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SHORTING RESTRICTIONS, LIQUIDITY, AND RETURNS

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ABSTRACT

During the 1930's, as stock prices fell in the US, several restrictions were imposed on equity short sellers. This paper examines in detail three specific restrictions adopted at various times: (1) in 1932, brokers were required to secure written authorization before lending a customer's shares, (2) in 1931, shorting on a downtick was prohibited, and (3) in 1938, this provision was tightened to require that all short sales be executed on a strict uptick. Short interest and securities lending data indicate that each event made shorting more difficult. Average returns associated with the events are significantly positive, consistent with the limits-to-arbitrage notion that when there are restrictions on shorting, optimists have more influence on prices. This paper also examines the evolution of liquidity around these shorting restrictions. Consistent with the rational expectations model of Diamond and Verrecchia (1987), the written authorization requirement increased bid-ask spreads and decreased liquidity. In contrast, the tick restrictions have the opposite effect. Liquidity actually improves with these restrictions. I argue that the tick restrictions force shorts to supply liquidity rather than demand liquidity, thereby reducing spreads. These findings may be relevant in policy debates concerning the uptick rule.

1. Introduction

Do short sale constraints matter? Clearly, such constraints affect portfolio decisions and other optimization problems. In the past few years, financial economists have come to agree that they may also affect equilibrium prices.

If there are such limits to arbitrage, in the language of Shleifer and Vishny (1997), then it is possible for securities to become overpriced. However, it takes more than market imperfections to bring this about. In a rational expectations world, such as Diamond and Verrecchia (1987), prices remain unbiased around fundamental value. However, if there is investor heterogeneity, such as in Duffie (1996) or Duffie, Garleanu and Pedersen (2002), or agents are less than fully rational, such as in Miller (1977), then shorting restrictions can have an effect. In that case, pessimists (agents with low valuations) are shut out of the market, and prices can be determined by optimists (agents with high valuations).

There is mounting evidence that this heterogeneity is present and affects prices. Lamont and Thaler (2002) and Mitchell, Pulvino, and Stafford show that during the late 1990's, spinoffs in the tech sector were so overpriced that arbitrage (or something very close to arbitrage) would have been possible in a frictionless market. But short positions were very difficult to establish. Pontiff (1996) provides similar evidence for closed-end funds, and Ofek and Richardson (2002) do the same for a broad cross-section of technology stocks in the late 1990's. Jones and Lamont (2002) show that in the 1920's and 1930's, stocks that were expensive to short had abnormally low future returns, even after accounting for shorting costs.

There has been much less work on the intersection between short sales and other quantities of interest, such as volatility and liquidity. Diamond and Verrecchia (1987) is perhaps the only theoretical model to address the effect of shorting restrictions on bid-ask spreads, price adjustment, and other measures of transaction costs and information incorporation. Their model builds on a simple Glosten and Milgrom (1985) framework, and it predicts that if some market participants are prohibited from shorting, prices adjust more slowly to new negative information. As a result of this slower adjustment, market-makers tend to lose more to the remaining informed traders. In order to protect themselves from these informed traders, market-makers must set wider bid-ask spreads.

Empirical work in this area is also sparse. Reed (2002) investigates the asymmetry of price adjustment in response to information about earnings. Aitken, Frino, McCorry, and Swan

(1998) show that in Australia, where a short sale is publicly identified as such immediately on execution, short sales have a larger impact on price than regular-way sales. Both of these results are consistent with the Diamond-Verrecchia model.

This paper takes a different tack, looking at the effects of short selling by examining changes in the regulatory regime that affect the short-sale constraint. In that sense, this paper is related to Sorescu (2000) and Danielsen and Sorescu (2001), who view the introduction of listed options on a stock as relaxing the short-sale constraint. In contrast, this paper looks at several discrete events in the US in the 1930's that tighten the constraint by making shorting more difficult. While they focus on prices, this paper focuses more on changes in liquidity.

This paper examines three such events. First, in October 1931 the New York Stock Exchange de facto prohibited short sales at a price lower than the previous sale. That is, short sales could not be executed on downticks. Second, in April 1932 the Exchange required all brokers to obtain written authorization from their customers before hypothecating (lending) their shares. Third, in February 1938, the Securities and Exchange Commission implemented the so-called uptick rule, which required all short sales to take place at a price strictly higher than the previous sale. All three of these events made shorting more difficult, but in different ways. The paper examines returns, volatility, and liquidity around the events, focusing on the similarities and differences between the three events.

