

# **Empirical Analysis of Japanese Stock Lending Market:**

## **Estimation of effect of tightening of short-selling regulations**

Jun Uno

Junya Umeno

Risa Muroi

### **Summary**

In this paper, we examine in detail the relationship between the Japanese stock and securities lending markets. The estimation results imply that, albeit to a limited extent, the transactional activities of lending market participants may have been affected by a tightening of short-selling regulations. The results also show that an increase in lending market liquidity has a positive effect on stock trading market liquidity as well, but that the effect may have diminished after the tightening of regulations on short-selling

### **Jun Uno**

Professor, Graduate School of Finance, Accounting and Law, Waseda University.

In 1975 he obtained a BA from the School of Political Science and Economics, Waseda University. During 2002-04 he was Professor, School of Commerce, Chuo University, and during 2006-09 held the post of Dean, Graduate School of Finance, Accounting and Law, Waseda University. He was awarded a Graham & Dodd Scroll 1 in 1991 from the Financial Analysts Journal, and won the 42nd Nikkei Economic Book Award from Japan Center for Economic Research. Editor of *Gendai Finance* (Modern Finance), member of the Securities Analyst Examination Board, Director of the Japanese Securities Investment Advisers Association, and member of GPIF Investment Committee. His publications include “Number of shareholders and stock price: evidence from Japan” *Journal of Finance* 1998, and “Microstructure of the Stock Market” (in Japanese) *Nihon Keizai Shimbun* 1998.

### **Junya Umeno**

Vice President, BlackRock Japan Co., Ltd.

Currently in charge of trading various assets for pension clients, and analyzing market microstructure. His service with the firm dates back to 2006, including his years with Barclays Global Investors (BGI), which merged with BlackRock in 2009. At BGI he was a Trader, responsible for multi asset class trading. Prior to joining BGI, he was a Senior Trader at Franklin Templeton Investments from 2002 to 2006. He began his business career at Kosei Securities in 1996 on the proprietary trading desk of equity trading department. He earned a BA from Kobe University in 1996 and an MBA in Finance from Waseda University in 2006.

### **Risa Muroi**

Managing Director, BlackRock Japan Co., Ltd.

Currently head of Securities Lending Department at BlackRock Japan Co., Ltd. which covers securities lending activities for the Asian region. She joined the firm in June 2000, including her years with Barclays Global Investors (BGI), which merged with BlackRock in 2009. Prior to joining BGI, Risa served as head of Equity Finance at Société Générale Securities, Tokyo Branch. She is also an executive member of the Pan-Asian Securities Lending Association. She holds a BA in Business Administration from Midwestern State University in Texas.

## 1. Introduction

The purpose of this paper is to analyze and model interaction between lending market and stock trading market liquidity. Use an estimation model to show the impact of the tightening of short-selling regulations at end-October 1998, we found a negative impact on stock market liquidity.

In the second half of 2008, during the height of global stock market turmoil, regulatory authorities around the world tightened short-selling regulations in their respective markets. The Japanese regulators enacted tighter short-selling regulations on October 27, 2008, as follows:

- The prohibition of naked short-selling (effective from October 30, 2008).
- Reporting obligations for holders of short-selling positions of a certain scale (in principle, 0.25% or more of the total number of shares outstanding) to exchanges through securities companies and the public announcement of such information by the exchanges (effective from November 7, 2008).
- Continuation of existing uptick rules that prohibit short-selling at a price equal to or lower than the latest execution price.

With regard to the effect of restricting short-selling through tightening regulations, Bris, Goetzmann, and Zhu (2004), for example, point out that stock prices are less efficient in countries that impose short-selling constraints. Saffi and Sigurdsson (2007) state that, based on an empirical analysis of outstanding stock loan inventory and stock lending fees, short-selling constraints lower the price efficiency of the market<sup>1</sup>.

On the other hand, there are some contradictory assertions that short-selling itself increases market volatility and destabilizes the market. For example, Lamont (2003) states that short-selling lowers prices and disrupts price formation. Thus, prior studies on the impact of short-selling on prices are not exactly consistent.

Suzuki (2005) analyzed Japanese domestic lending market behavior. However, the scope of data analysis does not cover the entire domestic lending market, and, to the best of our knowledge, there is no established comprehensive review of the Japanese lending market. When analyzing short-selling and lending markets, the lack of disclosed information is always a challenge. However, in Japan, information is disclosed on a regular basis—margin transaction balances by exchanges, standardized loan transactions by Japan Securities Finance Co., Ltd., and general loans by the Japan Securities Dealers Association (JSDA). Japan's information

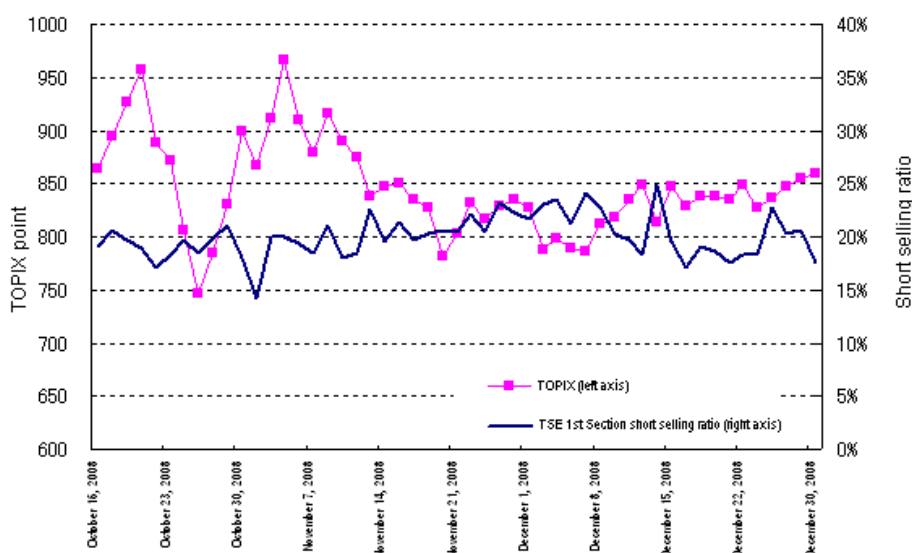
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<sup>1</sup> Bai, Chang, and Wang (2006) report similar results. As theoretical papers, refer to Miller (1977), Diamond, and Verrecchia (1987), etc.

disclosure can be considered to be more advanced than in other countries. In addition to such domestic lending market data, we use securities lending data collected globally from major lenders to characterize functions of the Japanese stock lending market. As far as we know, this is the first study to provide a comprehensive view of the Japanese domestic as well as overseas stock lending market by verifying the above information disclosure in an exhaustive manner.

When looking at the relation between regulatory tightening and short-selling activities via the daily short-selling ratio (ratio of the value sold short to total executed value, Exhibit 1) released by the Tokyo Stock Exchange (TSE), from October 2008 onward the ratio seems to have temporarily decreased at the end of that month when regulations on short-selling were tightened; however, it has stayed at around 20% since then<sup>2</sup>.

