TRADING RESTRICTIONS AND STOCK PRICES

Robin Greenwood
Harvard Business School
rgreenwood@hbs.edu

First draft: May 2005
Revised: June 5, 2006

Abstract

Firms can manipulate their stock price by limiting the ability of their investors to sell. I examine a series of corporate events in Japan in which firms actively reduced their float – the fraction of shares available to trade – for periods of one to three months, locking investors into their long positions. Theory predicts that the greater are the restrictions, the greater is the impact of trading on price. Particularly severe restrictions are associated with returns of over 30 percent, most of which are reversed when the restrictions are removed. Firms are more likely to issue equity or redeem convertible debt during the restricted period, suggesting strong incentives for manipulation.

* I thank Malcolm Baker, Chris Malloy, Ken Froot, Hideki Hanaeda, Seki Obata, David Scharfstein, Mike Schor, Erik Stafford, Tuomo Vuolteenaho, Josh Coval, and seminar participants at the University of Connecticut, the University of Massachusetts, Harvard, and the Adam Smith Asset Pricing Conference for useful discussions. I also thank James Zeitler for help with Datastream, Mako Egawa and Chisato Toyama for help in Japan, and Andrew Campbell, Hae Mi Choi, and Mike Schor for research assistance.
I. Introduction

Can firms increase their stock price by constraining the ability of investors to trade? A growing literature in finance suggests that when there are limits-to-arbitrage, prices may deviate from fundamentals, often for sustained periods. These papers argue that among other things, noise trader risk (De Long, Shleifer, Summers, Waldmann, 1990), short-sales constraints (e.g., D’Avolio, 2002; Lamont and Jones, 2002), investor withdrawals (Shleifer and Vishny, 1997), or systematic psychological biases (Barberis and Thaler, 2004) can make investors unwilling or unable to trade against mispricing.¹

As long as there are benefits to having a high stock price, firms have strong incentives to further constrain investors from bringing prices back to fundamentals. This paper shows that firms can increase stock prices by restricting the ability of their investors to trade.

This idea that trading restrictions can increase stock price applies in a variety of settings, but is most obvious in initial public offerings, where differences of opinion about the prospects of the firm are high. At IPO, many firms choose to offer only a small fraction of the total shares outstanding to the public, releasing a part of the float after a lockup period during which employees and some other investors are not allowed to sell. When the restrictions are lifted, prices fall (e.g., Brav and Gompers, 2003; Bradley et al, 2001; Field and Hanka, 2001, and Ofek and Richardson, 2000). Trading restrictions also play an important role in the pricing of PIPEs (private investments in public equity). In a PIPE, the firm issues equity to a private party, but does not register the shares for several months. When the equity is registered, prices fall.

In this paper, I present a simple model of trading restrictions and stock prices, which I then analyze using a series of corporate actions in Japan, known hereafter as the “stock split bubble.” During the stock split bubble, the average stock split ratio grew from 1.15-for-1 in the

¹ See also Chen, Hong, and Stein (2002), Duffie, Garleanu, and Pedersen (2002), Nagel (2005), on the effects of short-sales constraints.
first quarter of 1995 to over 10-for-1 in the last quarter of 2004. Figure 1 shows that cumulative abnormal event returns associated with the announcement and execution of a stock split grew from approximately zero to over 30 percent during the same interval, with some splits earning abnormal returns of a few hundred percent.

To see how the returns accruing around stock splits are related to trading restrictions, consider the unusual institutional arrangement in Japan, in which new post-split shares are not distributed to shareholders until several weeks after the ex-date of the split. This arrangement stems from laws stipulating that stock transactions must be settled with physical shares, unlike many countries in which it is done electronically. Thus, when a firm announces a stock split, registered shareholders on ex-date Y do not receive the new shares until the “pay-date” Z, typically two months later. For example, Nikkyu, a parking lot operator, announced a 21-for-1 stock split, with an ex-date of July 28, 2004. Registered shareholders on July 28 were entitled to twenty additional shares, but the shares were not deposited in their accounts until September 19, the pay-date. Between these two dates, investors were free to buy and sell their old shares, but because they were unable to buy or sell the new shares, they were effectively forced to hold a long forward position in Nikkyu equal to a fraction of their ex-date position. Thus, during this time, the effective float – the fraction of the firm available to be bought and sold – fell by 95 percent (=20/21). On September 19, the new shares were distributed and investors were free to sell. Over the course of a few days, the price of Nikkyu stock fell by over thirty percent.

A series of 2,094 of these stock split events serves as a form of natural experiment to understand the consequences of trading restrictions for stock prices. The restrictions resulting from a split are straightforward: Investors who decide after the ex-date that the stock is overpriced can act on this view only insofar as they can sell their old holdings. Of course, positions in the new shares could be offset by taking short positions in the old shares. These short

---

2 These figures correspond to splits announced in the first quarter of 1995 and the last quarter of 2004. Effective dates for split are typically within one or two months of the announcement.
positions could then be closed by delivering the new shares on the pay-date.\(^3\) However, a large subset of investors, including mutual funds and insurance companies, and perhaps small retail investors, are unlikely to short at any price. More importantly, even investors who want to short must find a counterparty to borrow the shares from, which becomes exceedingly difficult once the split is announced.\(^4\) In addition, investors who are willing to go short are also likely to be constrained by the event. To receive the new shares, shareholders must be in physical possession of the shares on the ex-date.\(^5\) Thus, many outstanding short positions at the time of the announcement are likely to be called in by lenders, possibly causing a short squeeze.

A simple model helps clarify the mechanism by which trading restrictions affect stock prices. There are two main ingredients. First, investors trade. Second, when the split occurs, investors with long positions are required to hold them from one period to the next. The higher is the split ratio, the greater is the share of each investor’s holdings that cannot be sold until the pay-date, and thus the more binding is the restriction.

The model offers several insights. First, as long as investors want to trade, prices go up when restrictions are put in place. Without trading, the stock split does not affect stock prices, as the constraints it imposes are non binding. In this case, the split is just a change in units. The mechanism driving price changes, therefore, is a change in the slope of the investor demand curve, interacted with trading volume. Second, limiting the ability of some investors to sell only affects prices insofar as there are not other investors who cannot go short. Thus, it is the interaction of short sales constraints and trading restrictions that cause stock splits to have such large effects on prices.

---

\(^3\) Although theoretically possible, this trade is difficult to execute in large size, because one must find a party willing to lend a large block of shares.

\(^4\) When the float is reduced by 90%, for example, the dollar value of the tradable holdings of large investors also falls by 90%. Thus even if an investor were to borrow from a large shareholder, it would be difficult to amass a large short position.

\(^5\) This mechanism also appears in the United States. Lamont (2005) shows that it is one of several techniques that firms use to dissuade investors from lending out their shares.
Consistent with the model, event returns (returns between the announcement and a few days after the ex-date) are significantly positive, and strongly correlated with the inverse split ratio, a measure of the trading restrictions placed on investors. Event returns are also positively related to measure of trading volume, consistent with the notion that trading restrictions are more likely to bind when investors do a lot of trading. Pay-date returns, however, are negative on average, and additionally bear an opposite relation with the inverse split ratio. The dual relationships between event returns and the split ratio, and pay-date returns and the split ratio, rule out explanations that are based solely on the split conveying information about fundamentals. Such explanations say that the announcement of the stock split acts as a signal of future earnings or dividends, thus predicting stock returns on announcement of the split only.

The main empirical tests treat the split as exogenous, ignoring the question of whether the splits were an attempt at active manipulation. In the final section of the paper, I argue that the (a) the number and timing of the events, and (b) the increase in the median split ratio over the course of the sample, (c) the increased incidence of equity issuance and managerial stock redemptions, and (d) reports of abnormally high convertible bond redemptions, and (e) reports of management insiders generating profits by lending out their shares, are all consistent with firms taking active measures to increase their stock price, and enjoying the benefits that the high subsequent stock prices provide. While this evidence is only suggestive, it allows for an interpretation of the events from the broader lens of firms balancing the costs and benefits of market manipulation. Of course, while the specific mechanism used to restrict trade, and thus manipulate prices, is specific to Japan (and would probably be illegal in the United States), the episode is consistent with growing empirical evidence that firms attempt to exploit market inefficiencies to reduce their cost of capital.

---

Consistent with the above interpretation, it is not surprising that regulators have taken a dim view of the entire stock split phenomenon. In a few cases, particularly high ratio splits have been forced to distribute the shares immediately.\footnote{In a few cases when the split ratio exceeded 100-for-1 or more, trading was halted entirely during the week after the ex-date. This allowed the splitting firm time to determine who was a shareholder on the effective date and distribute their new shares to these investors, in time to restart trading one week later.} On March 5, 2005, the Tokyo Stock Exchange (TSE) announced that it would discourage stock splits in which the split ratio exceeded 5-for-1. In addition, the TSE seems to have recognized that firms have used the splits to enrich some shareholders at the expense of others: in its new guidelines, it discouraged stock splits within six months of convertible bond issuance. Finally, several large brokerage houses agreed in early 2005 to take steps to make it easier for investors to trade their forward claims on the new shares.

The results in this paper have implications beyond the objective of understanding the split bubble in Japan. First, supply shifts in the market for shares that can be sold or sold short can have significant effects on asset prices. This differs from the results in Cohen, Diether, and Malloy (2005), who argue that decreases in the supply of lendable shares play only a minor role in determining stock prices. Second, and more generally, the results show that firms have incentives to limit the ability of investors to trade, particularly when differences of opinion are high. My results help rationalize the restrictions that firms place on many of their shareholders around the IPO.

The paper is organized in two parts. The first part describes the conditions under which trading restrictions affects asset prices (Section II), provides a historical overview of the split bubble (Section III), and tests the main hypotheses suggested by the theory (Section IV). The second part of the paper (Section V) presents evidence that the trading restrictions were an attempt at market manipulation. Section VI concludes.

II. \textbf{A model of trading restrictions and stock prices}
This section outlines the mechanism by which trading restrictions affect stock prices. I modify an approach taken by Chen, Hong, and Stein (2002). While the model is written in general terms, it maps easily to the setting of stock splits in Japan.

The set-up can be summarized as follows. Every period, investors draw random valuations of a risky asset. As their draws are independent across investors and over time, an investor who is optimistic one period may turn out to be pessimistic the next period. However, because the distribution of valuations remains fixed, investors trade but prices do not change from one period to the next - even if there are short sales constraints. When a stock split is announced, however, the following period investors are required to hold onto a fraction of their initial long positions, irrespective of their current valuations of the asset. In the final period, the constraint is relieved.