The paper is organized as follows. Section 2 provides some background information on the process of shorting stocks in the 1920's, and Section 3 continues the narrative into the early 1930's. The three events are considered in Sections 4 through 6. Section 7 analyzes the three events together, Section 8 describes some additional events that might be studied in future work, and Section 9 draws some policy and other conclusions.

2. The US securities lending market prior to the 1930's

During the 1920's, there were relatively few restrictions on shorting in the United States, and professional traders made wide use of the practice. As is true today, the main requirement was that the short had to borrow shares in order to deliver them to the counterparty on the buy side. There were a number of ways to borrow shares. Then, as now, brokers could arrange loans internally between customers or contact another broker directly. During this time period, a member could also borrow and lend shares at the "loan post" on the floor of the New York Stock

Exchange. Jones and Lamont (2002) provide more details about this centralized equity lending market that no longer exists in the U.S.

Now, a short's broker is required to make a good faith effort to locate in advance the shares to be lent. Evans, Geczy, Musto, and Reed (2002) provide an excellent discussion of the current extent of the locate requirement and the incidence of fails by some of those exempt from the locate requirements; Fleming and Garbade (2002) discuss delivery fails in today's fixed income market. During the 1920's, however, there was no such requirement, and brokers often met at the loan post after the close to obtain shares needed for delivery the next day.

Margins on short positions were determined by the broker, and were subject to NYSE regulation for Big Board issues. Margin requirements differed over time and also depended on the share price, with low-priced stocks commanding much higher margins than high-priced stocks. As a general rule, margins were on the order of 25%, in contrast to the 50% level required today. As is true today, the short-seller did not have use of the short proceeds.

Then, as now, the broker borrowing shares had to post cash collateral and received interest on that cash collateral. Today, that interest rate is known as the rebate rate in the equity markets and the repurchase rate or repo rate in the fixed income markets. During the period considered in this paper, the rate was known as the loan rate, loaning rate, or stock lending rate. This rate can vary over time and across securities.[1] If there were sufficient shares available for lending, the loan rate would be close to the call money rate. If the demand exceeded the supply of lendable shares, however, the borrower would have to pay more to borrow the shares. This payment would come in the form of a lower rate on the cash collateral. During the sample period, some stocks loaned at positive rates, some loaned flat (at a zero rate), and some stocks loaned at a premium (a negative loan rate). Positive rates were not usually passed on to the short customer, unless the customer was an investment trust or other large entity. Negative loan rates were always passed through, however.

Then, as now, most security loans were overnight loans, so a short was potentially exposed to buy-in risk if the loan counterparty recalled the shares for some reason. In the late 1800's and early 1900's, corners and near-corners were common, and shorts were occasionally

[1] For example, Davolio (2002) and Geczy, Musto, and Reed (2002) analyze a recent cross-section of rebate rates obtained from a major U.S. securities lender.

exposed to such recalls at inopportune times. However, these problems receded for the most part by the 1920's.[2]

Shorting itself also receded during the 1920's, as it was generally a good way to make a small fortune out of a large fortune during a period of generally rising stock prices. Beginning soon after the stock market crash of 1929, however, short selling found itself at the center of the American financial stage.

3. 1930's prohibitions and restrictions on shorting

Shorting has not always been well-understood, and it was banned at various times in various financial markets. Meeker (1932), who was the New York Stock Exchange economist at the time of writing, provides a useful history. Many prohibitions were enacted after price collapses. For example, the Dutch attempted to legislate against short sales following the tulip bulb craze of the early 1600's, and the British Parliament forbade short sales after the South Sea bubble burst in 1720. Germany outlawed short sales of certain agricultural securities in 1896 following a sharp commodity price deflation. All of these acts were eventually repealed. In the US, the New York state legislature banned short sales in 1812, but the law was soon ignored and was formally repealed in 1858. During World War I, American authorities were worried about shorting by enemy agents. From 1917 to1919, the NYSE required all brokers to confidentially identify those selling short, with an explicit threat to reveal their identities in the event of unusual price behavior. The threat was never carried out.

