Margin Requirements and Stock Market Volatility

Margin requirements in the stock market restrict the amount of credit that brokers and dealers can extend to their customers for the purpose of buying stocks. The current initial margin requirement of 50 percent implies that at least 50 percent of the value of a new stock purchase should come from investors' own capital. If the stock price rises after the initial purchase, investors can withdraw the differential from their margin account or can use it to buy additional stock on 50 percent margin. If the price declines after the initial purchase, investors are not required to add funds to their margin account unless their equity position falls below the so-called maintenance margin, which is currently 25 percent.[1]

Federal regulation of securities margins was mandated by Congress in the Securities Exchange Act of 1934. The stock market experience of the late 1920s led Congress to conclude that credit-financed speculation in the stock market might create excessive market volatility. In the absence of adequate margin requirements, optimistic investors with relatively low degrees of risk aversion might borrow large amounts of funds to buy stocks, causing a price rise that could not be justified by economic fundamentals. The price rise might then feed on itself, the speculators could use their increased wealth to borrow more funds and purchase more stock, thus driving prices even higher. This pyramiding effect could in turn be followed by a market collapse if less optimistic investors began to sell in the belief that the market had been overbought. As the price declined, brokers and other creditors would ask for more collateral on their loans to speculators. If some speculators could not provide the additional collateral, creditors would sell the stocks they kept as collateral, forcing prices still lower. This outcome would generate further calls for collateral, more liquidations, and additional price declines. Congress reasoned that the imposition of margin requirements could prevent the excessive volatility caused by this process of pyramiding and depyramiding and gave the Federal Reserve jurisdiction over the level of initial margin requirements.[2]

Do initial margin requirements curb speculative excesses in the stock market and reduce stock price volatility? This question has gained new importance among regulators and students of financial market developments following the sudden collapse of stock prices in October 1987.[3] Clearly, theory alone cannot provide a definite answer. Those who believe that speculation is stabilizing because it deepens the market and increases liquidity are likely to view margin requirements as harmful. Those who believe that an

[1]Note that brokers themselves set maintenance margins higher than 25 percent and vary them across customers and across time.

[2]For a review of the pyramiding-depyramiding process, see Kenneth D. Garbade, "Federal Reserve Margin Requirements: A Regulatory Initiative to Inhibit Speculative Bubbles," in Paul Wachtel, ed., *Crises in the Economic and Financial Structure* (Lexington, Massachusetts: Lexington Books, 1982). Garbade also discusses Congress' related objectives in imposing margin requirements, such as protecting small investors and inhibiting the diversion of credit to unproductive speculative activities.

[3]See, for example, the "Interim Report of the Working Group on Financial Markets," submitted to the President of the United States, May 1988. See also Arturo Estrella, "Consistent Margin Requirements: Are They Feasible?" in this issue of the *Quarterly Review*.

unchecked market is often subject to destabilizing speculation are likely to think that margin requirements could prevent speculative excesses The question can only be resolved empirically

This article examines the empirical relationship between initial margin requirements and the volatility of stock prices in the cash market Since 1934, the Federal Reserve has changed the initial margin requirement in stocks 23 times (Table 1) The different levels of initial margin requirements during the last 50 years make it possible to analyze the presence or absence of an association between initial margin requirements and volatility. Certainly, stock market volatility can also vary over time for reasons unrelated to margin requirements and the unrestrained behavior of speculators For example, in an environment with more volatile interest rates or cash flows, one expects to find more volatile stock prices Thus the present study also takes into consideration economic factors that may influence stock price volatility

The empirical evidence reveals an economically and statistically significant negative relationship between initial margin requirements and stock market volatility Higher initial margin requirements are associated with a reduction in both actual stock market volatility and excess stock market volatility, that is, volatility which is over and above the volatility caused by the variability of the economic environment

Margin requirements and destabilizing speculation: the theoretical connection

The proposition that margin requirements help curb destabilizing speculation is based on two implicit claims The first claim is that speculation by some groups of investors can be destabilizing The second claim is that margin requirements can impose an effective constraint on the market activities of speculators. The first claim is plausible but is not accepted by all economists For example, Milton Friedman argues that speculation is destabilizing only if speculators on the average lose money by selling when assets are low in price and buying when assets are high [5] Although Friedman's position is shared by many economists, increasing numbers of market professionals and academic economists believe that the high daily and monthly volatility of stock prices may be the result of asset churning by speculators who have very short-term investment horizons Furthermore, economists have constructed theoretical models of destabilizing speculation featuring speculators who do not lose money These models show that speculation can destabilize prices in an efficient market, but they do not claim to show that speculation will necessarily destabilize prices The effect of speculation on price volatility is an empirical question [6]

The claim that margin requirements can impose a binding constraint on the behavior of destabilizing speculators is also plausible Finance theory predicts that the less risk-averse investors, that is, the potential speculators, hold more stocks and less cash in their portfolios and are therefore more likely to be constrained by margin requirements than the more risk-averse and conservative investors [7]

Although there is a theoretical connection between margin requirements and destabilizing speculation, the connection would be uninteresting if its quantitative magnitude were trivial or nonexistent Thus at the

