns during the pre-World War II period were significantly more volatile than during the 1946-1970 period.[2] There was disagreement, however, on whether aggregate stock price volatility had increased in the 1970's.

The Standard and Poor's 500 Composite Index (SP500) was selected as the proxy for the market portfolio. This is a value-weighted index, of broad coverage, that provides a historical daily listing back to 1928. In order to better capture volatility as opposed to trend, daily returns (calculated as percent changes in the index) were employed.

Analysis of Return Distribution

The characteristics of the market return series distribution were studied in detail, because the type of distribution affects the appropriateness of the alternative market volatility measures, and because the nature of the distribution determines which statistical tests are suitable for hypothesis testing. For the purpose of analysis, the 1928-1975 time span was broken into three-year, six-year, twelve-year, and twenty-four-year subperiods. Also, additional subperiods were formed

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[2] Lawrence Fisher and James H. Lorie, "Some Studies of Variability of Returns on Investments in Common Stocks," The Journal of Business, Vol. 43, No. 2 (April, 1970), pp. 99-134; R. R. Officer, "The Variability of the Market Factor of the New York Stock Exchange," The Journal of Business, Vol. 46, No. 3 (July, 1973), pp. 434-453; Steven C. Leuthold, "The Causes (and Cures?) of Market Volatility," The Journal of Portfolio Management, Vol. 2, No. 2 (Winter, 1976), pp. 21-25; Dennis E. Logue, "Are Stock Markets Becoming Riskier?" The Journal of Portfolio Management, Vol. 2, No. 2 (Spring, 1976), pp. 13-19.

to correspond to major "bull" and "bear" markets. Based upon studies of return distribution symmetry, comparisons of return distributions with normal distributions, and Kolmorgorov-Smirnov (K-S) tests for normality,[3] it was concluded that return distributions for almost all the periods do not come from normal populations. All the return distributions exhibited signs of peakedness and fat-tails relative to normal distributions. Because of these results it was necessary to select volatility measures able to deal with fat-tailed non-normal distributions, and employ non-parametric tests for analyzing changes in the level of market volatility.

Analysis of Volatility

Five different volatility measures--standard deviation (SD), semi-standard deviation (SSD), mean absolute deviation about the mean (MAD1), mean absolute deviation about the median (MAD2), and interquartile range (IQR)--were employed in studying the return-series data. All five measures were calculated on monthly, quarterly, and half-yearly bases from daily percent changes in the SP500 Index. All fifteen time series plots showed twin peaks of significantly higher volatility during the depression years (1929-1939). Also, the relatively low level of post-World War II volatility "appeared" to be broken only during the period 1973-1975. Correlation analysis verified the patterns of similarity shown among time-series plots for the various volatility measures.

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[3] Hubert W. Lilliefors, "On the Kolmorgorov-Smirnov Test for Normality With Mean and Variance Unknown," Journal of the American Statistical Association, Vol. 62, No. 318 (June, 1967), pp. 399-402; Lindgren and McElrath, Introduction to Probability and Statistics, pp. 151-153; and Siegel, Nonparametric Statistics for the Behavioral Sciences, pp. 47-52.

The Siegel-Tukey test was used to test the null hypothesis that the market returns for the two sample periods come from populations with equal dispersions, against the alternative hypothesis that the two samples come from populations with significantly different dispersions.[4] Results from applying the Siegel-Tukey test after adjusting median values to paired adjacent three-year periods revealed that for most pairings, there was a slight, yet significant (at the .05 confidence level), difference in dispersion. When the 1973-1975 period was singled out for comparison with other three-year periods because of its "seemingly" high level of volatility, a number of important findings resulted: (1) the period 1973-1975 showed significantly more dispersion than every other three-year period beginning with 1940-1942; (2) the 1973-1975 level of dispersion was surpassed only by the twin peaks of the great depression--1931-1933 and 1937-1939; and (3) the 1973-1975 level of dispersion was not significantly different from the level of volatility attained in 1928-1930 and 1934-1936.

Conclusions

The results of this prior study indicated two major conclusions. One is that daily market return distributions do not appear to come from normal populations. For the various time periods studied, all the return distributions exhibited signs of peakedness and fat-tails relative to normal distributions. Second, the results provided strong evidence that aggregate market volatility has not been constant over

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[4] Sidney Siegel and John W. Tukey, "A Non-parametric Sum of Ranks Procedure for Relative Spread in Unpaired Samples," Journal of the American Statistical Association, Vol. 55, No. 291 (September, 1960), pp. 429-445.

time, but rather has experienced major changes. The twin peaks of the great depression--1931-1933 and 1937-1939--showed the highest levels of volatility. The recent 1973-1975 period, however, showed significantly more volatility than every other three-year period beginning with 1940-1942.

As noted, because changes in the level of market volatility can affect the aggregate stock market and the systematic risk for individual securities, it is important to examine what variables should influence these changes and empirically test the hypothesized variables.

PRIOR STUDIES ON FACTORS INFLUENCING MARKET VOLATILITY

Officer Study

The most comprehensive analysis of factors that might influence market volatility was by Officer.[5] The initial part of the study examined a monthly moving series of standard deviations of returns for the NYSE covering the period 1897-1969. The main conclusion of this segment of the study was that the level of volatility before and after the 1930's was generally similar compared to a very high level during the 1930's--i.e., the decline in volatility after the 1930's was a return to "normal" volatility. The rest of the study examined a number of variables set forth as possible factors that may influence market volatility.

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[5] Officer, "The Variability of the Market Factor of the New York Stock Exchange," Op. Cit.

The initial analysis considered specific events that might have an impact. Some observers have felt that the formation of the Securities and Exchange Commission (SEC) in 1933 had an effect, but an analysis of the time series plot of volatility clearly did not support this. Another suggestion is that the availability of margin requirement changes would reduce volatility--i.e., the Federal Reserve theoretically raises the requirements during periods of speculation which should reduce trading and volatility. The results of the analysis suggested that margin requirements are changed <u>after</u> the variability in the market has already started to change. Therefore it is felt that margin requirements are not an effective means of controlling market volatility. Finally, there was a consideration of the changing composition of stocks on the Exchange which should cause a decline because they are becoming more diversified. A comparison of the actual changing portfolio to several derived portfolios that did not change composition indicated no significant difference in variability. Hence, it was concluded that none of these factors were relevant and Officer turned to the analysis of economic factors that reflect business fluctuations.

The first variable considered was the Federal Reserve Board's Industrial Production Index for three periods: 1919-1929; 1929-1944; and 1944-1969. He specifically related a moving variability series of this variable to the market variability series. The results indicated a definite relationship between the series during the 1930's; some slight relationship during the 1920's and virtually no relationship during the period 1944-1969. A consideration of industrial production and wholesale prices indicated that wholesale prices added very little to explaining stock price variability. After some tests of the relationship between the two series, it was concluded that the abnormal behavior of market variability during the 1930's can be related to business activity as reflected in industrial production.

In an attempt to further examine the relationship between business fluctuations and the market factor, Officer considered the two major business fluctuation theories: the income-expenditure theory and the quantity of money theory. It was not possible to analyze the income-expenditure theory because none of the proxies for investment had any relationship to the stock market factor. The quantity of money theory was tested by examining the relationship between market variability and variability in the M2 money supply (cash plus demand and time deposits), during three subperiods. The results indicated that nearly all the relationships found between variability of percentage changes in the money supply and market variability changes can be attributed to the large increase in both these variables in 1929. Then Officer examined the impact of both industrial production and the money supply. Again, the results indicated that only during the first subinterval was there any substantial contribution by the money supply and it appeared that all of this was due to what happened in 1929. It was concluded that the variability of the market during the 1930's could be related to industrial production while the money supply was only relevant around 1929.