In the early part of the 20th century, sharp downdrafts in a particular stock or in the market overall were often attributed to so-called "bear raids." In a bear raid, professional traders would organize a pool of capital and then aggressively short the target stock or stocks. This generally drove down the share price. Ideally, the pool would then cover its short at a profit. Contemporaneous accounts stress the manipulative aspects of these trading strategies. However, these professional traders were often in possession of material negative private information about a company's performance, so bear raids could sometimes contribute to efficient price discovery.

As a result of this history, some immediately pointed to bear raids as the cause of the stock market crash of October 1929. Short sellers were blamed, much as portfolio insurance and

[2] However, see Jones and Lamont (2002) for a discussion of Wheeling and Lake Erie Railroad, which was nearly cornered inadvertently in 1927 by two competing acquirers who were each buying up as many shares as possible on the open market as part of a bid to gain control.

program trading were later blamed for the 1987 crash. In 1929, the New York Stock Exchange's initial response was to collect data from members on short interest. As of November 12, 1929, short interest in NYSE stocks was a minuscule 0.15% of outstanding shares. By way of comparison, NYSE short interest on September 13, 2002 was 2.3% of shares outstanding.

As prices continued to fall through 1930 and into 1931, a noisy debate ensued. Shorting opponents pressed for an outright ban in the press and in the policy arena, while New York Stock Exchange officials took the lead in defending the practice. The political pressure was considerable. Members of the US Congress introduced bills prohibiting shorting, and even J. Edgar Hoover launched an investigation into shorting. While the Exchange publicly defended shorting, Exchange officials privately encouraged members to minimize their shorting activity.

On Sunday, September 21, 1931, Great Britain announced that it was abandoning the gold standard. Among the major stock exchanges in Europe, only Paris opened the next day. All were concerned about the likely selling pressure. In contrast, the New York Stock Exchange felt it was important to open at the usual hour of 10:00am, but Exchange officials were concerned about waves of selling as well as the general political climate. They decided to ban short selling completely on that day. Short sales were also banned the following day. Against expectations, stock prices advanced on both days. However, Richard Whitney, the president of the NYSE, reported later that

> Within two hours after short selling was forbidden, the Governing Committeee found there was a real danger of technical corners and of crazy and dangerous price advances. At one time there were accumulated orders to buy approximately eight thousand shares of General Motors stock at the market. No stock was offered for sale within many points of 30¼, which was the last preceding sale and the highest price that the stock reached at any time during this period. Something had to be done immediately…

The London Stock Exchange reopened the next day, September 23, 1931, and the New York Stock Exchange again permitted short sales, stating that the two-day ban was not a reversal of its long established policy allowing short selling but a temporary emergency measure. Prices advanced on that day as well, though they declined for two weeks thereafter.

One might be tempted to study the behavior and liquidity of the market during the two-day prohibition period, but the ban on shorting was clearly not an exogenous event. It was a period of great uncertainty and volatility, and separating out the effect of the shorting ban from

the effects of the devaluation of sterling would be nearly impossible. Figure 1 summarizes the behavior of the market and the behavior of short interest around the ban.

4. April 1932: Hypothecation requires written authorization

As the debate over short selling continued through 1931 and into 1932, more members of the public began to understand the mechanics of selling short. In particular, they realized that shorts needed to borrow shares to open a position. Opponents of short selling encouraged stockholders to refrain from lending their shares. Some investment trusts and brokerage firms did in fact refuse to lend shares, even though this action was typically not individually rational for a lender, given the substantial economic benefits to lending shares during this time period.[3] Unfortunately, there appear to be no hard data on the magnitude of such contractions in the supply of lendable shares.

Though a few brokers refused to lend shares, most brokers can and did lend the shares of their customers held in "street name". Brokers did not need permission from the investor to do so. The only way to prevent one's shares from being lent was to take physical delivery of stock certificates. This was cumbersome at best, and impossible if shares were held on margin. Nevertheless, anecdotal evidence indicates that a number of investors took this route, though they may also have been concerned about their ability to take possession of the shares in the event of the broker's insolvency (customer accounts were to be segregated, but there was no equivalent of deposit insurance and thus little prospect of recovery in the event of corporate malfeasance). In response to these trends, the New York Stock Exchange required brokers to secure written authorization from an investor before lending his shares. The new requirement was advertised as giving investors control over the use of their shares, but the rule was also designed to stem the tide of investors taking physical delivery of their share certificates. The new requirement was announced on February 18, 1932, well in advance of the effective date of April 1, 1932.

