MARGIN REQUIREMENTS, SPECULATIVE TRADING, AND STOCK PRICE FLUCTUATIONS: THE CASE OF JAPAN*

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An increase in margin requirements in the First Section of the Tokyo Stock Exchange is followed by a decline in margin borrowing, trading volume, the proportion of trading performed through margin accounts, the growth in stock prices, and the conditional volatility of daily returns. The nonmarginable Second Section stocks show a smaller change in volatility and only a delayed weak price response. The hypothesis that margin requirements restrict the behavior of destabilizing speculators can explain these correlations but cannot explain the observation that individuals, the most active users of margin funds, appear to be good market timers.

I. INTRODUCTION

The abrupt daily stock price changes of recent years have rekindled interest among regulators in ways to contain stock market volatility. One recommendation put forward after the 1987 stock market crash by the Presidential Task Force on Market Mechanisms, headed by current Treasury secretary Nicholas Brady, was to harmonize the relatively lower margins in the newly developed stock index futures markets with the prevailing margins in the traditional cash markets in order to control financial leverage and speculation, the presumed culprits of market disruptions. Margin requirements are official restrictions on the amount of borrowing available to investors from brokers and dealers for the purpose of buying stocks.[1]

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1. A margin requirement of, say, 60 percent in the cash market implies that an investor can borrow no more than $40 in order to buy a stock worth $100. The cash market margin requirement is currently 50 percent. In futures contracts—where no borrowing or lending takes place because no initial capital is required—the margin serves as collateral against default on the contract and as a means of settling the gains and losses in the contract gradually. Futures margins in the S&P 500

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Economists agree that higher margins would restrict margin credit and stock trading. However, there is little consensus that the higher margins would also result in a more efficient market that is less vulnerable to disruptions. If the higher margins primarily restrict noise traders and, more generally, destabilizing speculators, then excess volatility and mispricing would subside. However, if the higher margins restrict rational investors and thus reduce the market's liquidity, they would enhance, not reduce, excess volatility and mispricing. Hardouvelis [1988, 1990] finds that in the United States over the last 60 years excess stock return volatility and long-term deviations from fundamentals were attenuated both at times of high margin requirements and at times when margin requirements increased. In addition, after controlling for the influence of third factors in the Federal Reserve's decision to change margin requirements, volatility over annual horizons is also related negatively to margin requirements. On the other hand, Salinger [1989], Schwert [1989], and Hsieh and Miller [1990] among others shifted the focus to short-run volatility and argued that the negative association between margin requirements and volatility may not reflect a causal relation, and that the negative association found by Hardouvelis is weak and is driven primarily by the depression years.[2]

While the debate on the effectiveness of margin regulation in curbing short-run volatility in the U. S. stock market continues, the empirical research is constrained by a small effective sample size. Since 1934 margin requirements have changed only 22 times, and no changes have occurred since 1974. Hence the U. S. data are not rich enough to provide very powerful statistical tests of interesting hypotheses, especially hypotheses applicable to a more contemporary financial environment.

This article examines the influence of margin requirements on the trading activity of investors and the stability of stock prices in the Tokyo Stock Exchange (TSE). Japanese margin regulation, first imposed in 1951, is very similar to regulation in the United States. The authorities responsible for changing margin requirements in Japan are the individual stock exchanges. The TSE is the

index were around 6 percent before the October 1987 crash. For a description of U. S. margin regulation in cash and derivative markets, see Sofianos [1988]. For an analysis of the implications of different margin requirements in cash and derivative markets, see Estrella [1988].

2. See also Roll [1989]; Kupiec [1989]; Kumar, Harris, and Chance [1989]; Jones, Mulherin, and Titman [1990]. For a response to most of those findings, see Hardouvelis [1989].

largest stock exchange in Japan and has taken a very active interest in setting the appropriate level of margin requirements. Since 1951, it has changed margin requirements over 100 times; half of those changes took place during the last twelve years. The more frequent and more recent margin changes in Japan provide considerable statistical power that can shed light on the effectiveness of margin regulation in today's financial markets. Furthermore, the TSE collects and publishes detailed data on the activity of margin accounts, data that enable us to test the effects of margin requirements on quantities as well as prices. Similar data do not exist in the United States.[3]

Since this is the first study of the effects of margin requirements in Japan, it is important to establish the basic stylized facts about the short-run response of the Japanese market before one can examine the topic of excess volatility and long-term stock price deviations from their fundamental values. In addition, the contested issue in the academic debate in the United States is the effect of margin requirements on *short-run* returns and volatility. For these reasons, the empirical analysis focuses on horizons of a maximum length of one month. The article assesses the effects of a change in margin requirements on stock returns, the daily volatility of stock returns, trading volume based on margin accounts, total trading volume, and the amount of margin borrowing by both long-buyers and short-sellers. It also examines the differential impact of margin requirements on the trading behavior of different groups of market participants, such as TSE members, institutional investors, individual investors, or foreigners. This part of the inquiry can shed some light on the influence of noise traders in the TSE. The empirical analysis is carried out over a sample period from 1951 through 1988 and over two separate subperiods to determine whether the effects of margin regulation have diminished in the 1980s, an era of deregulation in Japanese financial markets.

The article is organized as follows: Section II describes Japanese margin regulation. Section III investigates the TSE's decision to change margin requirements. Section IV isolates the 100 instances when margin requirements changed and examines the

3. Moreover, the Japanese market, being the largest foreign stock market both in terms of capitalized value and trading volume, is important on its own merit. Other major foreign stock markets, such as the British and the German markets, do not have official margin requirements. Roll [1989, p. 235] describes margin requirements in different countries during the October 1987 worldwide stock market crash.

effect of a change in margin requirements on stock returns. The same section focuses on issues of causality by investigating the differential response between stocks for which margin borrowing is allowed and stocks for which margin borrowing is not allowed. Section V extends the analysis to daily volatility. Section VI analyzes the effects of margin requirements on margin trading volume, total trading volume, and the amount of margin borrowing by both long-buyers and short-sellers. Section VII examines the buying and selling activity of different groups of investors and market professionals. Finally, Section VIII concludes with a summary of our principal findings.

II. Margin Regulation in Japan[4]

Margin transactions were allowed for the first time in 1951, two years after trading began at the TSE. However, not all stocks that are traded at the TSE are eligible for margin lending. The TSE allows margin lending only for stocks that are traded in the First Section. The First Section represents more than 95 percent of the capitalized value of the TSE and encompasses listings of the largest companies. New companies are usually classified in the Second Section, while foreign stocks trade in the Foreign Section. At the end of October 1989, 1705 stocks were listed in the TSE, of which 1156 traded in the First Section, 433 in the Second Section, and 116 in the Foreign Section. Our empirical analysis focuses on the stocks that are traded in the First Section, but also makes use of the price behavior in the Second Section. The differential impact that changes in margin requirements may have on the stock prices of the two sections of the TSE provides information on the question of true causation from margin requirements to stock prices.

As in the United States, margin borrowing in Japan is less than 2 percent of the capitalized value of the stock market. For example, as of the end of 1988, total open interest in margin borrowing by both long-buyers and short-sellers in the First Section of the TSE was 1.53 percent of the capitalized value of the First Section. However, the relative size of margin borrowing

4. The information in this section comes from a variety of sources, the most important of which is lengthy private correspondence with TSE officials. See also Bronte [1982], Japan Securities Research Institute [1986], and *Tokyo Stock Exchange Fact Book*, [1989]. See Frankel [1992] for a general review of Japanese finance and Takagi [1989] for an overview of the Japanese stock market.

understates the importance of margin borrowers in influencing the movement of stock prices: margin transactions represent a substantial fraction of total trading volume. In 1987 and 1988 the fraction of "regular way"[5] volume transactions that was due to margin accounts was 16.7 and 19.6 percent, respectively.[6]

II.A. Initial and Maintenance Margins

As in the United States, margin regulation in Japan specifies both initial and maintenance margin requirements. Initial margin requirements can be fulfilled by depositing either cash or securities. The securities can be either bonds or stocks. If the margin requirement is 60 percent and the investor chooses to deposit cash as collateral, the required amount of cash is 60 yen per 100 yen transaction. However, if the investor chooses to deposit securities in lieu of cash as collateral for the 100 yen loan, the market value of the required securities will be larger than 60 yen. Japanese authorities discount the market value of securities by a certain percentage, which is called the "loan value." For instance, if the loan value on collateral stocks is 70 percent, the investor is required to deposit stocks with a minimum market value of $60/0.7 = 85.71$ yen. The loan value varies with the type of security: 95 percent for government bonds, 90 percent for government-guaranteed bonds, 85 percent for other bonds, and 80 percent for convertible bonds. Stocks have a lower loan value than bonds. The loan value of stocks has varied over time, but the loan value of bonds has remained constant.

Initial margin requirements are imposed only at the time of the transaction. After the original transaction the margin requirements become less strict and are called maintenance margins. In Japan, maintenance margins specify that the customer's capital with the broker must always be larger than 20 percent of the price of the stock at the time it was originally bought or sold on margin. If the customer's capital drops below the designated minimum of 20 percent, margin calls will occur. For example, if a customer bought a stock worth 100 yen and deposited 60 yen as collateral, the price of the stock could fall to 60 yen without triggering a margin call, but a further price drop below 60 yen would cause an

5. All market orders are "regular way" unless otherwise indicated. A regular way transaction is settled through the clearing department of the exchange on the third business day following the day of contract.