**Exhibit 1** Changes in TOPIX and TSE 1st Section Short-selling Ratio



Looking at the trend in Exhibit 1, it is difficult to conclude that permanent change occurred around end-October 2008 when short-selling restrictions were tightened. Understanding there were multiple factors contributing to the trend during the period concerned, such as market turmoil triggered by the collapse of Lehman Brothers, we examined the question in detail as described below.

<sup>2</sup> As a preceding study on the short-selling ratio, for example, Diether, Lee, and Werner (2005) point out that short-selling accounted for 24% of the trading volume of NYSE-listed stocks and 31% of the trading value of NASDAQ-listed stocks in 2005.

The structure of this paper is as follows. Section 2 describes the stock lending market and its functions. Section 3 provides data descriptions and hypotheses, as well as the results of our stock lending model estimation. Section 4 gives an analysis of interaction between stock and stock lending markets. Section 5 presents conclusions.

## **2. Lending and Data Sources**

### **2.1 Lending market structure**

When selling short, investors are required to procure stock certificates to guarantee that they will deliver shares to the party that purchased the shares on settlement date. The lending market exists as a place to make such procurements. First, we overview the OTC lending market as a place to borrow and lend stocks.

Participants in the lending market include lenders, borrowers, and intermediaries. Lenders are typically pension funds, insurance companies, and other parties that own and opt to lend securities. Lenders earn additional income on their assets and provide liquidity to the stock lending market by doing so. Borrowers are typically broker/dealers, hedge funds, and asset managers that need to borrow securities for hedging market risk, selling short, and avoiding settlement failures. Intermediaries such as custodians, asset managers, and brokers, facilitate transactions between lenders and borrowers.

At the start of a lending transaction, stock certificates are lent by a lender to a borrower in exchange for collateral in excess of the market value of the loaned stock certificates. Compensation to the lender is negotiated, based on the type of collateral and the scarcity value of the security lent. The values of both the loaned stock certificates and the collateral received are marked to market on a daily basis to ensure the amount of collateral remains at an agreed level. The borrower compensates the lender for any distributions (dividends, etc.) that the lender would have received if still in possession of the certificates. At the end of the transaction, the stock certificates are returned by the borrower and the collateral is returned by the lender. If the collateral received was cash, the interest on the collateral calculated using the prescribed interest rate is paid from the lender to the borrower, and both the interest rate and lending fees are paid on a monthly basis.

## 2.2 Data description

The following data sources regarding the short-selling of individual stocks and lending of Japanese stocks are available<sup>3</sup>. Exhibit 2-1 summarizes the scope of each data source.

- (a) Margin Trading Weekend Balance by Individual Security (standardized margin balance + negotiable margin balance)  
<http://www.tse.or.jp/market/data/margin/>  
Released by TSE. Discloses weekly data as of every Friday after the close of trading on the second business day of the following week (usually Tuesday).
- (b) Outstanding Cash Loans and Stock Loans by Individual Security ((standardized) outstanding loans)  
<http://www.jsf.co.jp/de/stock/search.php?target=balance>  
Released by Japan Securities Finance Co. Ltd. Represents daily total volume of the margin trading system (standardized margin trading and negotiable margin trading) for which securities companies request cash loans or stock loans to Japan Securities Finance Co., Ltd. Crossing orders within securities companies are offset in the data.
- (c) Lending Weekend Outstanding Report by Individual Security (general loans outstanding, domestic)  
<http://www.jsda.or.jp/html/toukei/kabu-taiw/index.html>  
Released by JSDA. Discloses weekly OTC stock lending transaction data for those traded outside of the margin trading system, which includes lending transactions made by association members based on contracts construed in accordance with Japanese law.
- (d) Other information vendors  
Data Explorers<sup>4</sup> collects securities lending data from approximately 116 owners of securities, 80 major lenders, and 36 borrowers. The data includes both the lendable supply of securities and outstanding loans. Data is collected (via self-reporting) daily<sup>5</sup>.

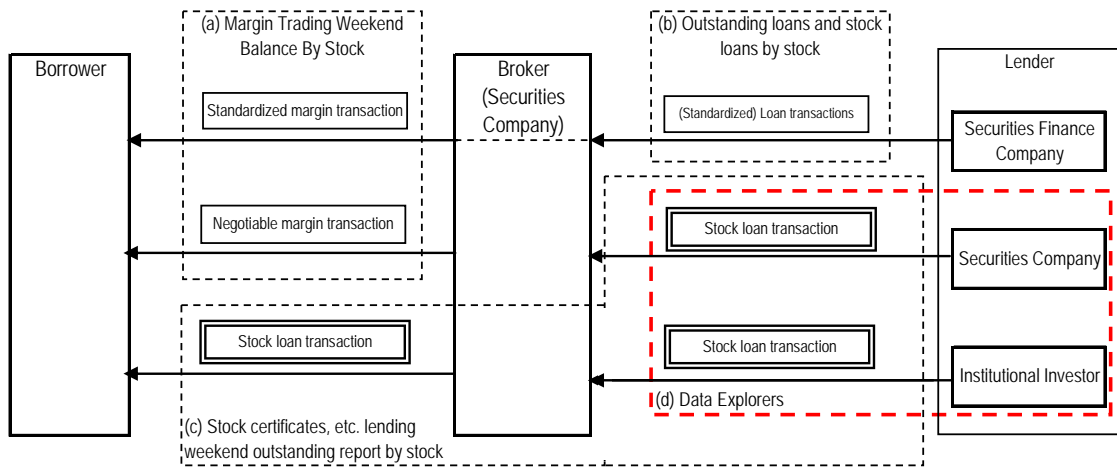
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<sup>3</sup> Due to space constraints here, refer to the respective website for a detailed explanation of each data source.

<sup>4</sup> Data Explorers is a U.K. corporation (established in 1998) specializing in lending-related data. [www.performanceexplorer.com](http://www.performanceexplorer.com)

<sup>5</sup> According to Saffi and Sigurdsson (2007), Data Explorers data covers inventory status and lending results of 90% or more of stocks on a market capitalization basis in stock markets worldwide, and 60% or more on a number of shares basis.

**Exhibit 2-1 Scope Covered by Data**



When an investor is selling short on margin, he/she can select either a standardized margin transaction or negotiable margin transaction. Standardized margin transactions are regulated by the exchange, and, if an investor chooses this route an intermediary broker can procure the corresponding stock certificates from Japan Securities Finance Co., Ltd., in the form of a standardized loan transaction. Negotiable margin transactions are more flexible as they are not regulated, however brokers cannot utilize standardized loan transactions. Instead, for both negotiable margin transactions and non-margin short-selling, an intermediary broker procures corresponding stock certificates through a (general) stock loan transaction. Broader participants trade in the (general) stock loan market.