Leuthold Study

The study by Leuthold examined market volatility on the basis of daily market fluctuations for the period 1897 to 1975.[6] Leuthold concluded that sharp day-to-day market swings had increased in frequency in recent years. This recent market instability is especially dramatic when compared to the "quiet" 1941-1972 period. Leuthold contends that the reason for the increase in day-to-day volatility is the institutional market of recent years. Although no direct empirical evidence is presented indicating a relationship between market volatility and institutional trading, a number of arguments are offered for why one would "expect" institutional trading to cause an increase in volatility. The current authors question this belief based upon the results of several studies.[7] Still, it is because of this pervasive folklore that we specifically examine the impact of institutional trading on stock price volatility.

Logue Study

After discussing reasons why some observers expect stock prices to become more volatile, and also why the long-term outlook calls for a decline in volatility, Logue examined stock price volatility for several

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[6]Leuthold, "The Causes (and Cures?) of Market Volatility," Op. Cit.

[7]Frank K. Reilly, "Institutions on Trial: Not Guilty," Journal of Portfolio Management, Vol. 3, No. 2 (Winter, 1977), pp. 5-10; Frank K. Reilly and John M. Wachowicz, Jr., "How Institutional Trading Reduces Market Volatility," Journal of Portfolio Management, Vol. 5, No. 2 (Winter, 1979), pp. 11-17; Frank K. Reilly, "Block Trades and Stock Price Volatility," Financial Analysts Journal, forthcoming; and Neil Barkman, "Institutional Investors and the Stock Market," New England Economic Review, Federal Reserve Bank at Boston (November/December, 1977), pp. 60-78.

countries during the period 1958-1974. In general the results indicated no significant increase during the period either in nominal returns or real returns adjusted for inflation. In terms of causes, it is notable that an analysis of inflation rates for the several countries indicated that the variability of the rate of inflation had <u>increased</u> in the United States and Canada during this recent period.

Summary of Prior Studies

There have been few studies that have examined the factors that might influence the volatility of stock prices. Also, those that have examined variables have derived the potential explanatory variables in an *ad hoc* manner. Given these variables, Officer found a relationship with industrial production and a very limited relationship with the money supply. Leuthold contended there was a positive relationship with institutional trading but never tested it. Finally, Logue found an increase in the volatility of inflation during the period but did not relate this to stock price volatility.

MACROECONOMIC FACTORS INFLUENCING MARKET VOLATILITY

In order to understand what should contribute toward a change in market return volatility, it is helpful to consider a basic security valuation model. Specifically, if one can identify which variables determine the value or price of a security, one can see that changes in these variables will contribute toward a change in overall value. Further, if any of these valuation variables become more volatile over time, security prices (and returns) should change more often by greater amounts--i.e., security returns should become more volatile.

Valuation Model

The best known valuation model is that of the present value of dividends:[8]

$$P_0 = \sum_{t=1}^{\infty} D_t/(1+k)^t$$

where P_0 = present price;

D_t = dividend in period t;

k = required rate of return on investment.

It has been shown that this formulation can be simplified if one assumes a constant rate of growth in dividends (g) for an infinite period of time.[9] The simplified formulation is:

$$P_0 = [D_0(1+g)]/(k-g).$$

Given this formulation, the price of a security is a function of the current dividend, the required rate of return on this class of risky assets, and the expected growth rate of dividends. Changes in the value of any of these variables should result in a change in security price and return.[10] Therefore, if there is a change in the volatility of any of the valuation variables (D_0, k, g), one should expect a change in the volatility of security prices and returns.

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[8]This model was first developed by John B. Williams, The Theory of Investment Value (Cambridge: Harvard University Press, 1938).

[9]See Myron J. Gordon, The Investment, Financing and Valuation of the Corporation (Homewood, Illinois: Richard D. Irwin, Inc., 1962), Chapter 3.

[10]Changes in variables affecting the price of a security may offset each other in such a way that no change in price occurs. This would be the exception rather than the rule, however.

Macroeconomic Variables

If we turn from the price of a single security to the level of the SP500, it seems logical to assume some connection between our simplified valuation model and certain macroeconomic variables. In fact, Robichek and Cohn suggest just such a connection:

> It is reasonable to think that k and g are related to underlying macroeconomic variables. k is a discount rate and as such should be related to other interest rates. Indeed, the capital asset pricing model posits that the risk free rate is a component of k. The rate of growth, g, is a function of the outlook for corporate profits which in turn should be related to movements in GNP. One would therefore expect rates of return on equity securities to be related to changes in GNP and in interest rates.[11]

Growth Variables

Looking first at growth (g), it seems reasonable that growth in dividends for the market should be related to some measure of overall business activity.

Gross National Product. Gross National Product (GNP) is probably the most widely used measure of total economic activity.[12] It measures the market value of the nation's output of final goods and services. Using the rate of change in GNP as a proxy for growth (g), we should expect variability in this rate of change to be related to variability in market return. One major drawback to using the rate of change in GNP as a proxy for growth, is that GNP is only reported quarterly.

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[11] Alexander A. Robichek and Richard A. Cohn, "The Economic Determinants of Systematic Risk," Papers and Proceedings of the Thirty-Second Annual Meeting of the American Finance Association, in The Journal of Finance, Vol. 29, No. 2 (May, 1974), p. 442.

[12] Elizabeth W. Angle, Keys for Business Forecasting, 4th ed. (Richmond: Federal Reserve Bank of Richmond, 1975), p. 7.

Industrial Production Index. The Industrial Production Index (IPI), compiled by the Federal Reserve, is the second most popular summary indicator of U.S. economic activity.[13] It measures total physical output in the industrial sector--manufacturing, mining, and gas and electric utilities--as an index, with 1967 equal to 100.

The IPI is a more useful measure of business activity than GNP because it is published monthly. Also, since the IPI measures physical output, there is no need to adjust for inflation. The rate of change in IPI is, therefore, used as our measure of "real" growth.

Discount Rate Variables

We can conceive that the discount rate applicable to the aggregate stock market is a function of the risk-free rate, an inflation premium, and a risk premium.[14] It then remains for us to find proxies for these theoretical variables.

The corporate Aaa bond yield was chosen to serve as a proxy for the nominal riskless rate, which would include the risk-free rate plus an inflation premium. This approach of using the corporate Aaa bond yield as a proxy for the nominal riskless rate has been followed by other researchers.[15]

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[13] Angle, Keys for Business Forecasting, p. 16.

[14] For an extended discussion of the variables, see Frank K. Reilly, Investment Analysis and Portfolio Management (Hinsdale, Ill., The Dryden Press, Chapter 1.

[15] See, for example, Uri Ben-Zion, "A Time Series Measure of Risk," Journal of Economics and Business, Vol. 27, No. 1 (Fall, 1974), pp. 60-63.

The corporate Baa bond yield could be used as a proxy for the aggregate stock market discount rate (k). With the corporate Baa bond yield serving as a proxy for the market discount rate (k) and the corporate Aaa bond yield as a proxy for the nominal riskless rate, the difference between the yield on Baa bonds and the yield on Aaa bonds becomes our market "risk premium" proxy. While the selected proxy variables may not be equivalent in magnitude to the theoretical variables, they should be proportional to the theoretical variables.[16] Since our concern is with the variability of the theoretical variables, and not magnitude, no statistical problems are created by choosing proxies that are proportional to theoretical variables. Specifically, one would expect movements in our proxy for the risk premium and movements in the "true" risk premium to be correlated over time. Thus, there would be strong correlation between changes in the volatility of our proxy and changes in the volatility of the "true" risk premium.