6. In the United States, data on the fraction of trading that is due to margin accounts are not collected on a systematic basis. However, sporadic surveys in the 1970s by the NYSE showed that margin trading was quite substantial, as in Japan.

immediate margin call. The 60 yen new market price implies an unrealized loss of 40 yen; hence the customer's capital with the broker becomes 20 yen, or exactly 20 percent of the original price of 100 yen.[7]

Although the official initial margin requirement has changed many times since 1951, the official maintenance margin requirement has remained at 20 percent. Of course, brokers and dealers can always impose more stringent initial or maintenance margin requirements on their customers. But data on individual dealers' margin requirements, although desirable, are not available. Our empirical analysis, therefore, will be based on the historical changes of the official initial margin requirements.

Figure I presents a summary of all margin requirement changes since the imposition of official margin requirements in 1951. Initial margin requirements vary between 30 and 70 percent; the loan value of stocks varies from a discount of 70 percent to a heavier discount of 50 percent. Only once did the discount value rise to 80 percent. Observe that, in the early to late 1970s, the TSE employed an additional regulatory restriction on margin loans, a minimum cash requirement. On two occasions the minimum cash requirement reached a maximum of 30 percent, but the more typical requirement was 10 percent. In the framework of our previous example of a margin requirement of 60 percent and a loan value of 70 percent, a 10 percent minimum cash requirement implies that customers have to deposit 10 yen in cash and then choose between an additional 50 yen of cash or an additional minimum of $50/0.7 = 71.43$ yen worth of securities. Given a posi-

7. When investors deposit securities in lieu of cash, margin calls can also occur if the collateral security declines in value. Suppose that the loan value is 70 percent for stocks and the customer deposits a stock worth $60/0.7 = 85.71$ yen. Assume for simplicity that the price of the stock bought on margin remains at 100 yen. Then a margin call will occur if the market price of the collateral stock falls from 85.71 yen to slightly below 28.57 yen, a decrease which is equivalent to $(28.57) \times (0.7) = 20$ yen of cash.

The calculation of the official maintenance margin is more complicated when, in addition to the change in the price of the collateral stock, there is a change in the price of the stock originally bought on margin. An increase in the price of the stock bought on margin does not count as a capital gain in the calculation of maintenance margins, but a decrease in its price does count as a capital loss. For example, let us assume that in addition to the fall in the price of the collateral stock from 85.71 yen to 28.57 yen, the price of the stock bought on margin increases from 100 yen to 110 yen. Despite this unrealized capital gain of 10 yen, margin calls will occur the moment the collateral stock drops below 28.57 yen, as in the earlier example. Next, suppose that the price of the stock bought on margin drops from 100 yen to 90 yen, causing an unrealized capital loss of 10 yen. In this case, margin calls will occur well before the collateral stock drops to 28.57 yen. Margin calls will occur when the price of the collateral stock falls below 42.86 yen, which is equivalent to $(42.86) \times (0.7) = 30$ yen of cash.

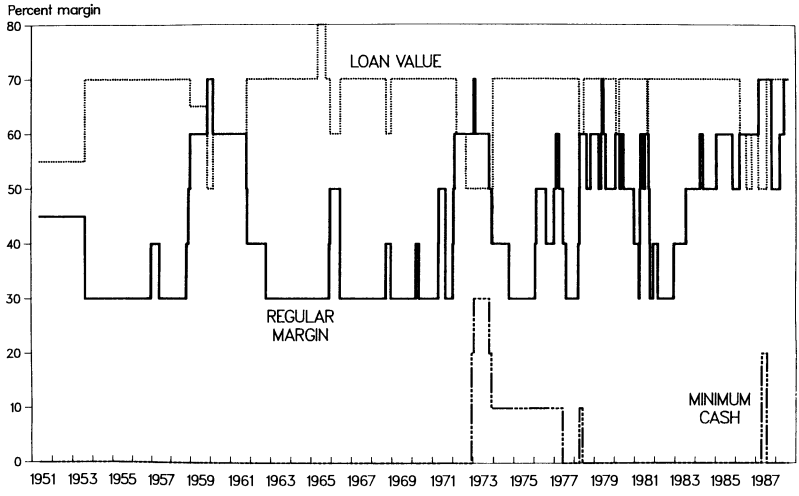

FIGURE I
Margin Requirements in the First Section of the Tokyo Stock Exchange

tive premium on cash, a positive minimum cash requirement has the same effect on the market as raising the margin requirement.[8]

II.B. The Effective Margin Requirement

The TSE has traditionally used two different methods to affect investor behavior in the stock market: changing the initial margin requirement, M_t^c and changing the loan value of stocks L_t, where the subscript t denotes the business day. To incorporate both tools in one variable, we define the effective margin requirement as the required market value of stocks per unit of margin loan.[9] The effective requirement M_t is then the ratio of the official margin requirement M_t^c and the loan value of stocks L_t:

$$M_t = 100\ (M_t^c/L_t). \tag{1a}$$

The above ratio does not take into account the occasional additional cash-only requirements, C_t. To incorporate these require-

8. We have confirmed this statement with the TSE.

9. The opportunity cost of depositing cash as collateral is larger than the opportunity cost of depositing stocks. Cash pays no interest, while stocks carry dividends and the potential for appreciation during the time of the margin loan. Similarly, given the very low interest rate of bonds, stocks have a greater potential for high returns. Investors would prefer depositing stocks to depositing cash or bonds as collateral. Hence, a change in the loan value of stocks is an effective restriction for most investors and should be taken into account.

ments, we adjust the definition of the effective margin requirement as follows:

$$M_t = 100\,[\delta C_t/L_t + (M_t^c - C_t)/L_t], \tag{1b}$$

where δ is a parameter that reflects the extra opportunity cost associated with cash deposits. In the empirical analysis of the following sections, we arbitrarily assume that δ equals 1.5, but we have checked the sensitivity of the results to different values of δ ranging from 1 to 2. The results are not very sensitive to the particular choice of δ. To verify this last point, we present some of the later results a second time by excluding all cases when C_t changed (Tables II.A and II.B). For this purpose we use equation (1a) to describe our effective margin requirement.

Over the 37-year period from 1951 to June 1988, M_t has changed 96 times. Of the 96 changes, 60 are changes in initial margin requirements alone; 17 are changes in the loan value alone; five are minimum cash changes alone, ten represent simultaneous changes in initial margin and loan value; and four reflect concurrent changes in the minimum cash requirement and loan value.

III. The TSE Response Function

We begin our analysis by examining the rationale for changing margin requirements. The behavior of the TSE provides information on possible third factors beyond margin requirements that could affect investors' market behavior and, hence, sheds light on the nature of causality extending from margin requirements to stock prices, stock volatility, and other variables of interest. For example, if changes in margin requirements are successful in reversing previous price trends, one may argue that this phenomenon is simply the result of coordinated monetary actions by the Bank of Japan or fiscal actions by the Ministry of Finance. Suppose for the sake of argument that news hits the market that the previously overheated economy that drove stock prices up has caused the Bank of Japan and the Ministry of Finance to follow restrictive policy actions. A fall in the market that coincides with an increase in margin requirements might stem from the anticipated negative effect of the future restrictive monetary policy on the economy and on the profitability of publicly traded companies, and not from the increase in margin requirements.

Table I presents the results of an ordered-response logit model

TABLE I
THE DECISION TO CHANGE MARGIN REQUIREMENTS: ORDERED-RESPONSE LOGIT MODEL

Independent variable	Coefficient	t-statistic
c_1	−2.86*	−4.18
c_2	5.26*	7.20
R	0.195*	5.74
GV	0.0055*	2.51
MV	0.80*	3.38
σ	0.26	0.62
IPI	0.10	1.07
DR	−0.19*	−2.36
	$-2 \times \ln(\text{Likelihood}) = 706.54$	

Notes. The sample consists of 1500 weekly observations from 01/27/58 through 10/31/88. The dependent variable takes the value of 1 for a decrease in the effective margin of equation (1b) of the text, 2 for no change in the effective margin, and 3 for an increase in the effective margin. The explanatory variables are as follows: $R \equiv$ Rate of return in percent of the First Section TOPIX from the end of week $j-5$ to the end of week $j-1$, where j denotes the observation week. $GV \equiv$ Growth in trading volume in percent from week $j-5$ to week $j-1$. $MV \equiv$ Margin trading volume as a percent of total trading volume from month just passed. $\sigma \equiv$ Standard deviation of returns in percent from previous 24 business days. $IPI \equiv$ Growth in industrial production index in percent of month just passed. $DR \equiv$ Bank of Japan discount rate in percent of month just passed.
*Statistically significant at the 5 percent level in a two-tailed test.

with three states of a hypothetical TSE response function. Briefly, assume that the TSE's unobserved disposition to alter margin requirements, Z_t, has a logistic distribution. Assume also that a decrease in margin requirements occurs when $Z_t < \beta' X_t + c_1$, that no change in margin requirements occurs when $\beta' X_t + c_1 < Z_t < \beta' X_t + c_2$, and that an increase in margin requirements occurs when $\beta' X_t + c_2 < Z_t$. X_t represents a set of indicator variables and β', c_1, and c_2 are parameters to be estimated. The likelihood function to be maximized:

$$(2) \quad \prod_{t=1}^{T} F(\beta' X_t + c_1)[F(\beta' X_t + c_2) - F(\beta' X_t + c_1)][1 - F(\beta' X_t + c_2)],$$

where F denotes the logistic cumulative distribution function.[10] The model is estimated over the sample period from 1958, when most macroeconomic series become available, through 1988. The

10. See Maddala [1983, pp. 46–49] for more details. The maximization of the likelihood function was performed using GAUSS [1986].