Exhibit 2-2 and Exhibit 2-3 give a comparison of the four data sources. The analysis period is between August 1 and December 25, 2008, using weekly averages. Outstanding balances expressed as a ratio of the market value of outstanding amount to market capitalization (= number of loaned shares outstanding to total number of shares issued) by stock. Data on premium charges is recalculated into annual premium charge rates<sup>6</sup> based on Suzuki (2005). Stock lending fees are also expressed in annualized terms using the simple average of TSE 1st Section listed stocks during the analysis period.

<sup>6</sup> Defined as 
$$\text{Premium charge rate} = \frac{\left( \frac{\text{Premium charge announced}}{\text{Number of premium charge days}} \right)}{\text{Lending price}} \times 365 \times 100(\%) \cdot \text{Suzuki (2005)}$$

## Exhibit 2-2 Changes in Weekly Outstanding Margin and Outstanding Loan Data

Week	(a) Margin trading weekend balance by stock (Tokyo Stock Exchange)			(b) Outstanding loans and stock loans by stock (Japan Securities Finance Co. Ltd.)				(c) Stock certificates, etc. lending weekend outstanding report by stock (Japan Securities Dealers Association)			(d) Other information vendors (Data Explorers)			
	A	B	C	A	B	C	D	A	B	C	A	B	C	D
	Number of stocks	Outstanding balances of margin trading Shares sold/short	Outstanding balances of margin trading Shares bought on margin	Number of stocks	Outstanding stock loans	Outstanding loans	Premium charges (Annual rate %)	Number of stocks	Loans outstanding	Borrowings outstanding (Dollars + subdollars)	Number of stocks	Outstanding stock loans ratio	Outstanding stock loan inventory ratio	Stock lending fees (Annual rate)
20080801	560	0.41%	0.84%	1375	0.27%	0.29%	1.55%	1689	1.30%	1.54%	1692	0.87%	4.58%	1.34%
20080808	560	0.41%	0.84%	1377	0.26%	0.28%	1.77%	1690	1.31%	1.52%	1692	0.89%	4.62%	1.28%
20080815	556	0.41%	0.84%	1376	0.26%	0.28%	3.86%	1691	1.28%	1.52%	1692	0.90%	4.62%	1.28%
20080822	555	0.41%	0.84%	1374	0.26%	0.28%	3.52%	1691	1.25%	1.49%	1692	0.91%	4.61%	1.24%
20080829	561	0.42%	0.81%	1380	0.27%	0.28%	3.65%	1691	1.24%	1.54%	1692	0.94%	4.61%	1.24%
20080905	559	0.41%	0.79%	1374	0.26%	0.28%	2.52%	1691	1.25%	1.50%	1692	0.95%	4.62%	1.24%
20080912	564	0.40%	0.78%	1374	0.25%	0.27%	2.00%	1691	1.24%	1.50%	1692	0.96%	4.62%	1.27%
20080919	558	0.37%	0.76%	1377	0.23%	0.27%	9.15%	1692	1.22%	1.54%	1692	0.95%	4.57%	1.76%
20080926	557	0.37%	0.78%	1377	0.23%	0.29%	14.06%	1692	1.18%	1.52%	1692	0.93%	4.44%	1.34%
20081003	555	0.36%	0.75%	1381	0.22%	0.28%	2.03%	1695	1.18%	1.45%	1692	0.84%	4.34%	1.76%
20081010	564	0.33%	0.60%	1380	0.21%	0.25%	2.43%	1695	1.25%	1.46%	1692	0.79%	4.23%	2.25%
20081017	556	0.35%	0.61%	1385	0.21%	0.23%	2.92%	1695	1.20%	1.45%	1692	0.76%	4.22%	1.26%
20081024	556	0.35%	0.61%	1385	0.22%	0.22%	3.47%	1695	1.18%	1.43%	1692	0.72%	4.13%	1.19%
20081031	560	0.35%	0.55%	1389	0.22%	0.21%	3.51%	1695	1.17%	1.43%	1692	0.72%	4.16%	1.14%
20081107	569	0.35%	0.54%	1388	0.22%	0.20%	3.38%	1695	1.17%	1.44%	1692	0.69%	4.04%	1.03%
20081114	560	0.35%	0.56%	1382	0.22%	0.20%	3.17%	1694	1.12%	1.42%	1692	0.69%	4.10%	0.98%
20081121	561	0.36%	0.54%	1388	0.22%	0.20%	3.57%	1694	1.09%	1.40%	1692	0.71%	4.36%	1.00%
20081128	559	0.36%	0.54%	1389	0.23%	0.19%	3.25%	1694	1.09%	1.41%	1692	0.73%	4.02%	1.16%
20081205	561	0.37%	0.52%	1387	0.23%	0.19%	3.66%	1695	0.94%	1.30%	1692	0.73%	3.99%	0.99%
20081212	560	0.37%	0.52%	1389	0.24%	0.18%	4.03%	1689	0.95%	1.31%	1692	0.75%	3.99%	0.90%
20081219	565	0.39%	0.54%	1387	0.23%	0.18%	12.55%	1688	0.92%	1.30%	1692	0.73%	3.95%	1.04%
20081226	561	0.39%	0.54%	1386	0.23%	0.18%	8.13%	1689	0.91%	1.24%	1692	0.73%	4.28%	1.14%
Total		0.38%	0.67%		0.24%	0.24%	4.34%		1.16%	1.44%		0.81%	4.31%	1.27%

## Exhibit 2-3 Outstanding Margin and Outstanding Loan Data by Market Capitalization Rank

Week	(a) Margin trading weekend balance by stock			(b) Outstanding loans and stock loans by stock				(c) Stock certificates, etc. lending weekend outstanding report by stock			(d) Other information vendors			
	A	B	C	A	B	C	D	A	B	C	A	B	C	D
	Number of stocks	Outstanding balances of margin trading Shares sold/short	Outstanding balances of margin trading Shares bought on margin	Number of stocks	Outstanding stock loans	Outstanding loans	Premium charges (Annual rate %)	Number of stocks	Loans outstanding	Borrowings outstanding (Dollars + subdollars)	Number of stocks	Outstanding stock loans ratio	Outstanding stock loan inventory ratio	Stock lending fees (Annual rate)
1 (Large market capitalization)	102	0.31%	0.24%	326	0.15%	0.10%	1.52%	320	1.38%	1.65%	339	1.19%	9.02%	0.32%
2	115	0.40%	0.30%	300	0.20%	0.14%	2.90%	308	1.34%	1.82%	339	1.10%	5.00%	0.94%
3	99	0.45%	0.67%	285	0.26%	0.23%	3.11%	302	1.23%	1.55%	338	0.78%	3.68%	1.40%
4	119	0.40%	0.82%	262	0.26%	0.29%	4.78%	359	0.97%	1.15%	338	0.44%	2.48%	1.71%
5 (Small market capitalization)	126	0.33%	1.21%	210	0.36%	0.43%	15.90%	297	0.87%	1.09%	338	0.36%	1.38%	1.92%

In these two exhibits, the A columns show the number of stocks for which data was available and analyzed. The B columns show demand via the proportion of stocks on loan. The C columns show the available supply of stock. Columns D report the annualized borrowing fee. For the analysis period, we observed a gradual decline in both B and C for all data sources. In addition, nearly 60% of the stock certificate procurement in margin selling (a-B) is covered by standardized loan transactions (b-B).