A. Setup

The model has four periods, 0, 1, 2, and 3. There is a single risky asset in fixed positive supply of one share which pays a liquidating dividend of \( D = F + \varepsilon \) in period 3, where \( F \) is the fundamental and \( \varepsilon \), the noise term, is normally distributed with mean of zero and variance one.

A continuum of risk averse traders with CARA utility and risk tolerance \( \gamma \) operate in the capital market. They are present in total mass of one. Their unconstrained demand for the risky security is given by \( \gamma(V_i - P) \), where \( V_i \) denotes trader \( i \)'s private expectation of the fundamental \( F \). However, traders face short sale constraints which prevent them from taking short positions in the risky asset. Thus, their demand is characterized by

\[
Q_i = \text{Max}[0, \gamma(V_i - P)]
\]  

(1)

Every period, traders’ private expectations are drawn randomly from a uniform distribution on the interval \([F-H, F+H]\). Because these draws are independent over time, a trader who is bearish in one period may be bullish the next, and vice-versa. Formally, \( H \) is a measure of
disagreement between investors and should be interpreted as a proxy for the trading intensity of the asset. The larger is $H$, the more likely it is that today’s buyer will be a seller tomorrow, and thus the higher is trading volume.

The chronology is as follows.

Period 0: Prices are set following an initial draw from the distribution of valuations $V_0$.

Period 1: “The event date”: Investors are constrained to hold a fraction $k$ ($0 \leq k < 1$) of their period-0 positions. Prices are set following a draw from the distribution of valuations $V_1$.

Period 2: “The pay date”: The constraint is relieved. Prices are set following a draw from the distribution of valuations $V_2$.

Period 3: The liquidating dividend is paid.

B. Solving for equilibrium prices

At time 0, prices are set based on an initial draw from the distribution of valuations $V_0$. Investors for whom $V_{i0} > P_0$ have positive holdings of the asset, while investors for whom (1) binds hold zero positions. The unconstrained investors thus have an aggregate demand function given by

$$Q_{0}^{Unconstrained} = \frac{1}{2H} \int_{P}^{F+H} \gamma(V_{i0} - P_0) dV_{i0}$$

(2)

Setting total supply of 1 unit equal to the demand from the unconstrained traders, and solving, yields period 0 prices:

$$P_0 = F + H - 2 \sqrt{\frac{H}{\gamma}}$$

(3)

Proof: See appendix
The equilibrium price exceeds $F - 1/\gamma$, the price that would have obtained in the absence of short sale constraints. This is Miller’s (1977) familiar result that with short sale constraints, prices are set by bullish investors. The greater the disagreement $H$ between investors, the higher is the price. Importantly, equilibrium requires that the market clearing price exceed the valuation of the most bearish investor, or $\gamma H \geq 1$.

In period 1, a stock split occurs and investors take another draw from the distribution of valuations. The effect of the stock split is to lock investors into their long positions from the previous period. Specifically, an investor who is long $x$ units of the asset in period 0 is constrained to be long $kx$ units ($0 \leq k < 1$) or more in period 1, where $k = 1 - 1/S$ and $S$ denotes the split ratio. For example, in a 4-for-1 stock split, $k = 3/4$ because investors are locked into $\frac{3}{4}$ of their initial position between the ex-date and the pay-date. Thus the model corresponds to the mechanism used in Japan, where a split locked an investor with $x$ units of a stock into a nontradable forward position of $kx$, and a spot position of $(1-k)x$.

Following the discussion above, period-1 demand function of investor $i$, $Q_{it}$, is a function of the investor’s demand in period-0 and her current draw from the distribution of valuations $V_{it}$

$$Q_{it} = \text{Max}[kQ_{i0}, \gamma(V_{ii} - P_i)]$$

(4)

Note that because $Q_{i0} \geq 0$, equation (4) implies that $Q_{it} \geq 0$.

To calculate period 1 prices, one has to recognize that the short sale constraint defined by (4) binds for traders who (a) held positive positions at the end of the previous period ($V_{i0} > P_0$), and (b) for whom their current valuations $V_{it}$ would cause them to reduce their positions below $kQ_{i0}$. Integrating over the distributions of valuations in period 0 and period 1 yields aggregate demand from these traders

$$Q_{it}^{\text{Constrained}} = \frac{1}{4H^2} \int_{V_{i0} = P_0}^{V_{i0} = F - H} \int_{V_{i1} = P_0 + k(V_{i1} - P_0)}^{V_{i1} = P_0 + k(V_{i1} - P_0)} k\gamma(V_i - P_0) dV_{i1} dV_{i0}$$

(5)

The remaining traders are unconstrained, they have aggregate demand given by
The first term on the right-hand-side of equation (6) is total demand from traders who held long positions before the split (ie, for whom $V_{i0}>P_0$) but are now unconstrained ($V_{i1}>P_1+k(V_{i1}-P_0)$). The second term is the total demand of traders who held no position before the split - their short sale constraint was binding in period 0 – and now desire positive positions.

Substituting equation (3) for $P_0$ into (5) and (6) above, and setting total demand from the constrained and unconstrained traders equal to the total supply of one unit, yields the period-1 price:

$$P_1 = F + H + \frac{k}{\gamma} \sqrt{\frac{4H\gamma(1-k)+k^2(1-\frac{4}{3}\sqrt{H\gamma})}{4}}.$$

(7)

**Proof:** See appendix

The equilibrium price holds under some conditions. Importantly, the price must fall between $F-H$ and $F+H$ so that the constraint described in (4) binds for at least one investor. This requires that the constraint not to be so severe as to not have enough willing sellers to accommodate new demand from buyers.

This equilibrium price $P_1$ has a number of properties. First, note that if $k=0$, prices are unchanged from the previous period. Second, it is straightforward to show that for $0\leq k<1$ and $H\gamma>1$, $P_1>P_0$.

In period 2, the constraint imposed by the split is relieved and investors once again draw private valuations from the uniform distribution $V_{i2}$. As this period is symmetric to period 0, the period 2 price is equal to the period 1 price.
\[ P_2 = F + H - 2 \sqrt{\frac{H}{\gamma}}. \] (8)

C. Event returns

I define the event return as the change in the price between period 0 and period 1, and the pay-date return as the change in the price between period 1 and period 2. Because of the symmetry of period 0 and period 2, the event return is the same magnitude as the pay-date return, but with opposite sign

\[ P_1 - P_0 = -(P_2 - P_1) = \frac{k}{\gamma} - \frac{1}{\gamma} \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} + 2 \sqrt{\frac{H}{\gamma}}. \] (9)

It is straightforward to prove the following:

**Proposition 1.** The event return \((P_1 - P_0)\) is positive and increasing in trading restrictions \(k\), trading intensity \(H\), and the interaction.

\[ \frac{d(P_1 - P_0)}{dk} > 0; \quad \frac{d(P_1 - P_0)}{dH} > 0; \quad \frac{d^2(P_1 - P_0)}{dHdk} > 0. \] (10)

**Proposition 2.** The pay-date return \((P_2 - P_1)\) is negative and decreasing in float reduction \(k\), trading intensity \(H\), and the interaction.

\[ \frac{d(P_2 - P_1)}{dk} < 0; \quad \frac{d(P_2 - P_1)}{dH} < 0; \quad \frac{d^2(P_2 - P_1)}{dHdk} < 0. \] (11)

**Proof:** See Appendix

D. Discussion

The model relates returns between the ex-date and the pay-date, and after the pay-date, to the degree of trading restrictions \(k\) (and hence to the split ratio \(S\)) and \(H\), a measure of trading
intensity. In doing so, it has abstracted away from strategic interactions between different groups of traders, as well as the behavior of prices between the announcement of the split and the effective date. Indeed, intuition dictates that rational traders who anticipate the interactions in the model would attempt to buy in advance of the split and dump shares just prior to the pay-date, thereby dampening the effects. Consistent with that, several of the high split ratio events show declines in price after the effective date but well before the pay-date. By assuming no strategic behavior, the model implies a degree of irrationality on behalf of its traders. Full rational traders would recognize that in the period 1 equilibrium, they are overpaying, and therefore downweight their initial signal.

There are two essential assumptions in the model. First, there is trade. In Harrison and Kreps (1978), Varian (1989), Harris and Raviv (1992), Kandel and Pearson (1995), Odean (1998), and Scheinkman and Xiong (2003), investors trade because of differences in beliefs. In my model, differences of beliefs arise in a highly stylized form: investors draw valuations every period from a uniform distribution. Second, the stock split prevents investors from selling. By preventing bearish traders from accommodating buys from other traders, the split effectively increases the price impact of trade. Combined with high trading volume, therefore, trading restrictions make prices go up. The interaction of trading volume and the price impact of trade makes it easy to see why there was room for market manipulation. During a split, an investor could cause large fluctuations in price by trading in only a few shares.

A final observation: In the absence of trading, the stock split, and trading restrictions more generally, do not affect prices. To see this, suppose that investors maintained the same private valuations in period 1 as they did in period 0 (i.e., there was no new draw of valuations, so that \( V_{it} = V_{i0} \)). Then their desired quantities of the risky asset would not change from period 0 to period 1, and the short sale constraint imposed by the split would not bind for a single investor.
III. The Split Bubble

While stock splits have long been common in Japan, before 1999, over 95 percent of splits were in ratios of 1.3-for-1 or less. In the United States, low ratio stock splits are known as stock dividends. In Japan, low ratio stock splits were intended to keep dividend per share ratios constant following unexpected positive shocks to cash flow. Low ratio stock splits were therefore associated with small positive event returns. For the most part, unlike the United States (ie, Lakonisho and Lev, 1987), low ratio splits appear to be unrelated to price. For example, Nagano Keiki, an electronic instruments manufacturer, executed 1.10-for-1 splits in 1995, 1996, 1997, 2000, and 2001. During this time, its stock price rose from ¥1100 to above ¥2500, then fell to below ¥700 before rising again to over ¥1400 in 2003. In the specific case of Nagano Keiki, the average abnormal announcement return for these five splits was approximately 3 percent.

Figure 2 plots the distribution of stock split ratios in 2-year periods starting in 1995. The figure shows that splits with ratios exceeding 1.5-for-1 were rare prior to 1999. This was for several reasons. First, exchange rules fixed commissions on small trades, making low priced stocks expensive to trade. Second, Japanese Commercial Law required net assets per share to remain above 50,000 yen for publicly traded firms, limiting the willingness of firms to increase the number of shares (Hanaeda and Serita, 2004).

Two events made it easier for Japanese firms to split. First, on October 1, 1999, the Tokyo Stock Exchange changed the rules governing brokerage commissions, which had been set at fixed rates for small transactions. Following the deregulation, severe price competition among online brokers lowered trading fees by as much as 90 percent. Around the same time, some firms began to split at higher ratios, with the stated intention to “improve liquidity” and “attract small investors”, who had only recently become an important class of investors. Second, the law
requiring net assets per share to remain above 50,000 yen was repealed in 2001, allowing firms to split at much lower prices.

