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Commentary: *Stock Market Margin Requirements and Volatility*

GIKAS A. HARDOUVELIS
Department of Finance
Rutgers University
New Brunswick, NJ 08903
and Research Department
Federal Reserve Bank of New York

Michael Salinger has provided a very thoughtful and well-balanced article on margin requirements. The article builds upon and extends some of my earlier work on margin requirements and stock market volatility. Professor Salinger, however, reaches a different conclusion than I did about the influence of margin requirements on the stock market. Similarly, Richard Roll's article in this issue expresses strong doubts about the effectiveness of margin requirements. He surveys some recent work that calls into question the robustness of my results. Thus before I comment on Salinger's own work, I would like to provide a more general perspective on the issue of margin requirements and answer the basic objections of my critics. I begin in section 1 by describing the main question. Then in section 2, I give an example of the effects of margin requirements on long swings in stock prices, a key variable of interest. In section 3, I respond to the econometric criticisms of Salinger and other critics. In section 4, I comment more generally on Salinger's article. Finally, in section 5, I summarize my thoughts on the effects of margin requirements and propose possible extensions of current empirical work.

1. The key question

When I began my own research on the effectiveness of margin requirements, I was struck by the fact that despite the voluminous literature on margin requirements, no author ever examined the most interesting question: Do margin requirements in the cash market affect the behavior of destabilizing speculators, as Congress believed some 50 years ago? Or is it the case that margin requirements affect primarily the behavior of rational investors and, by restricting liquidity in the market, contribute perhaps to higher volatility? Clearly, the key variables of interest are measures of excess volatility and other speculative deviations from fundamentals, but the existing literature did not analyze such measures.

I wish to thank Richard Cantor for comments and Valerie LaPorte for editorial assistance. The views expressed here do not reflect the views of the Federal Reserve Bank of New York or the Federal Reserve System.

I found two articles that examined the effect of margin requirements on actual, as opposed to excess, volatility. Officer (1973) finds a weak negative relationship between the two variables and interprets it as evidence that volatility affects the behavior of the Federal Reserve in setting margin requirements. Douglas (1969), however, finds a very strong negative relationship (a t-statistic of 10), which he interprets as evidence that higher margin requirements reduce volatility. Neither article controls for the behavior of the Federal Reserve, and each one only partially controls for the variability of the economic environment. I decided to sharpen the results of the two authors and then focus on the key question of whether margin requirements affect excess volatility.

My critics concentrate exclusively on what I thought was the noncontroversial and perhaps less exciting part of my article, the relationship between margin requirements and *actual* volatility. My estimate of this relationship turned out to be stronger than Officer's but weaker than that of Douglas. Therefore, I don't see the basis for the claim by some of my critics (repeated by Roll in his article) that I am the only one in the literature reporting a negative association between margin requirements and stock price volatility, implying that my results are an aberration. But before I address criticisms of my results on actual volatility, let me discuss what I feel are some of the most interesting results on the relationship between margin requirements and long swings in stock prices.

2. Margin requirements and long swings in stock prices: an example

Recall the Fama and French (1988) result that high price-dividend ratios predict subsequent low stock returns. Fama and French propose two alternative explanations of the negative correlation. The first explanation runs as follows: a high price-dividend ratio reflects an overvalued market. Later on, stock prices decline to line up closer to fundamentals, and this movement generates a negative return. The second explanation asserts that a high price-dividend ratio reflects a low risk premium in a correctly valued market, and the low subsequent returns reflect a low reward for the small amount of risk that market participants had rationally expected. While it is difficult to discriminate between the two hypotheses, I found that the size of the negative correlation between price-dividend ratios and subsequent stock returns in excess of the risk-free rate varies systematically with the level of margin requirements: the negative correlation is weaker in periods of high margin requirements *and* in periods when margin requirements increase. Furthermore, the results are robust to the inclusion or exclusion of the depression years from the sample (see the May 1989 revision of my paper).