While there was ample time for brokerage firms to secure the needed signatures, they were apparently unable to do so in sufficient quantity. On March 31, the supply of lendable

[3] Jones and Lamont (2002) document that during this time period the general collateral rate (the rebate rate for stocks that were easy to borrow) was zero. This was well below the call money rate, which was in the neighborhood of 2% in 1931 and 1932.

shares contracted considerably.[4] A sub-headline in The New York Times reports that "Brokers Scurry to Gain Consent of Security Owners to Put Out Holdings." ("Stock loan rates rise on new ruling," March 31, 1932, p. 29). This wreaked havoc on the securities lending market. Share lenders were able to extract substantial concessions from borrowers. Figure 1 reports the time series of loaning rates for a number of active stocks. There were negative rebate rates in 27 stocks that day, with daily rates ranging between 1/256 and 1/2 percent. For example, U.S. Steel was generally the most actively traded issue on the NYSE and was typically easy to borrow for shorting purposes. On March 31, however, Steel loaned at a premium of 1/2 percent per day, or 19.5 cents per share per day based on the share price of $39. This represents an annualized cost of more than 180% per year to maintain a short position.

These high premiums did not last for long, however, as the price system worked its usual magic. High lending fees made more shares available for lending. The increase in the cost of shorting induced many to cover their shorts, reducing shorting demand. Within two weeks, conditions in the securities lending market had returned to normal. For example, by then Steel's daily premium had declined to 1/128 percent per day, a much more reasonable annualized cost of about 3%. Table 2 also provides a comparison of the average premiums in the nine trading days before and after April 1. Many more stocks loaned at premiums in April vs. the previous month. The average premium on these stocks was 3.9 basis points per day in April vs. 2.4 basis points per day in March, though the difference is not statistically significant.

Brokers would not pass this lending income through to their retail shareholders, but investment trusts and other large investors could receive this additional cash flow. The return enhancement was substantial in many cases. For example, in the one-month period between March 15, 1932 and April 15, 1932, a US Steel investor could have earned an additional 1.72% return from lending income, for an annualized "dividend" rate of 22.7%.

I use this event as a temporary exogenous shock to the supply of lendable shares. It is impossible to know for certain how many shares became at least temporarily unavailable for lending, though just prior to the effective date the New York Times reported that "25 to 40 per cent of the floating supply of stock – or shares held by brokers – have not yet given their consent. The floating supply is estimated by brokers at 35,000,000 to 40,000,000 shares, while the short

[4] March 31 is the first relevant date because there was next-day settlement of both security loans and transactions during this time period. In fact, loans and transactions were processed almost identically through the same clearing system.

interest is placed at between 2,000,000 and 3,000,000 shares." ("Stock loan rates rise on new ruling," March 31, 1932, p. 29). However, the exact size of the supply shock is only important if the goal is to estimate demand or supply curves. By looking at the price of shorting (the stock loan or rebate rate), it is clear that written authorization was an important supply shock.

The price of shorting went up at the beginning of April 1932, and the quantity of shorting fell sharply as well. Figure 2 graphs the changes. Aggregate short interest on the NYSE was 3,177,712 shares just prior to the announcement date of February 18, 1932. Short interest was essentially unchanged over the next six weeks, and in fact rose slightly as of March 31, 1932 to 3,279,398 shares. Over the first two weeks of the new hypothecation regime, short interest fell sharply to 2,323,738 shares by April 14, a decline of 29.1%. Even though short interest is quite volatile during this period, this decline is statistically significant.

The Diamond-Verrecchia model predicts that if some market participants are prohibited from taking short positions, prices should not be affected on average. The April 1932 written authorization requirement is not an ideal experiment, because the loan crowd evidence indicates that shares were available for lending, though at high prices. No short sellers were ruled out of the market, at least for the large stocks studied here. However, because the cost of maintaining a short position rose considerably at the start of April, it seems likely (and the short interest evidence confirms) that some shorts decided to exit their positions or avoid taking new ones.

