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Are Japanese margin buyers informed?☆

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ABSTRACT

Using Japanese long sample (1977–2010) market data, we examine whether margin buying is informed trades about future stock returns and whether they are related to undervaluation of the market. We find that margin buying increases when temporary returns are higher contemporaneously. We do not find that Japanese margin buying is well-informed in predicting future permanent changes in stock returns. Further, we find that margin buying is not related to the undervaluation of stock market prices.

1. Introduction

Margin buying (also known as margin purchase or buying on margin) refers to the purchase of stocks by borrowing money from a broker, which allows investors to buy more stocks than they would be able to normally do. It is a natural consequence of investment by credit based on market predictions. Regulators believe that margin buying could destabilize stock markets; consequently, they continuously monitor the margin-buying behavior of investors. While a number of studies have investigated short selling as an important policy issue, margin buying has been neglected in the academic context despite the fact that margin buying is a mirror image of short sales to some extent.[2]

Chang, Luo, and Ren (2014) find that intensified margin-buying activities are related to lower contemporaneous returns; however, these trades have no predictive power in terms of stock returns in China. Hirose, Kato, and Bremer (2009) were the first to test the relationship between margin buying and stock returns for Japan. Their market-level and firm-level analyses show that margin buying traders follow herding behavior. However, their study focuses on the role of margin

☆ The first author, Bong-Soo Lee, died in early 2015. This paper is dedicated to the memory of Bong-Soo Lee, an outstanding scholar and mentor. This work was supported by a 2-Year Research Grant from Pusan National University.

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[2] The effects of short sales on stock markets have long been a major concern for regulatory bodies as well as practitioners and academics. Critics argue that short selling encourages speculation and pushes stock prices down, sometimes in a panicked market. Advocates argue that it provides important information about investor views on companies and maintains liquidity as well. The most debatable issue is whether short sales exert an unfavorable effect on stock prices. During the global financial crisis in 2008, many regulators restricted stock market participants from selling short. Academics have generally argued that such restrictions are against both the efficiency of the price discovery process as well as the enhancement of market liquidity. Financial historians warned that the bans in 2008 did not work and that such measures were often driven more by political concerns than by proved market theories. Meanwhile, at an aggregate market level, Ko and Lim (2006) find that short selling information cannot be used as an indicator for predicting future stock markets.

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buying as a market sentiment in herding behavior of investors, not on the dynamic lead and lag relationship between changes in margin buying and stock market returns.

There are two types of margin buying similar to short selling in Japan: standardized margin buying and negotiable margin trading. Margin buying in Japan mainly involves individual investors, which implies that margin buying reflects a sentiment of individual investors, not that of institutional investors. Kamesaka, Nofsinger, and Kawakita (2003) and Ko, Kim, and Cho (2007) find that individual investors in the Japanese stock markets are not well-informed.[3] When we combine the findings of all the relevant empirical studies and Japanese margin-buying characteristics, we can hypothesize that Japanese margin buying must be a consequence of past returns; however, it is not likely to predict future returns.

This study examines whether margin buying is informed trades about future stock returns and whether margin buying helps to predict future stock returns, especially the future permanent component of returns in addition to the temporary component of returns. We are interested in the relation between margin buying and the future permanent component of stock returns because if margin buyers are informed traders and contribute to future returns, they should be informed about the future permanent component of returns as well as the temporary component of returns. Additionally, we examine whether margin buying is associated with current undervaluation.

To examine the above issues, we propose an empirical framework that helps us identify the permanent and temporary components of stock returns, test whether margin buying involves informed decisions, and identify over- and undervaluation of the market prices. We use Japanese market data for more than 30 years (1977–2010) to study the effect of margin buying on stock prices at an aggregate market level. This study is different from the extant literature like Hirose et al. (2009) in the following respects: First, we employ a structural vector auto-regression approach to study the dynamic behavior of margin buying and stock returns at an aggregate market level. Second, market returns are decomposed into fundamental and non-fundamental parts to investigate the relationship between margin-buying behavior and undervaluation of stock prices. Finally, we also analyze the interrelationship between margin buying and short selling. Asian market regulators generally tend to be more concerned about the effect of margin buying on stock prices at an aggregate market level than at an individual stock level.[4] Hence, understanding the nature of margin buying is important for making stock market policies in Japan.

The remainder of the paper is organized as follows. In Section 2, we describe the data. Section 3 explains how to identify the permanent and temporary components of stock returns based on a bivariate time-series model. We then discuss how to test whether margin buying constitutes informed trading based on the potential information asymmetry between investors and present empirical estimation results. Section 4 discusses how to identify over- and undervaluation of the stock market based on a multivariate time-series representation. The final section summarizes our findings and concludes the paper.