included indicator variables are the lagged growth in stock prices, lagged growth in trading volume, the most recent public information on the ratio of margin trading to total trading, the recent volatility of daily stock returns, the most recent growth in the industrial production index, and the most recent Bank of Japan discount rate. The sample is weekly because the TSE's decision to change margin requirements is a weekly decision and not a daily one, and because most of our independent variables are based on data that are available either weekly or monthly.[11]

Table I shows that the probability of an increase in margin requirements is higher when lagged stock returns are high: TSE officials watch for rapid increases (decreases) in stock prices before they raise (lower) margin requirements. This behavior is very similar to the historical behavior of the Federal Reserve in the United States [Hardouvelis, 1990]. Observe also that the probability of an increase in margin requirements is also higher when the recent growth in trading volume is high and the recent ratio of margin trading to total trading is high.[12]

Lagged volatility does not affect the TSE's decision function. The lagged growth rate in the industrial production does not affect it either. However, the Bank of Japan discount rate does matter. If the discount rate is high, the TSE is *less* likely to raise margin requirements. Hence, it appears that the TSE eases up when the Bank of Japan tightens, suggesting that the hypothesis that a coordinated effort of the different regulators may lead to spurious correlations is not consistent with the evidence. We have also included other macroeconomic variables such as the lagged rate of inflation or the previous change in the discount rate; again, we were unable to uncover any correlations. Of course, the lack of econometric evidence on the presence of correlations with macroeconomic variables does not negate the potential presence of

11. Most of the data were obtained directly from the Tokyo Stock Exchange. However, the data can also be found in the *Monthly Statistics Report* of the TSE. In particular, the daily TOPIX composite indexes for the First and Second Sections are given in Table 3.1, daily trading volume in Table 2.1, monthly information of spot and margin transactions in Table 2.5, information on trading volume by types of investors in Table 14.1, and information on outstanding margin transactions in Table 15. A complete record of all margin changes is available through the TSE. Finally, all monthly macro variables employed in Table I were retrieved from the DRI database.

12. In private correspondence, TSE officials in Tokyo mentioned that they view increases in those variables as indicators of rising speculation. The officials also mentioned that another major indicator of speculative excess is the turnover rate in margin accounts, that is, how frequently investors close and reopen margin accounts. Such data are not publicly available.

coordinated macro policies, for it may simply reflect our technique's possible low detective power.

IV. Do Margin Requirements Affect the Growth in Stock Prices?

We now turn to our event analysis. We isolate the days of a margin change and examine the behavior of Japanese stock returns and other variables of interest around those days. We use an investment horizon of 24 business days, or approximately one month. A longer horizon would not be very informative because of severe data overlapping, especially in the 1970s and 1980s. A shorter horizon would compromise our estimates of volatility as well as other quantity measures we explore in later sections. For example, data on margin borrowing are available weekly, while changes in margin requirements can occur any day within the week, which creates a slight misalignment. Our interval of a month allows us to construct measures of change in margin borrowing that reduce the measurement error created by the misalignment.

The analysis assumes that changes in margin requirements come as a surprise to the market. If changes in margin requirements are anticipated, then market participants should already have acted to discount their effects before the occurrence of a margin change, and we would therefore be unable to find any margin effects on stock prices, trading volume, and so forth. Overall, it is possible that some of the margin changes were partly anticipated; our methodology would then have low power to detect effects from margin requirements to stock prices and other variables of interest.

In this section we ask the following questions. Do margin changes affect stock returns? And if they do, does the effect persist in the 1980s? Finally, does the estimated correlation between margin requirements and stock returns reflect true causation running from margin requirements to stock returns?

IV.A. Regressions at the Monthly Frequency

Table II.A examines the First Section TOPIX return over two intervals of 24 business days, before and after the margin change. We regress the change in the average geometric ex-dividend daily return, ΔR_i, on the change in the average level of M_t over each

TABLE II.A
THE EFFECT OF MARGIN REQUIREMENTS ON STOCK RETURNS IN THE FIRST SECTION OF THE TSE

Regression model: $\Delta R_i = \alpha_0 + \alpha_1 \Delta M_i + u_i$		
	Effective margin	Cash margin/ loan value
Full sample: 06/01/51–06/03/88		
α_0	0.02903	0.03377
	(1.12)	(1.27)
α_1	−0.00784*	−0.00758*
	(−7.43)	(−6.65)
R^2	0.330	0.332
Nobs	96	91
RMSE	0.254	0.254
$F(2,92)$	0.29	0.45
t-stat	0.17	0.77
First subperiod: 06/01/51–04/03/78		
α_0	0.04807	0.05086
	(1.42)	(1.65)
α_1	−0.00774*	−0.00844*
	(−5.94)	(−5.72)
R^2	0.434	0.432
Nobs	48	45
RMSE	0.233	0.240
Second subperiod: 04/04/78–06/03/88		
α_0	0.00930	0.01840
	(0.23)	(0.46)
α_1	−0.00813*	−0.00665*
	(−4.68)	(−3.74)
R^2	0.323	0.241
Nobs	48	46
RMSE	0.276	0.270

Notes. $\Delta R_i = R_{A,i} - R_{B,i}$, where $R_{A,i}(R_{B,i})$ is the geometric daily ex-dividend return in the First Section of the TSE from business day −24 (−1) to business day −1 (24), where day 0 denotes the date of the ith change in margin requirements. $\Delta M_i = M_{A,i} = M_{A,i} - M_{B,i}$, where $M_{A,i}(M_{B,i})$ is the average daily level of margin requirements during the interval from business day −24 (1) to business day −1 (24). The effective margin is defined in equation (1b) of the text. Cash margin over loan value is defined in equation (1a). R^2 is the coefficient of determination, *Nobs* is the number of observations, and *RMSE* is the root mean squared error of the regression. $F(2,92)$ tests for structural stability of α_0 and α_1 across the subperiods, while t-stat tests only for α_1. The numbers in parentheses are t-statistics.

*Statistically significant at the 5 percent level in a two-tailed test.

interval, ΔM_i:[13]

$$\Delta R_i = \alpha_0 + \alpha_1 \Delta M_i + u_i. \tag{3}$$

On certain occasions, two consecutive margin changes occur in less than 24 business days, and this occurrence creates some overlapping between the different observation intervals. We partly address this overlapping problem by using as an independent variable the change in the average margin of each interval of 24 business days that surrounds day 0 of the margin change, as opposed to the single change in margin at day 0.

The regression coefficients are negative and statistically significant. The estimated regression coefficient of -0.00784 for the full sample implies that after the initial margin requirement increases from 50 to 60 percent (assuming a typical level of 70 percent for the loan value and no minimum cash requirements), there will be a price reversal in the market equal to $-[(0.00784) \times (10/0.7)]/2$ or -0.06 percent, each day over a period of a month. This reversal is equivalent to a cumulative drop of about 1.44 percent over the month.

Table II.A also shows regression results for two subperiods. The break point is March–April 1978, so that 48 margin changes occur in the first half, and 48 margin changes occur in the second half of the sample. The regression coefficient of ΔM_i remains very similar across the two halves of the sample, and formal F-tests of structural change cannot reject the null hypotheses of parameter stability. The second column in Table II.A presents the results of regressions that exclude the five cash-only margin changes; the effective margin requirement is defined by equation (1a). The results do not change.[14]

IV.B. Is There a Causal Relation? A Comparison to Second Section Stocks

We now examine the response of stocks traded in the Second Section of the TSE. Investors are not allowed to borrow on margin

13. Our definition of return R_i does not include dividends and hence reflects the growth in stock prices alone. However, for all practical purposes, one could interpret R_i as total return because dividends in Japan are very small relative to the size of the capital gain or loss.

14. One question we frequently encounter is whether the reversals in Tables II and III were also observed after January 1990. Japanese stock prices fell almost 30 percent over the course of the first quarter of 1990 *after* the TSE increased margin requirements in December 1989. Then in March 1990 the TSE decreased the margin requirements twice over two consecutive weeks, and stock prices began to rebound. So the recent experience is consistent with our findings, although we do not claim that margin requirements were the main causal factor behind those price swings.

either to buy or short-sell those stocks. It follows that if margin requirements are a truly causal variable, they should have a stronger impact on First Section stocks than on Second Section stocks. Evidence of such a stronger impact would be evidence of true causality. On the other hand, the close substitutability of the two indices in investors' portfolios may make it hard to econometrically detect a differential effect. Thus, lack of a differential response would not necessarily constitute evidence against the interpretation of causality.

Before we estimate the effects of margin changes on Second Section stock returns, it is useful to assess the nature of the association between monthly ex-dividend stock returns in the Second Section, R_m^{ss}, and the First Section, R_m. The contemporaneous relation between the two returns is described by the following regression equations:

(4a)
$$R_m^{SS} = \underset{(0.377)}{0.408} + \underset{(0.056)}{0.984}\, R_m$$

$R^2 = 0.55$, $RMSE = 5.92$, $\sigma^{SS} = 8.79$, $\sigma = 6.62$
Sample: 10/61–8/88, $N = 253$;

(4b)
$$R_m^{SS} = \underset{(0.872)}{-0.035} + \underset{(0.118)}{0.656}\, R_m$$

$R^2 = 0.32$, $RMSE = 7.08$, $\sigma^{SS} = 8.51$, $\sigma = 7.31$
Sample: 10/61–8/88, $N = 69$,

where R^2 denotes the coefficient of determination, $RMSE$ the root mean squared error in percent, σ^{ss} the standard deviation of R_m^{ss}, and σ the standard deviation of R_m. Numbers in parentheses are standard errors. Equation (4a) is estimated over the 253 months of no margin change, and equation (4b) is estimated over the 69 months of at least one margin change. The sample period begins in October 1961, when the Second Section stock returns first become available.