Data sources (c) and (d) give very different results primarily because (d) includes loan transactions booked overseas, and made by securities companies or/and other trust banks, etc. Although measuring supply accurately in the lending market is a difficult task, we believe Data Explorers' (d) data which collects information from most major lenders globally, offers sufficient coverage for our analysis. In looking at B, the outstanding balance of (c) shows the highest value and thus it could be argued that it is the most significant data, however, a double counting may exist<sup>7</sup> as pointed out by Suzuki (2005). We therefore concluded that the data of (d) Data Explorers is appropriate for the purpose of this analysis.

<sup>7</sup> Suzuki (2005) points out that there is a possibility that outstanding balances are inflated by double counting due to a repetition of lending transactions between securities companies in (c) Lending Weekend Outstanding Report by Stocks released by JSDA. Data Explorers adjusts for potential double counting by eliminating data with same execution size, data, and rate between borrowers and lenders.



When examining the data in quintiles by market capitalization, margin transactions (a) and standardized loan transactions (b) tend to be used for small and medium market capitalization stocks and the general loan market for stocks with larger market capitalization. The reasons why large stocks see more lending transactions in the general loan market are that the general loan market has more stock loan inventories and provides good usability, as borrowing costs are fixed at the time of contract unlike daily bidding to determine fees applied to margin transactions.

Premium charges (b-D) increased from the middle to end-September 2008 and stock lending fees (d-D) also showed a similar movement from mid-September to mid-October<sup>8</sup>. It is thought that the increase in both payment levels is caused by an increase in demand associated with dividends and a decrease in supply associated with ex-dividend dates at end-September. In general, premium charges are higher than stock lending rates, however, as can be seen from Exhibit 2-3, this can be dependent on the fact that standardized loan transactions tend to be used for small and medium market capitalization stocks with relatively high lending rates whereas general loan transactions are used for those stocks with large market capitalization with lower lending rates. In this paper, for our model estimation, we use outstanding stock loan, outstanding stock loan inventory, and stock lending fee data provided by Data Explorers.

### **3. Empirical Analysis of the Lending Market**

Here we estimate factors that determine lending market liquidity.

#### **3.1 Sample period**

The period of analysis in this paper is from August 1 to December 25, 2008. Since there were important regulatory changes around the end of October, we compare the period from two months before to two months after the announcement of changes. We have omitted the period from December 26 to 30, 2008 due to certain large-cap stocks being suspended as a result of switching to an electronic stock certificate system. Only stocks listed on the TSE 1<sup>st</sup> Section during the entire period of analysis are subject to our analysis.

We estimated the effects of the announcement of the tightening of short-selling regulations and the implementation of these regulations by respectively

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<sup>8</sup> The premium charge is a single-day rate applied to lending transactions on the execution date. Stock lending fees are a weighted average of individual lending transaction rates on overall outstanding stock loans. Therefore, it is important to recognize that stock lending fees may not reflect daily changes in market demand as directly as premium charge.

dividing the period of analysis into two periods: that before, and that after the tightening of short-selling regulations announced on October 27, 2008.

### **3.2 Stock lending model for the lending market**

This section estimates the stock lending model for lending markets. We focused on the size of lendable stocks (the ratio of lendable stocks to total number of shares issued [%]) and stock lending fees as indicators that show the liquidity of the lending market and estimated the factors using panel regression.

The following items are listed in prior literature as factors that affect the liquidity of the lending market and stock market:

*i. Market capitalization*

In general, the supply of stock available for lending comes from the holdings of large institutional investors, and consists mainly of large market capitalization stocks. Large market capitalization stocks tend to have higher liquidity in the stock market, and similarly for the lending market, and as such we expect the stock loan inventory to be generally substantial relative to demand.

*ii. Degree of undervaluation*

Indicators such as PER (Price Earnings Ratio, stock price divided by earnings per share) and PBR (Price Book Ratio, stock price divided by book value per share) can be used as indicators to measure degree of undervaluation<sup>9</sup>. In this paper, past PBR, which is more familiar in Japan, is adopted with reference to Saffi and Sigurdsson (2007). Stock portfolios held by institutional investors on the supply side include those based on active strategies in which investors themselves determine whether a stock is undervalued or overvalued. As a result, stock portfolios supplied as inventory are likely to include more undervalued stocks. When the stock loan inventory of undervalued stocks is assumed to increase, the outstanding stock loan inventory is expected to increase in proportion to degree of undervaluation. On the other side of the coin, since short-selling is used for overvalued stocks, it is assumed that outstanding stock loans and stock lending fees tend to decrease in proportion to degree of undervaluation.

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<sup>9</sup> Saffi and Sigurdsson (2007) and Suzuki (2005) obtained results consistent with the hypothesis using actual B/P and PER, respectively.

iii. *Cumulative abnormal return*

Many previous studies examined the relation between stock returns and short-selling in the stock market<sup>10</sup>. This paper uses cumulative abnormal return for the most recent five business days (excluding the current day) and cumulative abnormal return for the five business days from the sixth to tenth business day following the most recent five business days as explanatory variables. If abnormal returns are assumed to revert to the mean, stocks with positive cumulative abnormal returns are expected to have negative abnormal returns in the future. If investors carry out short-selling based on the above, they will short sell stocks whose past cumulative abnormal returns are positive. Therefore, it was expected that cumulative abnormal returns and outstanding stock loans would have a positive correlation.

iv. *Cross-listing*

In the case of a stock that is cross-listed on foreign exchanges, it is considered that price formation is more efficient than for a stock listed only on domestic exchanges (Doidge, Karolyi, Lins, Miller, and Stulz (2005)). Therefore, we added a dummy variable to 260<sup>11</sup> stocks that are available via American Depositary Receipts (ADRs).

v. *Free-Float Weight*

We focus on the Free-Float Weight used by TSE in the calculation of TOPIX. According to the TSE definition, the Free-Float Weight is a “weight reflecting the ownership of free-float shares (deemed to be available for trading in the market).” Stocks with high Free-Float Weights are deemed to be highly liquid in the stock lending market due to a low concentration of ownership among shareholders.

vi. *Nikkei 225 membership flag*

In relation to arbitrage transactions between cash and futures, index members’ stocks are traded by the proprietary trading desks of securities firms and other institutions. Therefore, when buying futures and selling cash, the short-selling of cash equity will increase outstanding stock loans.

vii. *Net asset value of equity investment trusts employing market neutral strategy*

A growing number of hedge funds and other investors use investment

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<sup>10</sup> Refer to studies by Hong and Stein (2003), Saffi and Sigurdsson (2007), Bris, Goetzmann, and Zhu (2006), Suzuki (2005), etc.