2. Data

We collect data from each issue of the Monthly Statistics Report (MSR) of the Tokyo Stock Exchange (TSE). The weekly margin-buying interests of the TSE are obtained from the section entitled "Outstanding Margin Transactions" of the MSR. We reassemble monthly margin-buying interests from the weekly data. Weekly data of margin buying are used for testing its information role. Monthly data are used for testing its relationship with over- and undervaluation of stock prices because market fundamentals such as earnings, dividends, and discount rates are available on a monthly basis. Because the TSE has reported weekly data since September 1977, this study covers the sample period from October 1977 through April 2010. The MSR gives us all the other stock market data. Until 1990, margin buying had been allowed only for stocks in the first trading section; at present, it is allowed for the stocks designated by the TSE.[5] Thus, the Tokyo Stock Price Index (TOPIX) is used for calculating market returns, i.e., the value-weighted stock index of the TSE first trading section.

Table 1
Descriptive statistics.
This table shows descriptive statistics for margin buying (MB), short selling (SI), and market return for the TOPIX. The sample period is from October 1, 1977 to April 30, 2010. Panel A gives weekly statistics and Panel B, monthly statistics.

Variable	Average	Autocorrelation	Dickey–Fuller stat.	Correlation coefficients	
				Short (SI)	Market return
Panel A. Weekly statistics (# of observations = 1667)					
Margin (MB)	−.0038***	.0817***	−37.59***	.1610***	.0915***
Short (SI)	−.0014***	.1977***	−33.40***		.2156***
Market return	.0009	−.0370	−42.33***		
Panel B. Monthly statistics (# of observations = 391)					
Margin (MB)	−.0023***	.3420***	−13.79***	.2515***	.2930***
Short (SI)	−.0003	−.0691	−21.11***		.2823***
Market return	.0039	.0668	−18.43***		

*, **, *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Like short interests, margin-buying interest at time t is the sum of 'margin-buying interests' for all stocks available in the stock market. The investors' behavior of margin buying for the tth week (or month) should be estimated by a change in margin buying from the end of $t-1$th week (or month) to the end of tth week (or month). On the other hand, margin-buying volume depends largely on market trading volume, hence, must be standardized by the previous week's (or month's) trading volume of the stock market. Here, we use market trading volume for the TOPIX. This approach is also used by Chang et al. (2014) while Hirose et al. (2009) do not standardize the change in margin-buying interests by market trading volume. This study employs the following definition or estimation method of margin-buying variable (i.e., MB or change in margin-buying interests):

$$MB_t = \frac{\text{Margin buying}_t - \text{Margin buying}_{t-1}}{\text{Trading Volume}_t}$$

Panel A of Table 1 shows the weekly statistics for three variables, i.e., margin buying (MB), short selling (SI), and market return. Short selling is a standardized change in weekly (or monthly) short interests as in margin buying. Average weekly margin buying and short selling are all negative. This implies that margin and short interests are likely to be offset-traded when trading volume is relatively small.[6] Positively significant autocorrelations indicate the persistence of weekly margin buying and short selling. Dickey–Fuller tests confirm that all three variables are stationary. Interestingly, margin buying and short selling are positively correlated while they expect different future market status,

[3] Ko (2012) shows that domestic individual investors have information disadvantage in an Asian emerging index futures market.

[4] Asian regulators tend to believe that they can stabilize stock markets by changing stock market policies. Since their goal is to stabilize domestic stock markets, they focus on the aggregate stock market, not individual stocks.

[5] Since 1991, some stocks in the second trading section of the TSE have been allowed to buy on margin. Hence, margin-buying variable must not be related to stock market returns calculated by the index of the second trading section before 1991. Our preliminary tests confirm the non-existence of such a relationship. Due to the change of margin regulation, the TOPIX returns may not reflect the performance of all the stocks that can be bought on margin. However, we expect that the change of margin regulation would not have an effect on our results because the capitalization of the stocks allowed for margin buying in the second trading section is relatively too small compared to that of the TOPIX stocks.

[6] Offset-trading is buying back stocks for short covering and selling margined stocks, which produces negative values for changes in margin and short interests.

which implies that they cannot substitute each other in any market condition. Market return is positively correlated with margin buying and short selling. Monthly statistics in Panel B are not much different qualitatively from those in Panel A except for autocorrelation of short selling.

3. Informational role of margin buying

We examine two issues in this section: whether margin buying is related to the future permanent levels of stock returns; and whether margin buying decisions are informed decisions. An empirical framework is developed to identify the permanent and temporary components of stock returns and to test whether margin buying involves informed decisions.