There is a striking difference between the estimated slope coefficients in equations (4a) and (4b). During months of no margin change, the slope coefficient is statistically indistinguishable from unity suggesting that common economywide factors lie behind the price movements of the two indexes, and thus, the two indices are—over monthly horizons—very close substitutes in investors' portfolios. However, during the months when margin changes occur, the slope coefficient drops to 0.66. Movements in the two

stock indexes are not aligned as closely as during months of no margin changes, suggesting that index-specific factors become more important. By construction, the margin requirement is the factor that is present in the First Section, absent in the Second Section, and changes during those months. Thus, margin requirements may be a causal factor behind the deterioration of an almost one-to-one relation between the monthly aggregate returns in the two sections of the TSE. Alternatively, it is possible that the TSE decides to change margin requirements exactly because First Section stocks behave unusually relative to Second Section stocks, in which case margins simply follow the deterioration of the one-to-one relation and do not necessarily worsen it.

Table II.B repeats the regressions of Table II.A but uses the ex-dividend return on Second Section stocks, R^{ss}:

$$\Delta R_i^{SS} = \beta_0 + \beta_i \Delta M_i + u_i. \tag{5}$$

Observe that the growth of stock prices in the Second Section is also negatively related to the change in margin requirements, but the correlation is considerably weaker. The regression slopes in Table II.B are two times smaller than the slopes in Table II.A, and the R^2's are four times smaller. Also, in contrast to the response of First Section stocks, in the second half of the sample, the response of Second Section stocks diminishes substantially and becomes statistically insignificant. A test of the null hypothesis that $\alpha_1 = \beta_1$, that is, that the slope coefficients are the same across the two regression equations reflecting the normal one-to-one monthly relationship between the two stock indexes (equation (4a)), is rejected very strongly in the whole sample period and in each of the subperiods.

The weaker response of Second Section stocks to margin changes does not yet constitute clear evidence of true causality from margins to stock prices because regression equations (3) and (5) do not separate the price behavior of the period after the margin change from the price behavior of the period before the margin change. For clearer evidence we turn to an analysis at the daily frequency.

IV.C. Analysis of Daily Prices and Returns

Figures II and III provide a clearer view of the effects of margin decreases and increases, respectively, on the stock prices in the First and Second Sections of the TSE. The figures plot the cumulative ex-dividend returns from a strategy of buying the

TABLE II.B
THE EFFECT OF MARGIN REQUIREMENTS ON STOCK RETURNS IN THE SECOND SECTION OF THE TSE

Regression model: $\Delta R_i^{SS} = \beta_0 + \beta_1 \Delta M_i + u_i$

	Effective margin	Cash margin/ loan value
Full sample: 10/11/61–06/03/88		
β_0	−0.0173	−0.02058
	(−0.57)	(−0.65)
β_1	−0.00348*	−0.00364*
	(−2.76)	(−2.62)
R^2	0.081	0.078
Nobs	88	83
RMSE	0.285	0.288
H^0: $\beta_1 = \alpha_1$, t-stat =	4.13*	3.71*
$F(2,92)$	0.27	0.27
t-stat	0.70	0.74
First subperiod: 10/11/61–10/20/78		
β_0	−0.023	−0.016
	(−0.49)	(−0.33)
β_1	−0.00431*	−0.00465*
	(−2.24)	(−2.13)
R^2	0.106	0.105
Nobs	44	41
RMSE	0.314	0.323
H^0: $\beta_1 = \alpha_1$, t-stat =	2.61*	2.56*
Second subperiod: 03/10/78–06/03/88		
β_0	−0.00895	−0.02184
	(−0.23)	(−0.56)
β_1	−0.00253	−0.00257
	(−1.53)	(−1.453)
R^2	0.053	0.050
Nobs	44	42
RMSE	0.259	0.255
H^0: $\beta_1 = \alpha_1$, t-stat =	3.30*	2.72*

Notes. See the notes to Table II.A. $\Delta R_i^{ss} = R_{A,i}^{SS} - R_{B,i}^{SS}$, where $R_{A,i}^{SS}$ ($R_{B,i}^{SS}$) is the geometric daily ex-dividend return in the Second Section of the TSE from business day −24 (−1) to business day −1 (24), where day 0 denotes the date of the ith change in margin requirements. The sample period is smaller than in Table II.A because data on Second Section stock prices become available in October 1961. The null hypothesis H_0: $\beta_1 = \alpha_1$ states that during the sample periods of the present table, the slope coefficients of the Second and First Section stock returns are the same.

*Statistically significant at the 5 percent level in a two-tailed test.

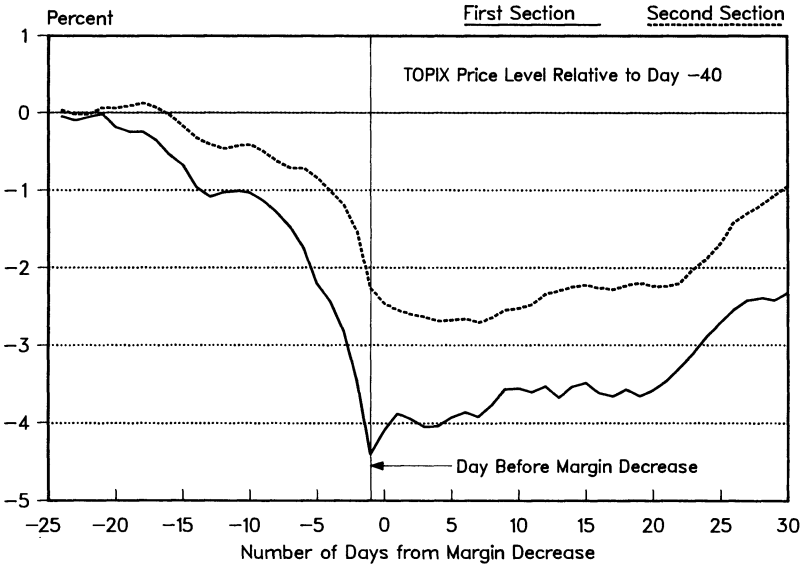

FIGURE II

Stock Prices When Margin Requirements Decrease

Notes. A margin decrease is announced after markets close on day −1 and becomes effective on day 0. For each trading day k, the plotted P_k is the average $P_{k,i}$ across the N decreases in margin requirements, where i denotes the ith decrease in margin requirements:

$$P_k = \left(\frac{1}{N}\right)\sum_{i=1}^{N} P_{k,i}, \qquad P_{k,i} = \frac{\text{TOPIX}_{k,i}}{\text{TOPIX}_{-40,i}} - 1.$$

In the First Section $N = 52$, and in the Second Section $N = 47$.

portfolio of stocks in the TOPIX of either the First or the Second Section on the fortieth business day before the margin change and subsequently selling the same portfolio on business day k, where k runs from day −39 to day 30. In other words, the figures plot the evolution of stock prices relative to day −40.[15] In each figure we plot a vertical line on business day −1. Margin requirement changes are announced after the market closes on business day −1 and become effective for all transactions on business day 0. Hence, if changes in margin requirements affect the market, we ought to see a price reversal on business day 0.

The figures show that the large difference between the re-

15. Hardouvelis [1989] presents figures that reflect returns, not prices. See also Hardouvelis and Peristiani [1990].

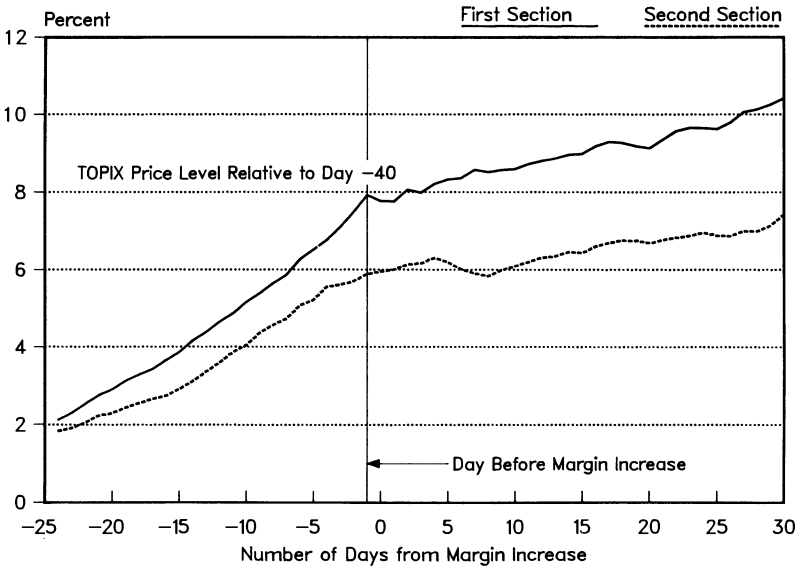

FIGURE III

Stock Prices When Margin Requirements Increase

Notes. A margin increase is announced after markets close on day −1 and becomes effective on day 0. For each trading day k, the plotted P_k is the average $P_{k,i}$ across the N increases in margin requirements, where i denotes the ith increase in margin requirements:

$$P_k = \left(\frac{1}{N}\right)\sum_{i=1}^{N} P_{k,i}, \qquad P_{k,i} = \frac{\text{TOPIX}_{k,i}}{\text{TOPIX}_{-40,i}} - 1.$$

In the First Section $N = 44$, and in the Second Section $N = 41$.

sponse of the two stock indices to margin changes in Tables II.A and II.B originates from the price behavior both after and before a margin change. However, the price behavior after a margin change—especially after a margin decrease—provides clear support for the interpretation of causality: Figure II shows that stock prices in the First Section increase immediately after the imposition of lower margin requirements. Yet stock prices in the Second Section continue their decline on day 0 and on subsequent days. Second Section Stocks do not rebound until the tenth day following the margin decrease. The immediate response of First Section stocks together with the delayed response of Second Section stocks suggest that margin requirements have a special direct causal role in the behavior of First Section stock prices.