I interpret these findings to mean either that high (or increasing) margin requirements reduce the degree of mispricing in the market and hence the excess volatility over the long term that is generated by the presence of irrational price swings or that high (or increasing) margin requirements reduce the perceived risk in the market. Under either interpretation, higher margin requirements are effective.[1]

3. Response to the critics

Let me now address the criticisms of my results on actual volatility. The first criticism is that the negative correlation is due to the depression years and is not observed after the 1940s. This is one of Salinger's criticisms as well, although he correctly points out that even if the depression years were solely responsible for the negative correlation, the results might still be relevant for today's financial environment. The criticism is only partly correct. It is true that to exclude the depression years weakens the estimated correlation between margin requirements and volatility, yet the correlation remains statistically significant. It is also true that the size of the correlation varies across different subsamples, but such variables should be expected. At different points in time the relative effects of margin requirements on destabilizing speculators and on stabilizing rational investors may well differ. Please also note that the criticism does not apply to the relationship between margin requirements and excess volatility, which is equally strong in the post-depression sample.

Table 1 repeats some of Salinger's tables using the S&P index and an index of small stocks but shows the results for various subperiods. The index of small stocks represents the two smallest deciles of the New York Stock Exchange stocks in terms of capitalized value; its source is Ibbotson Associates. Note that the negative association is present in *every* subperiod, although the size of the correlation varies. The coefficient of margin requirements is typically statistically significant for both the S&P Composite and the index of small stocks. Although not shown in table 1, when additional control variables are added, such as the lagged growth in stock prices or the volatility of the industrial production index, the negative coefficient of margin requirements is more significant. This evidence is quite impressive when one recalls that since November 1935, margin requirements changed only 22 times and, thus, checking for subperiod negative correlations is asking too much of the data.

Salinger's second major criticism of my article runs as follows: if one adds 12 lags of volatility in the basic regression, the effect weakens substantially even in the 1935–1987 sample. The first row of table 2 confirms the criticism. The margin coefficient is now insignificant for both stock indices. The size of the coefficient drops substantially relative to its size in table 1, although given the estimated persistence in volatility, the size of the estimated long-run effect of margin requirements on volatility is only slightly smaller than in table 1. To assess the importance of the criticism, observe that adding 12 lags of volatility in the bivariate contemporaneous relationship between margin requirements and volatility is arbitrary and may not be innocuous. Lagged volatility may proxy for other excluded factors that affect both margin requirements and current volatility. For purposes of symmetry, the second row of table 2 adds 12 lags of each of the control variables from my earlier paper. Observe that the second row reinstates my earlier results: the margin coefficient is now statistically significant for both indices. Clearly, the results of the second row are more reliable because they control for third factors that may adversely influence the relationship between margin requirements and volatility.

The importance of controlling for third factors in the relationship between margin requirements and volatility can be illustrated by the following example. My earlier paper shows that the Federal Reserve would increase margin requirements following a run-up in

Table 1. Volatility, margin requirements and margin debt

$$\sigma_{mt} = \sum_{i=1}^{12} \alpha_i \, SEASON_{it} + \beta_1 \, M_t + \beta_2 \, DEBT_t + u_t$$