Table 1

Initial Margin Requirements

(In Percent)

Effective Date	Rate	Effective Date	Rate
10/15/34	45	01/16/58	50
02/01/36	55	08/05/58	70
11/01/37	40	10/16/58	90
02/05/45	50	07/28/60	70
07/05/45	75	07/10/62	50
01/21/46	100	11/06/63	70
02/01/47	75	06/08/68	80
03/30/49	50	05/06/70	65
01/17/51	75	12/06/71	55
02/20/53	50	11/24/72	65
01/04/55	60	01/03/74	50
04/23/55	70		

Sources New York Stock Exchange *Fact Book*, 1987, p 54, and Board of Governors of the Federal Reserve System, *Annual Report*, various issues

[5] Milton Friedman, "The Case for Flexible Exchange Rates," in *Essays in Positive Economics* (Chicago, Illinois University of Chicago Press, 1953)

[6] See Oliver D Hart and David M Kreps, "Price Destabilizing Speculation," *Journal of Political Economy*, vol 94 (October 1986), pp 927-52 A step towards modeling destabilizing speculation is also taken by Bradford J DeLong, Andrei Shleifer, Lawrence H Summers, and Robert J Waldman, "The Economic Consequences of Noise Traders," National Bureau of Economic Research, Working Paper no 2395, October 1987

[7] Dudley G Luckett, "On the Effectiveness of the Federal Reserve's Margin Requirements," *Journal of Finance*, vol 37 (June 1982), pp 783-95, utilizes data on investors' equity positions in margin accounts and finds that margin requirements constrain investment in the stock market Another piece of evidence consistent with the claim that margin requirements constrain investment in the stock market is the fact that total margin borrowings as a fraction of the value of the New York Stock Exchange stocks decrease after an increase in margin requirements, see Gikas A Hardouvelis, "Margin Requirements, Volatility, and the Transitory Component of Stock Prices," Federal Reserve Bank of New York, Research Paper no 8818, July 1988

present stage, the key research question is empirical in nature

The Federal Reserve's reaction function

One factor complicating the empirical analysis of margin requirements and their effects on market volatility is the behavior of the Federal Reserve as a regulator of margins Thus before we turn to the effects of margin requirements on stock price volatility, a rough characterization of the Fed's behavior is in order Recall that the Federal Reserve has changed the initial margin requirements 23 times since 1934. Increases in margin requirements were presumably initiated during periods when stock prices were perceived to be influenced by excessive speculation, while decreases in margin requirements were initiated during calmer times, perhaps in order to enhance participation in the market and increase liquidity[8]

[8]The following excerpt from the 1951 *Annual Report* of the Board of Governors is representative of the Fed's explanations of margin requirement changes "Although the total amount of credit in use in the stock market had not assumed heavy proportions, there had been some increase during the preceding months, together with increases in the volume of trading and in prices of securities The expanding business and economic situation appeared to be encouraging stock market activity and speculation, and the Board of Governors believed that in the existing circumstances a further substantial price advance supported by a rapid expansion of stock market credit was a distinct possibility The increase in margin requirements was effected as a preventive measure" (p 81) Also

Table 2

The Federal Reserve's Reaction Function

$$M_t = -0.001 + 0.956^{*} M_{t-1} + 0.024^{*} (P_{t-1}/\bar{P}) - 0.274\ MCREDIT_{t-1} + u_t$$

(.008) (.014) (.007) (.251)

$\bar{R}^2 = 0.95$, SEE = .034, $\bar{M} = 0.59$

Sample November 1934 to December 1987

*Statistically significant at the 5 percent level

M_t	= Official margin requirement (in decimals)
$MCREDIT_{t-1}$	= Ratio of broker margin credit to the total value of the New York Stock Exchange stocks at the end of month t-1
$P_{t-1}/\bar{P}$	= S&P Composite index (including dividends) at the end of month t-1 divided by the average S&P Composite of the previous five years
$\bar{R}^2$	= Coefficient of determination adjusted for degrees of freedom
SEE	= Regression standard error
$\bar{M}$	= Sample average of M_t

Note Numbers in parentheses are standard errors adjusted for conditional heteroskedasticity When the sample period ends in 1974, the regression results are similar When an index of small stocks is substituted for the S&P Composite, the results are also similar

Two indicators of speculative excesses are the level of stock prices relative to trend and the amount of margin credit Both variables are prominent in the explanations given by the Fed after changes in margin requirements. A regression of the level of margin requirements on lagged values of these indicators may provide a characterization of the Fed's regulatory response to speculative excesses. Table 2 presents the regression results. Observe that the Fed's setting of margin requirements is not very sensitive to the amount of broker and dealer credit, but it is sensitive to the level of stock prices relative to trend.[9] When stock prices rise above trend, indicating that excessive buying may be present, the margin requirement tends to increase.