Greater insight into the factors contributing toward changes in market return volatility can be achieved by identifying the determinants of the corporate Aaa bond yield and by isolating the market "risk premium."

Determinants of corporate Aaa bond yield. There is a discussion of the determinants of the corporate Aaa bond yield in an article by Keran.[17] Keran observed that the long-term interest rate is equal to

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[16] The use of the difference between the yield on corporate Baa bonds and the yield on corporate Aaa bonds as a proxy variable which is proportionate to the market "risk premium" is discussed in Ben-Zion, "A Time Series Measure of Risk," p. 60.

[17] Michael W. Keran, "Expectations, Money, and the Stock Market," Federal Reserve Bank of St. Louis Review, Vol. 53, No. 1 (January, 1971), pp. 16-31.

the real rate of interest and the expected rate of change in prices. Further, he posited that the real rate of interest is a function of a short-term liquidity effect (measured by the current rate of change in the money stock) and a real growth component.[18] Therefore, it is reasonable to assume that changes in the nominal corporate Aaa bond yield would be a function of changes in the rate of change in the price level (i.e., changes in the rate of inflation), changes in the growth rate of the money supply,[19] and changes in real growth.

To more fully explain changes in the variability in market returns, it is necessary to describe the variability in the corporate Aaa bond yield--our proxy for the nominal riskless rate--in terms of the variability of its determining factors. The first step in this process is to find proxies (or operational variables) to describe (1) the rate of change in prices--i.e., the rate of inflation, (2) the growth rate of the money supply, and (3) real growth.

The three most widely used measures of price movements in the United States are the GNP Implicit Price Deflator, the Consumer Price Index (CPI), and the Wholesale Price Index (WPI).[20] The rate of change in any of these indexes could serve as a proxy for the rate of

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[18] Keran, "Expectations, Money, and the Stock Market," p. 21.

[19] While the money supply enters into a number of models attempting to explain stock market "levels," it is assigned varying degrees of importance. Keran sees changes in the money supply affecting the discount rate through a short-run liquidity effect. Homa and Jaffee seek to explain the level of stock prices "solely" by means of the money supply. Kenneth E. Homa and Dwight M. Jaffee, "The Supply of Money and Common Stock Prices," The Journal of Finance, Vol. 26, No. 5 (December, 1971), pp. 1045-1066.

[20] Angle, Keys for Business Forecasting, p. 20.

inflation. As discussed in an article by Wallace and Cullison, because of the way the GNP deflator is computed, changes in the index can measure changes in things other than prices.[21] Also, the WPI measures prices paid for transaction, rather than prices paid by consumers which is what the CPI measures. Because we are concerned with individual investors and because of the widespread familiarity with the CPI, we selected it as our proxy for the rate of inflation.

Growth in money is measured as the rate of change in the money stock. The Federal Reserve defines a number of money stock measures. Previous studies relating stock prices (and/or returns) to money measures have considered money to be either M1 or M2[22]--currency plus private demand deposits adjusted constitute M1, while M2 is considered to be M1 plus time deposits. In this study, M1 is employed as the money stock measure.

The IPI is stated in real terms. Therefore, the rate of change in IPI (unadjusted) will serve as a proxy for real growth.

Risk premium variable. The difference between the yield on Moody's grade Baa bonds and the yield on Moody's Aaa bonds (in month t) serves as our proxy variable for the market risk premium.[23]

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[21]William H. Wallace and William E. Cullison, Measuring Price Changes: A Study of the Price Indexes, 3rd ed. (Richmond: Federal Reserve Bank of Richmond, 1976), p. 14.

[22]For example, in Officer, "The Variability of the Market Factor of the New York Stock Exchange," the money measure used was M2. In Homa and Jaffee, "The Supply of Money and Common Stock Prices," however, M1 was employed.

[23]This risk premium formulation has been used before; see, for example, Ben-Zion, "A Time Series Measure of Risk," pp. 60-63.

The results of our search for macroeconomic variables to serve as proxies for growth (g) and the discount rate (k) are summarized in Table 1.

Form of the Models

The specifications of two alternative models that are analyzed using stepwise regression are presented in Table 2. Because of the non-normal characteristics of the return series distribution, the market volatility measure chosen as the dependent variable would have to correctly quantify dispersion from a non-normal distribution. Two measures that meet this criterion were selected--mean absolute deviation about the median (MAD2), and the interquartile range (IQR). The idea was to see whether results would vary with the volatility measure employed. The two models related market volatility to a proxy for the variability in growth (g)--i.e., variability in the growth of the Industrial Production Index (IPI); to variability in the determinants of the nominal riskless rate--i.e., variability in the growth of money (M1); variability in the rate of inflation (CPI), and variability in real economic growth (IPI); and variability in risk premium changes (Baa-Aaa).[24]

The two models are estimated in an additive linear form. These models are abstractions of the more complex interrelationships that

[24] Note that IPI is doing double duty--accounting for variability in (g) and variability in the real growth component of the nominal riskless rate.

TABLE 1

SUMMARY OF MACROECONOMIC VARIABLES
RELATED TO STOCK VALUATION MODEL

Theoretical Variables	Operational Variables
Growth (g):	Rate of change in ... Industrial Production Index
Discount Rate (k):	Corporate Baa Bond Yield on Seasoned Issues
Risk-free Rate plus Inflation Premium:	Corporate Aaa Bond Yield on Seasoned Issues
Risk Premium:	Corporate Baa Bond Yield on Seasoned Issues Minus Corporate Aaa Bond Yield on Seasoned Issues
Determinants of Nominal Corporate Aaa Bond Yield	
Real Growth:	Rate of change in ... Industrial Production Index (IPI)
Growth in Money:	Rate of change in ... Money Supply (M1)
Rate of Inflation:	Rate of change in ... Consumer Price Index (CPI)

TABLE 2

RELATIONSHIPS STUDIED WITH REGRESSION ANALYSIS

Dependent Variable	Independent Variables
MAD2	(Baa-Aaa) IPI CPI M1
IQR	(Baa-Aaa) IPI CPI M1

where:

MAD2 = the half-yearly mean absolute deviation of the market return about the median--with MAD2 calculated from daily percent changes in the SP500.

IQR = the half-yearly interquartile range of market returns--with IQR calculated from daily percent changes in the SP500.

(Baa-Aaa) = the half-yearly sample standard deviation of monthly percent changes in "risk premium"--with "risk premium" measured as the difference between the yield on Moody's grade Baa bonds and the yield on Moody's grade Aaa bonds.

IPI = the half-yearly sample standard deviation of monthly percent changes in the seasonally-adjusted Industrial Production Index.

CPI = the half-yearly sample standard deviation of monthly percent changes in the Consumer Price Index.

M1 = the half-yearly sample standard deviation of monthly percent changes in the quantity of money--with the quantity of money measured as seasonally adjusted M1.

produce market return volatility and are similar to those used by Officer[25] and Keran.[26]

Given the form of our basic valuation model, variability in the valuation variables should result in variability in market returns. Therefore, we should expect all dependent variables in both alternative regression models to have positive signs.