Starting in 2000 and 2001, larger stock splits (ratios greater than or equal to 2) became more prevalent. Figure 2 shows that the number of firms announcing splits with ratios between 2 and 3 increased from 3 in the period 1995-1996 to 98 in the period 2001-2002, then again to 219 in the period 2003-2004.

Data

To start my analysis, I collect data on every split announced in Japan between January 1995 and April 1, 2005, merging information from three sources. The bulk of the observations are from Bloomberg, which lists the split ratio, announcement date, the ex-date, and the pay-date. Prior to 1997, announcement dates contain some errors, and I fix these by looking them up manually. The remaining observations are filled in by searching the newswires for split announcements that may have been missed by Bloomberg (small over-the-counter firms, typically), and by scanning Datastream for capital changes in Japanese listed securities. After throwing out duplicates, foreign firms, and splits that were not complete by the time of writing, the final database contains 2,094 stock splits, announced between January 5, 1995, and April 1, 2005.\(^8\) The median market capitalization for a splitting firm is approximately ¥ 24 billion (about US$ 240 million), and the mean is ¥ 122 billion (about US$ 1.2 billion) although this decreases somewhat in the later years. Thus splits were executed primarily by smaller firms, but sometimes by very large firms as well. Sony, Softbank, and Fuji Television, among other prominent large firms, announced splits during my sample period. Each split is matched with unadjusted prices, returns, dividends, and volume.

---

\(^8\) Splits announced by foreign firms are thrown out because the split decision is typically linked to the split of an underlying foreign security. Foreign splits comprise less than 10 observations in the raw data.
Table 1 summarizes the basic data. The median split ratio for the full sample is 1.20, with a standard deviation of 49.23. The low median reflects the fact that low split ratios were common during the late 1990s. The mean split ratio is 3.53, much higher than the median due to several large (100-for-1, 200-for-1, 1000-for-1 and 2000-for-1) outliers, all occurring after 2001.

The table shows that the announcement date of a split falls 26 trading days before the ex-date, on average, and that the pay-date falls 39 trading days after the ex-date. The somewhat longer period between the pay-date and ex-date is explained by the time required to print new share certificates for ex-date holders. Until legislation was passed in June 2004, settlement of stock transactions was performed with physical stock certificates. To a first approximation, therefore, it was not possible to sell the new shares until they were distributed on the pay-date. There were some exceptions, however: institutional investors could participate in a when-issued market for the post-split shares. Those transactions were settled with the new shares or cash following the pay-date. Empirically, there is little trading volume in the when-issued market, with most securities not trading at all, and the remainder having most of their volume on the when-issued auction occurring on the ex-date.

The table also summarizes returns and turnover during the event window. Firms exhibit positive abnormal returns before splitting, on average, of 31 percent. Both announcement and ex-date abnormal returns are positive, with median abnormal returns over the entire event period (the day before announcement to five days after the ex-date) of 6 percent. Returns around the pay-date are negative, on average.

Panel B of the table repeats the summary statistics from Panel A on the subset of firms with split ratios greater than or equal to 2. Recall from Figure 2 that these higher split ratio observations are concentrated in the period between 1999 and 2004, with well over half of the

---

9 On June 9, 2004, the Japanese government passed the “Law Concerning Book-Entry Transfer of Corporate Bonds, Stocks, and Other Securities.” Under the law, stock certificates of publicly listed companies will be dematerialized by 2009. The Tokyo Stock Exchange has accelerated the program, allowing electronic deposit of the shares starting in January 2006.
sample occurring between January 2003 and December 2004. The main takeaway from Panel B is that the higher split ratio observations do not differ substantially the remainder of the sample along the dimension of market capitalization. Larger split ratio firms do, however, tend to have higher pre-split average turnover and higher pre-split prices. Announcement and ex-date returns are substantially higher, while returns around the pay-date period are more negative.

Event and pay-date returns

Table 2 summarizes abnormal returns surrounding stock splits. Following standard event-study methodology, abnormal returns for security $i$ on trading day $t$ are calculated as the difference between the raw return $R_{it}$ and the return on the value-weighted TOPIX index $R_{mt}$

$$AR_{it} = R_{it} - R_{mt}$$

In the top panel, returns start one day before the announcement of the splits and end ten days after. In the bottom panel, returns start one day before the ex-date and end ten days after.

The table shows significantly positive cumulative abnormal returns surrounding both the announcement and effective day of stock splits. For the full-sample, average announcement period abnormal returns are approximately 6 percent, and ex-date abnormal returns average approximately 5 percent.

The remainder of Table 2 summarizes abnormal returns for various subsets of the data. I first break the data into the 1995:1999 and 2000:2005 subperiods. In the early period, abnormal announcement returns are low (about 2.5 percent) but significantly positive. This is consistent with the idea that the announcement of a split conveys some news about fundamentals. In the later years, however, announcement returns are over 9 percent. This pattern is repeated for the

---

10 The magnitude of the findings in Table 2 and Table 3 ensures that the results are unchanged if I alternately use (a) raw returns, (b) security specific risk adjusted returns, or (c) market adjusted returns. The results are stronger for buy-and-hold abnormal returns (buy-and-hold returns of the security, minus the buy-and-hold return of the benchmark), but I do not report these here because of some debate as to their statistical properties (see Mitchell and Stafford (2000) and Brav and Gompers (2000).
ex-date returns. Between 1995 and 1999, abnormal returns around the ex-date are insignificantly different from zero. Between 2000 and 2005, they are approximately 9 percent.

The remaining panels show that the distinction between the early and late samples is not as meaningful as the distinction between low and high split ratios. Low ratio splits earn announcement returns of 3 percent, compared with over 17 percent for high ratio splits. More strikingly, low ratio splits earn ex-date returns insignificantly different from zero, while high ratio firms earn over 31 percent.

Table 3 summarizes abnormal returns around the pay-date, calculated the same way as above. On the pay-date, the float is released as shareholders who were registered on the ex-date receive $S-1$ new shares, where $S$ denotes the split ratio. For the full sample, cumulative abnormal returns for the 21-day window starting ten days before the pay-date and ending ten days after the pay-date are negative three percent. In the early sample from 1995 to 1999, pay-date returns are slightly lower in magnitude, while in the late sample, they are slightly higher. As in the previous table, the important distinction turns out to be between low- and high-ratio splits. Low ratio splits have no returns around the pay-date, while high ratio splits have pay-date returns of a stunning negative 16 percent. Thus, over half of the returns accruing to shareholder immediately after the ex-date are given back when trading restrictions are removed.\(^{11}\)

IV. Results

This section performs the basic tests of the model. I begin with an analysis of trading volume during the event period. I then verify the model’s predictions on the relation between ex-date returns, trading restrictions, and measures of disagreement. Next, I verify the predictions on

\(^{11}\) When measured on a buy-and-hold basis, about three quarters of the ex-date period returns are given back in the period surrounding the pay-date. The difference between the buy-and-hold returns and the cumulative abnormal returns is mechanically driven by the high announcement and ex-date returns.
the relation between pay-date returns, the split ratio, and disagreement. Finally, I ask whether the results might be better explained by alternative theories.

Trading volume

The primary assumption of the model is that stock splits restrict investors’ ability to sell shares. In theory, as the split ratio becomes very large, it becomes virtually impossible for a shareholder to sell all but a small fraction of her claim on the firm. It seems reasonable that for extremely high ratio splits (say 100-for-1 or more), that small shareholders would not sell any shares, even at overvaluation of several hundred percent, because the benefits of selling at a high price would be offset by transactions costs. Therefore, trading volume should decline in the period between the ex-date and the pay-date, potentially increasing to normal levels after that.

Figure 3 plots average turnover around the announcement, ex-date, and pay-date, sorted by split ratio. Turnover is defined as trading volume, denominated in yen, divided by market capitalization. For each firm, I winsorize the turnover series at the 1 percent level to remove extreme outliers.

Consistent with the assumptions of the model, the figure shows that trading volume declines between the ex-date and the pay-date, climbing again to announcement-period levels as the pay-date approaches. More importantly, turnover between the ex-date and pay-date drops the most for high ratio stock splits.

Figure 3 warrants some additional observations. First, turnover increases just prior to the pay-date. This increase is probably due to smart-money arbitrageurs trying to close long positions in advance of the exodus by individual traders after the pay-date. Although this
behavior is not present in the model, it is consistent with models in which arbitrageurs sell in advance of liquidations by other traders (eg, Brunnermeier and Pedersen, 2005).12

Second, the figure shows that higher ratio stock splits tend to be higher turnover stocks to start with. The high turnover may arise because these stocks have high levels of disagreement over fundamentals. Alternatively, the turnover may arise because these stocks were already heavily traded by individuals prior to the split announcement. Both interpretations are consistent with the view that the firms with the most to gain from stock splits choose higher split ratios.

Third, the figure shows an increase in turnover between the announcement and the ex-date, with larger increases for larger split ratios. The model leaves out this period, but it seems reasonable that some of the disagreement about the implications of the split is resolved during that time. Alternatively, this turnover may partly reflect smart money arbitrageurs trading in advance of the constraints they know will affect other investors.

Table 4 analyzes the relationship between changes in turnover induced by the stock split, and the split ratio. I first calculate average daily turnover for each stock in the 50 trading day period before the split is announced. I then run univariate regressions of abnormal turnover during the announcement, ex-date, and pay-date periods \( V_i - \bar{V}_i \) on \( k \), the transformed split ratio (\( k = 1 - 1/S \))

\[
V_i - \bar{V}_i = a + bk_i + u_i
\]  

(13)

Results are shown separately for announcement period turnover and turnover between the ex-date and pay-date. Announcement period volume is unrelated to the split ratio, except for the subsample of 2-for-1 or greater splits, for which announcement period turnover is positively correlated with the split ratio. Consistent with the assumptions of the model, abnormal volume

12 Unlike the Brunnermeier and Petersen (2005) model, however, it seems unlikely that the smart-money has any role in accelerating liquidations by other traders.
between the ex-date and pay-date has a strong negative correlation with the split ratio. Thus, high ratio stock splits reduce volume below their usual levels.