3.1. A bivariate model: under-identification of the model

In this section, we briefly discuss the structural vector autoregression (VAR) identification, in general, as well as how to identify the permanent and temporary components of stock returns. Let's consider a 2-by-1 vector (Z_t), consisting of real stock returns (R_t) and margin-buying interest (MB), where $Z_t = [R_t, \mathrm{MB}_t]'$.[7] By the Wold theorem, Z_t has the following bivariate moving average representation (BMAR):

$$\mathrm{Z_t} = [\mathrm{R_t}, \mathrm{MB_t}]' = \mathrm{B(L)e_t}, \quad (1)$$

where R_t = real stock returns; MB_t = margin-buying interest; e_t is a 2-by-1 vector of disturbances (or shocks) consisting of e_{1t} and e_{2t}; L is the lag operator (i.e., $L^n x_t = x_{t-n}$); $B_{ij}(L)$ for $i,j = 1,2$ is a polynomial in the lag operator L (i.e., $B_{ij}(L) = \sum_k b_{ij}^k L^k$ *with* $\sum_k \equiv \sum_{k=0}^{\infty}$); and the disturbances are orthonormalized such that $\mathrm{var}(e_t) = I$.

This representation indicates that real stock returns and margin-buying interest are driven by two types of disturbances, e_{1t} and e_{2t}. The dynamic effects of these two types of disturbances on real stock returns and margin-buying interest are indicated by the coefficients of the polynomials b_{ij}^k for $i, j = 1, 2$, and $k = 1, 2, 3, \ldots$. That is, b_{ij}^k measures the effect of e_j on the ith variable in k periods.

3.2. Permanent and temporary restrictions for identification

We'd like to identify the two types of shocks (or components) as permanent and temporary shocks to stock returns. Once we empirically identify the two shocks, following Blanchard and Quah (1989), we can examine whether the permanent and temporary shocks to stock returns provide new insights about the relation between stock return and margin buying.

In the BMAR model of $Z_t = [R_t, \mathrm{MB}_t]' = B(L)\, e_t$, coefficient b_{12}^k measures the effect of the second shock on the first variable (i.e., stock return, R_t) after k periods. Therefore, the identifying restriction for the temporary shocks (say, e_2) is represented by the restriction that the coefficients in $B_{12}(L)$ add up to zero:

$$\mathrm{B_{12}(L)|_{L=1}} = \mathrm{B_{12}(1)} = \Sigma_k \mathrm{b_{12}^k} = 0, \quad (2)$$

which implies that the cumulative effect of e_2 on R_t is zero. With this restriction, e_2 has only a temporary effect on R_t (or stock prices) over time. In the absence of an equivalent restriction for e_1, e_1 is allowed to have a permanent effect on R_t (i.e., stock prices) over time. As a result, in Eq. (1), $B_{11}(L)e_{1t}$ will be a permanent component of stock returns and $B_{12}(L)e_{2t}$ will be a temporary component of stock returns.[8]

Table 2
Regression of weekly margin buying on stock returns.
We regress weekly change in margin-buying interests on stock returns and the permanent and temporary components of returns. The *t*-statistics are in parentheses. The sample period is from October 1, 1977 to April 30, 2010 (1667 observations). RET ($\mathrm{RET^P}$ and $\mathrm{RET^T}$) is raw stock return (permanent and temporary returns, respectively).

Independent variable	Model 1	Model 2	Model 3	Model 4
Constant	−.0039***	−.0038***	−.0038***	−.0038***
	(−4.20)	(−4.11)	(−6.87)	(−6.82)
RET (return)	.1422***			
	(3.82)			
$\mathrm{RET^P}$ (permanent returns)		−.0082		−.0109
		(−.11)		(−.40)
$\mathrm{RET^T}$ (temporary returns)			9.3894	9.3896
			(17.11)	(17.18)
Adj. R^2	.0086	−.0006	.6382	.6380

*, **, *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Once we empirically identify the permanent and temporary components of stock returns, we regress the changes in margin-buying interest (MB) on stock returns and their permanent and temporary components, respectively, to examine the relation between margin buying and stock returns. The estimation results using weekly observations (1667 observations from October 1, 1977 to April 30, 2010) are presented in Table 2. Table 2 shows that the change in margin-buying interests is significantly positively related to stock returns and to temporary returns but not to permanent returns. In model 2, adjusted R^2 is even negative because margin buying is not related to permanent return at all. This is confirmed when we include both permanent and temporary returns in the MB regression. When temporary returns are included in explanatory variables, adjusted R^2s increase to more than 60%. This finding indicates that margin buying increases when temporary returns are higher contemporaneously. That is, Japanese margin buyers tend to increase their margin buying when temporary returns are contemporaneously higher. The permanent and temporary returns will be used again below to test whether or not margin buyers are informed.

3.3. Informed margin buying and two-sided regression-based causality tests (Sims test)

This section provides a simple and parsimonious time-series model in which there is information asymmetry between potentially informed margin buyers and other uninformed investors, and relates the information asymmetry to permanent and temporary returns. In such a case, margin-buying decisions may contain (or convey) new information about future stock returns. In fact, some margin-buying decisions may be informative events (i.e., forward-looking), while others may be non-information events (i.e., backward-looking) with respect to stock returns. The margin-buying decision is related to future stock returns when it is an informative event in the context of information asymmetry. Although informed margin buyers and other uninformed investors observe the same financial variables such as current and past stock returns and fundamentals, other uninformed investors may not recover all the information that the margin buyers use in margin buying.[9] Our model is very useful because it provides a regression model that tests the predictive power of margin buying in the context of potential information asymmetry.