Results of Regression Analysis

Stepwise regressions were run for the entire 1928-1975 period and for two subperiods, 1928-1951 and 1952-1975. The outcomes from these regressions are contained in Table 3.[27] The overall results are quite good in terms of the coefficients of determination (R^2's) for the total period (.677 and .650), and for the two subperiods (.813 and .797 for 1928-1951; and .411 and .488 for 1952-1975). Regarding the results for individual variables, in all six regressions the risk premium variable (Baa-Aaa) is the first variable to enter the regression. Thus, variability in the "risk premium" always explains the greatest amount of variance in the market volatility variable and the coefficients for the (Baa-Aaa) variable possess high t-values (ranging from 4.662 to 11.518). Of the remaining variables, only M1 consistently had positive coefficients with t-values close to (or greater than)

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[25] Officer, "The Variability of the Market Factor of the New York Stock Exchange," pp. 434-453.

[26] Keran, "Expectations, Money, and the Stock Market," pp. 16-31.

[27] The possibility of multicollinearity can be studied by reference to the correlation matrices presented in Table 4.

TABLE 3

DETERMINANTS OF MARKET RETURN VOLATILITY

Time Period	Dependent Variable	Constant Term	Baa-Aaa	M1	CPI	IPI	F Stat.	R^2	D-W Stat.
			(t-values of the coefficients)						
1928-1975 96 Half Years	MAD2	.000	.065 (9.48)	.127 (4.05)	.384 (3.74)	.050 (2.36)	47.62	.677	1.203
	IQR	.001	.105 (9.85)	.150 (3.10)	.498 (3.13)	.059 (1.81)	42.31	.650	1.184
1928-1951 48 Half Years	MAD2	.001	.097 (11.52)	.090 (2.86)	.138 (1.14)	.020 (0.93)	46.79	.813	1.658
	IQR	.003	.151 (11.40)	.092 (1.86)	.125 (0.66)	.108 (0.32)	42.11	.797	1.550
1952-1975 48 Half Years	MAD2	.002	.031 (4.66)	.362 (2.06)	.132 (0.54)	.010 (0.31)	7.50	.411	1.489
	IQR	.003	.056 (5.08)	.655 (2.20)	.076 (0.19)	.036 (0.64)	8.74	.448	1.290

TABLE 4

PEARSON PRODUCT MOMENT CORRELATIONS BETWEEN REGRESSION VARIABLES

1928-1975 (96 Half Years)

	IQR	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.692	*.651			
CPI	*.385	*.442	.087		
M1	*.249	*.326	-.091	*.274	
IPI	*.479	*.528	*.296	*.413	*.303

1928-1951 (48 Half Years)

	IQR	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.881	*.871			
CPI	.181	.216	.154		
M1	.060	.131	-.084	-.056	
IPI	*.420	*.473	*.413	.262	.164

1952-1975 (48 Half Years)

	IQR	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.615	*.589			
CPI	.186	.216	.272		
M1	.231	.219	-.035	-.054	
IPI	.199	.163	.182	.175	.040

*Correlation is significant at the .05 confidence level.

2.000 (the range being from 1.856 to 4.052). Therefore, it appears that changes in the variability of monetary growth also has an influence on aggregate market volatility.

The 1928-1975 period's Durbin-Watson (DW) statistics, however, indicate positive autocorrelation at the .05 confidence level. In the regressions for the two subperiods, the DW-statistic indicated either significant positive autocorrelation in the residuals or the values fall in the inconclusive range.[28]

According to Johnson,[29] autocorrelation does not affect our ability to obtain unbiased estimates of the regression coefficients, but the actual sampling variances of these estimates may be larger than those achievable under a different method of estimation. In addition, the calculated sampling variances obtained by applying the usual least-squares formulae are likely to underestimate the actual variances. The calculated t-values and R^2's are also no longer valid.

Because of the DW-statistics, it was assumed that autocorrelation was present in all regression equations. It was necessary to adjust

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[28] A table showing significance points for the Durbin-Watson statistic can be found in most basic econometric textbooks. For example, see J. Johnston, Econometric Methods, 2nd ed. (New York: McGraw-Hill Book Company, 1972), p. 430.

[29] Johnston, Econometric Methods, p. 246.

the variables according to a procedure suggested by Durbin.[30] The entire set of regressions was run again after correcting the variables for autocorrelation. The results from these adjusted regressions are contained in Table 5.[31]

Adjusting for autocorrelation lowered the final-step R^2's (.352 and .257 for the 1928-1975 period; .673 and .561 for the 1928-1951 period; and .289 and .219 for the 1952-1975 period.) However, transforming the variables did not affect the relative ability of the risk premium variable (Baa-Aaa) to explain market return volatility. The adjusted (Baa-Aaa) variable continues to be the first variable to enter each regression and it always explains the greatest amount of variance in the market volatility variable. In addition, the coefficient for the (Baa-Aaa) variable is always positive as expected and is highly significant. Thus, for the three time periods studied, and

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[30] Variables were adjusted to remove autocorrelation using a two-page procedure first suggested by Durbin. This method can be illustrated by reference to a simple model:

$$Y_t = \alpha(1-\rho) + \rho Y_{t-1} + \beta X_t - \beta\rho X_{t-1} + \varepsilon_t.$$

As the first step, ordinary least-squares (OLS) regression is applied to this relation to produce consistent estimates of the parameters. After letting r denote the estimated coefficient of Y_{t-1}, the second step involves using r to compute transformed variables $(Y_t - rY_{t-1})$ and $(X_t - rX_{t-1})$ and applying OLS to these transformed variables. The coefficient of $(X_t - rX_{t-1})$ is the estimate of β and the intercept term divided by (1-r) is the estimate of α.

This two-stage method can be extended to deal with more than one independent variable. This procedure is more fully described in Johnston, Econometric Methods, pp. 263-264.

[31] The possibility of multicollinearity can be studied by reference to the correlation matrices presented in Table 6.

TABLE 5

DETERMINANTS OF MARKET RETURN VOLATILITY WITH
ALL VARIABLES ADJUSTED TO REMOVE AUTOCORRELATION

Time Period	Dependent Variable	Constant Term	Baa-Aaa	M1	CPI	IPI	F Stat.	R^2	D-W Stat.
			(t-values of the coefficients)						
1928-1975 96 Half Years	MAD2	.001	.033 (4.35)	.092 (3.23)	.259 (2.82)	.027 (1.51)	12.23	.352	1.990
	IQR	.002	.046 (4.10)	.080 (1.90)	.290 (2.14)	.027 (1.04)	7.77	.257	1.887
1928-1951 48 Half Years	MAD2	.001	.084 (7.79)	.092 (2.75)	.151 (1.26)	.024 (1.06)	21.58	.673	2.223
	IQR	.002	.117 (6.53)	.087 (1.70)	.167 (0.93)	.018 (0.53)	13.43	.561	2.159
1952-1975 48 Half Years	MAD2	.002	.026 (3.78)	.257 (1.58)	.230 (0.97)	(a)	5.84	.289	2.103
	IQR	.003	.036 (3.15)	.326 (1.27)	.096 (0.25)	.027 (0.55)	2.95	.219	2.053

(a) The F-level and/or tolerance level was insufficient for this variable to enter the regression equation.