*Announcement and Ex-date returns*

The model predicts that returns around the split should be related to the split ratio and the disagreement over the news that the split imparts for the firm’s fundamentals. Figure 4 takes a first look at this prediction. I sort the full sample of stock splits into eight groups according the split ratio. The figure plots the cumulative average abnormal return for the stocks in each group, shown in event time, in the interval starting four days before the announcement and ending 35 days after the ex-date. For low ratio splits (ratio<1.5), typical in the early years of the sample, event returns are slightly positive but small. As the split ratio increases, abnormal event returns increase quickly. For splits with ratios of 100 and above, the figure shows average abnormal event returns close to 200 percent. Buy-and-hold abnormal returns for these high ratio stock splits are even higher (not shown).

Table 5 provides the formal test corresponding to the results in Figure 4. Recall that Proposition 1 says that event returns are increasing in the transformed split ratio, disagreement $H$, and the interaction. I estimate

$$R_{it} = a + bk_i + cH_i + dk_iH_i + u_{it}$$

(14)

$k$ denotes the percentage float reduction (one minus the reciprocal of the split ratio), as described in Section II. In the model, $H$ measures disagreement among investors. I measure $H$ using average daily turnover during the 50 days before the announcement of a split. This is a measure of how much investors disagreed about the cash flows of the firm in the past, and hence the amount that they *would have traded* in the absence of the restrictions imposed by the split. Clearly, $H$ is an imperfect proxy, because it captures how much investors already disagree about the value of the firm, rather than how much investors disagree about the value of the firm.
following the splits. To the extent that the split *induces* trading activity (e.g., by creating traders who think the split indicates good news about the firm), measurement error on $H$ may be correlated with the split ratio.

To start, abnormal returns are measured starting one day before the announcement and ending ten days after the ex-date. Estimates from (14) are shown for both the full sample of splits, as well as the subsample of splits with ratios greater than or equal to 2. Event returns have a strong positive relation with the transformed split ratio in both samples. This confirms the primary prediction of the model, that trading restrictions increase asset prices. The stronger the restriction, the more prices go up.

The second column of the table shows that event returns are positively related to measures of past trading volume, consistent with the notion that constraints imposed by the split matter the most when they are likely to bind.

The third column of the table shows that event returns are strongly positively correlated with the interaction of past trading volume and the split ratio. Thus, a higher split ratio binds more strongly when trading volume is high.

The right-hand columns of Table 5 repeat the basic tests on abnormal returns measured during a 22-day period surrounding the ex-date. These returns characterize changes in prices occurring for investors who bought just prior to the imposition of the trading constraints, and sold some period before the trading constraints were relieved. Because the ex-date typically occurs a few weeks after the announcement, focusing on the ex-date period reduces concerns about the split announcement conveying improved fundamentals about the firm.

The table shows that returns during the ex-date window show strong positive correlations with the transformed split ratio, trading volume, and the interaction of the transformed split ratio and trading volume. In both the univariate and multivariate specifications, the results appear stable across low and high split ratios.
Pay-date returns

On the pay-date, the new shares created because of the split are distributed to all investors who held shares on the ex-date. The model predicts that the returns around the pay-date should be negatively related to the degree of trading restrictions, and negatively related to past measures of trading volume. Figure 5 looks at this prediction. As before, I sort the full sample of stock splits into eight groups according the split ratio. The figure plots the cumulative average abnormal return for the stocks in each group, shown in event time, in the interval starting twenty days before the pay-date and ending 20 days after the pay-date. For low ratio splits (ratio<1.5), pay-date returns are not distinguishable from zero. As the split ratio increases, abnormal event returns increase quickly. For splits with ratios between 10-for-1 and 100-for-1, the figure shows average abnormal pay-date period returns of approximately minus forty percent.

In the figure, the dotted line indicates the placement of the pay-date. Particularly for the high ratio splits, a portion of the negative pay-date return occurs before the pay-date. It is plausible that this comes from front running arbitrageurs who understand that individual investors will sell on the ex-date, lowering the price. These traders may try to profit by selling their shares and/or selling short in advance of the exodus.

Table 6 shows the tests that correspond to Figure 5. I estimate

\[ R_{it} = a + bk_i + cH_i + dk_iH_i + u_{it} \]

where \( R_{it} \) now denotes the cumulative abnormal return in the 21-day window around the pay-date. Results are shown separately for the full-sample and for splits of ratios of 2-for-1 or more.

Consistent with the model’s predictions, pay-date returns are strongly negatively related to the split ratio. Furthermore, using the same measure of investor disagreement as before, there is some evidence that pay-date returns are negatively related to pay-date returns. Also consistent
with my predictions, the table shows that pay-date returns are negatively related to the interaction between the float reduction and my proxy for disagreement.

To summarize, the data confirm all of the model’s predictions. Temporary trading constraints increase prices, with the amount of increase positively related to the degree to which the constraints are likely to bind. The symmetry of the ex-date and pay-date effects reduce concerns that the independent variables proxy for changes in perceived fundamentals occurring during the split.

**Economic Consequences of Trading under Constraints**

An important question is whether the effects measured thus far are of economic significance. To the extent that stock splits inhibit trading, it is possible that prices shoot up after the ex-date, but with nobody trading, the wealth transfer between constrained and unconstrained traders could be minimal.

A simple calculation runs to the contrary. Figure 3 reveals that while volume is certainly reduced during the ex-date to pay-date period, it is still significant. Summing over the events in my sample, there is approximately $150 billion of trading volume between the ex-date and pay-date. With average ex-date event returns of 30 percent for high ratio stock splits, this yields a total wealth transfer of $22 billion dollars ($150 \times 30 \times \frac{1}{2}$, where $\frac{1}{2} \times 30$ is the average degree of overpricing at the time of any particular trade).

A more formal calculation of the wealth transfer can be done as follows. I calculate the yen amount by which investors overpaid for a given stock during the ex-date to pay-date period

$$ WealthTransfer_{it} = \sum_{t=Ex-date}^{Pay-date} BHR_{it} \cdot P_{it,Ex-date} \cdot Turnshares_{it} $$

(16)

$BHR$ denotes the buy-and-hold return, starting the day before the ex-date, $P$ is the split-adjusted price just prior to the ex-date, and $Turnshares$ is the number of shares traded on that day. For the
sample of splits with ratios of 2-for-1 or greater, I calculate an aggregate wealth transfer of $22 billion.

*Fundamentals-based explanations of the results*

A large empirical literature documents that stock splits in the United States usually occur after increases in stock prices and are associated with small positive abnormal returns upon announcement.\(^{13}\) Because the splits do not themselves affect a company’s cash flows, three broad classes of explanations have been suggested to account for these returns.

The first explanation, proposed by Fama, Fischer, Jensen and Roll (1969), says that the market interprets stock split announcements as good news for future dividends. Consistent with this, they find that firms that split are more likely to experience an increase in dividend in the year after the split. A slightly different explanation, along the same lines, says that the information contained in stock splits relates to earnings rather than dividends. Lakonishok and Lev (1987), McNichols and Dravid (1987), and Asquithy, Healy and Palepu (1989) analyze evidence in favor of this theory.

The dividend/earnings news theory cannot fully explain the results in this paper, because market efficiency requires the stock price reaction to occur at the time of announcement only. The theory could, however, explain some of the returns that accrue on the announcement date. Returning to the last set of results for high ratio stock splits in Table 2, one could attribute the positive average returns around announcement to news about fundamentals, but it would be unreasonable to argue the same for the 31.35 percent return around the ex-date. More importantly, there is no reason why positive news about future earnings or dividends would be associated with significantly negative returns around the pay-date (Table 3).

A second class of theories says that the value of the underlying security goes up because of an increase in liquidity associated with the split. Although this theory is popular in market folklore, evidence in support of it is mixed. Copeland (1979) shows that while the number of shareholders following a split tends to go up, liquidity declines.

A related theory, similar to the liquidity theory, says that a stock split may increase firm value by increasing the investor base. Merton (1987) proposes such a model, in which he shows that firms have incentives to increase the number of shareholders. Amihud, Mendelson, and Uno (1999) test his theory by studying reductions in stocks’ minimum trading unit. These reductions make stock more accessible to individual investors, who are potentially liquidity constrained before the reduction in trading unit. Amihud, Mendelson, and Uno find that increases in the investor base increase the price.

Under market efficiency, the liquidity/investor base theories predict returns around the announcement of the split, but not thereafter.

A final possibility, discussed in Lamont (2005), is that announcement of a stock split can cause a short squeeze by forcing investors with outstanding short positions to liquidate their positions. Because shareholders must be registered on the ex-date to receive their new shares, shares on loan may be recalled between the announcement and ex-date, wiping out short interest. To the extent that buying activity by these investors influences prices, a short squeeze may result. While plausibly responsible for some of the returns accruing around announcement, this theory does not predict significant differences between low- and high-ratio stock splits. In the data, however, announcement returns for high ratio splits are significantly higher.

To summarize, several classes of explanations have been put forth to explain why returns are positive, on average, on announcement of a stock split. However, none of these theories predict returns in the ex-date to pay-date period, which must therefore be due to trading constraints. While future work may it interesting to further decompose split announcement
returns during this unusual period of Japanese financial history, it takes me away from my current objectives.

V. Evidence for manipulation

Thus far, the data support the broad conclusions of the model. The model does not, however, say anything about firms’ motivations to impose the trading restrictions in the first place. This section suggests that trading restrictions imposed by stock splits were a form of market manipulation. I first ask whether firms or their managers were more likely to sell equity following a split. I then describe two highly publicized ways that managers were able to exploit the reduction in float. Finally, I describe regulator’s responses to the growing incidence of stock splits, showing that their reaction is consistent with efforts to curb market manipulation.

Issuing equity after split announcement

Other than the increased recognition that might accompany a temporarily higher stock price, the shareholders of a firm (in contrast to its managers) do not benefit unless the firm issues equity. Equity issuance may occur in a seasoned offering, options grants to employees, or via a stock-financed merger.

Table 8 summarizes equity issuance before and after the announcement of a split. Although I do not have specific data on equity issuance, I can infer it by calculating the change in the split-adjusted number of shares outstanding. When the total shares outstanding increases by one percent or more, I classify it as an issuance of equity. It is reasonable to think of small equity issues (say, changes in shares outstanding of 1-5%) as option exercises, and possibly equity conversions of convertible bonds. Larger equity issues (say, greater than 5 percent, say) are more likely to be seasoned equity offerings.
The table shows that firms are more likely to issue equity after a split announcement than before. Of course, both the split announcement and the sale of equity to the public could be driven by past returns. Thus, for each firm announcing a split, I select a matching firm based on pre-announcement stock returns and firm size.\(^{14}\) For the matched firm, I then ask whether it issued equity in the corresponding periods. The table shows that controlling for these determinants, firms are still more likely to issue equity after announcement of a split than before.

**Convertible bonds and lending out shares**

Some managers took more direct approaches to profiting from the trading restrictions faced by some, but not all of its investors. This section describes evidence, taken from press reports (Nikkei Report 2005a, 2005b, 2005c, 2005d, 2005e) about two techniques used to execute these transactions.