On the announcement date of February 18, stocks generally rose, with the DJIA moving up 3.51%, from 82.24 to 85.13. Around the effective date of April 1, stocks declined. When stock loan rates shot up on March 31, the day before the new rule took effect, the Dow fell by 5.2% (the 6th worst day of the 151 trading days in the first half of 1932). On April 1, the Dow fell by 1.50%. On both days, the decline was ascribed to developments concerning a new transaction tax on securities trades, as well as disappointment that shorts were able to borrow shares more easily than expected. Nevertheless, none of these moves are big enough to reject the null hypothesis that the written authorization requirement had no effect on stock prices. So far, the evidence is consistent with Diamond-Verrecchia and the rational expectations model.

Diamond-Verrecchia also predicts that if some market participants are prohibited from taking short positions, then bid-ask spreads should widen. Jones (2002) shows that bid-ask spreads widened considerably during 1932, but his underlying data are monthly. Finer data are needed here. To directly investigate the behavior of bid-ask spreads and other characteristics of

individual security returns, daily open-high-low-close, volume, and closing bid-ask data on the 30 Dow Jones Industrial Average stocks are hand-collected from the New York Times for the 20 days around the effective date of the NYSE's hypothecation rule.

Table 2 investigates the effect of the written authorization rule on various measures of volume, volatility, and market quality. There is weak evidence that volatility is higher beginning April 1, 1932. The average intraday price range for the 30 DJIA stocks rises from $0.82 to $1.11, with a t-statistic of more than 4. Individual security volatility, defined as the cross-sectional average absolute value of individual daily security returns measured from close to close, also rises from 2.445% to 3.093%, but this increase is not statistically distinguishable from zero. Volume also rises substantially. The average Dow stock trades 9,454 shares in a day pre-event, rising to 15,451 shares in the first part of April. Dollar volume also increases, though not as much, since stock prices generally fell during this period.

Most importantly, bid-ask spreads widen sharply following the imposition of these stock lending rules. Average spreads go from 19.8 cents beforehand to 22.9 cents afterward, with a t-statistic of 3.10. Proportional bid-ask spreads are defined as dollar spreads divided by the quote midpoint. These expand even more dramatically, from 0.59% to 0.78%. This is in accord with the predictions of the rational model.

With daily data over a short window, it is difficult to calculate many standard measures of market quality. For example, since many trades take place inside the quotes, researchers using modern intraday data tend to prefer effective spreads (defined as the difference between the transaction price and the prevailing quote midpoint) over quoted spreads. However, it is difficult to measure effective spreads without prevailing quotes or other intraday data. In fact, it is worth noting that there are some intraday data available for this time period. During this period, Francis Emory Fitch published daily a list of each trade in each stock on the NYSE. Though there is no time stamp, transactions are grouped into two-hour baskets and are listed in sequence. Each transaction lists a trade price and the size of the trade. These data are kept in the archives of the New York Stock Exchange. In principle, it would be possible to infer effective spreads and other interesting microstructure quantities from these data, but a vast amount of effort would be required to make these data machine-readable.

Another important market quality measure is the price impact of a given trade. This measure is particularly important to traders who split or work orders, executing them gradually

over time. While intraday data can provide the most precise estimates of this quantity, it is possible to use daily data to calculate price impacts as well. Consider, for example, the continuous-time version of Kyle (1985). In that model, the coefficient λ, which is determined by the underlying distribution of liquidity traders and private information, measures the price change in response to a unit of order flow. In the continuous-time limit, the total squared variation in the price should equal the total volume multiplied by the Kyle lambda. Thus, the price impact of a unit of trade can be estimated as the variance of returns divided by trading volume (also see Pastor and Stambaugh, 2001, for an alternative estimator).

The variance of returns can be easily calculated using close-to-close returns. However, Garman and Klass (1980) and Yang and Zhang (2000) show that open, high, and low prices can also be incorporated to provide a more efficient estimate of the variance of returns. The intuition is that the open price provides another data point for the sample path, while the high and low provide some indication of the total variability along the sample path during a given day. I use the Yang and Zhang estimator for each stock's variance and scale that variance by the sum of the security's trading volume over the entire sample period. The result is an estimate of Kyle λ for that stock.