TABLE 6

PEARSON PRODUCT MOMENT CORRELATIONS BETWEEN REGRESSION VARIABLES ADJUSTED TO REMOVE AUTOCORRELATION[a]

Second Half 1928-Second Half 1975 (95 Half Years)

	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.390			
CPI	*.332	.120		
M1	*.296	-.114	.079	
IPI	*.288	.118	.154	*.248

Second Half 1928-Second Half 1951 (47 Half Years)

	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.756			
CPI	.256	.168		
M1	.201	-.099	-.002	
IPI	*.385	.283	.192	.212

Second Half 1952-Second Half 1975 (47 Half Years)

	MAD2	(Baa-Aaa)	CPI	M1
(Baa-Aaa)	*.480			
CPI	.194	.125		
M1	.130	-.160	.028	
IPI	.109	.152	.055	.090

[a]Only correlations with MAD2 shown because IQR results are very similar.
*Correlation is significant at the .05 confidence level.

regardless of which of two measures were used to proxy market volatility, variability in the adjusted "risk premium" variable was the most important macroeconomic factor in explaining changes in market return volatility.

The importance of the other independent variables is not so apparent. For five of the six regression equations studied, the adjusted M1 variable is the second variable to enter the stepwise regression equations; and, the coefficient is positive but only significant in two cases. In one instance the adjusted CPI enters second and in two instances the adjusted CPI coefficient is significant. Finally, the coefficient of the adjusted IPI variable is never significant. These results indicate the importance of the adjusted (Baa-Aaa) variable since most of the explanatory power of the regression equations, as measured by R^2, is provided by just one variable--adjusted (Baa-Aaa).

Notably, both alternative regression models provided relatively consistent results. Therefore, the choice of MAD2 or IQR as the dependent market volatility variable made no difference to our overall conclusions.

EFFECT OF INSTITUTIONAL TRADING ON MARKET VOLATILITY

The separate analysis of the institutional impact on stock price volatility is important for two reasons. First is the phenomenal growth of institutional trading in absolute terms and relative to total trading.[32] Second is the continuing difference of opinion

[32] This growth is documented extensively in Reilly, Investment Analysis and Portfolio Management, Chapter 4.

regarding the impact of institutional trading on the functioning of the market. On the one side is the pervasive folklore that contends that institutional trading reduces market liquidity and increases price volatility.[33] On the other side are several empirical studies by Reilly and Wachowicz, and Barkman mentioned earlier which indicate that, either there is no significant relationship between institutional trading and stock price volatility, or there is a significant negative relationship which is completely at odds with the folklore. Therefore, to assess the relative importance of institutional activity, a special study of the 1964-1975 period is made. We begin with 1964 because detailed data for institutional trading is not available prior to this time. Also, prior to this period institutional activity was quite stable at a low level.

Institutional Trading Data

The U.S. Securities and Exchange Commission publishes a data series called "Quarterly Common Stock Transactions and Activity Rates of Selected Financial Institutions," which gives the dollar volume of stock purchases and sales for various broad institutional groups. The financial institutions covered are: (1) private non-insured pension

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[33]Besides the article by Leuthold, the following articles make similar contentions: "Are the Institutions Wrecking Wall Street?" Business Week (June 2, 1973); Jonathon R. Laing, "Fiduciary Grants: Huge Sums Managed by Bank Trust Units Stirs Up Controversy," Wall Street Journal (January 7, 1975); David McClintick, "Illiquid Stocks--Lack of Ready Buyers and Sellers Imperils the Stock Market," Wall Street Journal (December 10, 1971).

funds,[34] (2) open-end investment companies,[35] (3) life insurance companies,[36] and (4) property-liability insurance companies. Statistics are available from the beginning of 1964 and can be found in the SEC Statistical Bulletin.[37] The following measures of institutional activity are calculated from combined data provided on the four groups of financial institutions:

Absolute Measures of Institutional Activity (Quarterly)

(1) Dollar value of institutional PURCHASES and SALES--(P+S);

(2) Dollar value of institutional PURCHASES--(P);

(3) Dollar value of institutional SALES--(S); and

(4) "Net" dollar value of institutional PURCHASES (SALES)--(P-S).

Purchase plus Sales (P+S) provides a measure of total institutional trading activity. However, because there may be additional information contained in its components, this total figure is then broken apart. Purchases (P) and Sales (S) are looked at separately to determine if market return volatility reacts differently to these alternative actions. Some, for example, might speculate that the market reacts more strongly to institutional sales than to institutional purchases. In addition, because purchases and sales during

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[34] Includes pension funds of corporations, unions, multiemployer groups, and non-profit organizations; also includes deferred profit-sharing funds.

[35] Includes mutual funds reporting to the Investment Company Institute, a group whose assets constitute about 90 percent of the assets of all openend investment companies.

[36] Includes both general and separate accounts.

[37] Securities and Exchange Commission, Statistical Bulletin (Washington, D.C.: U.S. Government Printing Office).

a specified time period are not equal, a Net Purchases (P-S) variable is derived.

It is also possible to derive a relative measure of institutional activity by dividing each absolute measure by the total dollar value of stock volume for the quarter on U.S. Stock Exchanges.[38] The resulting relative measures are as follows:

Relative Measures of Institutional Activity (Quarterly)

(1) $\frac{\text{Dollar value of institutional PURCHASES and SALES}}{\text{Total dollar value of stock volume on U.S. Stock Exchanges}}$ --[(P+S)/T];[39]

(2) $\frac{\text{Dollar value of institutional PURCHASES}}{\text{Total dollar value of stock volume on U.S. Stock Exchanges}}$ --[P/T];

(3) $\frac{\text{Dollar value of institutional SALES}}{\text{Total dollar value of stock volume on U.S. Stock Exchanges}}$ --[S/T];

(4) $\frac{\text{"Net" dollar value of institutional PURCHASES (SALES)}}{\text{Total dollar value of stock volume on U.S. Stock Exchanges}}$ --[(P-S)/T].

In addition, the total dollar value of stock volume (T) was considered as a separate measure so that the relationship between total market trading activity and market return volatility could be studied.

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[38] The total dollar value of stock volume figure represents all round-lot sales and odd-lot sales of customers and dealers on all U.S. Registered Stock Exchanges. As such it does not include the OTC market. On a monthly basis, this figure can be found in the SEC Statistical Bulletin in a table entitled "Market Value and Volume of Sales on United States Securities Exchanges."

[39] An adjustment to the total dollar value of stock volume figures in [(P+S)/T] might seem warranted because the institutional transaction figure includes both purchases and sales. However, doubling the total stock volume figure to reflect both purchases and sales would only result in a scale change for the percentage figures.

Levels and Percent Changes

An analysis of the relationship between the level of institutional trading activity and the level of market return volatility can be affected by the existence of strong secular trends in the series. For example, it is possible to imagine two series that do not move in the same direction during individual subperiods but, because both series have strong positive or negative trends, the correlation between the two series for some total period will be significantly positive. If such a condition exists it is necessary to attempt to eliminate the trend component from both series before examining the relationship.

Table 7 provides some information regarding the presence of trends in both institutional trading activity measures and measures of market return volatility. Institutional trading activity has experienced a strong positive trend since 1964, both absolutely and relative to total market trading activity.[40] The largest increase in absolute institutional trading measures was the 325 percent growth in institutional sales (S), while the 95 percent increase in the relative sales (S/T) variable was the largest single increase in relative institutional trading measures. The results in Table 7 also confirm the recent increase in market return volatility. All the measures of market

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[40] There is one exception, however. Relative institutional activity, when measured as (P-S)/T, does not reveal a positive trend. This is because the positive trend of "net" purchases (P-S) is less than the positive growth trend of total market trading activity (T)--thus causing this one particular relative measure to show a decline.