The tendency of the Federal Reserve to raise margin requirements when stock prices are high relative to trend and lower them when stock prices are low relative to trend may create a spurious negative correlation between margin requirements and stock market volatility. This spurious relationship should be taken into account if the true relation between margin requirements and volatility is to be assessed correctly. The spurious relation arises as follows· Finance economists have found a negative relationship between stock prices and stock price volatility. During periods of high stock prices, the debt-to-equity ratio of firms that are publicly traded is low and, consequently, stock price volatility is low[10] Since high stock prices cause both an increase in margin requirements and a decrease in stock price volatility, they may result in a negative correlation between margin requirements and stock price volatility This correlation could be falsely interpreted as evidence that higher margin requirements cause a decrease in volatility. The empirical work of the following section avoids such a false interpretation by including stock prices relative to trend as an extra explanatory variable in the regressions

Margin requirements and volatility

There is an extensive empirical literature on the effects

Footnote 8 continued
characteristic is the Board's explanation after a decrease in margin requirements in 1962 "In making this change, the Board noted that there had been a sharp reduction in stock market credit in recent weeks, with an abatement in speculative psychology" (*Annual Report*, 1962, p 113)

[9]More involved "Granger causality" tests show that margin requirements Granger cause (are temporally prior to) margin borrowings, but margin borrowings do not Granger cause margin requirements

[10]This phenomenon is theoretically plausible and is observed in practice See Andrew A Christie, "The Stochastic Behavior of Common Stock Variances Value, Leverage and Interest Rate Effects," *Journal of Financial Economics*, vol 10 (December 1982), pp 407-32

of margin requirements but, surprisingly, empirical work on the influence of margin requirements on stock market *volatility,* is scarce. Thomas Moore contends that margin requirements are an ineffective tool for controlling volatility because the volatility of stock prices has remained relatively stable despite several changes in margin requirements since 1934.[11] James O'Brien takes a similar position, arguing that short-term speculative excesses have not been a characteristic of the post-1929 period.[12] A detailed study by the Board of Governors of the Federal Reserve System is more cautious, concluding only that the evidence is insufficient for a definite answer on the effectiveness of margin requirements.[13] The studies by O'Brien and the Board of Governors are very careful and quite extensive, but they focus on the relationship between margin requirements and the level or the rate of change of stock prices rather than the volatility of stock prices. Moore does not provide any regression evidence whatsoever. Nevertheless, the relationship between margin requirements and stock price volatility was studied by George Douglas and by R. R. Officer, and both authors found a negative association between the two variables. This section complements their work and seeks to sharpen their empirical analysis by using more available data and running a more complete set of regressions with variables that these authors excluded from their analyses.[14]

Because theory does not provide any guidance on the use of real or nominal stock prices, both measures are used. Specifically, monthly realized real rates of return and realized excess nominal rates of return are used to calculate the volatility measures. Real rates of return are constructed from a nominal stock price index that includes dividends, deflated by the consumer price index (CPI) Excess nominal rates of return are nominal returns minus the known one-month Treasury bill rate at the beginning of the one-month holding period.[15] It turns out that the volatility measures based on real rates of return are very similar to the volatility measures based on excess nominal rates of return. The reason for the similarity is that the monthly volatility of stock prices overwhelms the volatilities of the CPI and the Treasury bill rate.

The volatility measure used in this study is the standard deviation of monthly returns calculated over 12 consecutive months. This appears to be the best measure for capturing the possible presence of a pyramiding and depyramiding process in stock prices, a process likely to last more than a few months Furthermore, this volatility measure focuses the analysis on longer-run volatility.[16]

The empirical analysis utilizes both large and small stocks. Large stocks are represented by the Standard and Poor (S&P) Composite index, and small stocks are represented by an index that consists of the ninth and tenth deciles of the New York Stock Exchange when its stocks are ranked by their capitalized values. For each month in the sample, a standard deviation is constructed from the data of that month and the previous 11 months. Chart 1 plots the standard deviations of the S&P Composite and of small stocks together with the official margin requirement. Observe that small stocks are more volatile than the large stocks in the S&P Composite and that the early 1930s are characterized by unusually high volatility.[17]

Chart 1 brings out a crucial point: the monthly sample from the early 1930s to the present is long but, for the purposes of this analysis, it is effectively very small because margin requirements did not change often The small effective sample size requires more refined statistical techniques and more caution in interpreting all empirical results. A casual examination of the data would not be informative. For example, if investigators simply scanned the chart, they might falsely conclude that no relationship existed between margin requirements and volatility after 1934 and, for this reason, forgo a more detailed analysis of the data. Thus the

[11]Thomas G Moore, "Stock Market Margin Requirements," *Journal of Political Economy,* vol 74 (April 1966), pp 158-67

[12]James M O'Brien, "Speculative Bubbles in Stock Prices and the Need for Margin Regulation," Unpublished Working Paper, Board of Governors of the Federal Reserve System, December 1984

[13]Board of Governors of the Federal Reserve System, *A Review and Evaluation of Margin Requirements,* Staff Study, December 1984

[14]See George W Douglas, "Risk in the Equity Markets An Appraisal of Market Efficiency," *Yale Economic Essays,* Spring 1969, pp 3-45, and R R Officer, The Variability of the Market Factor of the New York Stock Exchange," *Journal of Business,* vol 46 (July 1973), pp 434-53