<sup>11</sup> Including both listed and OTC stocks (source: Website of the bank of New York Mellon: [http://www.adrbnymellon.com/home\\_dr.jsp](http://www.adrbnymellon.com/home_dr.jsp))

strategies that include short-selling. We used the net asset value of investment trusts employing market neutral strategy as a proxy variable for investment activities. Here, among the publicly offered investment trusts whose net asset values are announced on a daily basis, we used the total net asset value<sup>12</sup> of the top nine investment trusts that adopt an equity market neutral strategy. The values of outstanding stock loans and net asset value of investment trusts were expected to have a positive correlation.

*viii. R-squares ( $R^2$ ) of the market model*

Bris, Goetzmann, and Zhu (2004) point out that stocks subject to heavy short-sale constraints have a lower correlation with the market, and the R-squares ( $R^2$ ) of the market model can be a proxy variable for short-sale constraints. Demand for borrowing stock, which the market model does not incorporate sufficiently, will increase as there would not be an alternative means to sell short. As a result, R-squares and outstanding stock loans were expected to have a negative correlation. In this paper, we used R-squares of the model in which log returns for individual stocks are regressed with TOPIX log returns.

*ix. Other*

D'Avolio (2007) points out that investors' differing opinions is a factor affecting the lending market. Biais, et al (1999) points out the relation between the speed of stock price reaction at the time of a downward revision of business performance and short-selling. In Japan, Suzuki (2005) points out that sectors, finance events, remaining values of convertible bonds, etc. have explanatory power. This paper does not include these items due to data collection constraints, etc.

### **3.3 Model estimation of outstanding stock loan inventory and stock lending fees**

The following ten explanatory variables were used for modeling the lending market. The outstanding stock loan inventory or stock lending fees were set as dependent variable L, in other words, we run two separate regressions using two dependent variables.

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<sup>12</sup> The net asset value and number of units outstanding that show the inflow and outflow of funds into and from investment trusts have almost the same explanatory power in the regression analysis, etc. during the investigation period. Publicly offered investment trusts employed this time are as follows: Goldman Sachs Japan Stock Market Neutral, Japan Stock Market Neutral Wrap /Shinko, GS Japan Stock Market Neutral Open, SAM Analytic Japan Stock Neutral, Nomura Japan Stock Market Neutral Funds SMA, Nomura Japan Stock Market Neutral Funds 0305, Japan Equity Market Neutral/Resona, Sumitomo Trust Market Neutral, Mitsubishi UFJ Market Neutral Open.

$$L = \alpha + \beta_1 \cdot CAP\_LN + \beta_2 \cdot PBR + \beta_3 \cdot CAR5 + \beta_4 \cdot CAR6\_10 + \beta_5 \cdot ADR + \beta_6 \cdot N225FLAG + \beta_7 \cdot TPXFF + \beta_8 \cdot R2 + \beta_9 \cdot FUND\_NAV + \beta_{10} \cdot DATE\_DUMMY + \varepsilon$$

*L* : Outstanding stock loan inventory (ratio to the total number of shares issued and outstanding) or stock lending fees

*CAP\_LN* : Natural logarithm of the market capitalization of individual stocks (unit: million yen; as of end-July 2008)

*PBR* : Daily actual PBR

*CAR5* : Cumulative abnormal return for the most recent five business days (excluding the current day)<sup>13</sup>

*CAR6\_10* : Cumulative abnormal return for the five business days from the sixth to tenth business day following the most recent five business days

*ADR* : Stocks that are listed as ADRs = 1, Otherwise = 0

*N225FLAG* : Nikkei 225 constituents<sup>14</sup> = 1, Otherwise = 0

*TPXFF* : Free-Float Weight for TOPIX calculation as of end-July 2008

*R2* : R-squares of the market model adjusted for degrees of freedom

*FUND\_NAV* : Natural logarithm of the total net asset value of market neutral investment trusts (unit: million yen)

*DATE\_DUMMY* : Date of November 18 or 19<sup>15</sup> = 1, Otherwise = 0

Estimation was performed using two types of models. With Model 1, the estimation was performed for the entire period using the above variables. With Model 2, the estimation was performed for the entire period using interaction terms obtained by multiplying the above variables by a period dummy variable which has value 0 before announcement of the tightening of regulations on short-selling (on or before October 27, 2008) and the value of the variable itself ("DMY\_" is added to the beginning of the variable in the regression

<sup>13</sup> The  $\beta$  value was calculated using a market model which employs TOPIX as an index. The  $\beta$  value was estimated based on daily data for the period from January to July 2008.

<sup>14</sup> Nikkei 225 constituents were replaced on October 1, 2008. Kumagai Gumi and Toagosei were removed and Pacific Metals and Hitachi Construction Machinery included.

<sup>15</sup> Examining the data shows there was a sudden increase in outstanding stock loan inventory across a broad range of stocks during the previous two days, which indicates that some unusual circumstances existed. This may have been caused by incorrect data due to errors in reporting by a lender, etc.

analysis) after the announcement (on or after October 28, 2008) in addition to the above variables. Based on the coefficient of the dummy variable and the t-value, we verified the impact of the announcement of the tightening of regulations on short-selling on supply and demand factors in the lending market using a panel regression<sup>16</sup>. The estimation results are shown in Exhibit 3.

**Exhibit 3 Results of Panel Regression Analysis of Outstanding Stock Loan Inventory and Stock Lending Fees**

	Explained variable: Outstanding stock loan inventory				Explained variable: Lending fees			
	Model 1		Model 2		Model 1		Model 2	
	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value
CAP_LN	0.0150	134.51	0.0157	102.34	-0.0036	-64.82	-0.0037	-51.81
PBR	-0.0018	-13.28	-0.0016	-9.48	0.0023	23.62	0.0024	20.99
CAR5	-0.0022	-1.61	-0.0040	-2.04	-0.0086	-10.98	-0.0143	-11.64
CAR6_10	-0.0053	-3.58	-0.0043	-1.78	-0.0070	-8.86	-0.0131	-10.66
ADR	0.0169	32.86	0.0180	25.56	-0.0001	-0.83	-0.0007	-4.22
N225FLAG	-0.0059	-11.29	-0.0062	-8.61	0.0005	4.16	0.0001	0.62
TPXFF	0.0516	70.85	0.0548	53.95	-0.0007	-1.78	0.0000	-0.05
R2	0.0012	1.69	0.0023	2.35	-0.0073	-20.32	-0.0067	-13.93
FUND_NAV	0.0221	31.33	0.0202	11.58	0.0030	0.98	-0.0316	-3.98
DATE_DUMMY	0.0066	13.00	0.0066	12.27	-0.0020	-1.03	0.0015	0.85
DMY_CAP_LN			-0.0017	-7.69			0.0004	3.68
DMY_PBR			-0.0007	-2.40			-0.0003	-1.24
DMY_CAR5			0.0004	0.13			0.0120	7.67
DMY_CAR6_10			-0.0053	-1.71			0.0120	7.48
DMY_ADR			-0.0028	-2.74			0.0013	4.90
DMY_N225FLAG			0.0007	0.73			0.0007	3.11
DMY_TPXFF_JUL			-0.0078	-5.39			-0.0015	-1.94
DMY_R2			-0.0030	-2.08			-0.0013	-1.72
DMY_FUND_NAV			0.0024	10.61			-0.0014	-5.24
Intercept	-0.3758	-50.50	-0.3668	-20.14	0.0213	0.68	0.3821	4.62
Coefficient of determination adjusted for degrees of freedom	0.566		0.569		0.2001		0.2033	
Number of samples	70392							