Figure II also shows that a number of days after the margin

decrease, both First and Second Section stock prices continue drifting up, a development which suggests that perhaps factors other than margin requirements may also come into play. Alternatively, it is possible that margin requirements are the only causal factor and the upward drift of First Section stock prices simply reflects unexploited profit opportunities. The drift in Second Section stock prices would then be justified as the lagged response of Second Section prices to First Section prices. Indeed, Table II.C

TABLE II.C
THE INTERTEMPORAL RELATION BETWEEN DAILY RETURNS IN THE FIRST AND SECOND SECTIONS OF THE TSE

Regression model: $Y_t = Seasonals + \Sigma_{i=1}^{4}\alpha_i Y_{t-i} + \Sigma_{i=1}^{4}\beta_i X_{t-i} + u_t$

	First section return	Second section return
α_1	0.174*	0.312*
	(4.17)	(12.76)
α_2	−0.039	0.041
	(−1.76)	(1.66)
α_3	0.032	0.014
	(1.28)	(0.75)
α_4	−0.004	0.025
	(−0.02)	(1.51)
β_1	−0.039*	0.123*
	(−2.17)	(3.82)
β_2	0.042	−0.060*
	(1.83)	(−3.67)
β_3	−0.021	0.015
	(−1.13)	(0.81)
β_4	0.009	−0.018
	(0.53)	(−0.75)
R^2	0.023	0.171
Nobs	7839	7839
RMSE	0.716	0.582
Chi-square(4)	6.98	41.96*
P-value	[0.140]	[0.000]

Notes. The sample period runs from 10/03/1961, when data on the Second Section of the TSE become available, through 08/31/1988. *Y* and *X* refer to the daily ex-dividend returns in either the First or the Second Section of the TSE. Each equation includes six daily dummies: one for Monday, Tuesday, Wednesday, Thursday, and two for Friday depending on whether or not it was followed by Saturday trading; and eleven monthly dummies. *t*-statistics are in parentheses. The chi-square statistic tests the null hypothesis of no Granger causality, H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$. Each equation is estimated using OLS, but the standard errors are corrected for conditional heteroskedasticity and a moving average of order 24 with an autocovariance dampening factor of 0.5.

*Statistically significant at the 5 percent level in a two-tailed test.

TABLE III
DAILY RETURNS DURING PERIODS OF MARGIN CHANGES

Days from margin change	Decrease in margin		Increase in margin	
	First section	Second section	First section	Second section
−10	−0.031	0.009	0.285*	0.169
−9	−0.097	−0.073	0.219*	0.294*
−8	−0.153	−0.127	0.241*	0.185
−7	−0.200	−0.110	0.211	0.167
−6	−0.282*	−0.164	0.371*	0.312*
−5	−0.481*	−0.250*	0.231*	0.132
−4	−0.248*	−0.278*	0.238*	0.310*
−3	−0.386*	−0.175	0.312*	0.055
−2	−0.656*	−0.368*	0.358*	0.093
−1	−0.973*	−0.746*	0.402*	0.169
0	0.341*	−0.163	−0.143	0.060
1	0.231*	−0.105	−0.013	0.041
2	−0.077	−0.076	0.273*	0.119
3	−0.133	−0.046	−0.111	0.008
4	0.003	−0.073	0.253*	0.127
5	0.114	0.016	0.118	−0.103
6	0.068	−0.053	0.018	−0.166
7	−0.076	−0.100	0.196	−0.103
8	0.186	−0.031	−0.067	−0.069
9	0.210	0.145	0.068	0.140
10	0.010	0.026	0.019	0.099
11	−0.058	0.059	0.103	0.078
12	0.089	0.130	0.091	0.101
13	−0.147	0.036	0.063	0.031
14	0.127	0.014	0.077	0.092
15	0.046	−0.032	0.007	−0.049
16	−0.158	−0.078	0.174	0.150
17	−0.055	−0.059	0.116	0.091
18	0.090	0.061	−0.026	0.063
19	−0.095	0.025	−0.076	−0.018
20	0.100	−0.059	−0.065	−0.068
21	0.142	0.017	0.188	0.065
22	0.209	0.081	0.205	0.076
23	0.194	0.233*	0.090	0.056
Number of margin changes	44	41	52	47

Notes. Margin changes are announced after markets close on day −1 and become effective on day 0. Daily returns equal $100(\text{TOPIX}_t/\text{TOPIX}_{t-1} - 1)$ and do not include dividends. The daily average return and standard deviation over the full sample are 0.044 and 0.785, respectively, in the First Section; and 0.042 and 0.670 in the Second Section.

*Statistically significant at the 5 percent level in a two-tailed test.

confirms such an intertemporal relation across the two sections. It presents Granger causality tests between the stock returns of the two sections of the TSE. For brevity, the table reports the results of regressions that use only four lags, but the evidence is similar when the VAR is expanded to include 24 lags. Observe that returns in the First Section Granger cause returns in the Second Section, but returns in the Second Section do not Granger cause returns in the First Section. Thus, the larger company stocks of the First Section lead the smaller company stocks of the Second Section.[16]

Figure III shows that the increase in margin requirements is not able to reverse the overall trend in stock prices, but it does reduce it. Apparently, the TSE authorities cannot affect a bullish market as readily as they can affect a bearish market.[17] Observe that First Section stocks decline on the day of the change and the following day, whereas Second Section stocks continue their upward movement. Again, this is some—albeit weak—evidence that margin requirements do have a special role in First Section stocks.

Table III complements the information in Figures II and III. It presents the individual daily returns from day −10 to day +23, where day 0 denotes the day of a margin change. The table shows that statistically significant reversals are observed only in the First Section stocks following a decrease in margin requirements. The price reversals observed in the figures tend to be gradual; hence, day-to-day changes in prices are not statistically significant.

The overall results suggest that margin requirements do have a causal role, although it seems that other factors may also come into play.[18]

16. The presence of price limits may be one reason for the positive autocorrelation in daily stock returns. In the case of Second Section stocks, infrequent trading in some stocks and, hence, stale prices in the index, may be another reason for the positive autocorrelation.

17. When equation (3) of Table II.A is estimated separately for positive and negative margin changes, it produces statistically significant slope coefficients in both cases. The size of the coefficient in the case of positive margin changes is, however, about two thirds the size of the response in the case of negative margin changes.

18. One objection to the interpretation of true causality that we frequently encounter is the following: an unusual upswing in stock prices would eventually subside by itself; the margin decrease (increase) is innocuous and simply happens to occur because of the previous fall (increase) in prices. There are many answers to this claim. First, an *immediate* reversal in prices can occur by chance with very low probability. Second, stock prices in the Second Section do not reverse their trend immediately. Third, in Hardouvelis and Peristiani [1990] we present a time series model in which we control for stock price swings and show that margin requirements continue to have a negative impact on stock returns.

Another objection to the interpretation of true causality is based on the

V. Margin Requirements and the Volatility of Daily Returns

We now turn to daily stock return volatility. The effect of margin changes on volatility helps us determine whether margin requirements restrict the behavior primarily of destabilizing or stabilizing investors. If the market is dominated by destabilizing investors and, as the following section shows, an increase in margin requirements restricts them from trading, we should observe a decrease in volatility. However, if the market is dominated by rational investors, an increase in margin requirements that causes a drop in market participation by rational investors will lead to an increase in volatility.

V.A. The Relation Between Volatility and Returns

Before we examine the effect of margin requirements on volatility, we investigate the possible presence of a negative relation between stock returns and volatility. This negative relation is a stylized fact about the stock market in the United States [Black, 1976; Christie, 1982]. The presence of such a relation in Japan would imply that stock returns should be a control variable in our regressions of volatility on margin requirements. A failure to account for such a relation would generate a spurious positive correlation between changes in margin requirements and changes in volatility because an increase in margin requirements causes a decrease in stock returns, and the decline in stock returns would subsequently cause an increase in volatility.

Let R_m denote the average daily return of the month, and let σ_m denote the volatility of daily returns, defined as the standard deviation of the residuals of separate second-order autoregressive models of daily returns of each month. The simple correlation between σ_m and R_m is -0.25, while the rank correlation is -0.12. A more precise regression of contemporaneous volatility on contem-

potential presence of superior information among regulators. If regulators, for example, have private information that the underlying fundamentals do not support the existing optimism among investors about the stock market, they will increase margin requirements to avert a possible future abrupt collapse in stock prices. In such case, the increase in margin requirements acts as a mere signal to market participants that the economic fundamentals do not justify their enthusiasm about the market's future prospects. Stock prices would then decline not because the margin requirement became a more binding constraint, but only because it represented adverse news about economic fundamentals. This hypothesis, however, predicts the same response in the two sections of the TSE, a prediction rejected by the data.

poraneous return leads to the following results:

$$\sigma_m = \underset{(0.037)}{0.625} - \underset{(0.064)}{0.466}\, R_m, \tag{6}$$

$$R^2 = 0.067, \quad RMSE = 0.328, \quad DW = 1.12,$$
$$\text{Sample: } 5/49\text{–}8/88, \quad 447 \text{ observations},$$

where R^2 denotes the coefficient of determination, *RMSE* the root mean squared error of the regression, *DW* is the Durbin-Watson statistic for first-order serial correlation, and standard errors are in parentheses. Regression equation (6) shows that an increase in stock returns of 1 percent is associated with a decline in volatility of 0.47 percent.[19]

V.B. Margin Requirements and Volatility

We now turn to the main theme of this section: the relation between the change in volatility and the change in the effective margin requirement during intervals of 24 business days surrounding the margin change. As in the previous section we estimate the various relations over the whole sample and over two subperiods. However, in the interest of brevity, we only present the results for the definition of the effective margin requirement of equation (1b). We show the univariate OLS results as well as the results of regressions that incorporate control variables:

$$\Delta\sigma_i = \alpha_0 + \alpha_1 \Delta M_i + \alpha_2 \Delta R_i + \alpha_3 \Delta V_i + u_i, \tag{7}$$

where $\Delta\sigma_i$ represents the change in the level of volatility for a 24-day interval before and after the margin change i, ΔM_i is the change in margin requirements defined in Table II.A, ΔR_i is the change in cumulative ex-dividend stock returns, and ΔV_i represents the change in the growth of trading volume from the first 24-day period interval to the second and is defined in Table V. We include volume as an additional control because, according to Table V, the change in margin requirements and the change in volume are correlated, and it is possible that volatility and volume are also correlated. Nevertheless, we also show the results without this additional control.[20]

19. The coefficient estimates were obtained by a maximum likelihood method that corrected for the presence of a fourth-order autoregressive model of the errors. The results are comparable when the regression equations are in first differences or when reverse regressions of return on volatility are performed.