[15]The purpose of subtracting the one-month Treasury bill rate from realized nominal stock returns is to construct a measure of stock

Footnote 15 continued
return volatility that is over and above the normal volatility of monthly interest rates Note that if inflationary expectations are incorporated into the one-month Treasury bill rate, then excess nominal returns are similar to real rates of return and have an advantage the data series on both stock prices and Treasury bill rates refer to the last trading day of the month and are, therefore, matched exactly In contrast, data on the consumer price index refer to days within the month and are announced much later

[16]Thus the empirical evidence in this study complements the evidence provided by the studies of O'Brien and the Board of Governors because that evidence could be interpreted as referring to short-run volatility

[17]The standard deviations in Chart 1 are based on real rates of return When excess nominal rates of return are used to construct volatility measures, the new chart is very similar

limitations of the sample may explain why previous studies have neglected to undertake a rigorous examination of the correlation between margin requirements and volatility

The regression analysis uses all the available monthly observations from the late 1920s through 1987 As noted earlier, for every month in the sample, a standard deviation is calculated using the returns of that month and the previous 11 months This standard deviation is matched with an average official margin calculated over the same 12 months The use of overlapping data provides more statistical power but also creates some technical difficulties [18]

[18]The use of rolling 12-month periods generates a moving average process of order 11 in the error term In this case, OLS standard errors are biased estimates of the true standard errors and lead to incorrect inferences Thus a modification of the OLS variance-covariance matrix is used, providing asymptotically consistent standard errors See Lars P Hansen, "Large Sample Properties of Generalized Methods of Moments Estimators," *Econometrica*, vol 50 (July 1982), pp 1029-54 An alternative setup would be a nonoverlapping annual sample with both stock return volatility and

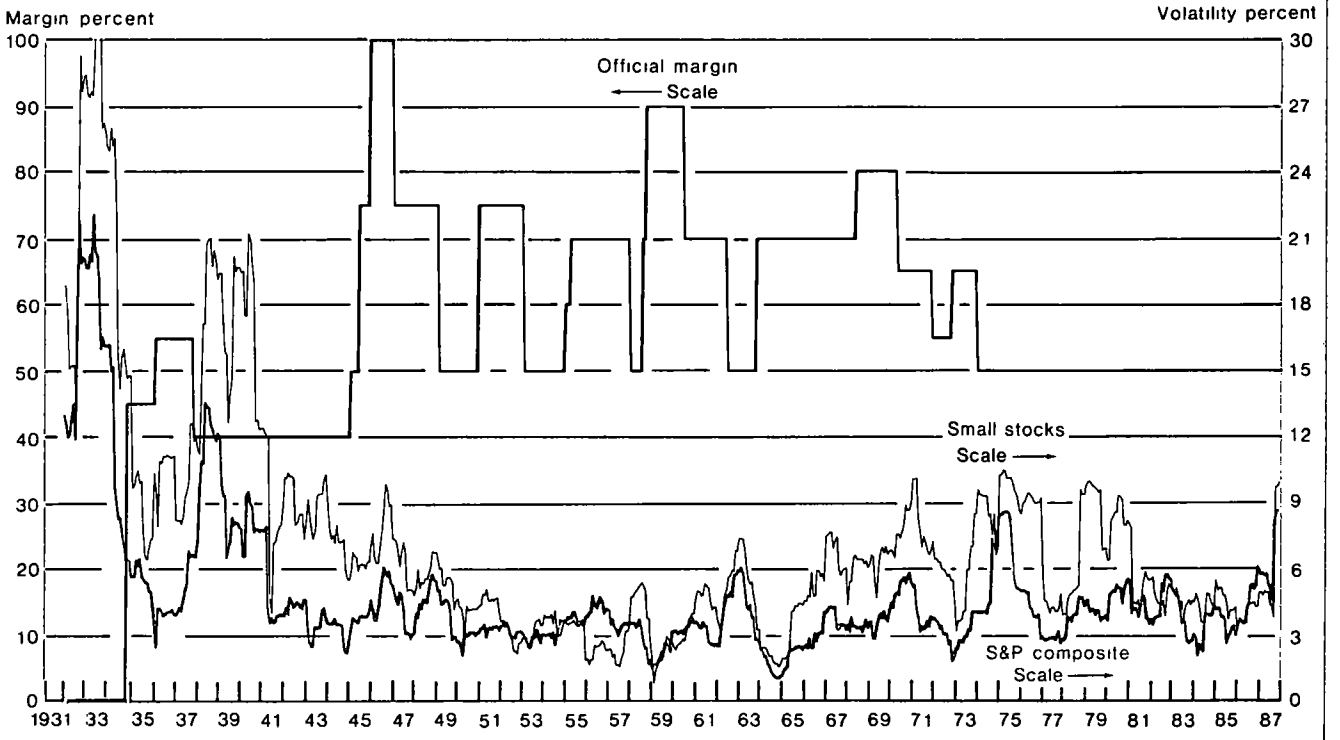
Tables 3 and 4 present the regression results Table 3 refers to real rates of return and Table 4 refers to excess nominal rates of return Two types of regressions are run the first includes the official margin requirement as the only explanatory variable, and the second includes additional explanatory variables that characterize the changing economic environment Let us examine the simple set of regressions first Observe that there is a statistically significant negative association between the official margin requirement and stock market volatility This is true for both large and small stocks and for volatility measures based on either real or excess nominal stock returns The negative association is present over the entire sample period and over the sample period that begins in November 1934, after the imposition of official margin requirements