TABLE 7

TRENDS IN INSTITUTIONAL TRADING ACTIVITY MEASURES
AND MEASURES OF MARKET RETURN VOLATILITY (1964-1975)

Measures of Institutional Trading Activity	1964	1975	Percent Change
P+S	17,890	66,438	271.37
P	10,655	35,622	234.32
S	7,235	30,816	325.93
P-S	3,420	4,806	40.53
T	72,149	157,197	117.88
Relative Measures of Institutional Trading Activity*	**1964**	**1975**	**Percent Change**
(P+S)/T	.24827	.42227	70.08
(P/T)	.14796	.22660	53.15
(S/T)	.10031	.19567	95.07
(P-S)/T	.04765	.03092	-35.11
Measures of Market Return Volatility*	**1964**	**1975**	**Percent Change**
MAD2	.00253	.00761	200.79
IQR	.00432	.01340	210.19

*Average of four quarters.

return volatility increased by approximately 200 percent during the 1964-1975 period.[41]

The analysis of the institutional trading series and the market return volatility series thus indicates that both sets of series experienced strong secular trends during the period of analysis. Therefore, it is necessary to transform the data in order to eliminate the trend components.

There are two common alternative techniques for eliminating trend. The first method calls for regressing a variable containing a trend component against time and using the resulting residuals about the regression line as a de-trended variable series. The second method involves computing percent changes in the series over time. Correlations that relate such percent change series would indicate whether changes in the amount or proportion of institutional activity are related to changes in market return volatility. A percent change series holds more intuitive appeal than a series of residuals about a trend line because a percent change can, itself, be thought of as an active theoretical

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[41] In addition to the MAD2 and IQR measures of volatility, we also examined three other measures: standard deviation, semi-standard deviation, and mean absolute deviation around the mean. The correlations among the alternative volatility measures averaged over .95 so the additional measures are not needed. This strong relationship among risk measures is consistent with several prior studies: Edward I. Altman, and Robert A. Schwartz, "Common Stock Price Volatility Measures and Patterns," Journal of Financial and Quantitative Analysis, Vol. 5, No. 1 (January, 1970), pp. 603-625; Philip L. Cooley, Rodney L. Roenfeldt, and Naval K. Modani, "The Interdependence of Market Risk Measures," Journal of Business, Vol. 50, No. 3 (July, 1977), pp. 356-363; George E. Pinches and William R. Kinney, "The Measurement of the Volatility of Common Stock Prices," Journal of Finance, Vol. 26, No. 1 (March, 1971), pp. 119-125.

variable. In addition, the trend line method is more dependent on the presence of a constant linear trend than the second method. For these reasons, the percent change method was used to transform both series. Therefore, those who hypothesize that institutional trading activity contributes toward an increase in market return volatiity should expect significant positive correlations between changes in institutional trading activity and changes in the market return volatility measures.

Both quarterly and half-yearly correlations are presented between institutional trading activity measures and measures of market return volatility. In addition, correlations between alternative measures of market return volatility are presented, as well as correlations between institutional trading activity variables.

Volatility Measures and Trading Measures

Table 8 contains the correlations between percent changes in alternative price volatility measures and percent changes in institutional trading. The results indicate that these relationships are almost exclusively negative, which means that during quarters when institutions experienced a large increase in trading activity (whether purchases and/or sales), that there is a decrease in market return volatility. The correlations with the relative trading variables were likewise negative but not significant. These consistently negative correlations between changes in institutional trading and changes in stock price volatility are in direct conflict with the prevailing belief that hypothesizes a significnat positive relationship. The results were quite similar when six-month periods were examined rather than quarterly.

TABLE 8

PEARSON PRODUCT MOMENT (r) AND SPEARMAN RANK (rs) CORRELATIONS BETWEEN INSTITUTIONAL MARKET TRADING ACTIVITY MEASURES AND MEASURES OF MARKET RETURN VOLATILITY FOR THE PERIOD 2Q/1964-4Q/1975 (47 Quarters)

	%ΔMAD2		%ΔIQR	
	r	rs	r	rs
%Δ(P+S)	*-.366	**-.387	-.255	-.255
%ΔP	*-.354	**-.389	-.252	-.273
%ΔS	*-.351	*-.348	-.238	-.201
%Δ(P-S)	-.156	-.213	-.159	-.198
%Δ[(P+S)/T]	-.111	-.013	-.112	-.002
%Δ(P/T)	-.164	-.119	-.164	-.115
%Δ(S/T)	-.039	.024	-.040	.034
%Δ[(P-S)/T]	-.119	-.068	-.145	-.096
%ΔT	*-.296	*-.293	-.204	-.194

*Correlation is significant at the .05 confidence level.

**Correlation is significant at the .01 confidence level.

Thus, the correlations offer no support for the belief that a strong positive relationship exists between institutional trading and market return volatility. In fact, a negative relationship is suggested.

Regressions with Macroeconomic Variables and Institutional Trading Measures

In the prior section a number of economic variables were suggested as possible determinants of market return volatility. In this section, institutional activity measures are tested as additional independent variables in regression models similar to those presented previously. Because of the problem created by trends in the activity measures and trends in the most recent measures of market volatility, all variables were transformed into percent changes. Also, only percent changes in absolute measures of trading activity were included because prior results indicated that these absolute measures were related to the percent changes in market return volatility.

A list of the relationships studied, with the aid of regression analysis, is presented in Table 9. The same stepwise procedures employed previously were used in this analysis. The final step results of the stepwise regressions are contained in Table 10 with a designation of how the alternative variables entered the regression.

In all ten stepwise regressions, the institutional activity variable always enters first. Thus, the institutional trading activity variable always explains the greatest amount of variance in the market return volatility variable. Notably, the coefficient for the institutional activity variable always has a negative sign.

TABLE 9

LIST OF RELATIONSHIPS STUDIED WITH REGRESSION ANALYSIS

Dependent Variable	Independent Variable				
%ΔMAD2	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%Δ(P-S)
%ΔMAD2	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%Δ(P+S)
%ΔMAD2	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔP
%ΔMAD2	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔS
%ΔMAD2	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔT
%ΔIQR	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%Δ(P-S)
%ΔIQR	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%Δ(P+S)
%ΔIQR	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔP
%ΔIQR	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔS
%ΔIQR	%Δ(Baa-Aaa)	%ΔIPI	%ΔCPI	%ΔM1	%ΔT

where:

%ΔMAD2 = the percent change in the half-yearly mean absolute deviation of the market return about the median--with MAD2 calculated from the daily percent changes in the SP500;

%ΔIQR = the percent change in the half-yearly interquartile range of market returns--with IQR calculated from daily percent changes in the SP500;

%Δ(Baa-Aaa) = the percent change in half-yearly sample standard deviation of monthly percent changes in "risk premium"--with "risk premium" measured as the difference between the yield on Moody's grade Baa bonds and the yield on Moody's grade Aaa bonds;

%ΔIPI = the percent change in half-yearly sample standard deviation of monthly percent changes in seasonally adjusted Industrial Production Index;

%ΔCPI = the percent change in the half-yearly sample standard deviation of monthly percent changes in the Consumer Price Index;

%ΔM1 = the percent change in half-yearly sample standard deviation of monthly percent changes in the quantity of money--with the quantity of money measured as seasonally adjusted M1;

%Δ(P-S) = the percent change in the half-yearly "net" dollar value of institutional purchases;

%Δ(P+S) = the percent change in the half-yearly dollar value of institutional purchases and sales;

%ΔP = the percent change in the half-yearly dollar value of institutional purchases;

%ΔS = the percent change in the half-yearly dollar value of institutional sales;

%ΔT = the percent change in the half-yearly total dollar value of stock volume.