20. We have repeated the regressions using as a dependent variable the ratio of volatility to trading volume and the results are similar. Also the results are robust to

Table IV presents the results. The regression with no extra control variables shows the total effect of margin requirements on unconditional volatility. This effect is slightly negative but statistically insignificant. However, when the change in stock returns is included in the regression to obtain a more correct specification, the size of the volatility response to a change in margin requirements increases substantially and becomes statistically significant. A regression coefficient of -0.00968 implies that, holding stock returns constant and assuming a loan value of 70 percent, an increase in margin requirements from 50 to 60 percent would cause a decline in the volatility of daily returns of 0.00968×14.3, or 0.138, which is about one fifth the size of sample volatility. Observe that including volume as an additional control variable does not affect the results.

Table IV also shows that the impact of a change in margin requirements on volatility did not diminish during the 1980s, a period of deregulation in the Japanese markets. In fact, the negative regression coefficients increase after 1978 in all specifications of the regression equation.

Since Table IV uses a horizon of 24 business days, or approximately one month, estimates of α_2 in Table IV can be compared with the regression coefficient of R_m in equation (6) above. In fact, the estimate for the full sample in the regression that excludes trading volume is -1.021, while the estimate given by equation (6) is considerably lower at -0.466. This discrepancy is due to the fact that the regressions in Table IV use the 96 margin changes, while the regression of equation (6) uses all 447 monthly observations.[21] The discrepancy between the coefficient -1.021 of Table IV and the coefficient -0.466 of equation (6) raises the question of whether returns carry too much of a weight in the volatility regressions of Table IV and thus cause the margin coefficient to be significantly negative. To answer this question, we reestimated the same equation in Table IV by restricting the coefficient of ΔR_i to equal -0.466. In the restricted regression the estimated coefficient of ΔM_i is -0.0047 with a t-statistic of -2.97. When volume is included

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the precise measure of volatility. As in equation (6), Table IV uses the standard deviation of residuals obtained from a second-order autoregression over each individual time interval. Using the simple standard deviation of daily returns provides similar results. Similar results are also obtained when using the standard deviation of bi-daily returns to avoid a possible bias arising from the presence of daily price limits on individual stock prices.

21. When we reestimate equation (6) using only the 78 months characterized by at least one margin change, the regression coefficient becomes -0.998, which is more comparable to the estimate of -1.021 of Table IV.

TABLE IV

THE EFFECT OF MARGIN REQUIREMENTS ON STOCK RETURN VOLATILITY

Regression model, first section: $\Delta\sigma_i = \alpha_0 + \alpha_1 \Delta M_i + \alpha_2 \Delta R_i + \alpha_3 \Delta V_i + u_i$

Second section: $\Delta\sigma_i^{SS} = \beta_0 + \beta_1 \Delta M_i + \beta_2 \Delta R_i^{SS} + v_i$

	First section				Second section	
Full sample:	06/01/51–06/03/88				10/11/61–06/03/88	
α_0	0.106*	0.136*	0.130*	β_0	0.076*	0.073*
	(2.37)	(3.51)	(3.49)		(2.49)	(2.28)
α_1	−0.0011	−0.0091*	−0.0093*	β_1	−0.0007	−0.0015
	(−0.59)	(−4.84)	(−4.92)		(−0.54) [0.31]	(−1.10) [3.52]
α_2		−1.022*	−.981*	β_2		−0.226*
		(−7.02)	(−6.49)			(−2.01) [4.45]
α_3			−0.009			
			(−0.95)			
R^2	0.004	0.349	0.355		0.003	0.049
Nobs	96	96	96		88	88
RMSE	0.440	0.358	0.357		0.302	0.296
F-stat	1.21	3.70*	3.07*		0.69	7.47*
$t(\alpha_1)$	1.40	3.18*	3.37*	$t(\beta_1)$	1.18	2.06*
$t(\alpha_2)$		2.70*	2.56*	$t(\beta_2)$		4.55*
$t(\alpha_3)$			0.24			

TABLE IV (CONTINUED)
THE EFFECT OF MARGIN REQUIREMENTS ON STOCK RETURN VOLATILITY

Regression model, first section: $\Delta\sigma_i = \alpha_0 + \alpha_1 \Delta M_i + \alpha_2 \Delta R_i + \alpha_3 \Delta V_i + u_i$
Second section: $\Delta\sigma_i^{SS} = \beta_0 + \beta_1 \Delta M_i + \beta_2 \Delta R_i^{SS} + v_i$

	First section			Second section		
Full sample:	06/01/51–06/03/88			10/11/61–06/03/88		
First subperiod:	06/01/51–04/03/78			10/11/61–10/20/78		
α_0	0.068	0.097*	0.085*	β_0	0.075	0.078
	(1.58)	(2.41)	(2.07)		(1.74)	(1.81)
α_1	0.0013	−0.0031	−0.0031	β_1	0.0008	0.0013
	(0.79)	(−1.58)	(−1.56)		(0.45) [0.58]	(0.75) [1.56]
α_2		−0.575*	−0.523*	β_2		0.138
		(−3.70)	(−2.95)			(0.99) [3.14]
α_3			−0.012			
			(−0.97)			
R^2	0.013	0.215	0.232		0.005	0.028
Nobs	48	48	48		44	44
RMSE	0.297	0.268	0.268		0.284	0.285

Second subperiod:	04/04/78–06/03/88			03/19/79–06/03/88		
α_0	0.133*	0.146*	0.138*	β_0	0.072	0.065
	(1.69)	(2.22)	(2.35)		(1.74)	(1.68)
α_1	−0.0038	−0.0148*	−0.0157*	β_1	−0.0023	−0.0042*
	(−1.12)	(−4.77)	(−4.89)		(−1.10) [0.95]	(−2.50) [3.03]
α_2		−1.343*	−1.280*	β_2		−0.740*
		(−6.21)	(−5.72)			(−4.78) [2.24]
α_3			−0.015			
			(−1.06)			
R^2	0.026	0.476	0.489		0.031	0.378
Nobs	48	48	48		46	46
RMSE	0.545	0.405	0.404		0.320	0.259

Notes. See the notes to Table II.A. $\Delta\sigma_i$ and $\Delta\sigma_i^{SS}$, denote the change in the volatility of daily returns in the First and Second Section over two 24-business day horizons before and after the ith change in the margin requirement; volatility σ is the standard deviation of the residuals e_t of separate second-order autoregressions of daily returns, r_t, for each 24-business day horizon: $r_t = \gamma_0 + \gamma_1 r_{t-1} + \gamma_2 r_{t-2} + e_t$. ΔR and ΔR^{SS} are defined in Tables II.A and II.B; ΔM refers to the effective margin of equation (1b) and is also defined in Table II.A; ΔV refers to trading volume and is later defined in Table V. The sample for Second Section stocks is smaller because data become available in October 1961. Trading volume data for the Section Section are not available. F-stat tests for parameter stability across the subperiods of all coefficients, while $t(\alpha_i)$ or $t(\beta_i)$ tests for parameter stability of an individual coefficient. Inside the brackets are t-statistics for the null hypothesis that the response coefficients are equal across the two sections of the TSE, H_0: $\alpha_i = \beta_i$, $i = 1, 2$.

*Statistically significant at the 5 percent level in a two-tailed test.

as an additional control, the coefficient of ΔM_i in the restricted regression -0.0061 with a t-statistic of -3.59.[22]

Turning to the volatility of Second Section stock returns, observe that the effect of margin requirements on conditional volatility is significantly weaker. The t-statistic of the null hypothesis of equality in the conditional volatility responses across the two markets is 3.52. Volatility in the Second Section does show some negative response but only in the second subperiod. This weak negative response may simply be an artifact of the fact that Second Section stock prices tend to follow First Section stock prices.

The negative response of conditional volatility does not imply that the TSE can affect volatility. It simply shows that the imposition of margin requirements constrains the behavior of primarily destabilizing speculators. The hypothesis that margin requirements constrain the behavior of rational investors is rejected because in a rationally priced market, higher margin requirements that decrease liquidity, should have increased conditional volatility.

VI. The Effects on Margin Borrowing and Margin Trading

If an increase in margin requirements restricts the activities of investors, it should affect margin borrowing as well as the volume of trading based on margin accounts. In this section we analyze four quantity variables that capture the market behavior of margin investors. The first variable is total daily trading volume. Two additional variables are weekly: the total number of outstanding shares bought and sold using margin funds. The fourth variable is the monthly ratio of the flow of trades that use margin funds to the total trade flow.