In several of the high ratio stock splits (100-for-1 and higher), firms issued convertible debt prior to announcing the stock split. The convertible debt, issued in “private” transactions either to the management itself or to friends of the managers, could be converted into old shares during the period between the ex-date and the pay-date at a ratio that was adjusted for the split factor.\(^ {15}\) Thus shares created from the conversion were not subject to the same constraints facing ordinary shareholders, and could be sold immediately. For example, Cima Co. conducted a 101-for-1 stock split with an ex-date of January 26, 2005. On the ex-date, turnover was over 100%, a fact observers credited to bonds that the firm had issued overseas in November 2004 being converted into the old shares. After reaching a peak of 116 yen during the ex-date to pay-date period, the price eventually fell to 14 yen in intraday trading on February 8. Press reports cite

\(^{14}\) I sort possible matches first by pre-announcement stock return. Among the ten firms with the closest 50-day pre-announcement return, I select the one with the closest market capitalization.

\(^{15}\) Typically, the terms of the convertible bond specify that the conversion factor is to be multiplied by \(S\), where \(S\) is the split ratio.
market participants who “believe that the increase in supply was partly behind the sharp drop in share price.”

A second, and perhaps more obvious way that managers profited from the high split induced prices was to locate a large block of shares to borrow (which was difficult, due to the reduced float), sell them, and return the shares to the owner after the pay-date. Although managers appeared unwilling to go short themselves (perhaps because of fear of exposure), they executed similar transactions in which they were paid high fees for lending out their own shares to speculators, at borrowing costs of several hundred percent (annualized). For example, the *Nikkei Report* writes that the president of Moss Institute, an internet company executing a 100-for-1 stock split, lent out all of his shares (20 percent of the float) to a trader who sold them short after the ex-date (Nikkei Report, 2005a)

By early 2005, some of these transactions started receiving unfavorable press coverage, possibly leading to the later change in exchange rules.

*More splitting at higher ratios*

In the aggregate time series, the number of splitters, and the average split ratio, respond to the past returns earned by firms that have split. Thus, the split decision appears to be driven by the potential returns accruing to splitters, rather than more fundamental considerations.

Panel A of Figure 6 plots (lagged) equal-weighted average event returns and the number of new split announcements, in calendar time. Both series are aggregated at the quarterly level, with event returns calculated as before. The number of split announcements shows a loose positive correlation with the lagged return on splits. This can be interpreted quite simply: when the returns on splits are observed to be high, more firms split in an effort to increase stock price. In the context of the model, one can read the figure to say that when differences of opinion are high, firms have more to gain from splitting, and hence split more and at higher ratios.
Panel B of Figure 6 plots the time series of (lagged) average event returns together with the average log split ratio in that quarter. The average log split ratio shows a strong positive correlation with lagged event returns, consistent with the intuition that firms observing high returns to splits decide to split in higher ratios themselves.

To examine these claims more carefully, Table 8 shows the results of time-series regressions of the number of firms announcing stock splits with ratios greater than or equal to 2-for-1 in a particular quarter, on the average abnormal return accruing to firms that split in the previous quarter:

$$N_{Ratio \geq 2,t} = a + b\bar{R}_{Event,t-1} + u_t$$

(17)

The first column shows these results. The data show a significant positive relationship between the number of split announcements and lagged returns accruing to splits.

The next regressions looks at the determinants of changes in the number of firms announcing stock splits, $\Delta N_{Ratio \geq 2,t}$. Again, the table shows a positive correlation between this variable and average event returns in the previous quarter. Finally, the third specification scales the number of splits with ratios greater than or equal to 2 by the total number of splits (including splits with ratios of 1.1-for-1, for example) in that quarter. In the last specification, I show the relationship between the average log split ratio and the returns to splits in the previous quarter. Consistent with the idea that firms begin to associate higher split ratios with high event returns, the table documents a positive relationship between these two variables.

**Regulatory responses to the manipulation**

By early 2005, several large stock splits had generated a series of complaints from smaller investors. Traders blamed a system in which “a handful of investors are able to reap big profits by selling borrowed shares at a high level and buying them back at a lower level, and in which some large shareholders are able to make money by lending shares. This all comes at the
expense of average investors, who as usual are kept in the dark.” (Nikkei Report, 2005). Following an investigation by regulators, on March 5, 2005, the Tokyo Stock Exchange (TSE) announced that it would discourage stock splits in which the split ratio exceeded 5-for-1, additionally asking firms to refrain from carrying out stocks splits soon after issuing convertible bonds. According to the TSE, the purpose of the new guidelines was to “increase the transparency of stock trading” and to discourage “money games” by firms and speculative traders (Nikkei English News, 2005a; Nikkei English News, 2005c). The Osaka Securities Exchange, and the small cap Jasdaq Securities Exchange were expected to join the TSE in issuing similar guidelines.

In addition to the actions undertaken by the exchanges, in early March 2005, Japanese securities companies announced that they would make it possible for investors to immediately trade the new shares created through stock splits (Nikkei English News, 2005b). Under this proposal, securities firms and banks that use the Japan Securities Depository Center would electronically add the number of shares issued because of a split to investor accounts, enabling investors to trade shares the following business day. As a result, the Tokyo Stock Exchange announced that “issues arising from imbalances between demand and supply during the period up to the issuance of new share certificates are expected to be almost completely addressed and resolved” (Tokyo Stock Exchange, 2006).

VI. Conclusion

Firms can manipulate their stock price by restricting the ability of their investors to trade. When there are significant differences of opinion about the value of an asset and investors want to trade, restrictions increase prices. Firms may use the period of restrictions as an opportunity to raise equity, or managers may exploit it as an opportunity to sell overpriced shares.
This paper exploits an unusual institutional mechanism for executing stock splits in Japan to understand the effects of trading restrictions on stock prices. Because new post-split shares are not distributed until several weeks after the effective date of the split, investors can sell only a fraction of their holdings after the effective date. The higher is the split ratio, the larger is the forward position that investors must hold, and the higher are prices. When the shares are distributed, the constraint on bearish investors is relieved, and prices fall.

Consistent with a simple model, I show that following the ex-date of a split, returns are positively correlated with the log of the split ratio, a measure of the degree to which trading is restricted. When the shares are distributed, on the pay-date, returns are negatively related to the split ratio. I also find that returns (pay-date returns) are positively (negatively) related to ex-ante measures of trading volume, and interactions of trading volume and measures of trading restrictions.

Although the trading restrictions described in this paper are extreme – and probably would be illegal in the United States – more benign versions occur regularly in capital markets around the world. Many firms list only a small fraction of their shares outstanding at IPO, constraining the remainder of their investors from trading. Other firms may offer equity at a discount to private parties, under the condition that they not be allowed to sell it until it is registered. These are rational strategies if firms are trying to maximize proceeds.

More generally, when institutional constraints limit the ability of investors to bring prices back to fundamentals, firms may take actions to make these constraints more severe.
Appendix: Model Proofs

Start by solving for $P_0$. Evaluating (3), aggregate demand is given by a quadratic in $P_0$

$$Q_0 = \frac{\gamma}{4H} P^2_0 - \frac{\gamma(F+H)}{2H} P_0 + \frac{\gamma(F+H)^2}{4H}$$

(18)

Setting demand equal to total supply $S$ and solving for $P_0$ yields, after some algebra, two solutions

$$P_0 = F + H \pm 2 \sqrt{\frac{H}{\gamma}}$$

(19)

For the higher of these two solutions, the lower bound of the integral in equation (3) exceeds $F+H$, the valuation of the most bullish investor. Therefore, the period 0 price must equal

$$P_0 = F + H - 2 \sqrt{\frac{H}{\gamma}}$$

(20)

An equilibrium condition is that $P_0$ must bind for at least the one investor. This requires that

$$F + H - 2 \sqrt{\frac{H}{\gamma}} > F - H \Rightarrow H \gamma > 1.$$  

(21)

To get the period 1 price, we substitute (17) for $P_0$ into the following equation

$$\frac{1}{4H^2} \int_{V_i = F-H}^{V_i = F+H} \int_{V_o = R_0}^{V_o = R_i} k \gamma (V_i - P_0) dV_i dV_o + \frac{1}{4H^2} \int_{V_i = R_0}^{V_i = F+H} \int_{V_o = R_0}^{V_o = F+H} \gamma (V_i - P) dV_i dV_o + \frac{1}{4H^2} \int_{V_i = F-H}^{V_i = P_1} \int_{V_o = P_0}^{V_o = F+H} \gamma (V_i - P) dV_i dV_o = 1$$

(22)

After some algebra, this yields a quadratic equation in $P_1$:

$$\frac{\gamma}{4H} P^2_1 + \frac{k - \gamma(F+H)}{2H} P_1 + \frac{-6k(F-H) + 4k^2 \sqrt{\frac{H}{\gamma}} + 3\gamma(F+H)^2}{12H} = -1 = 0$$

(23)

Solving yields the solutions
\[ P_i = F + H \pm \left[ \frac{k}{\gamma} - \frac{1}{\gamma} \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \right] \]  

(24)

To check which of these is the solution, we require that if \(k=0\) then \(P_i = P_0\). Thus,

\[ P_i = F + H + \frac{k}{\gamma} - \frac{1}{\gamma} \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \]  

(25)

As before, for (21) to be an interior solution, it must bind for at least one investor, whose valuations are between \(F-H\) and \(F+H\). This requires that

\[ 0 > \frac{k}{\gamma} - \frac{1}{\gamma} \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} = -2H \]  

(26)

Or equivalently,

\[ (1-k)\sqrt{H\gamma} > \frac{1}{3}k^2 \]  

(26)

And

\[ 2k + H\gamma - \frac{k^2}{3\sqrt{H\gamma}} > 1 \]  

(27)

Of these conditions, (24) is redundant for \(H\gamma > 1\).

Define event returns as the difference between \(P_i\) and \(P_0\), then

\[ P_i - P_0 = \frac{k}{\gamma} - \frac{1}{\gamma} \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} + 2\sqrt{\frac{H}{\gamma}} \]  

(28)

We now prove that event returns are increasing in \(k\). Differentiating event returns with respect to \(k\) yields

\[ \frac{d(P_i - P_0)}{dk} = \frac{1}{\gamma} \left[ -\frac{4H\gamma + 2k(1-\frac{4}{3}\sqrt{H\gamma})}{\sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})}} \right] \]  

(29)

In the last term, the numerator is negative for \(H\gamma > 1\) and \(0 < k < 1\), and therefore the entire expression is positive.
Next, event returns are increasing in $H$, for $k>0$

$$
\frac{d(P_1 - P_0)}{dH} = \frac{1}{\sqrt{H\gamma}} - \frac{1}{2\gamma} \frac{4\gamma(1-k) - \frac{2}{3} k^2 \sqrt{\gamma}}{\sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})}}
$$

To prove that the expression above is positive, note that for $k=0$, it is zero for $k=0$.

$$
\frac{d(P_1 - P_0)}{dH} = 0.
$$

Thus, if $\frac{d^2(P_1 - P_0)}{dHdk} > 0$ for positive $k$, then $\frac{d(P_1 - P_0)}{dH} \geq 0$. This proof is below.