	S&P Index					Small Stocks Index				
Sample	β_1	β_2	R^2	SEE	DW	β_1	β_2	R^2	SEE	DW
34:11-87:12	−.037*		.04	.040	1.78	−.090*		.06	.065	1.65
	[−3.19]					[−4.55]				
		1.56*	.05	.040	1.79		3.31*	.07	.065	1.66
		[3.54]					[4.56]			
	−.015	1.30*	.05	.040	1.80	−.048*	2.51*	.08	.065	1.68
	[−1.25]	[2.68]				[−2.39]	[3.23]			
40:1-87:12	−.014		.03	.035	1.87	−.033*		.03	.050	1.80
	[−1.36]					[−2.09]				
		0.54	.03	.035	1.87		0.56	.02	.051	1.78
		[0.89]					[0.65]			
	−.011	0.26	.03	.035	1.87	−.038*	−.039	.03	.051	1.80
	[−0.87]	[0.35]				[−2.07]	[−0.39]			
47:1-87:12	−.027*		.04	.034	1.94	−.024		.04	.046	1.89
	[−2.32]					[−1.50]				
		0.40	.03	.034	1.92		−0.42	.04	.046	1.88
		[0.60]					[−0.49			
	−.030*	−0.21	.04	.034	1.94	−.040*	−1.23	.05	0.46	1.90
	[−2.07]	[−0.27]				[−2.08]	[−1.20]			

56:1-87:12	−.031*		.06	.035	1.90	−.027		.06	.048	1.88
	[−2.33]					[−1.43]				
		0.47	.05	.035	1.88		−0.32	.05	.049	1.88
		[0.64]					[−.033]			
	−.033*	−0.17	.06	.035	1.90	−0.42	−1.12	.06	.048	1.90
	[−1.98]	[−0.19				[−1.87]	[−0.98]			
34:11-55:12	−.33*		.07	.046	1.71	−.117*		.08	.083	1.61
	[−1.98]					[−3.98]				
		1.86*	.10	.045	1.77		4.18*	.11	.082	1.64
		[3.54]					[4.63]			
	−.001	1.84*	.10	.045	1.77	−.058	3.31*	.12	.082	1.66
		[−0.07]	[3.27]				[−1.88]	[3.39]		

Notes: $\sigma_m = \sqrt{(\pi/2)}\ |\hat{\varepsilon}_t|$, where $\hat{\varepsilon}_t$ is the estimated residual of the regression: $R_t = \Sigma_{i=1}^{12}\ \alpha_i\ SEASON_{it} + \Sigma_{i=1}^{12}\ \beta_i\ R_{t-i} + \varepsilon_t$, with R_t referring to the real monthly rate of return of a stock index including dividends. $SEASON_i$ is a monthly dummy variable. M_t is the official margin requirement. $DEBT_t$ is the ratio of broker-dealer credit to the capitalized value of the New York Stock Exchange. *t*-statistics are in brackets calculated from White (1980) heteroskedasticity-consistent standard errors. Asterisk, *, denotes statistical significance at the 5 percent level. R^2 is the coefficient of determination, *SEE* is the regression standard error, and *DW* is the Durbin-Watson statistic.

Table 2. Volatility and margin requirements

Sample: 35:10-87:12
Dependent variable: σ_m
Independent variable: 12 lags of σ_m, R, MCR, π, Y, $\sigma_m(Y)$, 12 monthly seasonals, and current M

Current M	Sum of 12 lags with t-statistic in brackets, and x^2 (12) for excluding all 12 lags with significance level in parentheses							
	σ_m	R	MCR	π	Y	σ_m(Y)	R^2	SEE
					S&P Index			
−.008	.61*						.12	.039
[−.073]	[4.46]							
	24.6*							
	(.017)							
−.030*	.50*	−.25	−.23*	−.60	−.48*	.03	.31	.036
[−2.58]	[4.53]	[−1.94]	[−2.07]	[−1.13]	[−2.32]	[0.14]		
	32.3*	58.8*	22.1*	16.4	18.3	26.9*		
	(.001)	(.000)	(.036)	(.175)	(.106)	(.008)		
					Small Stocks Index			
−.019	.74*						.21	.061
[−1.26]	[5.91]							
	48.5*							
	(.000)							
−.041*	.67*	−.19	−.29	−.54	−.06	.33	.33	.059
[−2.22]	[5.79]	[−1.50]	[−1.66]	[−0.66]	[−.017]	[0.86]		
	61.9*	14.8	15.3	17.6	16.4	26.4*		
	(.000)	(.254)	(.225)	(.123)	(.175)	(.010)		