The magnitude of the effect of margin requirements on volatility is economically significant For example,

Footnote 18 continued
the average margin calculated from January to December

Chart 1

Margin Requirement and Volatility



the estimated coefficient −0.110 in Table 3 shows that over the entire sample an increase in the margin requirement by 10 percentage points from, say, 50 percent to 60 percent decreases the monthly volatility of large stocks by 1.10 percentage points. The effect of margin requirements on small stocks is even greater (1.91 percentage points). To put these numbers in perspective, observe that the average monthly volatility of large stocks, $\bar{\sigma}$, is 4.8 percentage points and of small stocks, 7.4 percentage points. Thus a 10 percentage point increase in margin requirements decreases volatility by approximately one-quarter its average value.

The results from the entire sample could overestimate the effect of margin requirements on volatility. Recall that our measure of margin requirements is the official measure, tabulated in Table 1. The effective margin requirements, however, are those set by brokers and dealers who may add a spread over the official margin for certain customers and during certain time periods. The official margin requirement thus equals the unknown effective margin plus an error. This error causes a bias in the estimated coefficients.[19] Observe now that before October 1934 the official margin is zero, which is a more severe underestimate of the true effective margin of the pre-1934 period than the official margin of later dates. Recall also that the same pre-1934 period is characterized by unusually high volatility. Thus the combination of a downward-biased proxy of the true margin and an unusually high vol-

[19]See the discussion in G S Maddala, *Econometrics* (New York McGraw-Hill Book Company, 1977), pp 292-94

Table 3

Margin Requirements and the Volatility of Monthly Real Stock Returns

Regression Equation $\sigma_t = \beta_0 + \beta_1 \sigma_{t-12} + \beta_2 \sigma(y_t) + \beta_3 \sigma(r_t^{CB}) + \beta_4 (P_t/\bar{P}) + \beta_5 m_t + \epsilon_t$

Sample	Estimated Regression Coefficients β_0	β_1	β_2	β_3	β_4	β_5	$\bar{R}^2$	SEE	$\bar{\sigma}$	N
				S&P Index‡						
December 1931 to December 1987	110* (.015)					− 110* (025)	43	024	048	673
	091* (.022)	− 020 (125)	1 003* (186)	358* (125)	− 024* (010)	− 057* (017)	63	019		
October 1935 to December 1987	067* (010)					− 043* (016)	10	017	042	627
	.050* (012)	183* (074)	897* (267)	266* (092)	− 011† (007)	− 027* (011)	40	014		
				Small Stocks‡						
December 1931 to December 1987	179* (019)					− 191* (032)	47	039	074	673
	095* (022)	234* (119)	1 427* (290)	361* (173)	− 015* (005)	− 079* (025)	68	030		
October 1935 to December 1987	131* (020)					− 114* (031)	18	033	064	627
	055* (015)	470* (092)	1 393* (378)	242† (134)	− 009† (005)	− 048* (019)	57	024		

*Statistically significant at the 5 percent level

†Statistically significant at the 10 percent level

‡Inside the parentheses are standard errors corrected for conditional heteroskedasticity and the MA-11 process of the error term

σ_t = Standard deviation of the monthly real rate of return of stocks (nominal rate of return including dividends minus the CPI inflation rate), calculated from t-11 to t (in decimals)

$\sigma(y_t)$ = Standard deviation of the monthly percentage change in the industrial production index from t-11 to t (in decimals)

$\sigma(r_t^{CB})$ = Standard deviation of the monthly real rate of return on corporate bonds from t-11 to t (in decimals)

$P_t/\bar{P}$ = Average stock price from t-11 through t, divided by the average stock price from t-71 through t-12

m_t = Average official margin requirement from t-11 to t (in decimals)

$\bar{R}^2$ = Coefficient of determination adjusted for degrees of freedom

SEE = Regression standard error (in decimals)

$\bar{\sigma}$ = Sample average of σ_t (in decimals)

N = Total number of overlapping observations

atility during the pre-1934 period causes the estimated coefficient to be more negative than the true parameter For this reason, Tables 3 and 4 rerun the regressions starting in November 1934 Of course, now the new and less negative coefficient estimate is biased in the positive direction because a zero weight is assigned to the low margin/high volatility pre-1934 sample period Clearly, the coefficient that captures the influence of effective margins on volatility lies between the two estimates from the two different sample periods It is reassuring that the post-1934 set of estimates are qualitatively similar The estimated coefficient drops in magnitude but remains statistically significant Actual stock return volatility also drops in magnitude Thus an increase in margin requirements by 10 percentage points during the later sample decreases volatility by approximately 10 to 18 percent its average value