[7] To employ the two-sided regression method based on Sims (1972), we do not include any exogenous variables. This approach allows us to compare our findings with those of the previous studies like Hirose et al. (2009) and Chang et al. (2014).

[8] To determine the lag length, we used Akaike information criterta (AIC), which indicates that the lag length is 4. In Section 4, we also use AIC to determine the lag length of 1.

[9] We capture this intuition in a time-series concept of the non-invertibility of the moving average representation [see Box and Jenkins (1976, p.69) and Granger and Newbold (1986, p.145)].

Table 3
Tests of the information content of weekly margin buying using Sims (1972) causality tests.
The sample period runs from October 1, 1977 to April 30, 2010 (1667 observations). MB is the change in margin-buying interests.

Null hypothesis		Margin buying on returns (A) $MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j RET_{t-j} + \varepsilon_t$	Margin buying on permanent returns (B) $MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j RET^p_{t-j} + \varepsilon_t$	Margin buying on temporary returns (C) $MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j RET^T_{t-j} + \varepsilon_t$
H_0: $\gamma_j = 0$ for $j = 1, 2, 3, 4$	χ^2 (4)	136.24***	83.24***	120.68***
H_0: $\sum_{j=1}^{4} \gamma_j = 0$.	Sum of coeff.	.6790***	.6634***	6.0099***
	t-stat.	(10.68)	(8.99)	(7.76)
H_0: $\gamma_j = 0$ for $j = -1, -2, -3, -4$	χ^2 (4)	8.46*	.53	127.51***
H_0: $\sum_{j=-1}^{-4} \gamma_j = 0$.	Sum of coeff.	−.1874***	−.0399	7.8534***
	t-stat.	(−2.81)	(−.53)	(−9.84)
H_0: $\gamma_j = 0$ for $j = 1, 2, \ldots 26$	χ^2 (26)	198.53***	142.46***	596.54***
H_0: $\sum_{j=1}^{26} \gamma_j = 0$.	Sum of coeff.	.9391***	.9296***	37.3594***
	t-stat.	(7.01)	(6.81)	(11.01)
H_0: $\gamma_j = 0$ for $j = -1, -2, \ldots -26$	χ^2 (26)	38.01*	26.12	355.56***
H_0: $\sum_{j=-1}^{-26} \gamma_j = 0$.	Sum of coeff.	−.1798	.0016	−47.8933***
	t-stat.	(−1.40)	(.01)	(−16.37)

*, **, *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Sims (1972, Theorem 2) develops a two-sided regression model that is equivalent to the Granger (1969) causality test. It can be restated in our context. Consider the following two-sided regression:

$$MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j RET_{t-j} + \varepsilon_t \quad (3)$$

where $E(\varepsilon_t \cdot R_{t-j}) = 0$ for all j ($= -m, \ldots -1, 0, 1, \ldots m$). If the null hypothesis that all the coefficients of future returns are zero (i.e., $\gamma_j = 0$ for all $j < 0$) is rejected, then we can say that past MBs Granger-cause RET_t. We can use the two-sided regression model to test the predictive power of margin buying for market returns, which can be interpreted based on information asymmetry. The intuition behind this test is that including the lagged values of market returns would help us to control for potential feedback in margin-buying decisions.

3.4. Dynamic causal relations

In this section, we examine the dynamic relation between margin buying and returns, which is presented in Table 3. Column A shows that margin buying is Granger-caused by past returns, and the effect of returns on margin buying is significantly positive. This finding is robust when we include four (i.e., monthly interval) or 26 (i.e., half-yearly interval) lags in the regressions. However, margin buying has some predictive power for future returns although it appears to predict only negative future returns. This finding suggests that margin buying tends to increase mainly in response to past higher returns rather than in anticipation of future increases in returns. It is not surprising that margin buyers cannot effectively predict future increase in returns because margin buying is an individual investor sentiment that has no information for predicting future stock returns.[10]

Column B of Table 3 presents similar evidence for permanent returns. Margin buying increases in response to past increases in permanent returns; however, margin buying does not have predictive power for future permanent returns. This is robust for both the short run and long run. The absence of permanent return predictability of margin buying implies that margin buying is not performed by informed investors who are predicting future permanent changes in returns. As already mentioned, most margin buyers in Japan are individual investors and they are not well-informed as suggested by Kamesaka et al. (2003) and Ko et al. (2007). Thus, their margin buying does not predict future permanent returns.

[10] Unlike stock markets, Deeney, Cummins, Dowling, and Bermingham (2015) show that sentiment has an effect on oil futures prices during 2002–2013.