An alternative approach is to use the last transaction and the closing quote to estimate the adverse selection (permanent) and order processing (temporary) components of the bid-ask spread in a model such as Glosten and Harris (1988) or George, Kaul, and Nimalendran (1991). In these models, the adverse selection component of the spread is exactly equivalent to the permanent price impact of a trade. Before the ready availability of intraday data, these models were estimated on daily Nasdaq data, where a last transaction price and closing bid-ask quote were the only pieces of information available to the econometrician. The same data are available here, so in principle it should be possible to estimate the average price impact in this fashion. However, these estimators are very inefficient and require more data than have been collected to date.

The cross-sectional average price impacts are also given in Table 2. Prior to the written authorization requirement, a trade of 1,000 shares in a given direction resulted in a price move of about 2.7 basis points (averaged across all Dow stocks). After the event, price impacts went up slightly, to about 3.1 basis points for a 1,000-share trade. The difference is not statistically significant. Since the price impact dimension of liquidity does not seem to change much, one

can simply focus on the changes in spreads associated with the event and conclude that these hypothecation rules hurt market liquidity, consistent with the predictions of Diamond and Verrecchia (1987).

The evidence indicates a clear time-series association between this particular shorting restriction and liquidity. However, the cross-section may provide more detail about the link between the two. For example, if the shorting restriction binds more for some stocks than for others, the Diamond-Verrecchia model implies worse liquidity for those stocks affected most by the shorting restriction.

To operationalize this, the loan rate as of March 31 provides a good indication of the impact of the shorting restriction on a given stock. I regress the change in liquidity on this loan rate variable, with volume and market capitalization as control variables. The results are in Table 3. A stock's tightness in the securities lending market does not seem to be related to its change in liquidity. The coefficient on market cap is significant; liquidity in smaller Dow stocks worsens more than liquidity in large Dow stocks.

Overall, except for the lack of a cross-sectional relationship between the securities lending market and bid-ask spreads, the evidence associated with this event is broadly consistent with the Diamond-Verrecchia model. While this was a shock to the supply of lendable shares, I turn next to two events that represent shocks to shorting demand to see if those shocks have similar effects.

5. October 1931: Short sales on downticks prohibited

During the two-day ban on short-selling imposed during the sterling crisis of September 21-22, 1931, New York Stock Exchange officials were concerned that the prohibition was adding to volatility by making it impossible for specialists and other market-makers to provide liquidity. However, there was still considerable political pressure to rein in the shorts, so the NYSE decided on a less drastic course of action. On October 6, 1931, the Exchange announced that all sell orders had to be marked as either long or short. Short sales could not be executed at a price lower than the last sale. That is, short sales could not be executed on downticks. This was advertised as giving long sales priority over short sales, though there were no explicit priority rules to that effect. The clear goal was to inhibit bear raids without impeding the functions of market-makers.

The new policy was somewhat informal, since it did not involve promulgation of a formal New York Stock Exchange rule. The Exchange had always prohibited "demoralizing" trades, and the new prohibition simply classified short sales executed on a downtick as presumptively demoralizing. The key was the new requirement that all sales be marked long or short, since that enabled enforcement of the downtick policy. The new policy was announced on the ticker before the opening on October 6, and it was implemented immediately that day. Since trades were initiated by phone or wire with a manual paper trail, there were no technological impediments to the new rule and no reason to delay implementation. Furthermore, I could find no evidence that the impending change was announced or even leaked in advance. Daily rumor columns in all the major New York newspapers contain no mention of the new policy prior to its public release.

While it was not a ban on shorting, the downtick rule was an important restriction on short sales. It became somewhat more difficult to establish a short position in a declining market, and this inhibited shorts following a short-term momentum strategy. Figure 2 provides evidence. During this time period, the New York Stock Exchange was providing daily short interest figures and daily figures on "in-and-out" shorting, defined as short sales covered on the same day. As a result of October 6 trading, aggregate short interest fell from 2,597,898 shares to 2,173,800, a drop of 424,098 shares, or 16.3%.[5] In-and-out shorting also declined. These figures were released beginning eight trading days before the downtick rule. In-and-out shorts were 4.49% of daily volume in the eight days before the new policy, falling slightly and insignificantly to 4.14% of daily volume in the first twenty trading days of the new regime. Thus, it seems clear from these shorting activity measures that the new regime restricted short sales.