Charts 2 and 3 present scatterplots of the relationship between volatility and margin requirements for the post-1934 period Unlike Chart 1, the scatterplots show a clear negative relationship between volatility and margin requirements for both the S&P Composite and small stocks The line through the cloud of data points is the regression line The regression line has a negative slope and is steeper for small stocks, characteristics that are consistent with the results of the tables Observe that in the case of the S&P Composite, the negative slope is primarily driven by observations that belong to the 1930s and 1940s In the case of small

Table 4

Margin Requirements and the Volatility of Monthly Excess Nominal Stock Returns

Regression Equation $\sigma_t = \beta_0 + \beta_1 \sigma_{t\,12} + \beta_2 \sigma(y_t) + \beta_3 \sigma(i_t^{CB}) + \beta_4 (P_t/\bar{P}) + \beta_5 m_t + \epsilon_t$

Sample	Estimated Regression Coefficients β_0	β_1	β_2	β_3	β_4	β_5	$\bar{R}^2$	SEE	$\bar{\sigma}$	N
				S&P Index‡						
December 1931 to December 1987	112* (015)					− 112* (024)	44	024	048	673
	094* (022)	− 036 (127)	1 013* (191)	331* (120)	− 023* (010)	− 060* (017)	63	020		
October 1935 to December 1987	069* (010)					− 046* (015)	12	017	042	627
	051* (013)	186* (078)	890* (274)	244* (090)	− 011† (007)	− 029* (011)	40	014		
				Small Stocks‡						
December 1931 to December 1987	180* (019)					− 192* (031)	47	039	074	673
	097* (022)	229† (120)	1 432* (291)	300† (163)	− 015* (005)	− 081* (025)	68	030		
October 1935 to December 1987	134* (020)					− 118* (031)	18	034	064	627
	058* (016)	463* (099)	1 389* (387)	205 (133)	− 009† (005)	− 051* (019)	57	025		

*Statistically significant at the 5 percent level

†Statistically significant at the 10 percent level

‡Inside the parentheses are standard errors corrected for conditional heteroskedasticity and the MA-11 process of the error term

σ_t = Standard deviation of the monthly excess nominal rate of return of stocks (nominal rate of return minus the one-month T-bill rate at the end of the previous month), calculated from t-11 to t (in decimals)

$\sigma(y_t)$ = Standard deviation of the monthly percentage change in the industrial production index from t-11 to t (in decimals)

$\sigma(i_t^{CB})$ = Standard deviation of the monthly nominal rate of return on corporate bonds from t-11 to t (in decimals)

$P_t/\bar{P}$ = Average stock price from t-11 through t, divided by the average stock price from t-71 through t-12

m_t = Average official margin requirement from t-11 to t (in decimals)

$\bar{R}^2$ = Coefficient of determination adjusted for degrees of freedom

SEE = Regression standard error (in decimals)

$\bar{\sigma}$ = Sample average of σ_t (in decimals)

N = Total number of overlapping observations

stocks, the negative slope is a characteristic of the entire sample period.[20]

Let us turn now to the more complicated regressions that include additional explanatory variables. The additional variables are lagged volatility, the standard deviation of the monthly growth rate of the industrial production index, the standard deviation of the monthly rate of return of a five-year corporate bond, and stock prices relative to trend A standard deviation is again computed from variables over the current and previous 11 months The price relative to trend is the average price of the stock over the current and previous 11 months divided by the average price over an earlier 60-month period The volatility of the industrial production index serves as a proxy for the volatility of dividends, and the volatility of the corporate bond return as a proxy for the volatility of discount rates The price relative to trend is included in order to disentangle the direct effect of margin requirements on volatility from the possible spurious correlation arising from the effects of stock prices on both margin requirements and stock volatility Finally, lagged volatility is included in order to capture other variables that may affect stock market volatility with a delay

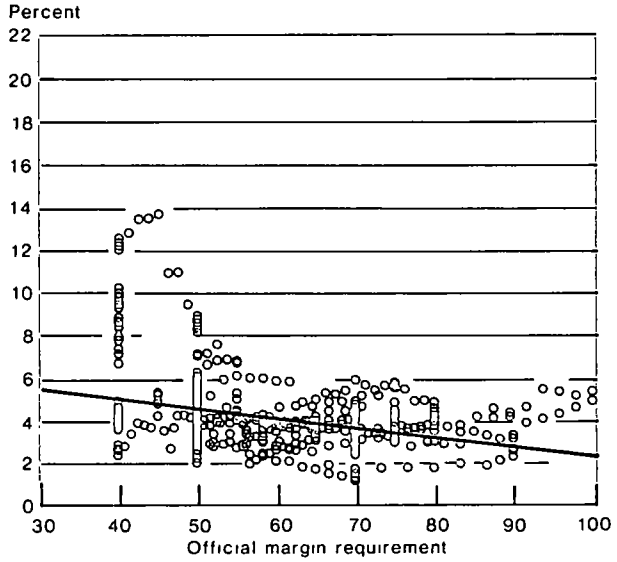
The inclusion of additional explanatory variables does not affect the qualitative results from the earlier simple regressions Margin requirements continue to have a negative and statistically significant effect on stock market volatility For example, Table 4 shows that over the post-1934 sample period, when other variables are kept constant, an increase in margin requirements by 10 percentage points decreases the volatility of large stocks by 0 29 percentage points and the volatility of small stocks by 0 51 percentage points, or by 7 to 8 percent of their average sample values The effect of margin requirements may appear economically small, but note that since volatility is positively related to lagged volatility, the long-run effect of margin