Column C of Table 3 shows that margin buying increases in response to past higher temporary returns despite anticipations of future declines in temporary returns in the short run as well as in the long run. Combined with the findings in Panels A and B, these findings suggest that margin buying occurs mainly in response to past increases in (permanent and temporary) returns in spite of potential future temporary declines in the stock market. This finding seems to provide some support for Figlewski (1984) that shows the exacerbating effect of margin buying through the mechanism of forced sales only to the extent that brokerage firms dump margined stocks that investors would not have sold otherwise.

Overall, we fail to find evidence that Japanese margin buyers are well-informed investors who can predict future permanent changes in stock returns. Margin buyers seem to primarily take advantage of past increases in market returns.

3.5. Margin buying and short sales: substitutes or complements?

Given the nature of margin buying and short sales, the two seem to substitute for each other. However, Jarrow (1980) suggests that the presence of short-selling activity could either increase or decrease the equilibrium prices since short selling could lead to non-negative changes in prices. For example, an optimistic investor may be willing to lend out shares to short sellers to increase the capital for purchasing more shares of a particular stock that the investor expects to continue to increase in price. Along with buying on margin, this type of proactive equity lending might be a way for optimistic investors to capitalize on the expectation of rising stock prices. Therefore, buying on margin and short selling might be complements. Thus, it would be interesting to examine the relation between short sale and margin buying.

For this purpose, similar to the changes in margin-buying interests, changes in short interests (SI) are calculated as follows:

$$SI_t = \frac{\text{Short interests}_t - \text{Short interests}_{t-1}}{\text{Trading Volume}_t}.$$

To determine whether margin-buying (MB) interest and short interest (SI) substitute or complement each other, we look at the dynamic relation between the two variables using the following regressions:

$$SI_t = \alpha + \sum_{j=1}^{m} \alpha_j SI_{t-j} + \sum_{j=1}^{m} \beta_j MB_{t-j}, \quad (4.1)$$

$$MB_t = \alpha + \sum_{j=1}^{m} \alpha_j MB_{t-j} + \sum_{j=1}^{m} \beta_j SI_{t-j}, \quad (4.2)$$

$$SI_t = \alpha + \sum_{j=1}^{m} \alpha_j SI_{t-j} + \sum_{j=0}^{m} \beta_j MB_{t-j}, \quad (5.1)$$

$$MB_t = \alpha + \sum_{j=1}^{m} \alpha_j MB_{t-j} + \sum_{j=0}^{m} \beta_j SI_{t-j}, \quad (5.2)$$

In Eqs. (4.1) and (4.2), we do not include contemporaneous MB and SI to focus on the dynamic relations between the two variables. In Eqs. (5.1) and (5.2), we do include the contemporaneous MB and SI for a robustness check in the presence of the contemporaneous relation. If the null hypothesis, H_0: $\sum_{j=1}^{m} \beta_j = 0$, is rejected and $\sum_{j=1}^{m} \beta_j$ is negative (positive) in (4.1), margin buying substitute (complement) short interest. A similar interpretation can be made for Eqs. (4.2), (5.1), and (5.2).

First, we consider only the lagged relations between the two variables based on Eqs. (4.1) and (4.2) in Panel A of Table 4. We find that margin buying has a negative (cumulative) net effect on short interest. The negative effect is marginal in the short run but significant in the long run. This indicates that short sales tend to decrease in response to increases in margin buying. However, short interest does not have a significant effect on margin buying over time. Second, we include the contemporaneous relation between the two variables based on Eqs. (5.1) and (5.2) in Panel B of Table 4. We find a similar relation as in the previous case, except that short interest leads to an increase in margin buying both in the short- and long-term when the concurrent period effect is included.

Overall, we find evidence of some asymmetric relation between short sales and margin buying. An increase in margin buying tends to substitute short sales, particularly in the long term; however, an increase in short sales does not seem to substitute margin buying, particularly when the concurrent period effect is included. This asymmetric relation between short sales and margin buying may be related to the finding that margin buyers are not well-informed relative to short sellers or could be due to some complementary relation as Jarrow (1980) points out. That is, there seems to be potential information asymmetry between short sellers and margin buyers such that margin buyers do not seem to take advantage of the relatively informed investment decisions of short sellers. As argued by Hirose et al. (2009), margin buying is mainly an activity of individual investors, but short selling is conducted by both institutions and individuals in Japan. We believe that the above information asymmetry could be due to the difference between margin buyers and short sellers.

4. The over- and under-valuation hypothesis

4.1. Identification of over- and undervaluation

To examine whether margin buying is related to the undervaluation of the stock market, we need a measure of undervaluation. We identify undervaluation (or overvaluation) as the difference between the actual price and the fundamental component of price (i.e., fair value or intrinsic value). The fundamental component is defined as the part of price that is related to fundamentals such as earnings, dividends, and discount rates. Therefore, in estimating a fundamental value (or intrinsic value), our approach can be viewed as a variation of an earnings-based valuation model (e.g., D'Mello & Shroff, 2000), a residual income model (i.e., Ohlson, 1995), or a dividend-based (e.g., usual dividend discount model) valuation model. When the actual stock price is above (below) the fundamental component of the stock price, the stock is deemed to be over-priced (under-priced).