First, we consider a model which uses outstanding stock loan inventory as the dependent variable. In Model 1, the sign of the conditions for the coefficients of each explanatory variable were as expected, except for cumulative abnormal returns. The coefficient of cumulative abnormal returns for the most recent five business days and the R-squares of the market model were significant at the 10% level and other coefficients were significant at the 1% level. Considering that the coefficient of determination adjusted for degrees of freedom in Model 1 equals 0.566, the model has high explanatory power.

We examined changes in the impact before and after the announcement using Model 2 (a model including interaction terms obtained by multiplying explanatory variables by a period dummy variable). As a result, we found, for

<sup>16</sup> As a Hausman Test failed to reject random period effects for P = 1, random effects were selected for the period. In order to cope with heteroscedasticity, White (diagonal) was selected as the estimation method.

example, that the coefficient of market capitalization decreased by 0.0017 from that before the announcement, which is significant at the 5% level (the t-value is  $-7.69$ ). As the coefficient before the announcement was 0.0157, it can be said that the correlation between market capitalization and outstanding stock loan inventory remains positive even after the announcement; however, the degree of impact has diminished from that before the announcement. Relations with ADRs, the Free-Float Weight, and outstanding stock loan inventory have also become weaker. On the other hand, the coefficient of PBR became more negative after the announcement, which is statistically significant. It shows that the relation regarding “stocks with higher PBR are less often supplied for lending” has further strengthened after the announcement. The relations between the net asset value of investment trusts and outstanding stock loans have also strengthened. The market model R-squares for the entire period is not significant at the 5% level. However, it results in a positive and significant level before the announcement, and a negative and significant one after. It implies the possibility that the supply of stocks that is closely related to the market trend had been reduced by the announcement. This indicates that lenders (such as passive funds) holding stocks that are closely related to the market index may have withdrawn their inventory in the wake of the tightening of short-selling regulations. The sign of the coefficient changed only for the market model’s R-squares. In summary, the changes in each coefficient indicate that the liquidity supply mechanism in the lending market has to a certain extent been affected by the announcement and actual implementation of the tightening of regulations on short-selling.

Next, we will consider the case in which stock lending fees are used as a dependent variable (on the right of Exhibit 3). As can be seen from the R-square in Model 1 of 0.2, this model captures the factors determining stock lending fees relatively well, though not as well as outstanding stock loan inventory. With regard to individual explanatory variables, the sign conditions for the coefficients are opposite to those on the left side of Table 3, except for cumulative abnormal returns and the net asset value of investment trusts. In other words, the following relation can be derived from the results of the analysis: factors that increase demand for stock borrowing and decrease the supply of stocks for lending can be factors that increase stock lending fees.

Overvalued stocks with small market capitalization and high PBR receive higher stock lending fees. Stocks with a large free float receive lower stock lending fees because they are supplied in large amounts to the lending market. Also, we can confirm that stocks with a low R-square in the market model tend to receive higher stock lending fees, reflecting large demand for them. From the above, it can be said that stock lending fees are determined by the forces of supply and demand in the lending market.

Looking at changes in the coefficients before and after the announcement in Model 2, the coefficient of market capitalization decreased slightly, but significantly, after the tightening of regulations. The sign of the coefficient of the ADR stock itself changed from negative to positive, which is consistent with a significant decrease in the ADR coefficient to outstanding stock loan inventory after the announcement in Exhibit 3. As no significant change is observed in the PBR coefficient, the behavior of investors reacting to undervaluation or overvaluation seems not to have changed either before or after the announcement. Furthermore, the coefficient of the Nikkei 225 membership flag, which was not significant before the announcement, became significant after the announcement, showing an increase in lending fees for Nikkei 225 constituents after the announcement. As a result of such increases in fees, market price efficiency may have diminished due to restrictions on arbitrage transactions between Nikkei 225 futures and the cash index.

In summary, the model estimation results indicate that supply and demand in the lending market are affected by factors such as company size, degree of undervaluation, cross-listing, index membership, the R-square for the market model, and the Free-Float Weight. It is possible that the announcement of a tightening of regulations on short-selling caused changes in, for instance, restrictions on arbitrage transactions and the stance of passive fund managers with regard to stock lending. The tightening of regulations on short-selling itself is also believed to have had an effect, albeit to a limited extent. In addition, stock lending fees can be viewed as being determined by the relation between supply and demand in the lending market.

#### **4. Interaction between Lending Market Liquidity and Stock Trading Market Liquidity**

Here, we investigate the impact of tightened short-selling regulations on the relation between lending market liquidity and stock trading market liquidity.

##### **4.1 Interaction of liquidity**

August to December 2008 was a period when sell orders, including short-selling, dramatically increased due to the spread of the global financial crisis. It is also an appropriate period to examine interaction between lending market liquidity and stock trading market liquidity. Suzuki (2005) points out that the lending market provides ample liquidity to the stock market. Biais, et al (1999) also announced study results that indicate that short-selling constraints lead to a substantial decrease in market-sell orders. Thus, it was thought that lending market liquidity and stock market liquidity are closely related.



In this section, we analyze how lending market liquidity has an impact on stock market liquidity. We used the following four variables as dependent variables: number of transactions, bid/ask spread, ask-side depth, and bid-side depth. Ask (bid)-side depth refers to limit order volume related to asked (bid) quotations at the most favorable price available. As explanatory variables, we employed the following two variables representing liquidity and supply/demand in the lending market: stock lending ratio ( $= \frac{\text{outstanding stock loans}}{\text{stock loan inventory}}$ )

and stock lending fees. In addition to the above, we added some factors related to stock market liquidity as control variables so as to estimate by panel regression.

Lending market liquidity depends on whether there is enough stock loan inventory to meet demand for stock borrowing and whether stocks can be borrowed with low lending fees at any time. With the existence of the lending market, if a difference of opinion among investors on stock prices develops, it is expected that short-selling contributes to the maintenance of efficient pricing in the stock market. Bessenbinder et al (1996) found that as a result of empirical analysis with open interest in the futures market as the proxy variable, a rise in open interest causes an increase in trading volume.