[20]The scatterplots also reveal considerable heteroskedasticity The estimation procedure automatically corrects for an unknown form of heteroskedasticity, as in Harbert White, "A Heteroscedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," *Econometrica*, vol 48 (May 1980), pp 817-38

Chart 2

S&P Composite Volatility Regressed on Official Margin Requirement

September 1935-December 1987

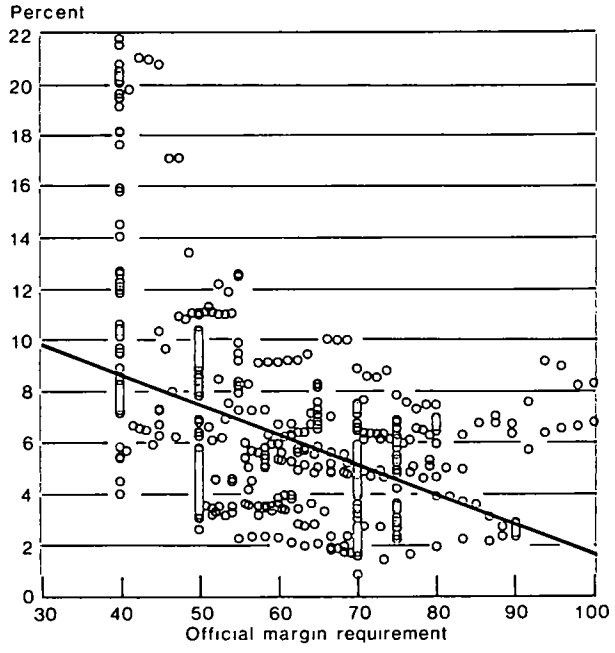


Notes Stock volatility is the standard deviation of monthly excess nominal rates of return during the last 12 months Official margin requirement is the average official margin requirement over the same 12-month period

Chart 3

Small Stock Volatility Regressed on Official Margin Requirement

September 1935-December 1987



Notes Stock volatility is the standard deviation of monthly excess nominal rates of return during the last 12 months Official margin requirement is the average official margin requirement over the same 12-month period

requirements is larger[21]

The estimated coefficients of the additional explanatory variables in Tables 3 and 4 confirm intuition and our earlier discussion Stock prices are more volatile when economic output is more volatile, when interest rates are more volatile, and, as finance economists have found, when stock prices are relatively low.[22]

Finally, note that a negative correlation between margin requirements and volatility does not necessarily imply causation from margin requirements to volatility A third, unknown variable may have caused both volatility and margin requirements to move in opposite directions However, the regression equations of Tables 3 and 4 take most plausible third variables into account First, the regression controlled for the variable that entered significantly in the Fed's reaction function, namely, the level of stock prices relative to trend Second, the regression controlled for lagged volatility and thus for possible delayed responses by the Federal Reserve to volatility changes Third, although there is no presumption that the Fed responded to volatility, if it had, it probably would have raised rather than lowered margin requirements following an increase in volatility. Thus the Fed's possible contemporaneous response to stock market volatility itself (as opposed to those other indicators of speculative excesses already taken into account) could only generate a positive correlation between margin requirements and volatility and work against the finding of a negative correlation.

Margin requirements and excess volatility

The previous section showed that an increase in margin requirements tends to mitigate stock market volatility However, volatility in itself is not a direct measure of speculative excess A more direct measure of speculative excess is excess volatility, or volatility that cannot be explained by the variation of current and expected future dividends and discount rates This section treats the relation between margin requirements and excess volatility

One could interpret the expanded regression results in Tables 3 and 4 as evidence of the effect of margin requirements on excess volatility The reason is simple. the regression equations include measures of the volatility of the fundamental determinants of stock prices such as dividends and discount rates, and thus the estimated effects of margin requirements on volatility are not effects that work their way through the included measures of the volatility of the fundamental determinants of stock prices The estimated coefficients reflect the effect of margin requirements on the unexplainable component of volatility The unexplainable component of volatility is a rough proxy of excess volatility.[23] However, unexplainable volatility is only a proxy of excess volatility because the regressions do not control perfectly for the variability of fundamental factors, particularly expected future dividends and discount rates Furthermore, the regression equations do not take into consideration the precise theoretical relation of dividends and discount rates to stock prices, that is, the present value model

Further analysis of the effects of margin requirements on excess volatility is beyond the scope of this article A more technical research paper that served as the basis of this article develops a precise measure of excess volatility and examines alternative evidence of excessive speculation in the form of long-run deviations of stock prices from their fundamental values.[24] One of the major findings of that paper is that during periods of low or decreasing margin requirements, excess volatility of stock prices is higher than during periods of high or increasing margin requirements Another finding is that "fads," that is, long-term deviations of stock prices from their fundamental values, are more prevalent during periods of low or decreasing margin requirements than in periods of high or increasing margin requirements Again, this evidence is consistent with the hypothesis that margin requirements help curb speculative excesses.[25]