To identify the fundamental and non-fundamental components of the stock price, we consider a 4×1 vector, Z_t, consisting of the first-differenced earnings (ΔY_t), the dividend payout ratio (D_t/Y_t), interest rates (r_t), and the PE ratio (P_t/Y_t), where $Z_t = [\Delta Y_t, D_t/Y_t, r_t, P_t/Y_t]'$. By the Wold theorem, the 4×1 vector, Z_t, has the following four-variable moving average representation (MAR):

$$Z_t = [\Delta Y_t, D_t/Y_t, r_t, P_t/Y_t]' = C(L)e_t \quad (6)$$

where e_t is a 4×1 vector consisting of e_t^y, e_t^d, e_t^r, and e_t^{nf}; e_t^d = earnings shock; e_t^d = dividend shock; e_t^r = interest rate shock; e_t^{nf} = non-fundamental shock; $C(L) = \left[\sum_k c_{ij}^k L^k\right]$ with $\sum_k \equiv \sum_{k=0}^{\infty}$ for $i, j = 1, 2, 3$, and 4, is a polynomial in the lag operator L; and the disturbances (innovations) are orthonormalized such that var.$(e_t) = I$. The four-variable model allows us to identify under- (over-) valuation.

This representation indicates that earnings, dividend payout ratios, interest rates, and PE ratios are driven by fundamental shocks and non-fundamental shocks (or disturbances), and the fundamentals are represented by earnings, dividends, and interest rates. The coefficient c_{14}^k measures the effect of the fourth (i.e., non-fundamental) shocks (e_t^{nf}) on the first variable (i.e., earnings changes) in k periods; the restriction ($C_{14}(L) = \sum_k c_{14}^k L^k = 0$) implies that the effect of the non-fundamental shocks (e_t^{nf}) on earnings is zero. Therefore, the requirements that the non-fundamental shocks (e_t^{nf}) do not affect earnings, dividends, and interest rates are represented by the coefficients in $C_{14}(L)$, $C_{24}(L)$, and $C_{34}(L)$ being zero (following Lee, 1998). In addition, for the purpose of identification, we impose the restrictions that the dividend

Table 4
Complementary and substitution effects of margin buying and short selling.
The sample period runs from October 1, 1977 to April 30, 2010 (1667 observations). SI (MB) is the change in short selling (margin buying) interests.

Panel A: Without considering concurrent effect		
Null hypothesis	$SI_t = \alpha + \sum_{j=1}^{m} \alpha_j SI_{t-j} + \sum_{j=1}^{m} \beta_j MB_{t-j}$	$MB_t = \alpha + \sum_{j=1}^{m} \alpha_j MB_{t-j} + \sum_{j=1}^{m} \beta_j SI_{t-j}$
H_0: $\sum_{j=1}^{4} \beta_j = 0$	Sum of coeff. −.0279 *t*-stat. (−1.61)	Sum of coeff. .3464 *t*-stat. (1.02)
H_0: $\sum_{j=1}^{26} \beta_j = 0$	Sum of coeff. −.1056*** *t*-stat. (−3.30)	Sum of coeff. .7463 *t*-stat. (1.62)
Panel B: With considering concurrent effect		
Null hypothesis	$SI_t = \alpha + \sum_{j=1}^{m} \alpha_j SI_{t-j} + \sum_{j=0}^{m} \beta_j MB_{t-j}$	$MB_t = \alpha + \sum_{j=1}^{m} \alpha_j MB_{t-j} + \sum_{j=0}^{m} \beta_j SI_{t-j}$
H_0: $\sum_{j=0}^{4} \beta_j = 0$	Sum of coeff. .0155 *t*-stat. (.80)	Sum of coeff. .6993* *t*-stat. (1.89)
H_0: $\sum_{j=0}^{26} \beta_j = 0$	Sum of coeff. −.0640** *t*-stat. (−2.00)	Sum of coeff. 1.0616** *t*-stat. (2.24)

*, **, *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

Table 5
Tests of the over- and undervaluation hypothesis.
This panel shows whether margin buying (MB) is related to undervaluation. Undervaluation is measured using PE ratios or market prices based on the 4-variable VAR model of $Z_t = [\Delta Y_t, D_t/Y_t, r_t, P_t/Y_t]'$, where ΔY_t is the first-differenced earnings, D_t/Y_t is the dividend payout ratio, r_t is the interest rate, and P_t/Y_t is the PE ratio. MB is the change in margin-buying interests. $(P/Y)_t^{nf}$ is the non-fundamental component of the PE ratio and P_t^{nf} is the non-fundamental component of stock price. These variables are all monthly observations for the sample period from January 1981 to April 2010 (352 observations).