Notes: M = official margin requirement.
σ_m = monthly volatility of R, defined in table 1.
R = monthly real rate of return on a stock index including dividends.
MCR = monthly rate of growth of the ratio of broker-dealer credit to the capitalized value of the NYSE.
π = CPI inflation rate, monthly.
Y = growth rate of the industrial production index, monthly.
$\sigma_m(Y)$ = monthly volatility of Y.
Estimation performed with conditional-heteroskedasticity correction (White, 1980).

stock prices and would decrease margin requirements following a downward trend in stock prices. Next, recall that Christie (1982) shows that during bull markets volatility is low and during bear markets volatility is high. Christie also provides evidence consistent with the hypothesis that higher stock prices *cause* volatility to decline because they result in a lower debt-equity ratio. Hence, if an increase in margin requirements were effective in the sense that it reversed a previous speculative rise in prices, then the new lower stock prices would cause volatility to increase. Thus, in the absence of an appropriate control for the recent rate of growth in stock prices, there is a bias against finding a negative association between current margin requirements and future volatility; there is also a bias toward a negative association between current margin requirements and lagged volatility.

The previous discussion explains the counterintuitive evidence of Schwert (1988), the first of my critics. Schwert argues that volatility Granger-causes margin requirements but margin requirements do not Granger-cause volatility. Schwert regresses current volatility on 12 of its own lags and 12 lags and 12 leads of the change in margin requirements. He finds a stronger negative relationship between volatility and lead changes in margin requirements than between volatility and lagged changes in margin requirements. Salinger responds to Schwert by adding the contemporaneous level of margin requirements and shows that the contemporaneous relationship between margin requirements and volatility is still the strongest. Salinger also points out that Schwert's results are counterintuitive. Suppose for the sake of the argument that the Fed did respond to an increase in volatility because it took it as a signal of excessive speculation. Under such circumstances, the Fed would increase, not decrease, margin requirements as the Schwert estimates show. I agree with Salinger's arguments and would like to add two points. First, the Fed never mentions volatility even as a remote reason for changing margin requirements. The ordered logit results of my earlier analysis on the Fed's disposition to alter margin requirements show no relationship either. Second, Schwert's counterintuitive result that a decrease in volatility is followed by an increase in margin requirements is due to third factors such as the level of the market. In the latest revision of my paper (May 1989), I show that, indeed, Schwert's Granger-causality results are reversed when additional control variables enter the original bivariate relation between margin requirements and volatility. The control variables are stock returns, the growth in margin credit, and the volatility of the industrial production index.

Another critic, Kupiec (1989), tackles a different aspect of my paper—my measure of volatility. I use two alternative measures of volatility, one annual and the other monthly. The annual measure is a standard deviation of monthly stock returns (or unanticipated stock returns) over a horizon of one year. The monthly measure is described in the notes of table 1 and is also used by Salinger and Schwert. Kupiec argues that volatility is not constant over a year or over a month and must be allowed to vary over time. He uses a GARCH-M model and finds that the effect of margin requirements on volatility, although negative, is insignificant.

Kupiec's criticism of my measure of volatility is misplaced. Volatility per se is *not* the variable of interest. As Salinger points out, the item of interest is the pyramiding–depyramiding process that generates long swings in stock prices and that prompted Congress to establish margin use some 50 years ago. One way to capture those price swings

is to use volatility measured over longer horizons such as a year. Volatility at high frequencies is not the appropriate measure. Furthermore, Kupiec's methodology limits the relevance of his results. The GARCH-M model imposes the Capital Asset Pricing Model on the data. Hence, his method assumes that the market understands the effect of margin requirements on volatility and correctly prices this risk. I interpret Kupiec's weak results as evidence that margin requirements affect excess volatility generated by irrational price swings that are unexpected and not priced in the market.