The final proof is that event returns are increasing in the interaction of $H$ and $k$:

$$
\frac{d^2(P_1 - P_0)}{dHdk} = -\frac{1}{2\gamma} \left[ \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \right] + \frac{1}{2} \left[ 4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma}) \right]^{3/2}
$$

To prove that this is positive,

$$
\left[ \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \right] + \frac{1}{2} \left[ 4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma}) \right]^{3/2} \geq 0
$$

$$
\left[ \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \right] + \frac{1}{2} \left[ 4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma}) \right]^{3/2} \leq 0
$$

$$
\left[ \sqrt{4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma})} \right] + \frac{1}{2} \left[ 4H\gamma(1-k) + k^2(1-\frac{4}{3}\sqrt{H\gamma}) \right]^{3/2} \leq 0
$$

The left-hand term in parentheses is negative. For the right-hand term, the denominator is positive, and the first term in the numerator is negative. Thus, all that is required is that the second term in parentheses in the numerator is positive.
\[2\gamma (1 - k) - \frac{1}{3}k^2 \sqrt{\frac{\gamma}{H}} > 0 \]

\[\Leftarrow 2(1 - k)\sqrt{H\gamma} > \frac{1}{3}k^2 \]  

(35)  

(36)

Which is true because of the constraint given in (26).
References


Copeland, Thomas E., 1979, Liquidity changes following stock splits, Journal of Finance 34, 115-141.


Tokyo Stock Exchange, 2006, Discussion paper on improvements to the listing system, Mimeo.

Figure 1. Returns to Splits, 1995-2004.

The sample is separated into five two-year intervals between 1995 and 2004. The figure shows the mean cumulative abnormal return for the splits that have ex-dates in each interval. The abnormal daily return is the difference between the return of the security and the return on the TOPIX market index. Abnormal returns are calculated for each day in the interval starting four days before the announcement of the event, and ending 35 days after the split becomes effective. Because the number of days between announcement and the ex-date vary by event, abnormal returns between six days after the announcement and two days before the ex-date are cumulated into one day. Split announcement days are collected from Bloomberg and various other sources. Returns are from Datastream.
The figure shows the distribution of split ratios in Japan between 1995 and 2004, in two year intervals. The full sample includes all firms that declared splits between January 1995 and December 2004. An S-for-1 split ratio describes a split in which S-1 new shares are distributed (on the pay-date) to all holders of 1 share on the ex-date. Splits that are announced in early 2005 are omitted from the picture. Within each interval, split ratios are sorted into the buckets \([1,1.5), [1.5,2), [2,3), [3,4), [4,5), [5,10), [10,100), [100, 2000), [2000, \infty)\), according to the ex-date of the split.
Figure 3. Turnover during a stock split

The figure shows average turnover around the announcement, ex-date, and pay-date for stock splits occurring in Japan between 1995 and March 2005, separated according to the split ratio. An S-for-1 split ratio is one in which S-1 new shares are distributed (on the pay-date) to all holders of 1 share on the ex-date. Turnover is yen denominated volume divided by total market capitalization. The average distance between the announcement date and the ex-date is 26 trading days; the average distance between the ex-date and the pay-date is 39 days. Because the distances between the announcement date, the ex-date, and the pay-date are specific to each event, volume the periods [Announcement-date+6:Ex-date+2] and [Ex-date+30:Pay-date-3] are averaged and assigned to one day. Announcement dates, pay-dates, and ex-dates are collected from Bloomberg. Volume is from Datastream.
The sample of stock splits between 1995 and 2005 is sorted into eight groups according to the split ratio. An \textit{S}-for-1 split ratio is one in which \textit{S}-1 new shares are distributed (on the pay-date) to all holders of 1 share on the ex-date. The figure shows the cumulative average abnormal return for the stocks in each group, shown in event time. The abnormal daily return is the difference between the return of the security and the return on the TOPIX stock index. Abnormal returns are calculated for each day in the interval starting four days before the announcement of the event, and ending 35 days after the split becomes effective. Because the number of days between announcement and the ex-date vary by event, abnormal returns between six days after the announcement and two days before the ex-date are cumulated into one day. Returns are from Datastream. Dashed lines indicate the announcement date and ex-date.
Figure 5. Pay-date returns by split ratio

The figure shows cumulative abnormal returns surrounding the split payment date, by split ratio. The sample of stock splits between 1995 and 2005 is sorted into eight groups according to the split ratio. An \( S \)-for-1 split ratio is one in which \( S \)-1 new shares are distributed, on the pay-date, to all holders of 1 share on the ex-date. The figure shows the cumulative average abnormal return for the splits in each interval. The abnormal daily return is the difference between the return of the security and the return on the TOPIX stock index. Abnormal returns are calculated for each day in the interval starting twenty days before the pay-date, and ending twenty days after. Returns are from Datastream.
Figure 6. Split premium, the split ratio, and new split announcements

Time series plots of the average split premium, the number of firms announcing splits, and the average log split ratio. In both panels, the solid line shows the average split premium, defined as the mean cumulative abnormal event return to all stock splits occurring in a quarter, lagged one period. In Panel A, the dotted line shows the number of firms that announce they will split during the quarter (although the effective date may be in the following quarter). In Panel B, the dotted line shows the average log split ratio of firms announcing splits in that quarter.

Panel A. Lagged effective date returns and number of new split announcements

Panel B. Lagged effective date returns and mean split ratio
Table 1. Summary statistics

Mean, median, standard deviation, and extreme values of selected variables. The full sample contains 2094 stock splits executed between January 1995 and April 2005, compiled from Bloomberg, newswires, and capital actions reported in Datastream. The split ratio is the ratio of new shares plus old shares to new shares. Market value is in millions of yen. The ex-date is the day on which one must be a shareholder in order to be entitled to receive the new shares. On the pay-date, additional shares created from the split are distributed to ex-date shareholders. The abnormal daily return is the difference between the return of the security and the return on the TOPIX stock index, and is presented in various cumulated intervals. Daily average turnover (volume/shares outstanding) is also shown for various intervals. Results are shown separately for the full sample and for the subsample of splits with ratios greater than or equal to 2-for-1.

Panel A: All splits (N= 2,094)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split Ratio</td>
<td>3.53</td>
<td>1.20</td>
<td>49.23</td>
<td>1.001</td>
<td>2000.00</td>
</tr>
<tr>
<td>Log(Split Ratio)</td>
<td>0.44</td>
<td>0.18</td>
<td>0.56</td>
<td>0.00</td>
<td>7.60</td>
</tr>
<tr>
<td>Float Reduction = 1 – 1/Split Ratio</td>
<td>0.29</td>
<td>0.17</td>
<td>0.23</td>
<td>0.001</td>
<td>0.9995</td>
</tr>
<tr>
<td>Market Value pre-split (¥ billion)</td>
<td>122.44</td>
<td>23.54</td>
<td>680.21</td>
<td>0.84</td>
<td>13790.40</td>
</tr>
<tr>
<td>Days between announcement and Ex-date</td>
<td>25.58</td>
<td>19.00</td>
<td>17.20</td>
<td>1.00</td>
<td>152.00</td>
</tr>
<tr>
<td>Days between Ex-date and Pay-date</td>
<td>39.21</td>
<td>39.00</td>
<td>3.52</td>
<td>4.00</td>
<td>68.00</td>
</tr>
<tr>
<td>Pre-split log Price</td>
<td>9.08</td>
<td>7.97</td>
<td>2.69</td>
<td>3.91</td>
<td>18.35</td>
</tr>
<tr>
<td>Cumulative Abnormal Returns (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Ann-200,Ann-1]</td>
<td>31.07</td>
<td>18.95</td>
<td>60.62</td>
<td>-174.86</td>
<td>753.07</td>
</tr>
<tr>
<td>[Ex-date-1,Ex-date+1]</td>
<td>4.57</td>
<td>1.93</td>
<td>19.96</td>
<td>-87.29</td>
<td>403.33</td>
</tr>
<tr>
<td>[Ex-date-1,Ex-date+20]</td>
<td>8.91</td>
<td>4.16</td>
<td>32.79</td>
<td>-109.17</td>
<td>826.41</td>
</tr>
<tr>
<td>[Ann-1,Ex-date+5]</td>
<td>12.85</td>
<td>6.00</td>
<td>38.30</td>
<td>-171.24</td>
<td>801.14</td>
</tr>
<tr>
<td>[Ann-10,Pay-date+50]</td>
<td>-3.33</td>
<td>-2.06</td>
<td>14.79</td>
<td>-139.54</td>
<td>147.53</td>
</tr>
<tr>
<td>[Ex-1, Pay-date+50]</td>
<td>12.76</td>
<td>6.33</td>
<td>52.98</td>
<td>-230.01</td>
<td>811.95</td>
</tr>
<tr>
<td>Volume (Turnover)</td>
<td>4.01</td>
<td>0.79</td>
<td>40.77</td>
<td>-283.05</td>
<td>747.27</td>
</tr>
</tbody>
</table>