Loan rates also provide confirmation that the shorting restrictions were an important demand shock. Of the 104 stocks for which overnight lending rates were reported in the Wall Street Journal at the end of September 1931, most lent flat, meaning the rebate rate was zero. None lent at a positive rebate rate. In the nine trading days prior to October 6, the mean number of stocks lending at a premium (at a negative rebate rate) was about 15. Over the rest of October, fewer stocks lent at a premium. The estimated regression is:

[5] Reported short interest is based on settled trades. Since there was next-day settlement at the time, the relevant short interest figures are from Tuesday October 6 and Wednesday October 7.

$$N_t = \underset{(1.51)}{14.88} \underset{(1.80)}{- 3.82}\, D_t + \varepsilon_t,$$

where N_t is the number of stocks lending at a premium, D_t is an indicator variable equal to 1 beginning on October 6 and zero otherwise, and Newey-West standard errors are in parentheses. Similarly, for all 104 stocks over the same time interval, the mean rebate rate in basis points per day $\bar{c}_t$ became less negative:

$$\bar{c}_t = \underset{(0.116)}{-0.779} + \underset{(0.139)}{0.451}\, D_t + \varepsilon_t,$$

In sum, rebate rates rose significantly, indicating less shorting demand relative to the supply of lendable shares.

The Diamond-Verrecchia model predicts that imposing shorting restrictions should have no effect on share prices on average. However, the market rose sharply on October 6, and short interest fell sharply. See Figure 3. The Dow Jones Industrial Average rose by 14%, from 86.48 to 99.34. This was the Dow's biggest one-day move in either direction during all of 1931 and 1932, which itself was a period of considerable tumult in the American economy and financial markets. Thus, even with just this single event, one can safely reject the rational expectations hypothesis with very low p-values ($p = 0.0017$). Market reaction to this rule appears consistent with the view of Miller (1977). Restricting the trades of pessimists seems to have increased market-clearing asset prices.

Chen, Hong, and Stein (2002) use breadth of ownership as a proxy for the dispersion of opinions about a stock. Unfortunately, there do not appear to be any data available on ownership or a cross-section of earnings forecasts or any related quantities. However, these models of imperfect capital markets also suggest that stocks with the greatest shorting demand (relative to lending supply) should be affected most by the shorting restrictions, and these data are available. Short interest is an equilibrium quantity measure, while the loan rate is the equilibrium measure of the price of shorting. Cross-sectional differences in event-day returns might be related to these shorting price and quantity measures. From September through November 1931, the Exchange collected daily short interest data for each NYSE stock. Thus, exact short interest data are available for the time of the downtick shorting prohibition.[6] Event-day returns (R_{i0}) and short

[6] In results not reported, I test whether daily changes in short interest predict next-day returns for the 30 DJIA stocks over this three month period. Previous work is mixed on this topic. Brent, Morse, and Stice (1990) find that monthly short interest does not predict either the cross-section or time-series behavior of returns, while Figlewski

interest for the previous day normalized by average daily share volume ($S_{i,-1}$) are available for the 30 Dow stocks, and a simple OLS cross-sectional regression yields:

$$R_{i0} = \underset{(0.012)}{0.140} + \underset{(0.006)}{0.003}\, S_{i,-1} + e_t.$$

Thus, returns on the event day do not seem to be at all related to the existing short interest.

Loan rates are available for 20 of the 30 DJIA stocks. For this subsample, a similar cross-sectional regression of event-day returns on the previous-day rebate rate $c_{i,-1}$ yields

$$R_{i0} = \underset{(0.011)}{0.153} + \underset{(0.706)}{0.431}\, c_{i,-1} + e_t.$$

Again, there is no evidence that the cross-section of event-day returns is related to tightness in the securities lending market. Thus, it appears that the market as a whole responded strongly to the restrictions on shorts, but did not distinguish between stocks based on measures of shorting activity. This is consistent with the optimist models if the effect of shorting is similar across stocks or if these shorting measures are poor proxies for cross-sectional differences in the effect of the new rules.

As noted earlier, Diamond-Verrecchia also makes predictions about market liquidity. Specifically, the model predicts that restrictions on shorting should increase bid-ask spreads. As in Section 4, daily open-high-low-close, volume, and closing bid-ask data on the 30 Dow Jones Industrial Average stocks were hand-collected for 20 days before and 20 days after the event.[7] However, the pre-event period includes the September 21-22, 1931 sterling crisis during which shorting was prohibited completely on the NYSE. To isolate the event of interest and exclude confounding influences, the pre-event period begins on September 25, 1931, after the effects of the sterling crisis had passed and the market had returned to normal. As a result, the pre-event period contains just nine days, while the post-event period continues to reflect 20 trading days.