In this paper, high lending market liquidity refers to a situation where stock lending fees remain stable at a low level and the stock lending ratio is high, reflecting various opinions of investors, including those involved in short-selling. On the other hand, stock lending fees can be a factor restraining the reflection of such various opinions in market prices by changing stock lending costs to those who sell short<sup>17</sup>. Therefore, it can be expected that the greater the liquidity of a stock in the lending market and the larger the divergence of opinion regarding that stock, the larger becomes the trading volume of the stock in the stock market. In this case, the bid/ask spread is expected to be narrower, reflecting active trading. As for depth, it is expected that the higher the stock lending ratio, the deeper the depth becomes, and the higher the stock lending fees, the shallower the depth becomes.

Similar to our latest review of the impact of tighter regulations on lending supply and fees above, we also used a period dummy variable (Model 2). If the regulations on short-selling have impaired the function of the lending market, the coefficient of the dummy variable was expected to have a sign opposite to that of the estimated coefficient for the period before the announcement.

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<sup>17</sup> D'Avolio (2007) uses stock lending fees in the lending market as a proxy variable for divergence of opinion among investors.

As additional determinants of stock market liquidity, market capitalization, price level, and the relative liquidity of individual stocks were taken into consideration. As trading volume and bid/ask spread differ depending on size of the stock and bid/ask spread is influenced by the relation between stock price level and minimum tick size, the inverse of stock price was incorporated as an explanatory variable. Furthermore, in line with Amihud (2002), we added the relative ILLIQ indicator (rILLIQ)<sup>18</sup>, assuming that investors care about the relation between the liquidity of an individual stock and the entire market. Relative ILLIQ is the ratio of the ILLIQ of an individual stock divided by market-average ILLIQ as of July 2008.

## **4.2 Changes in market liquidity indicators**

Changes in market liquidity indicators such as number of transactions, bid/ask spread (ratio to stock price, bps), and depth (product of the quantity of shares quoted and the stock price, unit: thousand yen) in the stock market during the period of analysis (from August to December of 2008) are shown in Exhibit 4.

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<sup>18</sup> This is the monthly average of the value obtained by dividing absolute daily return by the day's trading value, which is a proxy variable for the market impact per trading unit. ILLIQ and rILLIQ are calculated in the same way as in other papers. Refer to Uno and Kamiyama (2009). ILLIQ can also be calculated from one day's data.

## *Exhibit 4      Liquidity Indicators (Statistics and Monthly Averages)*

### Number of transactions

	Number of samples	Average	Standard deviation	August average	September average	October average	November average	December average
1 (Market capitalization: large)	31121	1054.2	699.7	808.5	931.5	1318.8	1190.4	1004.1
2	32611	479.7	398.5	393.5	459.9	590.1	517.3	428.6
3 (Market capitalization: medium)	32722	267.0	310.2	237.9	272.2	314.3	272.9	231.3
4	32482	124.9	174.7	113.2	132.0	146.9	122.6	106.4
5 (Market capitalization: small)	31344	76.6	153.3	82.5	84.5	84.1	64.4	63.9
<b>Total</b>	<b>160280</b>	<b>397.1</b>	<b>530.6</b>	<b>321.4</b>	<b>370.9</b>	<b>493.8</b>	<b>432.2</b>	<b>362.4</b>

### Bid-ask spread (bps)

	Number of samples	Average	Standard deviation	August average	September average	October average	November average	December average
1 (Market capitalization: large)	31121	26.0	21.1	20.0	21.6	30.4	30.2	27.8
2	32611	43.3	40.0	30.5	34.2	54.9	50.8	46.4
3 (Market capitalization: medium)	32722	70.8	58.0	51.7	57.7	93.9	80.5	70.3
4	32482	108.1	77.3	82.6	93.1	138.0	124.8	102.2
5 (Market capitalization: small)	31344	145.1	93.0	112.9	129.6	180.3	165.8	139.2
<b>Total</b>	<b>160280</b>	<b>78.6</b>	<b>76.5</b>	<b>59.9</b>	<b>67.4</b>	<b>98.5</b>	<b>90.1</b>	<b>77.3</b>

### Ask-side depth (thousand yen)

	Number of samples	Average	Standard deviation	August average	September average	October average	November average	December average
1 (Market capitalization: large)	31121	12326.8	17736.8	15723.5	15134.5	10333.5	9403.7	10739.0
2	32611	5085.0	10217.9	5577.6	5479.1	4414.7	4581.4	5399.2
3 (Market capitalization: medium)	32722	3950.1	8787.1	4249.5	3986.7	3482.0	3856.1	4225.3
4	32482	3939.4	9162.8	4222.8	4012.1	3504.8	3701.0	4282.9
5 (Market capitalization: small)	31344	3869.6	9172.2	4151.8	3921.7	3545.2	3528.2	4192.4
<b>Total</b>	<b>160280</b>	<b>5789.6</b>	<b>11918.8</b>	<b>6676.2</b>	<b>6417.2</b>	<b>5055.5</b>	<b>4998.4</b>	<b>5727.6</b>

### Bid-side depth (thousand yen)

	Number of samples	Average	Standard deviation	August average	September average	October average	November average	December average
1 (Market capitalization: large)	31121	11564.4	16665.6	13973.0	13784.3	10341.9	9311.7	10125.2
2	32611	4970.3	10120.4	5072.6	5120.6	4505.6	4772.0	5454.1
3 (Market capitalization: medium)	32722	4167.7	9481.0	4204.7	3997.3	3909.7	4254.1	4547.4
4	32482	4407.5	10352.0	4692.7	4219.8	4125.5	4151.7	4874.2
5 (Market capitalization: small)	31344	4571.2	10707.9	5051.3	4315.4	4469.2	4125.3	4844.5
<b>Total</b>	<b>160280</b>	<b>5894.7</b>	<b>12044.5</b>	<b>6507.7</b>	<b>6208.1</b>	<b>5463.5</b>	<b>5307.2</b>	<b>5934.3</b>

Through the observation period, the number of transactions increased, peaked in October, and then decreased somewhat after that but remaining above August and September levels. The movement of the bid/ask spread also shows almost the same characteristics as that of the number of transactions. The same movement can be seen even in data of the five groups by market capitalization for both number of transactions and bid/ask spread.

On the other hand, depth decreased compared with levels in August and September. The first group, which had the largest market capitalization, saw the biggest decrease. In light of the fact that large capitalization stocks experienced a larger price decrease in October 2008, it was estimated that the supply of limit orders to the market decreased significantly, which accelerated a price decline caused by a flood of sell orders.