[21]The slope coefficient of lagged volatility is 186 for the S&P Composite and 463 for small stocks Thus the effects of margin requirements cumulate as time goes on and, in the long run, they are 1 23 to 1 86 times larger than the short-run effects The multiplicative factors of 1 23 and 1 86 can be derived by iterative forward substitution They are equal to $1/(1-0\ 186)$ and $1/(1-0\ 463)$, respectively

[22]The size and statistical significance of lagged volatility conflict with an assertion made recently by James M Poterba and Lawrence H Summers in "The Persistence of Volatility and Stock Market Fluctuations," *American Economic Review*, vol 76 (December 1986), pp 1142-51, that shocks to volatility dissipate quickly Poterba and Summers use a slightly different volatility measure based on daily observations of the S&P Composite They also run simple autoregressive models with no additional explanatory variables

[23]In "The Persistence of Volatility," Poterba and Summers argue that volatility is well approximated by an AR(1) process In this article's specification, volatility is calculated over a one-year interval, and thus the lagged volatility of 12 months earlier is similar to an AR(1) term The inclusion of a lagged volatility measure in addition to the other contemporaneous variables sharpens the claim that the unexplainable volatility is a proxy of excess volatility

[24]See Gikas A Hardouvelis, "Margin Requirements, Volatility, and the Transitory Component of Stock Prices"

[25]For an exposition of the fads hypothesis, see Lawrence H Summers, "Does the Stock Market Rationally Reflect Fundamental Values?" *Journal of Finance*, vol 41 (July 1986, Papers and Proceedings of the 44th Annual Meeting of the American Finance Association), pp 591-600

Conclusion

Higher initial margin requirements in the cash market are statistically associated with a reduction in both actual and excess stock price volatility. The evidence should be interpreted with caution, however, because it is based on a small number of effective observations. Margin requirements have changed only 23 times since 1934. Furthermore, the last change in margin requirements occurred almost 15 years ago, in January 1974. Since that time, financial markets have changed drastically, especially with the introduction of derivative markets and the globalization of capital flows. Thus one can not use this article's findings to support specific policy changes in the cash market in full confidence that the article's predicted effects will be realized with great precision But the results do support the contention that increases in margin requirements reduce market volatility. At a minimum, the evidence shows that the presence of margins contributes to a more stable market.

Since the stock market crash of October 1987, the role of derivative markets in index-based contracts has become a major topic in the public policy debate. Futures and options markets in stock indexes are praised for providing liquidity and hedging capabilities to large institutional investors, but the same markets are also accused of contributing excessive volatility that spills over to the cash market. To date, the primary aim of margins in derivative equity markets has been to reduce the probability of contractual defaults and the risk of a derivative market breakdown, under the assumption that the volatility of stock prices is a given exogenous factor.[26] The results of this article suggest, however, that margins may play an additional role by affecting market volatility itself. The evidence from the cash market experience with different margin requirements over the last 50 years should be taken into account in assessing the adequacy of margins in derivative equity instruments.

Gikas A. Hardouvelis

[26]Another aim is the harmonization of margins in derivative markets with the margins in the cash market The feasibility of such harmonization is examined by Arturo Estrella in "Consistent Margin Requirements," in this issue of the *Quarterly Review*

Appendix: Data and Sources

The primary data source is the 1988 yearbook of the Ibbotson Associates, which contains end-of-month data from 1926 through 1987 Two aggregate stock price indexes are used The first is the Standard and Poor's Composite index. Currently, the S&P Composite includes 500 of the largest stocks, but before March 1957 it consisted of 90 of the largest stocks. The second index covers small capitalization stocks. It is composed of stocks making up the ninth and tenth smallest deciles of the New York Stock Exchange The data on the one-month Treasury bill rate and the five-year corporate bond yield also come from Ibbotson Associates

Data on the consumer price index were taken from Ibbotson Associates, and on the industrial production index, from the following sources: (i) for the period 1926-46, from *Industrial Production,* Board of Governors of the Federal Reserve System, 1986, (ii) for the period 1947-October 1987, from Citibase data banks, (iii) for November and December 1987, from *International Financial Statistics,* April 1988.

Data on broker and dealer margin credit come from: (i) the series entitled "Customer Net Debit Balances," which appears in *Banking and Monetary Statistics,* Board of Governors of the Federal Reserve System, 1943, Table 143; and *Banking and Monetary Statistics: 1941-1970,* 1976, Table 12.23; and (ii) the series entitled "Credit Extended to Margin Customers," which appears in various issues of the *Federal Reserve Bulletin* under the "Stock Market Credit" table. The first series runs from November 1931 through June 1970; the second series, from March 1967 through December 1987. The two series are not identical. To avoid an abrupt jump in July 1970, the second series was multiplied by the factor of 1 43, which is the average ratio of the first to the second series during the overlapping interval from March 1967 through June 1970. Data on the value of all New York Stock Exchange Stocks are end-of-month and come from New York Stock Exchange publications.