Panel B: Split ratio ≥ 2 (N=651)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Split Ratio</td>
<td>8.74</td>
<td>2.00</td>
<td>88.07</td>
<td>2.00</td>
<td>2000.00</td>
</tr>
<tr>
<td>Log(Split Ratio)</td>
<td>0.47</td>
<td>0.18</td>
<td>0.61</td>
<td>-2.30</td>
<td>7.60</td>
</tr>
<tr>
<td>Float Reduction = 1 – 1/Split Ratio (%)</td>
<td>0.60</td>
<td>0.50</td>
<td>0.14</td>
<td>0.50</td>
<td>0.9995</td>
</tr>
<tr>
<td>Market Value pre-split (¥ billion)</td>
<td>193.08</td>
<td>19.80</td>
<td>995.40</td>
<td>0.84</td>
<td>13548.60</td>
</tr>
<tr>
<td>Days between announcement and Ex-date</td>
<td>28.96</td>
<td>25.00</td>
<td>17.83</td>
<td>7.00</td>
<td>111.00</td>
</tr>
<tr>
<td>Days between Ex-date and Pay-date</td>
<td>39.06</td>
<td>39.00</td>
<td>3.91</td>
<td>4.00</td>
<td>68.00</td>
</tr>
<tr>
<td>Pre-split log Price</td>
<td>12.00</td>
<td>13.09</td>
<td>2.78</td>
<td>3.95</td>
<td>18.35</td>
</tr>
<tr>
<td>Cumulative Abnormal Returns (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[Ann-200,Ann-1]</td>
<td>61.07</td>
<td>51.00</td>
<td>75.97</td>
<td>-174.86</td>
<td>753.07</td>
</tr>
<tr>
<td>[Ann-1,Ann+1]</td>
<td>8.95</td>
<td>7.03</td>
<td>17.16</td>
<td>-25.82</td>
<td>287.31</td>
</tr>
<tr>
<td>[Ex-date-1,Ex-date+1]</td>
<td>11.21</td>
<td>5.49</td>
<td>33.35</td>
<td>-87.29</td>
<td>403.33</td>
</tr>
<tr>
<td>[Ex-date-1,Ex-date+20]</td>
<td>20.26</td>
<td>10.75</td>
<td>53.74</td>
<td>-109.17</td>
<td>826.41</td>
</tr>
<tr>
<td>[Pay-date-10,Pay-date+5]</td>
<td>-8.75</td>
<td>-8.04</td>
<td>19.47</td>
<td>-139.54</td>
<td>147.53</td>
</tr>
<tr>
<td>[Ann-10,Pay-date+50]</td>
<td>26.98</td>
<td>15.24</td>
<td>81.6</td>
<td>-230.01</td>
<td>811.95</td>
</tr>
<tr>
<td>[Ex-1, Pay-date+50]</td>
<td>8.62</td>
<td>0.46</td>
<td>63.35</td>
<td>-283.05</td>
<td>747.27</td>
</tr>
<tr>
<td>Volume (Turnover, %)</td>
<td>1.31</td>
<td>0.49</td>
<td>2.18</td>
<td>0.00</td>
<td>15.50</td>
</tr>
<tr>
<td>Daily Avg [Ann-50,Ann-1]</td>
<td>0.54</td>
<td>0.19</td>
<td>1.19</td>
<td>0.00</td>
<td>19.4</td>
</tr>
<tr>
<td>Daily Avg [Ann-date,Ex-date]</td>
<td>0.36</td>
<td>0.15</td>
<td>0.79</td>
<td>0.00</td>
<td>19.4</td>
</tr>
<tr>
<td>Daily Avg [Ex-date,Pay-date-1]</td>
<td>0.34</td>
<td>0.13</td>
<td>1.02</td>
<td>0.00</td>
<td>24.46</td>
</tr>
</tbody>
</table>
Table 2. Announcement and ex-date returns

Cumulative abnormal returns around the announcement date and ex-date for stock splits occurring in Japan between 1995 and March 2005, expressed in percentage terms. An S-for-1 split ratio is one in which S-1 new shares are distributed, on the pay-date, to all holders of 1 share on the ex-date. The abnormal daily return is the difference between the return of the security and the return on the TOPIX stock index. In Panel A, returns are accumulated beginning one day before the announcement date and ending ten days after. In Panel B, accumulation of returns begins one day before the ex-date and ends ten days after. Results are shown separately for the full sample, the subperiod 1995 through 1999, the subperiod 2000 through March 2005, the sample of splits with ratios less than two, and the sample of splits with ratios greater than or equal to 2. T-statistics are in brackets.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AR %</td>
<td>CAR %</td>
<td>[t]</td>
<td>AR %</td>
<td>CAR %</td>
</tr>
<tr>
<td>Ann -1</td>
<td>0.18</td>
<td>0.18</td>
<td>[1.90]</td>
<td>-0.59</td>
<td>-0.59</td>
</tr>
<tr>
<td>Announcement</td>
<td>1.11</td>
<td>1.29</td>
<td>[9.04]</td>
<td>0.66</td>
<td>0.06</td>
</tr>
<tr>
<td>Ann +2</td>
<td>0.73</td>
<td>4.98</td>
<td>[16.14]</td>
<td>0.40</td>
<td>1.69</td>
</tr>
<tr>
<td>Ann +3</td>
<td>0.11</td>
<td>5.09</td>
<td>[15.76]</td>
<td>0.06</td>
<td>1.75</td>
</tr>
<tr>
<td>Ann +4</td>
<td>0.15</td>
<td>5.24</td>
<td>[15.60]</td>
<td>0.40</td>
<td>2.15</td>
</tr>
<tr>
<td>Ann +5</td>
<td>0.02</td>
<td>5.26</td>
<td>[14.74]</td>
<td>0.08</td>
<td>2.23</td>
</tr>
<tr>
<td>Ann +6</td>
<td>0.01</td>
<td>5.27</td>
<td>[14.33]</td>
<td>0.06</td>
<td>2.29</td>
</tr>
<tr>
<td>Ann +7</td>
<td>0.07</td>
<td>5.33</td>
<td>[14.37]</td>
<td>0.17</td>
<td>2.46</td>
</tr>
<tr>
<td>Ann +8</td>
<td>0.22</td>
<td>5.55</td>
<td>[14.28]</td>
<td>0.10</td>
<td>2.56</td>
</tr>
<tr>
<td>Ann +9</td>
<td>0.44</td>
<td>5.99</td>
<td>[14.56]</td>
<td>0.38</td>
<td>2.94</td>
</tr>
<tr>
<td>Ann +10</td>
<td>0.06</td>
<td>6.04</td>
<td>[13.71]</td>
<td>-0.56</td>
<td>2.38</td>
</tr>
<tr>
<td>Eff-1</td>
<td>-0.64</td>
<td>-0.64</td>
<td>[-6.86]</td>
<td>-0.89</td>
<td>-0.89</td>
</tr>
<tr>
<td>Ex-date</td>
<td>3.66</td>
<td>3.02</td>
<td>[6.58]</td>
<td>0.19</td>
<td>-0.71</td>
</tr>
<tr>
<td>Eff+1</td>
<td>0.36</td>
<td>3.37</td>
<td>[7.53]</td>
<td>0.32</td>
<td>-0.38</td>
</tr>
<tr>
<td>Eff+2</td>
<td>0.57</td>
<td>3.95</td>
<td>[9.09]</td>
<td>0.28</td>
<td>-0.10</td>
</tr>
<tr>
<td>Eff+3</td>
<td>0.56</td>
<td>4.51</td>
<td>[10.07]</td>
<td>0.14</td>
<td>0.04</td>
</tr>
<tr>
<td>Eff+4</td>
<td>0.70</td>
<td>5.21</td>
<td>[11.03]</td>
<td>1.18</td>
<td>1.22</td>
</tr>
<tr>
<td>Eff+5</td>
<td>-0.44</td>
<td>4.78</td>
<td>[9.59]</td>
<td>-0.20</td>
<td>1.02</td>
</tr>
<tr>
<td>Eff+6</td>
<td>0.13</td>
<td>4.91</td>
<td>[9.65]</td>
<td>-0.09</td>
<td>0.93</td>
</tr>
<tr>
<td>Eff+7</td>
<td>-0.26</td>
<td>4.64</td>
<td>[9.03]</td>
<td>0.01</td>
<td>0.93</td>
</tr>
<tr>
<td>Eff+8</td>
<td>-0.22</td>
<td>4.42</td>
<td>[8.31]</td>
<td>-0.24</td>
<td>0.69</td>
</tr>
<tr>
<td>Eff+9</td>
<td>-0.25</td>
<td>4.17</td>
<td>[7.63]</td>
<td>-0.87</td>
<td>-0.18</td>
</tr>
<tr>
<td>Eff+10</td>
<td>0.61</td>
<td>4.78</td>
<td>[8.40]</td>
<td>-0.05</td>
<td>-0.23</td>
</tr>
</tbody>
</table>
Table 3. Pay-date returns

Cumulative abnormal returns around the pay date for stock splits in Japan occurring between 1995 and March 2005, expressed in percentage terms. An \( S \)-for-1 split ratio is one in which \( S \)-1 new shares are distributed, on the pay-date, to all holders of 1 share on the ex-date. On the pay date, additional shares created from the split are distributed to ex-date shareholders. The abnormal daily return is the difference between the return of the security and the return on the TOPIX stock index. Returns are accumulated beginning ten days before the pay date and ending ten days after. T-statistics are in brackets. Results are shown separately for the full sample, the subperiod 1995 through 1999, the subperiod 2000 through March 2005, the sample of splits with ratios less than two, and the sample of splits with ratios greater than or equal to 2.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AR %</td>
<td>CAR %</td>
<td>[t]</td>
<td>AR %</td>
<td>CAR %</td>
</tr>
<tr>
<td>Pay – 10</td>
<td>-0.21</td>
<td>-0.21</td>
<td>[-2.66]</td>
<td>0.16</td>
<td>0.16</td>
</tr>
<tr>
<td>Pay – 9</td>
<td>0.57</td>
<td>0.36</td>
<td>[3.05]</td>
<td>0.57</td>
<td>0.73</td>
</tr>
<tr>
<td>Pay – 8</td>
<td>0.46</td>
<td>0.82</td>
<td>[5.50]</td>
<td>-0.14</td>
<td>-0.20</td>
</tr>
<tr>
<td>Pay – 7</td>
<td>0.50</td>
<td>1.32</td>
<td>[8.09]</td>
<td>0.92</td>
<td>0.72</td>
</tr>
<tr>
<td>Pay – 6</td>
<td>0.31</td>
<td>1.63</td>
<td>[8.72]</td>
<td>0.40</td>
<td>1.12</td>
</tr>
<tr>
<td>Pay – 5</td>
<td>0.14</td>
<td>1.77</td>
<td>[8.82]</td>
<td>0.00</td>
<td>1.11</td>
</tr>
<tr>
<td>Pay – 4</td>
<td>-0.23</td>
<td>1.53</td>
<td>[7.19]</td>
<td>-0.16</td>
<td>0.96</td>
</tr>
<tr>
<td>Pay – 3</td>
<td>-0.65</td>
<td>0.88</td>
<td>[3.84]</td>
<td>-0.48</td>
<td>0.47</td>
</tr>
<tr>
<td>Pay – 2</td>
<td>-0.43</td>
<td>0.45</td>
<td>[1.91]</td>
<td>-0.60</td>
<td>-0.12</td>
</tr>
<tr>
<td>Pay – 1</td>
<td>-0.35</td>
<td>0.10</td>
<td>[0.40]</td>
<td>0.21</td>
<td>0.09</td>
</tr>
<tr>
<td>Pay – date</td>
<td>-0.33</td>
<td>-0.23</td>
<td>[-0.86]</td>
<td>0.04</td>
<td>0.14</td>
</tr>
<tr>
<td>Pay +1</td>
<td>-0.07</td>
<td>-0.30</td>
<td>[-1.03]</td>
<td>0.22</td>
<td>0.35</td>
</tr>
<tr>
<td>Pay +2</td>
<td>-0.92</td>
<td>-1.21</td>
<td>[-3.96]</td>
<td>-0.58</td>
<td>-0.22</td>
</tr>
<tr>
<td>Pay +3</td>
<td>-0.43</td>
<td>-1.65</td>
<td>[-5.10]</td>
<td>-0.53</td>
<td>-0.75</td>
</tr>
<tr>
<td>Pay +4</td>
<td>-0.41</td>
<td>-2.06</td>
<td>[-6.19]</td>
<td>-0.23</td>
<td>-0.98</td>
</tr>
<tr>
<td>Pay +5</td>
<td>-0.02</td>
<td>-2.08</td>
<td>[-6.08]</td>
<td>-0.03</td>
<td>-1.02</td>
</tr>
<tr>
<td>Pay +6</td>
<td>-0.38</td>
<td>-2.47</td>
<td>[-6.96]</td>
<td>-0.28</td>
<td>-1.29</td>
</tr>
<tr>
<td>Pay +7</td>
<td>-0.06</td>
<td>-2.52</td>
<td>[-6.97]</td>
<td>-0.04</td>
<td>-1.33</td>
</tr>
<tr>
<td>Pay +8</td>
<td>0.22</td>
<td>-2.30</td>
<td>[-6.09]</td>
<td>0.60</td>
<td>-0.73</td>
</tr>
<tr>
<td>Pay +9</td>
<td>-0.60</td>
<td>-2.90</td>
<td>[-7.58]</td>
<td>-0.89</td>
<td>-1.62</td>
</tr>
<tr>
<td>Pay +10</td>
<td>0.00</td>
<td>-2.89</td>
<td>[-7.46]</td>
<td>0.14</td>
<td>-1.48</td>
</tr>
</tbody>
</table>
Table 4. Determinants of turnover changes