TABLE 10A

DETERMINANTS OF MARKET RETURN VOLATILITY 2HY/1964-2HY/1975 (23 HALF YEARS)

Dependent Variable:	%ΔMAD2	%ΔMAD2	%ΔMAD2	%ΔMAD2	%ΔMAD2
Constant Term:	.058	.078	.077	.078	.053
First Variable to Enter:	%Δ(P-S)	%Δ(P+S)	%ΔP	%ΔS	%ΔT
Regression Coefficient:	-.429	-.853	-.818	-.861	-.738
(T Value):	(-1.969)	(-2.384)	(-2.396)	(-2.296)	(-2.196)
Second Variable to Enter:	%ΔCPI	%Δ(Baa-Aaa)	%Δ(Baa-Aaa)	%Δ(Baa-Aaa)	%ΔM1
Regression Coefficient:	.159	.185	.161	.216	.135
(T Value):	(1.212)	(1.849)	(1.644)	(2.061)	(1.651)
Third Variable to Enter:	%ΔM1	%ΔM1	%ΔM1	%ΔM1	%Δ(Baa-Aaa)
Regression Coefficient:	.102	.137	.135	.136	.147
(T Value):	(1.291)	(1.719)	(1.702)	(1.690)	(1.477)
Fourth Variable to Enter:	%Δ(Baa-Aaa)	%ΔCPI	%ΔCPI	%ΔIPI	%ΔCPI
Regression Coefficient:	.069	.043	.061	.026	.079
(T Value):	(.646)	(.336)	(.478)	(.221)	(.619)
Fifth Variable to Enter:	%ΔIPI	%ΔIPI	%ΔIPI	%ΔCPI	%ΔCPI
Regression Coefficient:	.054	.018	.017	.022	.032
(T Value):	(.468)	(.157)	(.147)	(.170)	(.272)
F-Statistic	1.793	2.242	2.256	2.140	2.028
R^2	.345	.397	.399	.386	.374
DW-Statistic	2.602*	2.249*	2.291*	2.212*	2.419*

*$(4-d_U)<DW<(4-d_L)$; therefore, the test of the hypothesis that the disturbance term is non-autocorrelated is inconclusive at the .05 confidence level.

TABLE 10B

DETERMINANTS OF MARKET RETURN VOLATILITY 2HY/1964-2HY/1975 (23 HALF YEARS)

Dependent Variable:	%ΔIQR	%ΔIQR	%ΔIQR	%ΔIQR	%ΔIQR
Constant Term:	.077	.083	.082	.077	.063
First Variable to Enter:	%Δ(P-S)	%Δ(P+S)	%ΔP	%ΔS	%ΔT
Regression Coefficient:	-.382	-.599	-.593	-.561	-.501
(T Value):	(-2.119)	(-1.871)	(-1.842)	(-1.699)	(-1.577)
Second Variable to Enter:	%ΔM1	%ΔM1	%ΔM1	%ΔIPI	%ΔM1
Regression Coefficient:	.054	.070	.071	.075	.067
(T Value):	(.797)	(.955)	(.945)	(.758)	(.871)
Third Variable to Enter:	%ΔCPI	%Δ(Baa-Aaa)	%Δ(Baa-Aaa)	%Δ(Baa-Aaa)	%Δ(Baa-Aaa)
Regression Coefficient:	.095	.089	.071	.105	.060
(T Value):	(.867)	(.998)	(.771)	(1.132)	(.642)
Fourth Variable to Enter:	%ΔIPI	%ΔIPI	%ΔIPI	%ΔM1	%ΔIPI
Regression Coefficient:	.066	.060	.058	.066	.075
(T Value):	(.675)	(.606)	(.531)	(.888)	(.679)
Fifth Variable to Enter:	%Δ(Baa-Aaa)*	%ΔCPI*	%ΔCPI	%ΔCPI*	%ΔCPI
Regression Coefficient:			.019		.034
(T Value):			(.156)		(.282)
F-Statistic	2.026	1.749	1.403	1.570	1.190
R^2	.310	.280	.292	.259	.259
DW-Statistic	2.190**	1.936**	1.957**	1.904**	2.044**

*Variable did not enter the regression equation; F-level and/or tolerance level was insufficient for further analysis.

**$d_U \leq DW \leq (4d_U)$; therefore, the hypothesis that the disturbance term is non-autocorrelated is accepted at the .05 confidence level.

Though the choice of the dependent variable--either %ΔMAD2 or %ΔIQR--did not affect the relative importance of the institutional activity variable, there were some differences in regression results.

Specifically, for the five regression equations with %ΔMAD2 as the dependent variable, it is the equation with percent change in purchases (%ΔP) as the independent activity variable that produces the largest R^2--(R^2=.399). In four out of the five equations, the institutional activity variable coefficient is significant at the .05 confidence level; and in the fifth equation, the institutional activity variable coefficient is almost significant with a t-value of -1.969. For the five regression equations with percent change in interquartile range (%ΔIQR) as the dependent variable, it is the equation containing %Δ(P-S) that shows the largest R^2--(R^2=.310); and, only in this equation is the institutional trading activity variable coefficient significant. The t-values for the coefficients of the other four activity variables are relatively high (ranging from -1.577 to -1.877), but not statistically significant.

Only after an institutional activity variable had entered a stepwise regression would any of the macroeconomic variables begin to enter. The coefficients for the macroeconomic variables always had positive signs. For those equations containing %ΔMAD2, the %Δ(Baa-Aaa) variable would usually (i.e., three out of five times) be the second variable to enter the regression, but it was only significant in one case. In all but one instance, the third variable to enter the regression was %ΔM1. Neither %ΔM1 nor any of the remaining macroeconomic variables were ever significant.

When the interquartile range was the dependent variable, the relative importance of the %Δ(Baa-Aaa) and %ΔM1 variables was reversed. In three out of five cases, %ΔM1 was the second variable to enter the regression; and, in four out of five cases, %Δ(Baa-Aaa) was the third variable to enter the regression. None of the other macroeconomic variables were ever significant in these regressions.

In every regression with %ΔIQR as the dependent variable, the DW-statistic calls for acceptance (at the .05 confidence level) of the hypothesis that the disturbance term is non-autocorrelated. For all regressions containing %ΔMAD2, the DW-statistic reveals that the test of the hypothesis that the disturbance term is non-autocorrelated is inconclusive. Since none of the regressions indicated significant autocorrelation, no adjustments were made to correct the variables for possible autocorrelation.

Table 11 contains a correlation matrix, useful for studying all regressions, that allows us to check the possibility of multicollinearity. The variable %ΔIPI had a significant negative relationship with all the activity measures. Thus, when %ΔIPI enters each stepwise regression, the activity variable will show a loss of significance.