Table V presents the regression results over a horizon of 24 business days. The independent variable ΔM_t is the same as in Tables II and IV. Among the four dependent variables, only total trading volume can be matched exactly with a change in margin requirements because it is available daily. The other three variables contain some mismatch that is unavoidable. To minimize the degree of mismatching, we transformed all variables to the daily

22. Running equation (6) over the months with no margin changes provides a slope estimate of -0.303. We also reestimated the conditional volatility equations of Table IV by restricting the coefficient of ΔR_i to equal -0.303 instead of -0.466. The coefficient of ΔM_i in the new restricted equation is -0.0035 with a t-statistic of -2.08. When volume is included as an additional control, the coefficient of ΔM_i in the restricted regression is -0.0049 with a t-statistic of -2.79.

TABLE V

THE EFFECT OF MARGIN REQUIREMENTS ON MARGIN BORROWING, TRADING VOLUME, AND MARGIN TRADING VOLUME

	Dependent variable			
	Margin borrowing shares bought	Margin borrowing shares sold	Total trading volume	Margin trading over total trading
Full sample	03/06/70 06/03/88	03/06/70 06/03/88	06/01/51 06/03/88	10/16/58 06/03/88
Constant	−0.0078	0.228	−0.610	−0.032
	(−0.10)	(1.15)	(−1.37)	(−0.10)
ΔM	−0.010*	−0.024*	−0.073*	−0.077*
	(−2.96)	(−2.89)	(−4.06)	(−6.02)
R^2	0.104	0.104	0.149	0.285
Nobs	77	77	96	93
RMSE	0.71	1.74	4.35	3.00
F-stat	2.55	1.71	1.39	16.59*
t-stat	2.10*	1.48	0.25	5.76*
First subperiod	03/06/70 07/23/79	03/06/70 07/23/79	06/01/51 04/03/78	10/16/58 04/03/78
Constant	−0.046	0.056	−1.401*	0.10
	(−0.39)	(0.25)	(−2.13)	(0.21)
ΔM	−0.017*	−0.036*	−0.063*	−0.102*
	(−3.33)	(−3.74)	(−2.81)	(−5.35)
R^2	0.243	0.280	0.125	0.399
Nobs	38	38	48	45
RMSE	0.72	1.38	4.35	3.29
Second subperiod	07/24/79 06/03/88	07/24/79 06/03/88	04/04/78 06/03/88	04/04/78 06/03/88
Constant	0.062	0.429	0.044	−0.019
	(0.58)	(1.41)	(0.07)	(−0.05)
Δm	−0.003	−0.011	−0.076*	−0.046*
	(−0.72)	(−0.88)	(−2.73)	(−2.85)
R^2	0.013	0.021	0.139	0.150
Nobs	39	39	48	48
RMSE	0.67	1.99	4.44	2.59

Notes. ΔM refers to the effective margin of equation (1b) and is defined in Table II.A. Margin borrowing is the change in the average net flow of shares borrowed on margin from the 24-business-day period before to the 24-business day period after the change in margin requirements, divided by the average stock of borrowed shares outstanding in margin accounts during the 24-business day period before the margin change. Trading volume equals $(\Delta V_A - \Delta V_B)/V_B$, where $\Delta V_A(\Delta V_B)$ is the average daily change in the trading volume over the 24 business days after (before) the margin change, and V_A is the average daily trading volume during the 24-business day period before the margin change. Margin trading over total trading is the change in the average percentage ratio from the 24-business-day period before to the 24-business-day period after the margin change. Margin borrowing is a weekly series; and margin over total trading is a monthly series; and, hence, in the above definitions, each business day takes the week's or the month's value. *F*-stat tests for parameter stability across the two subperiods of both coefficients, while *t*-stat tests only for the ΔM coefficient. The beginning of the sample periods is dictated by data availability. See also the notes of Table II.A.

*Statistically significant at the 5 percent level in a two-tailed test.

frequency by assigning to each business day the week's value of margin borrowing or the month's value of the ratio of margin trading to total trading. For example, five consecutive business days typically have the same number of shares bought or sold on margin; 24 consecutive business days may have the same ratio of margin trading to total trading. Subsequently, we defined the dependent variables as follows. First, margin borrowing for shares bought equals $(\Delta SB_A - \Delta SB_B)/SB_B$, where ΔSB_A (ΔSB_B) is the average change in the total open interest in the number of shares bought on margin over the interval of 24 business days after (before) the change in margin requirements, and SB_A is the average open interest in the number of shares bought on margin during the 24-business-day period before the change in margin requirements. We difference the open interest in the number of shares bought because it is a nonstationary series and because we want to transform the open interest, a stock variable, into a flow variable in order to reflect new borrowing. We divide by SB_B to correct for heteroskedasticity across time because the size of the flow of shares bought on margin and hence the size of the monthly changes in that flow increases over time. Second, margin borrowing for shares sold short on margin is defined in a manner similar to margin borrowing for shares bought on margin. Third, trading volume equals $(\Delta V_A - \Delta V_B)/V_B$, where ΔV_A (ΔV_B) is the average daily change in the trading volume over the interval 24 business days after (before) the change in margin requirements, and V_B is the average daily trading volume during the period of 24 business days before the change in margin requirements. We difference the daily trading volume because it is a nonstationary series, and we divide by V_B to correct for heteroskedasticity across time because the size of trading volume and hence the size of changes in trading volume increases over time. Fourth, margin trading over total trading is the change in the average ratio of trading due to margin accounts over total trading from the period of 24 business days preceding the margin change to the period of 24 business days following the margin change.

Table V shows a statistically significant negative effect on margin borrowing by both long-buyers and short-sellers. This negative effect is consistent with the hypothesis that an increase in margin requirements imposes a higher cost on investors in the stock market and consequently forces them to reduce their flow of borrowing from brokers and dealers. Of course, this negative effect alone does not necessarily imply that margin requirements repre-

sent an effective overall restriction on investor activity. If investors have alternative methods of leveraging themselves at no extra cost, then after an increase in margin requirements, they would simply substitute one form of debt for another and continue to buy or sell the securities they intend to trade irrespective of the level of margin requirements. To explore this possibility, we examine the actual trading activity of investors.

Table V also shows a clear negative and significant effect on both total trading volume and the ratio of trading due to margin activity. These negative relationships show that margin requirements not only restrict the amount of credit available to investors but also result in less trading activity. Furthermore, the evidence on the fraction of trading due to margin accounts implies that trading volume based on margin funds falls proportionately more than the trading volume of nonmargin investors. The *stronger* impact on investors who rely on margin funds implies that margin requirements are restrictive. Hypotheses that are based on third factors cannot explain this result.

The subperiod results for total trading volume show similar responses to margin changes in the two halves of the sample. The other three variables show weaker responses in the second subperiod, although the difference in responses across the subperiods is statistically significant only for shares bought on margin.

VII. Trading Activity by Different Groups of Investors

The previous section showed that trading volume declines following an increase in margin requirements and, furthermore, that trading volume through margin accounts declines proportionately more. In this section we examine more closely the trading activity of different groups of investors. The aim is to determine whether market professionals are better market timers than individuals and other nonprofessionals. A growing body of academic literature on the causes of the observed excessive stock price fluctuations in the United States and abroad claims that noise traders—nonprofessionals who follow fads instead of paying attention to company fundamentals—cause the market to deviate from fundamental values for long periods (see, for example, De Long, Shleifer, Summers, and Waldman [1990b], or Cutler, Poterba, and Summers [1990]). Given our evidence on the negative impact of margin requirements on the momentum of stock prices and the conditional volatility of their returns, it is worth examining

whether it is indeed noise traders who are primarily affected by changes in margin requirements.

The TSE publishes weekly data on the number of shares bought and sold by TSE members and nonmembers (customers). Members of the exchange are brokers and dealers who can trade on behalf of their own accounts or their customers' accounts.[23] Trading volume data on customer accounts are separated by type of customer: corporations, securities companies, individuals, and foreigners. Furthermore, corporations are divided into financial institutions (insurance companies, banks, and other financial institutions), investment trusts, business corporations, and other corporations. A priori, it is difficult to assess which group of investors would be composed of rational investors and which group would be composed primarily of noise traders. The presumption, however, is that individuals are more likely to follow fads and to be noise traders than are market insiders such as TSE member firms.

Table VI.A repeats the trading volume regressions of Table V for each of the different groups. There is a statistically significant decline in the trading volume of almost all the groups. This result should not be surprising because all groups use margin funds, even some TSE members, who typically use those funds to sell stocks short. A somewhat surprising result, however, is the lack of a distinctively stronger response by individuals. Although the TSE does not publish any data on each group's margin trading activity, from unofficial conversations we know that individuals are the heaviest users of margin funds.

Table VI.B provides information on the market timing ability of each group in the instances that margin requirements change. The dependent variable is now a function of the difference between the number of shares bought and sold. We compute the change in net buying from day -24 to day -1, the change in net buying from day 0 to day 24, and then regress the difference between these ex post and ex ante changes (after we divide by the ex ante trading volume to correct for heteroskedasticity) on the change in margin requirement, ΔM. We separated the events into negative and positive margin changes because Figures II and III show that a clear reversal in stock prices follows a margin decrease, while only a slowdown in the growth of stock prices follows a margin increase.

23. As of the end of 1989 the TSE had 114 members. Note that members cannot act as market makers. Members place their orders with one of the four companies at the TSE, called *saitori,* who execute them according to well-specified rules. The *saitori* are not allowed to trade on behalf of their own accounts.