Null hypothesis	Using non-fundamental components of PE ratio $MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j (P/Y)_{t-j}^{nf}$		Using non-fundamental components of prices $MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j P_{t-j}^{nf}$	
H_0: $\gamma_0 = 0$	Sum of coeff.	$.293 \times 10^{-3}$	Sum of coeff.	1.482×10^{-3}
	t-stat.	(.06)	*t*-stat.	(2.96)***
H_0: $\sum_{j=-1}^{1} \gamma_j = 0$	Sum of coeff.	$-.316 \times 10^{-3}$	Sum of coeff.	1.525×10^{-3}
	t-stat.	(−.46)	*t*-stat.	(2.10)**
H_0: $\sum_{j=-2}^{2} \gamma_j = 0$	Sum of coeff.	$-.992 \times 10^{-3}$	Sum of coeff.	$.532 \times 10^{-3}$
	t-stat.	(−1.24)	*t*-stat.	(.68)
H_0: $\sum_{j=-3}^{3} \gamma_j = 0$	Sum of coeff.	-1.127×10^{-3}	Sum of coeff.	1.418×10^{-3}
	t-stat.	(−1.21)	*t*-stat.	(2.01)**

*, **, *** denote statistical significance at the 10%, 5%, and 1% level, respectively.

shocks (e_t^d) do not affect earnings (i.e., $C_{12}(L) = 0$) and that the interest rate shocks (e_t^d) do not affect earnings and dividends (i.e., $C_{13}(L) = C_{23}(L) = 0$).[11]

In the above four-variable moving average representation (MAR) in Eq. (6), the fundamental and non-fundamental shocks to (or the components of) the PE ratios are characterized by the following restrictions on Z_t:

$$C_{12}(L) = C_{13}(L) = C_{14}(L) = C_{23}(L) = C_{24}(L) = C_{34}(L)s = 0 \quad (7)$$

[or $c_{12}^k = c_{13}^k = c_{14}^k = c_{23}^k = c_{24}^k = c_{34}^k = 0$, for all k].

Once we identify the fundamental and non-fundamental shocks to (or the components of) the PE ratios, the non-fundamental component of the PE ratios and that of the market prices are identified by $[C_{44}(L)e_t^{nf}]$ and $[Y_t\ C_{44}(L)e_t^{nf}]$, respectively. The restrictions in (7) are, in fact, imposed on the four-variable vector autoregressive representation (FVAR) of Z_t.

4.2. Tests of the over- and under-valuation

The non-fundamental components of the PE ratio and market price are $(P/Y)_t^{nf} = C_{44}(L)e_t^{nf}$ and $P_t^{nf} = Y_t\ C_{44}(L)e_t^{nf}$, respectively. The non-fundamental component is the difference between the observed PE ratio (or market price) and its fundamental component; thus, the difference represents a measure of overvaluation. To see whether margin buying is related to undervaluation, we regress margin buying on the non-fundamental components of the PE ratios (or prices) and examine the signs of the coefficients. If margin buying is related to undervaluation, we expect a significant negative sign for the coefficient.

Given the potential non-synchronous timing of the data, we consider the sum of up to the three period (i.e., $m = 3$) lead and lag coefficients. That is, in the following regressions,

$$MB_t = \alpha + \sum_{j=-m}^{m} \gamma_j (P/Y)_{t-j}^{nf} \quad (8)$$

we test the null hypothesis H_0: $\sum_{j=-m}^{m} \gamma_j = 0$ for $m = 0, 1, 2$, and 3, respectively. If the null hypothesis is not rejected, then margin buying is not related to undervaluation. If this null hypothesis is rejected and the sum of the coefficients $\sum_{j=-m}^{m} \gamma_j$ is significantly negative, then margin buying is significantly associated with undervaluation.

We present the regression results of margin buying on the measures of undervaluation in Table 5. In the margin-buying regressions in Table 5, the contemporaneous coefficient is 0.293×10^{-3}; however, it is insignificant with a *t*-statistic of 0.0620 (significance level of 0.9506). The sum of the one, two, and three lagged and lead coefficients on the non-fundamental component of the PE ratios are -0.316×10^{-3}, -0.992×10^{-3}, and -1.127×10^{-3}, respectively; none of them are significant. This indicates that margin buying is not significantly related to undervaluation in terms of PE ratios. When we use the non-fundamental component of stock market prices, $P_t^{nf} = Y_t\ C_{44}(L)\ e_t^{nf}$, the contemporaneous coefficient is 1.482×10^{-3} with a *t*-statistic of 2.9581 (significance level of 0.0031), which implies that margin buying is related to contemporaneous overvaluation at the 1% significance level. The sum of the one, two, and three lagged and lead coefficients on the non-fundamental component of stock prices are 1.525×10^{-3}, 0.532×10^{-3}, and 1.418×10^{-3}, respectively. The one and three lagged and lead coefficients are significant at the 5% significance level. This implies that margin buying is related to overvaluation in terms of market prices. Overall, in Table 4, we fail to find any significant evidence that margin buying is related to undervaluation.[12]