The level of total explanation obtained by the regression equations in this chapter is modest (e.g., the coefficients of determination never exceed .40). However, even in models that include percent change formulations of variables that have been used to explain volatility during prior periods, the institutional trading variables are still the first to enter the stepwise regressions. Notably, these institutional trading variables always have negative signs and possess

TABLE 11

PEARSON PRODUCT MOMENT CORRELATIONS BETWEEN REGRESSION VARIABLES 2HY/1964-2HY/1975 (23 HALF YEARS)

	%ΔIQR	%ΔMAD2	%ΔIPI	%Δ(Baa-Aaa)	%ΔM1	%ΔCPI
%ΔIPI	.347	.254				
%Δ(Baa-Aaa)	.082	.240	-.142			
%ΔM1	.025	.091	.028	-.217		
%ΔCPI	.022	.146	-.298	.274	-.118	
%Δ(P+S)	*-.444	*-.438	*-.487	.129	.314	-.042
%Δ(P-S)	*-.499	*-.454	*-.480	-.208	.248	.184
%ΔP	*-.469	*-.459	*-.498	.062	.319	-.014
%ΔS	-.398	-.397	*-.462	.223	.296	-.078
%ΔT	*-.430	*-.436	*-.487	.021	.348	.011

*Correlation is significant at the .05 confidence level.

relatively high t-values. Thus, for the time period considered, it seems that changes in institutional trading activity variables are most important in explaining changes in the level of market return volatility. Also, the fact that the relationship between percent changes in institutional activity and percent changes in market return volatility is negative offers further empirical evidence to contradict the belief that increases in institutional trading activity contribute toward an increase in stock price volatility.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Summary

A prior study indicated the importance of changes in aggregate stock market volatility and showed that market volatility had experienced significant changes over time. Therefore, the purpose of this study was to identify the primary factors that contribute to market volatility and test the relationship to determine the most important factors with a separate emphasis on the recent impact of institutional trading activity. The prior research in this area was limited and only indicated that the industrial production index was important during the 1930's.

A basic security valuation model was used to help identify macroeconomic factors that one should expect to contribute to market return volatility. Two alternative regression models were used in an attempt to relate market volatility to variability in the following: (1) the rate of change in the Industrial Production Index; (2) the rate of inflation; (3) the growth of the money stock (M1); and (4) the rate of change in a market "risk premium." Variability in "risk premium"--with "risk premium" measured as the difference between the yield on Moody's grade Baa bonds and the yield on Moody's grade Aaa bonds--proved itself to be the most important macroeconomic factor in explaining market return volatility during the total period 1928-1975.

Leuthold, among others, contends that increased institutional trading has made the stock market more volatile. To assess the relative importance of institutional activity on market volatility, a special study of the 1964-1975 period was made.

Statistics available in the Securities and Exchange Commission's Statistical Bulletin were used to calculate a number of quarterly "absolute" measures of institutional activity--the dollar value of institutional purchases and sales (P+S), the dollar value of institutional purchases (P), the dollar value of institutional sales (S), and the "net" dollar value of institutional purchases (P-S). "Relative" measures of institutional activity were formulated by dividing each absolute measure by the total dollar value of stock volume for the quarter on the U.S. Stock Exchanges (T). The resulting relative measures were as follows: [(P+S)/T], (P/T), (S/T), and [(P-S)/T]. In addition, the total dollar value of stock volume (T) was considered as a separate measure.

Both quarterly and half-yearly correlations were calculated between institutional trading activity measures and measures of market return volatility. It was necessary to transform the data by computing "percent changes" because the data series being compared exhibited strong secular trends. After adjusting for trend, by computing percent changes in all variables, correlation analysis revealed that the relationships between changes in institutional activity and changes in market return volatility were almost exclusively negative. Therefore, this correlation analysis offered no support for the belief that a strong positive relationship exists between institutional trading and market return volatility. A negative relationship is, in fact, much more likely.

Finally, in stepwise regressions, institutional trading activity variables were combined with previously identified macroeconomic variables in an attempt to further explain market volatility during the 1964-1975 time period. Because of the problem created by trends in institutional trading measures and recent measures of market volatility, all variables were transformed into percent changes. Though the level of total explanation obtained by the regression equations was modest, the institutional trading measures were always first to enter stepwise regressions, they possessed relatively high t values, and they were negative. Thus, for the time period considered, changes in institutional trading activity variables were most important in explaining changes in the level of market return volatility; but, the relationship was negative, which is clearly contrary to the contentions by many observers.

Conclusions

It is felt that the results of this study indicate two major conclusions. First, it was possible to identify macroeconomic variables that should explain the level of market return volatility. For all periods analyzed, the most important macroeconomic variable appears to be variability in monthly percent changes in the "risk premium"--with "risk premium" measured as the difference between the yield on Moody's grade Baa bonds and the yield on Moody's grade Aaa bonds. Second, an analysis of the importance of institutional trading activity on market return volatility provided no support for the belief that a strong positive relationship exists between institutional trading and market volatility. In fact, a negative relationship is suggested.

Implications

The empirical results and conclusions of this study have implications for those individuals interested in the factors which influence market volatility as well as individuals and government agencies concerned with the effect of institutional trading on the functioning of our capital markets.

The use of a basic security valuation model made it possible to derive macroeconomic variables that should influence market volatility. The macroeconomic variables studied were: (1) the rate of change in the Industrial Production Index (IPI); (2) the rate of inflation (CPI); (3) the growth in the money stock (M1); and (4) the rate of change in a market "risk premium" (Baa-Aaa). After correcting all variables for autocorrelation, two alternative regression models indicated that all independent variables had positive signs, as expected, and that changes in the variability of the "risk premium" variable explained changes in market volatility better than any other macroeconomic factor studied.

Officer's study had also looked into a set of factors that might influence market volatility. Separate regression analyses were performed relating market-factor variability to standard deviations of monthly percent changes in the Industrial Production Index, the Wholesale Price Index, and the M2 money supply. Regression results pointed toward a slight relationship between the Industrial Production Index variable and market-factor variability during the period February, 1919 to January, 1929 (Period 1); a positive relationship in the period February, 1929 to January, 1944 (Period 2); and no relationship in the period February, 1944 to June, 1969 (Period 3). Variability in the M2 variable was related to market-factor variability only during 1929; and, variability in the Wholesale Price Index was never significant in explaining market-factor variability.

Some comparisons between the results of our study and the results of Officer's study are possible because some variables similar to Officer's are employed in our study. The Industrial Production Index is once again present; however, the Consumer Price Index and the M1 money supply replace the Wholesale Price Index and the M2 money supply, respectively. An analysis of correlations between variables reveals, in general, significant positive correlations between the Industrial Production Index measure and measures of market volatility for the 1928-1951 subperiod (roughly equivalent to Officer's Period 2) and no significant correlations for the 1952-1975 period (roughly, Officer's Period 3). No significant correlations between market volatility and either the M1 or Consumer Price Index variables are found for either subperiod. Thus, the current study's results are in general agreement with Officer's. However, the "risk premium" variable (one not considered by Officer) shows significant positive correlations with the volatility variable in every subperiod.

Effect of Institutional Trading. Legislation restricting the freedom of large institutions to actively trade in the capital markets is a real possibility when the belief exists that increased institutional trading in the stock market leads to an increase in market return volatility. The empirical evidence provided in this study, however, does not indicate that institutions are the cause of any increase in market return volatility. In fact, the significant negative relationships indicate that an increase in institutional trading is related to a decline in market return volatility. Thus, it seems that institutional trading provides liquidity for the total market. In addition, we found significant positive correlations between institution purchases and sales which implies that institutions are providing liquidity for one another.

Given such conclusions, there is no justification for attempting to restrict trading by financial institutions. In fact, such restrictions could lead to an increase in market return volatility because restrictions would, by definition, reduce institutional trading activity and the liquidity available for all market participants.

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Faculty Working Papers

AN INVESTORS LOSS FUNCTION FOR EARNINGS FORECASTS WITH AN EMPIRICAL APPLICATION

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