Hsieh and Miller (1989) criticize my use of overlapping data with the annual measure of volatility, but ignore my work with the monthly volatility measure or my excess volatility results. It is well known that the presence of data overlapping generates a moving average in the regression error term, which renders the OLS standard errors inconsistent. For correct inferences, the standard errors have to be adjusted. I used the correction proposed by Newey and West (1987). However, Hsieh and Miller claim that even the Newey-West correction is not enough because the residual autocorrelation is too high. Given their criticism, one would have expected them to use nonoverlapping annual data in responding to my paper, or perhaps to use monthly data with my monthly measure of volatility. Instead, they also use overlapping data, but they take the first difference to eliminate the serial correlation generated by the data overlap. But since the residual autocorrelation is substantially smaller than unity, first differencing generates negative autocorrelation. So they are forced to use Cochrane-Orcutt correction for first order serial correlation in their regressions. Yet they are still stuck with substantial residual autocorrelation at lags 12 and beyond. I am puzzled by their roundabout methodology. Indeed, they follow a very unorthodox route for reasons that are hard to understand. I have re-estimated my annual volatility equations using nonoverlapping annual data and find results that are very similar to my earlier ones (table 4A of the latest revision).

The same Hsieh-Miller criticism is echoed by Richard Roll's article in this issue. Although the Newey-West correction is very standard, Roll discards my annual volatility results on the grounds that they are based on complicated econometrics. Yet, he subsequently espouses uncritically the even more complicated econometrics of Hsieh and Miller.

Hsieh and Miller do not end up contradicting my results. They claim that one of my control variables, the lagged growth in margin credit, does not belong in my regression and suggest that a simultaneous system ought to be estimated. I agree that estimating a simultananeous system is an interesting next step, and their article would have good value added had they done it. However, as things stand, I believe I have taken care of their criticism. Using an ordered-logit model of the unobserved Fed disposition to change margin requirements, I found that the Fed responded to recent runs in stock prices *and* changes in margin credit. This is consistent with the Fed's own description of the reasons that induced it to change margin requirements. Hence, when estimating the effect of margin requirements on volatility, one has to control for changes in lagged margin credit and the lagged rates of stock returns, as I did. Note that Hsieh and Miller also compare the volatility right before and right after a margin change and, in the absence of control variables, find no evidence of a negative association. They do find strong evidence of a negative association when the control variables are present. Of course, the results that make sense are the ones that control for the Fed's actions.

4. Comments on Michael Salinger's article

Salinger's article is particularly insightful because it focuses on the central question of the effect of margin requirements on price swings generated by the pyramiding–depyramiding process. He proposes an interesting hypothesis that the direct effect of margin requirements is primarily on upside volatility, because initial margin requirements of less than 100 percent allow the market to go up but do not necessarily drive it down (recall that it is maintenance margins that force the market down). He also proposes that margin debt may have an extra effect on downside volatility because margin calls may bite more with a larger amount of margin debt when the market begins to tumble. He finds little evidence for such nonlineaer effects, but his test may have low power. One way to increase the power of his test would be to lengthen the observational interval in order to allow for the presumed unraveling of stock prices.[2]

Salinger claims that it is margin debt that matters and not margin requirements because the effect of margin requirements on volatility becomes insignificant when margin debt is included in his regressions. Of course, margin requirements cause margin debt to change, hence his regression may simply reveal that in the pre-1940 period margin requirements affected both volatility and margin debt. But note that margin requirements may have an extra effect on speculators over and above the effect revealed by margin debt. The reason is that high margins increase the cost of buying stocks even if speculators manage to get funds from alternative sources. So it is conceivable that when margin requirements increase, margin debt might not change, yet fewer speculators would enter the market, and the market would become less volatile. The regressions in table 1 bear this out. For example, in the 1947–1987 and the 1956–1987 periods margin requirements have a significant effect on volatility but margin debt has an insignificant effect on volatility.