5. Conclusions

We have examined whether margin buying represents informed trading about future stock returns and whether it is related to the undervaluation of the market. For the empirical estimation, we use Japanese long-sample (1977–2010) market data. Our findings about margin buying in Japan can be summarized as follows. First, margin buying is significantly positively related to temporary returns but not to permanent returns, implying that margin buying increases when temporary returns are higher contemporaneously. Second, margin buying tends to increase mainly in response to past higher (temporary) returns. It is quite interesting to find that margin buying is not really related to future increases in returns, which implies that margin buyers are not well-informed investors for future stock market returns. Third, we fail to find any significant evidence that margin buying is related to undervaluation of stock market prices.

Regarding the relation between margin buying and short sales in Japanese market, we find evidence of some asymmetric relation between short sales and margin buying. An increase in margin buying

[11] These assumptions do not affect the identification and derivation of the non-fundamental component of prices. However, they help us identify the separate role of dividends and interest rates (following Lee, 1998). Changing the ordering between ΔY_t and D_t/Y_t does not affect our analysis or result.

[12] For the purpose of robustness check, we employ market-to-book (PB) ratio instead of PE ratio. When we use PB ratio, margin buying is significantly related to overvaluation not only contemporaneously but also over time.

tends to substitute short sales, particularly in the long term; however, an increase in short sales does not seem to substitute margin buying, including the concurrent effect in particular. This asymmetric relation between short sales and margin buying may be related to the finding that margin buyers are not well-informed relative to short sellers or could be due to some complementary relation as Jarrow (1980) points out.

The above findings imply that margin buyers are not well-informed investors for future stock market returns and margin buying is just a market sentiment that is not a driving force of stock price. Given that margin buying is not related to undervaluation and future increase in returns, we understand that margin buying does not destabilize the stock market. Its policy implication is that strict regulation of margin buying may not be needed, in particular, considering that margin buying tends to provide liquidity to short sellers.

References

Blanchard, O., & Quah, D. (1989). The dynamic effects of aggregate demand and supply disturbances. *American Economic Review*, *79*(4), 655–673.

Box, G. E. P., & Jenkins, G. M. (1976). *Time series analysis: Forecasting and control.* Holden–Day.

Chang, E., Luo, Y., & Ren, J. (2014). Short-selling, margin-trading, and price efficiency: Evidence from the Chinese market. *Journal of Banking & Finance*, *48*, 411–424.

Deeney, P., Cummins, M., Dowling, M., & Bermingham, A. (2015). Sentiment in oil markets. *International Review of Financial Analysis, 39*, 179–185.

D'Mello, R., & Shroff, P. (2000). Equity under-valuation and decisions related to repurchase tender offers: An empirical investigation. *Journal of Finance*, *60*(5), 2399–2421.

Figlewski, S. (1984). Margins and market integrity: Margin setting for stock index futures and options. *Journal of Futures Markets*, *4*(3), 385–416.

Granger, C. W. J. (1969). Investigating causal relations by econometric models and cross-spectral methods. *Econometrica*, *37*, 424–438.

Granger, C. W. J., & Newbold, P. (1986). *Forecasting economic time series* (2nd ed.). Academic Press.

Hirose, T., Kato, H. K., & Bremer, M. (2009). Can margin traders predict future stock returns in Japan? *Pacific-Basin Finance Journal*, *17*, 41–57.

Jarrow, R. A. (1980). Heterogeneous expectations, restrictions on short sales, and equilibrium asset prices. *Journal of Finance*, *35*(5), 1105–1113.

Kamesaka, A., Nofsinger, J. R., & Kawakita, H. (2003). Investment patterns and performance of investor groups in Japan. *Pacific-Basin Finance Journal*, *11*, 1–22.

Ko, K. (2012). Who wins in the money game? The case of KOSPI 200 futures. *Pacific-Basin Finance Journal*, *20*, 843–856.

Ko, K., & Lim, T. (2006). Short selling and stock prices with regime switching in the absence of market makers: The case of Japan. *Japan and the World Economy*, *18*, 528–544.

Ko, K., Kim, K., & Cho, S. H. (2007). Characteristics and performance of institutional and foreign investors in Japanese and Korean stock markets. *Journal of the Japanese and International Economies*, *21*, 195–213.

Lee, B. S. (1998). Permanent, temporary, and nonfundamental components of stock prices. *Journal of Financial and Quantitative Analysis*, *33*(1), 1–32.

Ohlson, J. (1995). *Earnings, book values and dividends in security valuation, Contemporary Accounting Research 11 (Spring), 661–668.*

Sims, C. (1972). Money, income, and causality. *American Economic Review*, *62*, 540–552.