TABLE VI.A
THE EFFECT OF MARGIN REQUIREMENTS ON THE TRADING ACTIVITY OF DIFFERENT GROUPS OF INVESTORS

Regression model: $\Delta VOL_i = \alpha_0 + \alpha_1 \Delta M_i + \epsilon_i$

					Fraction trading		
Group	α_0	α_1	R^2	*RMSE*	Mean	Min	Max
Individuals	−0.004	−0.069*	0.148	3.93	0.427	0.196	0.675
	(−0.01)	(−3.21)					
TSE members	0.228	−0.097*	0.316	3.41	0.250	0.122	0.393
	(0.52)	(−5.22)					
Foreigners	−0.402	−0.083*	0.257	3.37	0.077	0.016	0.213
	(−0.93)	(−4.52)					
Insurance cos.	−0.632	−0.007	0.004	2.57	0.011	0.002	0.048
	(−1.79)	(−0.47)					
Banks	0.147	−0.059*	0.104	4.14	0.054	0.002	0.227
	(0.28)	(−2.62)					
Other fin. inst.	0.336	−0.098*	0.129	6.13	0.006	0.001	0.029
	(0.53)	(−2.95)					
Investment trusts	−0.181	−0.088*	0.304	3.19	0.053	0.017	0.122
	(−0.44)	(−5.08)					
Business cos.	−0.131	−0.099*	0.240	4.21	0.079	0.033	0.185
	(−0.24)	(−4.32)					
Securities cos.	−0.192	−0.056*	0.172	2.96	0.028	0.012	0.054
	(−0.51)	(−3.51)					
Other corporations	0.238	−0.068*	0.177	3.53	0.010	0.003	0.022
	(0.53)	(−3.56)					

Notes. The sample consists of 61 observations from 08/12/74 through 06/03/88. ΔVOL_i is defined as in Table V, namely $(\Delta V_A - \Delta V_B)/V_B$, but the data are available only weekly; hence a week's trading volume is assigned to every trading day of that week. The fraction of trading denotes the ratio of each group's trading volume to the sum of the trading volumes of all the groups; the statistics, mean, min, and max are calculated over the entire sample period.

*Statistically significant at the 5 percent level in a two-tailed test.

The change in the net buying behavior of a group following a decrease in margin requirements provides information on its timing ability. If investor's net buying activity increases as stock prices decline before the decrease in margin requirements, and then increases as stock prices rebound after the decrease in margin requirements, the investor makes positive profits.

The first set of columns in Table VI.B show that individuals and insurance companies have a statistically significant positive

TABLE VI.B
MARGIN CHANGES AND MARKET TIMING BY DIFFERENT GROUPS OF INVESTORS

Regression model: $\Delta NETBUY_i = \beta_1 \Delta M_i + \nu_i$

	Decrease in margin			Increase in margin		
Group	β_1	R^2	*RMSE*	β_1	R^2	*RMSE*
Individuals	0.013*	0.384	0.40	0.003	0.073	0.24
	(4.18)			(1.56)		
TSE members	−0.013*	0.297	0.49	−0.010*	0.231	0.45
	(−3.44)			(−3.05)		
Foreigners	−0.045*	0.299	1.77	−0.025*	0.203	1.19
	(−3.46)			(−2.81)		
Insurance cos.	0.053*	0.136	3.22	0.037	0.072	3.17
	(2.10)			(1.55)		
Banks	0.000	0.000	2.13	0.011	0.039	1.42
	(0.02)			(1.11)		
Other financial inst.	0.021	0.088	1.60	0.035	0.094	2.55
	(1.64)			(1.78)		
Investment trusts	−0.005	0.004	1.78	0.015	0.049	1.54
	(−0.35)			(1.26)		
Business cos.	0.010	0.050	1.00	0.017*	0.163	0.91
	(1.27)			(2.46)		
Securities cos.	0.004	0.025	0.60	0.001	0.005	0.43
	(0.85)			(0.39)		
Other corporations	−0.011	0.026	1.66	0.011	0.047	1.16
	(−0.13)			(1.24)		

Notes. The sample consists of 61 observations (29 negative and 32 positive changes in margin requirements) from 08/12/74 through 06/03/88. $\Delta NETBUY_i$ equals $(\Delta B_{A,i} - \Delta B_{B,i})/V_{B,i}$, where $\Delta B_{A,i}$ ($\Delta B_{B,i}$) denotes the average daily change in the net number of shares bought (number of shares purchased minus number of shares sold) over the 24-business-day period after (before) the ith change in margin requirements; and $V_{B,i}$ denotes, similar to Table V, each group's average trading volume (number of shares bought plus number of shares sold, divided by two) of the 24-business-day period before the ith change in margin requirements. Because data on the number of shares bought or sold are available only weekly, we assign the week's value to each trading day of that week, as in Table V.

*Statistically significant at the 5 percent level in a two-tailed test.

response to a decrease in margin requirements and are therefore both good timers. TSE members and foreigners show a statistically significant negative response and hence are bad market timers. Foreigners may not be well acquainted with the Japanese stock price fluctuations, but the negative response of TSE members is somewhat surprising. TSE members are the insiders, who should have taken advantage of stock price fluctuations around the days of a margin change. Yet, it is the individuals, the outsiders, who take advantage of those fluctuations!

The net buying response after an increase in margin require-

ments is harder to interpret. Since stock prices continue to rise after an increase in margin requirements, good market timers ought to show no response. Indeed, both individuals and insurance companies that had shown market timing ability at times of margin decreases do not respond to margin increases. TSE members and foreigners, who had shown bad timing ability at times of margin decreases, tend to reduce their net buying as the growth in stock prices declines following margin increases. Such behavior does not reflect bad market timing.

One could only speculate on the reason for the bad market timing shown by TSE members when margin requirements decrease. One possibility is that TSE members follow positive feedback strategies: they buy when market prices rise and sell when market prices fall, because they rationally jump on the bandwagon of other irrational feedback participants instead of bucking the trend. De Long, Shleifer, Summers, and Waldman [1990a] argue that such behavior can be rational and, furthermore, characterizes many market insiders in the U. S. stock market. Another possibility is that member firms are passive respondents to the needs of their clients, who time the market very well around the days of margin changes.

Overall, the results of Tables VI.A and VI.B suggest that no simple account based on noise traders can explain the effects of margin requirements on stock prices and trading activity. We are, therefore, left with a puzzle. Neither a story based on rational investors nor a story based on noise traders can provide a fully satisfactory explanation.

VIII. Conclusions

This study of the effects of margin regulation in the Japanese stock market over the last 35 years demonstrated that changes in margin requirements have had a considerable influence on investor participation in the market and on the determination of stock prices throughout the entire sample period as well as the subperiod of the 1980s. Higher margin requirements are associated with lower overall trading volume, lower amounts of margin borrowing for either buying stocks or selling them short and, more interestingly, a lower proportion of total trading performed by investors who use margin funds. Hence in the Japanese stock market margin requirements bite: they constrain both the borrowing and the trading activity of investors.

Changes in margin requirements are negatively correlated with changes in the growth of stock prices. The correlation is stronger when, following rapid declines in stock prices, the TSE decreases margin requirements. In this case stock prices rebound immediately, although they do not completely reverse to the price level of the previous month right away. In the opposite case, when the TSE responds to rapid increases in stock prices by increasing margin requirements, the growth in stock prices declines, but the level of prices declines only temporarily.

The negative correlation between changes in margin requirements and changes in the rate of growth of stock prices does not necessarily imply causation from the former variable to the latter. Several alternative mechanisms could generate the correlation, such as the expectation of coordinated monetary or fiscal policies, the possession of superior information by the TSE about the macroeconomy, or simply the coincidence of margin changes with inevitable reversals in stock returns. These alternative mechanisms may have some role in the price reactions, yet they do not fully conform with all the empirical evidence.

The most striking piece of evidence in favor of the hypothesis of true causality from margin requirements to stock prices and against alternative hypotheses comes from a comparison of First Section with Second Section prices. Unlike First Section stocks, Second Section stocks are not eligible for margin borrowing. The hypothesis of true causality predicts a stronger response by First Section prices, whereas all the other hypotheses predict a similar response in the two sections of the TSE. We found that although at the monthly level stock returns in the two sections move almost one-for-one during months of no margin changes, and although at the daily level Second Section stocks tend to follow First Section stocks, the two indices behave quite differently after a margin change. First Section prices respond to the margin change immediately, whereas Second Section prices continue their previous trend and reverse that trend only with a considerable delay.

Daily volatility is unaffected by changes in margin requirements. However, controlling for the level of stock returns, the effect on conditional volatility is negative and statistically significant. This negative effect is stronger in the First Section than in the Second Section. The results on unconditional volatility suggest that the TSE cannot use margin requirements—and it does not—in order to affect daily volatility. The results on conditional volatility suggest that the restrictive effect of margin requirements

falls primarily on destabilizing speculators rather than rational investors. An increase in margin requirements implies that fewer destabilizing speculators trade in the market, and controlling for the stock price change, the market becomes less volatile.

A further examination of the behavior of different groups of investors, however, does not provide evidence consistent with our expectations of who those destabilizing speculators might be. For example, individual investors, who are apparently the most active users of margin funds, are good market timers: before a margin decrease, as stock prices decline, individuals increase their net buying activity; after the margin decrease, when prices increase, individuals increase their net selling activity. In contrast, TSE members, the presumed market insiders, are bad market timers.

We conclude that margin requirements in Japan, besides being an effective constraint on the trading activity of investors, counteract a previous run-up or run-down in stock prices and adversely affect conditional daily volatility. However, no simple story based either on rational investors or noise traders, can account for the volatility effects.

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