Salinger also claims that since the 1940s margin debt never exceeded 1.5 percent the capitalized value of the NYSE, and hence it is hard to believe that margin requirements could have a substantial effect on the market. This is a powerful argument, but I would like to raise an important counterpoint: margin accounts may have a disproportionate effect on the market if they trade very actively. Surveys in the 1950s, 1960s, and 1970s by the New York Stock Exchange showed that despite the relative small size of margin accounts, margin trading constituted approximately 15 to 30 percent of trading volume.[3] My own vector autoregression results showed that trading volume is reduced following an increase in margin requirements.

5. Conclusion and possibilities for future research

Margin requirements have changed only 22 times since their establishment in October 1934. Naturally, this diminishes the power of tests to distinguish among interesting hypotheses. Despite these limitations, there is a detectable and robust negative association between official margin requirements on the one hand and volatility, excess volatility, and the transitory component of stock prices on the other. This negative association is present in

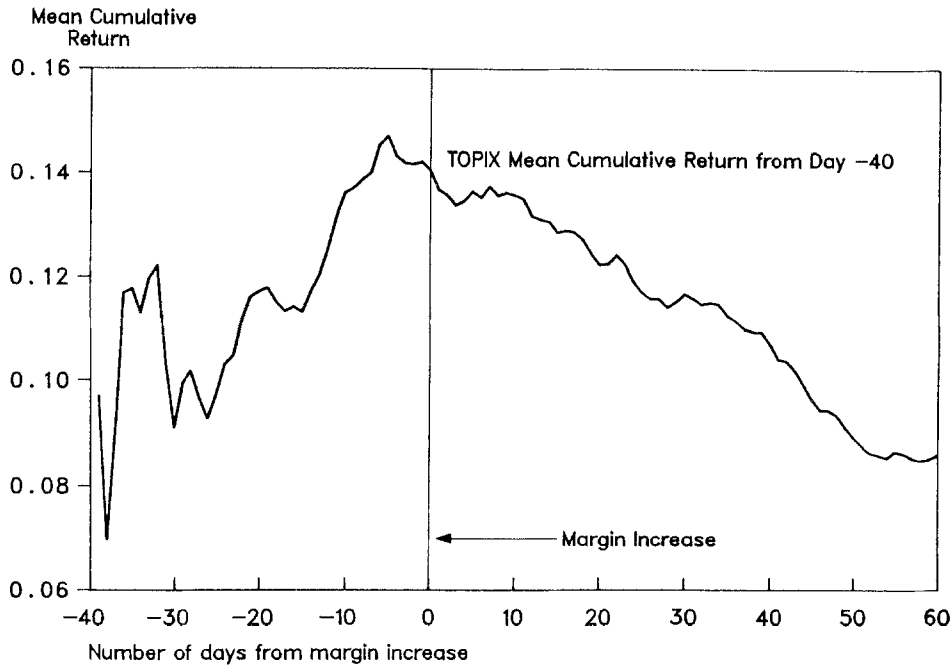

Fig. 1. The effect of an increase in margin requirements on Japanese stocks

the full sample as well as in the post-depression sample. However, the strength of the association is perhaps not of sufficient magnitude to change the strong prior beliefs held by some of my critics. Thus the question arises: Where should empirical research go from here?

Three directions for future research seem promising. First, given the small effective sample sizes (22 margin changes in the United States), it is desirable to use cross-sectional evidence of excess volatility. Kumar, Ferris, and Chance (1988) perform a cross-sectional analysis and find some evidence that the most speculative stocks are affected the most by margin requirements.

Second, it would be desirable to examine evidence from other countries that use margin requirements in a manner similar to the United States. For example, in Japan margin requirements have changed about 100 times. I am currently studying Japanese stock market data with Steve Peristiani of the New York Fed, and we have found that margin requirements have a very strong negative effect on both stock returns and volatility. Here I present two figures for the TOPIX index and comparable figures for the U.S. S&P index taken from my work with Peristiani. Figure 1 shows that in Japan margin increases occur following an upward trend in stock prices and then the market tumbles. Figure 2 shows that margin decreases occur following a downward trend in stock prices and then the market rebounds. The comparable effects in the United States are substantially weaker, as figures 3 and 4 reveal.