### 4.3 Estimation results related to the interaction of liquidity

The regression model used to estimate the correlation between lending market liquidity and liquidity of the stock trading market can be formulated as follows:

$$Q = \alpha + \beta_1 \cdot LENDING\_RATIO\_LN + \beta_2 \cdot LENDING\_FEE\_LN + \beta_3 \cdot CAP\_LN + \beta_4 \cdot \frac{1}{VWAP} + \beta_5 \cdot rILLIQ + \beta_6 \cdot SPRD\_R\_LN + \varepsilon$$

$Q$ : Natural logarithm of the number of transactions by stock in the stock market, or natural logarithm of the bid/ask spread as a basis point of share price, or natural logarithm of the ask (bid)-side depth (unit: thousand yen)

$LENDING\_RATIO\_LN$ : Natural logarithm of the stock lending ratio (outstanding stock loans / stock loan inventory)

$LENDING\_FEE\_LN$ : Natural logarithm of stock lending fees (per annum)

$CAP\_LN$ : Natural logarithm of the market capitalization of individual stocks (unit: million yen) (as of end-July 2008)

$VWAP$ : Daily volume weighted average price (VWAP) of each stock

$rILLIQ$ : The relative value of ILLIQ defined in Amihud to the entire TSE 1<sup>st</sup> Section (value for each stock as of July 2008)

$SPRD\_R\_LN$ : Natural logarithm of bid/ask spread (ratio to stock price, bps)

In Exhibit 5, Model 1 shows estimation results for the entire period and Model 2 estimation results obtained by adding the interaction terms obtained by multiplying post announcement variables (DM\_LENDING\_RATIO\_LN and DM\_LENDING\_FEE\_LN) to distinguish the period after the announcement of the tightening of regulations on short-selling.

#### Exhibit 5 Results of Regression Analysis of Liquidity Indicators

	Explained variable = Number of transactions (natural logarithm)				Explained variable = Bid-ask spread (natural logarithm in bps)				Explained variable = Ask-side depth (natural logarithm of the amount)				Explained variable = Bid-side depth (natural logarithm of the amount)			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value	Regression coefficient	t-value
LENDING_RATIO_LN	0.071	53.48	0.070	41.48	-0.065	-74.00	-0.073	-63.42	0.033	12.73	0.063	19.64	0.030	11.58	0.058	17.99
LENDING_FEE_LN	-0.012	-6.52	0.030	10.93	0.017	13.59	0.034	18.42	-0.213	-52.98	-0.292	-49.52	-0.214	-53.34	-0.283	-47.98
CAP_LN	0.202	76.47	0.210	78.96	-0.312	-215.04	-0.309	-208.76	0.621	115.60	0.606	111.07	0.597	110.86	0.584	106.70
1/VWAP	50.223	61.88	50.891	62.94	52.806	112.28	52.977	112.71	383.754	125.02	382.544	124.76	397.194	125.20	396.141	124.98
RILLIQ	-0.066	-31.86	-0.066	-31.91	0.046	32.66	0.046	32.62	-0.060	-22.87	-0.060	-22.82	-0.059	-21.33	-0.059	-21.29
SPRD_R_LN	-1.290	-247.27	-1.293	-247.54					0.174	20.43	0.181	21.24	0.162	18.78	0.168	19.48
DM_LENDING_RATIO_LN			-0.003	-1.27			0.018	9.82			-0.071	-14.16			-0.066	-13.09
DM_LENDING_FEE_LN			-0.065	-21.16			-0.025	-12.92			0.120	19.79			0.105	17.21
Intercept	8.051	187.33	8.045	187.43	7.147	476.93	7.136	476.11	-2.150	-29.06	-2.149	-29.11	-1.880	-25.32	-1.879	-25.37
Coefficient of determination adjusted for the degrees of freedom	0.744		0.745		0.646		0.647		0.483		0.485		0.488		0.489	
Number of samples	134587		134587		134797		134797		134797		134797		134797		134797	

With regard to number of transactions, the coefficient of the stock lending ratio is positive and significant (coefficient: 0.071, t-value: 53.48). Meanwhile, the coefficient of stock lending fees is negative and significant (coefficient: -0.012, t-value: -6.52). It shows the following relationship: the higher the

stock lending ratio and the lower stock lending fees are, the more actively are stocks traded. With regard to bid/ask spread, the higher the stock lending ratio, the smaller the bid/ask spread, and the higher the stock lending fees, the larger the bid/ask spread. From the above two results, we can see that greater liquidity in the lending market contributes to greater liquidity (larger number of transactions and narrower spread) in the stock trading market; however, when costs (stock lending fees) increase at the same time, stock trading market liquidity is less affected.

According to Model 2 estimation results, after the tightening of regulations on short-selling announced at end-October, the effect of the stock lending ratio on number of transactions diminished; however, the negative relation between lending fee and number of transactions strengthened. The effect of both stock lending ratio and lending fee on the bid/ask spread has in general decreased. These results suggest that the interaction between lending market liquidity and stock market liquidity has decreased as a whole, which may have had an adverse impact on stock market trading activity.

The coefficient of the stock lending ratio when using ask-side depth and bid-side depth as dependent variables is positive and significant in Model 1, which implies that an increase in stock lending activity makes depth in the stock market larger. An increase in stock lending fees has a negative effect on depth.

After the tightening of regulations on short-selling, the relation between depth and stock lending ratio has been reversed. The regression coefficient of ask (bid) depth and stock lending ratio after the tightening of regulations changed from positive to negative,  $0.033 - 0.071 = -0.038$  ( $0.030 - 0.066 = -0.036$ ). Also, the negative relationship between stock lending fee and depth has weakened. Thus, linkage between the lending market and stock market has been affected.

A complementary relationship exists between trading market and lending market liquidity as follows: the greater lending market liquidity is, the larger the number of stock market transactions, the smaller the bid/ask spread, and the more the depth. However, the results above suggest that this relation has been weakened or even reversed by the tightening of regulations on short-selling.

## 5. Conclusion

In this paper, we investigated margin transaction and stock loan transaction data, clarified the differences, and then examined the data to identify the actual situation

and characteristics of lending transactions of Japanese stocks and estimate factors that determine lending market liquidity.

As a result, we found that factors such as market capitalization, degree of undervaluation, cross-listing, adoption of indexes, the R-square of the market model, and Free-Float Weight affect supply and demand in the lending market. From the impact of the announcement of the tightening of regulations on short-selling, we can deduce that there may have been changes in the attitude of stock lending by index funds and the transaction constraints of arbitrageurs. This thusly confirms the impact of the tightening of regulations on short-selling. In addition, it is conceivable that stock lending fees respond to the relation between supply and demand in the lending market.

Regarding lending market liquidity and stock market liquidity, the following relation has been confirmed: the higher the liquidity of stocks in the lending market, the larger is the number of transactions in the stock market, and their bid/ask spreads tend to become small and their depth tends to increase. Interaction between lending market liquidity and stock market liquidity weakened after the announcement of the tightening of regulations on short-selling, and this could have been a factor further accelerating the decline in stock market liquidity.

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