OLS regressions of announcement and ex-date to pay-date period abnormal turnover on the split ratio

\[ V_t = a + b k + u_t \]

Turnover is the yen value of shares traded divided by total market capitalization. Abnormal turnover is the difference between the average daily turnover in a particular period and the average daily turnover during the 50 trading days before the announcement. In the regressions, S is measured alternately as the log of the split ratio, or as one minus the reciprocal of the split ratio. T-statistics are presented in brackets.

<table>
<thead>
<tr>
<th></th>
<th>Announcement Period Turnover</th>
<th>[Ex-date,Pay-date-1] period turnover</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full sample</td>
<td>Split Ratio ≥ 2</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.03</td>
<td>-0.65</td>
</tr>
<tr>
<td></td>
<td>[-0.65]</td>
<td>[-1.77]</td>
</tr>
<tr>
<td>k = 1 − 1/Split Ratio</td>
<td>-0.06</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>[-0.51]</td>
<td>[1.51]</td>
</tr>
<tr>
<td>R²</td>
<td>0.000</td>
<td>0.003</td>
</tr>
</tbody>
</table>
Table 5. Determinants of event returns

OLS regressions of announcement and ex-date abnormal returns on the split ratio, disagreement H, and the interaction of H and the split ratio:

\[ R_{it} = a + bk_i + cH_i + dk_iH_i + u_{it} \]

\( k \) is one minus the reciprocal of the split ratio and is a measure of the restrictions placed on trading between the ex-date and pay-date. Disagreement, H, is measured as the average turnover during the 50 trading days before announcement of the split. The dependent variable is alternately the cumulative abnormal return between one day before the announcement and the ex-date, or the cumulative abnormal return between one day before the ex-date and 20 days after. The table presents results for both the full sample and the subsample of splits for which the split ratio was 2-for-1 or greater.

<table>
<thead>
<tr>
<th></th>
<th>Y= Event return [Announcement day – 1, Ex-date + 10]</th>
<th></th>
<th>Y= Ex-date return [Ex-date – 1, Ex-date + 20]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Full Sample</td>
<td>Split Ratio &gt;= 2 (k&gt;0.5)</td>
<td>Full Sample</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-0.05 0.10 [-4.44]</td>
<td>-0.73 0.26 [-7.18]</td>
<td>-0.03 0.06 [-2.79]</td>
</tr>
<tr>
<td><strong>k = 1 – 1/Split Ratio</strong></td>
<td>0.64 0.45 [19.53]</td>
<td>1.69 1.35 [10.35]</td>
<td>0.42 0.28 [14.37]</td>
</tr>
<tr>
<td></td>
<td>[11.75] [10.35]</td>
<td>[7.29]</td>
<td>[8.04]</td>
</tr>
<tr>
<td></td>
<td>[11.37] [5.02]</td>
<td>[5.02]</td>
<td>[5.22]</td>
</tr>
<tr>
<td><strong>k x Turnover</strong></td>
<td>10.28 6.89 [8.68]</td>
<td></td>
<td>7.45 5.41 [6.94]</td>
</tr>
<tr>
<td></td>
<td>[3.26]</td>
<td></td>
<td>[2.75]</td>
</tr>
<tr>
<td><strong>R^2</strong></td>
<td>0.15 0.03 0.14</td>
<td>0.17</td>
<td>0.09 0.04 0.11</td>
</tr>
</tbody>
</table>
Table 6. Determinants of pay-date returns

OLS regressions of pay-date abnormal returns on the split ratio, disagreement $H_i$ and the interaction of $H_i$ and the split ratio:

$$R_{it} = a + bk_i + cH_i + dk_iH_i + u_{it}$$

$k$ is one minus the reciprocal of the split ratio and is a measure of the restrictions placed on trading between the ex-date and pay-date. Disagreement, $H_i$, is measured as the average turnover during the 50 trading days before announcement of the split. The dependent variable is cumulative abnormal returns starting ten days before the pay-date and ending ten-days after. Results are shown separately for the full-sample and for those splits with split ratios of 2-for-1 or greater.

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th>Split Ratio $\geq 2$ ($k \geq 0.5$)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Constant</strong></td>
<td>0.02</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>[-0.02]</td>
<td>[-0.07]</td>
</tr>
<tr>
<td></td>
<td>[0.01]</td>
<td>[0.11]</td>
</tr>
<tr>
<td>$k = 1 - 1/\text{Split Ratio}$</td>
<td>-0.19</td>
<td>-0.41</td>
</tr>
<tr>
<td></td>
<td>[-14.84]</td>
<td>[-7.60]</td>
</tr>
<tr>
<td>$\text{Turnover}$</td>
<td>-1.92</td>
<td>-1.03</td>
</tr>
<tr>
<td></td>
<td>[-8.17]</td>
<td>[-4.79]</td>
</tr>
<tr>
<td>$k \times \text{Turnover}$</td>
<td>-2.86</td>
<td>-2.47</td>
</tr>
<tr>
<td></td>
<td>[-5.93]</td>
<td>[-3.52]</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.10</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>0.03</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>0.20</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Table 7. Equity issuance around stock splits

This table describes equity issuance activity around stock splits. In Panel A, the measure of equity issuance is binary, taking a value of 1 if the firm issued equity during the period in question, and zero otherwise. Equity issuance is inferred from changes in split-adjusted shares outstanding. The table shows the percentage of firms that issued equity 100-days before a split announcement, as a fraction of all firms announcing splits. The second column shows the fraction of firms that issued equity within 100-days after the split announcement, as a fraction of all firms announcing splits. The “matched sample” describes equity issuance over the same intervals for a group of firms matched by size and past stock return, but that did not split. The panel also shows these same results, together with the corresponding matched sample, for the firms executing splits with a split ratio of 2-for-1 or greater.

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Before</th>
<th>After</th>
<th>After - Before</th>
<th>[t]</th>
</tr>
</thead>
<tbody>
<tr>
<td>All splits</td>
<td>2092</td>
<td>0.07</td>
<td>0.12</td>
<td>0.05</td>
<td>[5.14]</td>
</tr>
<tr>
<td>Matched Sample</td>
<td>2092</td>
<td>0.04</td>
<td>0.06</td>
<td>0.02</td>
<td>[3.07]</td>
</tr>
<tr>
<td>Difference</td>
<td>2092</td>
<td>0.02</td>
<td>0.07</td>
<td>0.04</td>
<td>[3.79]</td>
</tr>
<tr>
<td>Splits (Ratio≥2)</td>
<td>650</td>
<td>0.10</td>
<td>0.19</td>
<td>0.09</td>
<td>[4.31]</td>
</tr>
<tr>
<td>Matched Sample</td>
<td>650</td>
<td>0.04</td>
<td>0.09</td>
<td>0.04</td>
<td>[3.59]</td>
</tr>
<tr>
<td>Difference</td>
<td>650</td>
<td>0.06</td>
<td>0.13</td>
<td>0.07</td>
<td>[2.91]</td>
</tr>
</tbody>
</table>
Table 8. Corporate responses to the split premium

Time series regressions of the number of firms announcing stock splits with ratios greater than or equal to 2-for-1 in a particular quarter on the average event return accruing to firms that split in the previous quarter.

\[ Y = a + b \bar{R}_{Event,t-1} + u_t \]

A firm is defined to have split in quarter \( t \) if its ex-date falls before the end of the quarter. The dependent variable is alternately the number of firms announcing splits greater than 2-for-1, the change in this number from the previous quarter, the share of firms announcing splits greater than 2-for-1 as a fraction of all stock splits in that quarter, and the average of the log split ratio in that quarter.

<table>
<thead>
<tr>
<th>( Y = \text{N}_{\text{Ratio} \geq 2} )</th>
<th>( Y = \Delta \text{N}_{\text{Ratio} \geq 2} )</th>
<th>( Y = \text{N}<em>{\text{Ratio} \geq 2}/\text{N}</em>{\text{All}} )</th>
<th>( Y = \text{Log(Ratio)} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a )</td>
<td>10.97</td>
<td>-0.63</td>
<td>0.25</td>
</tr>
<tr>
<td>[2.81]</td>
<td>[-0.29]</td>
<td>[4.73]</td>
<td>[6.87]</td>
</tr>
<tr>
<td>( b )</td>
<td>29.29</td>
<td>8.22</td>
<td>0.36</td>
</tr>
<tr>
<td>[3.05]</td>
<td>[1.46]</td>
<td>[2.75]</td>
<td>[2.81]</td>
</tr>
<tr>
<td>( N )</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.20</td>
<td>0.05</td>
<td>0.17</td>
</tr>
</tbody>
</table>