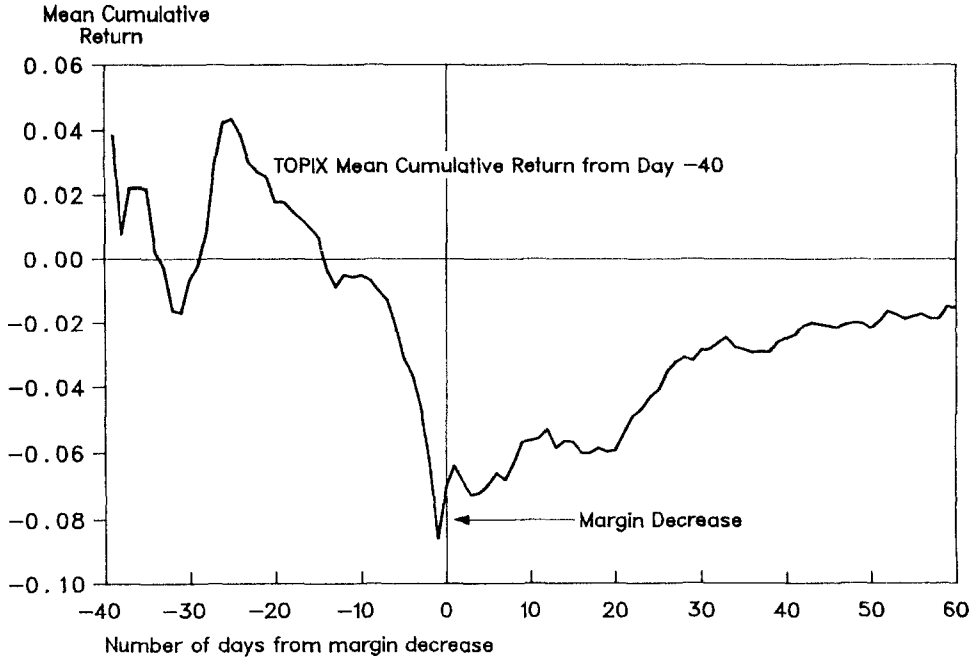

Fig. 2. The effect of a decrease in margin requirements on Japanese stocks

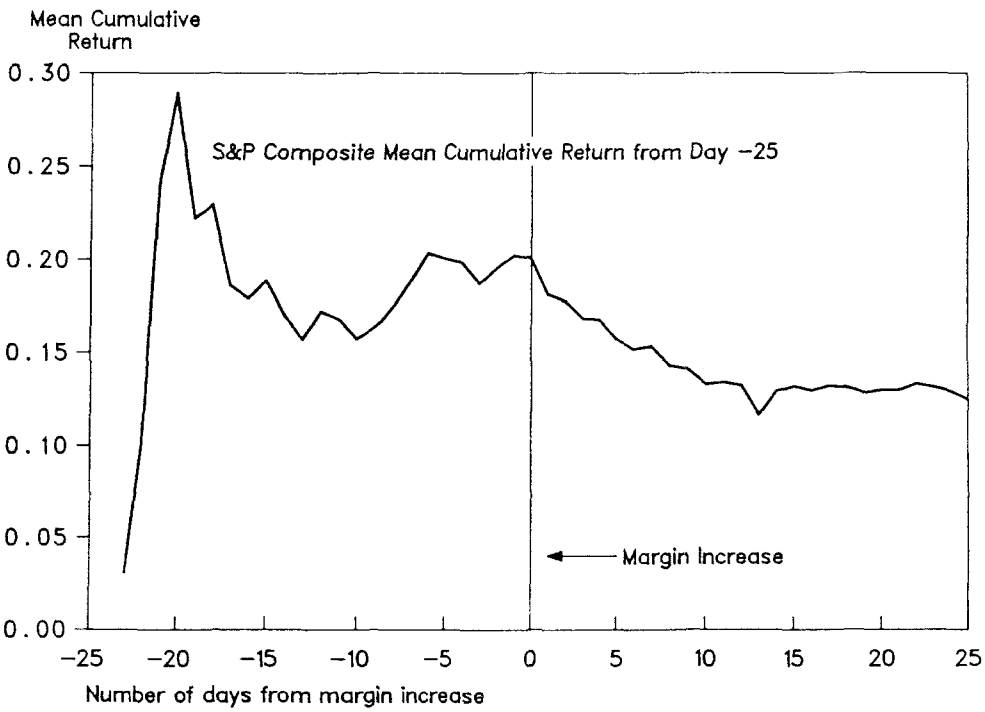

Fig. 3. The effect of an increase in margin requirements on U.S. stocks

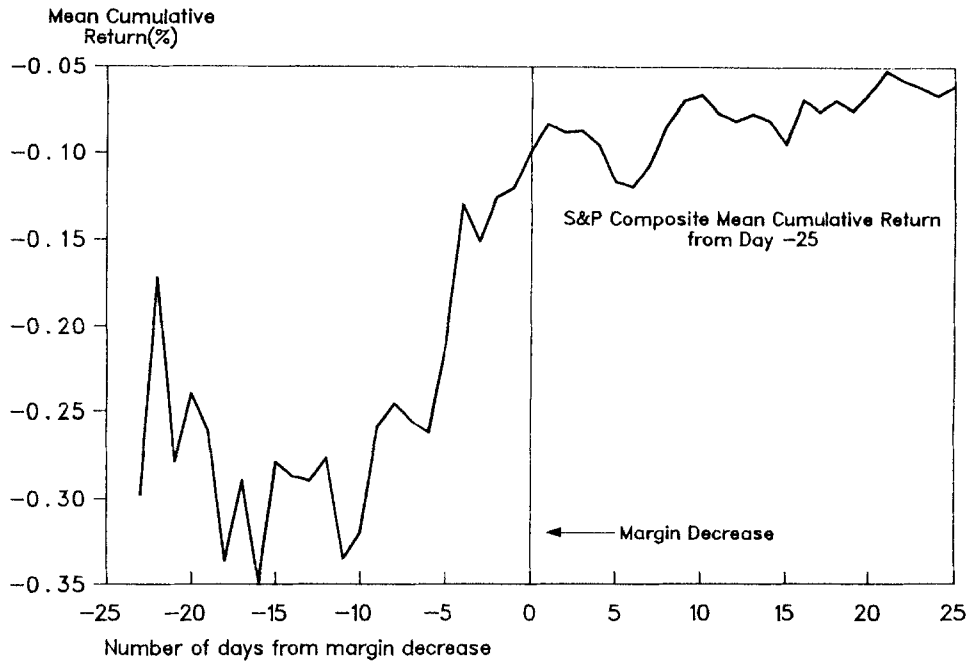

Fig. 4. The effect of a decrease in margin requirements on U.S. stocks

A third direction for future research would involve studying specific episodes of margin changes in greater detail. Salinger takes this direction when he focuses on the experience of the 1920s. Much can be learned from examining time periods characterized by unusual fluctuations in economic variables.

Notes

1. I favor the former interpretation that margin requirements affect the irrational swings of stock prices because in my earlier paper I show that regression-based tests of excess volatility reject less often during periods of high or increasing margin requirements.
2. A brief estimation over annual nonoverlapping horizons shows a significant extra effect for margin requirements in an up market (MARGUP) but no extra effect of debt in a down market (DEBTDN). I define an up market as a year that the market went up from December to December.
3. See the 1984 study of the Board of Governors of the Federal Reserve System.

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