Table 4 investigates the effect of the shorting tick test on various measures of volume, volatility, and market quality. Volatility, as measured by the average intraday price range and

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(1981) and Figlewski and Webb (1993) find some predictive power For these higher-frequency data, I find that short interest does not predict returns. Nor is the daily change in short interest contemporaneously correlated with daily returns.

[7] During this time period, the NYSE was open on Saturday mornings, so there were six trading sessions per week, or a little over 300 trading days per year. As a result, the average calendar month contains about 25 trading days, and 20 trading days represents about 3½ weeks of calendar time.

the average daily absolute return on each index component, does not reliably change after October 6. Neither does volume.

However, prohibiting downticks is associated with a substantial improvement in market liquidity. Average bid-ask spreads decline markedly, from 32.3 to 26.2 cents. Reported spreads are weighted by average dollar trading volume over the entire sample period to reflect the aggregate cost of market participants' trades over this interval. Results are almost identical using simple averages or value-weighting. Results are also the same using dollar volume-weighted proportional spreads, which fall from 0.730% pre-event to 0.592% post-event, with a t-statistic of 3.54 based on Newey-West standard errors.

As noted in the previous section, the price impact of a trade is also an important liquidity measure, particularly for those trading gradually over time. Price impacts are inferred from data following the procedure discussed in Section 4. The downtick shorting prohibition does not reliably affect the price impact of a trade in either direction. Before the no-downtick rule, an order for 1,000 shares in an average DJIA stock is estimated to move the share price by 4.3 basis points. Afterward, the same order is estimated to move prices an average of 6.1 basis points. However, there is considerable uncertainty in these estimates, since price impacts must be inferred from daily volume and price moves. The null of no change cannot be rejected. The t-statistic on the difference is only 0.85.

Overall, the evidence indicates that market liquidity improved when short sales were restricted in October 1931. This runs directly counter to the predictions of Diamond-Verrecchia. What accounts for this surprising result? One possibility is that the no-downtick rule was not a simple prohibition on shorting, and as a result it could have a more subtle effect on liquidity. The new policy surely dissuaded some short sellers from taking positions. Diamond-Verrecchia shows clearly that the absence of those traders should be associated with wider bid-ask spreads.

However, some shorts adapted to the new rule. Under the no-downtick regime, shorts could no longer demand liquidity without restriction. The new policy limited the prices at which shorts could execute. To put it another way, in a simple world of market orders and limit orders, shorts were often precluded from using a market order, and were forced to use a limit order with a higher limit price. Thus, conditional on the short continuing to participate, the new rules made the short more likely to supply liquidity, at least on one side of the market.

Of course, this is a simple, classical analysis of the problem in terms of income effects (total shorting demand falls) and substitution effects (shorts supply liquidity instead of demanding it). In general equilibrium, other participants might adjust their order submission strategies in response to those of the short sellers, further complicating the analysis. Nevertheless, while it appears that liquidity could go either way in response to a no-downtick rule, the empirical evidence strongly indicates that aggregate stock market liquidity improved beginning October 6.

A number of papers have shown that there are common factors in stock market liquidity. Despite the covariation, Hasbrouck and Seppi (2001) and Huberman and Halka (2001) demonstrate that there is still considerable idiosyncratic variation in liquidity. In this context, the analogous question is: did the downtick shorting prohibition affect liquidity equally across firms? If not, which stocks improved most?

Breen, Hodrick, and Korajczyk (2002) explore the cross-sectional determinants of liquidity and find that a number of firm characteristics are associated with price impacts. I use a subset of their variables, including volume, market cap, and share price, along with short interest and rebate rates, to explore the cross-section of liquidity changes. The results are in Table 5. None of the shorting activity variables are significant. In fact, as in the previous section, only size seems to matter, with a coefficient of 0.139 in the simple regression on log market capitalization. The maximum log market capitalization is 13.58 and the intercept in the simple regression is –1.846, so the regression line predicts a narrowing spread for all 30 stocks. Note that the Dow firms are generally some of the largest industrial issues, but within this sample at least, small stock liquidity improves more post-event.

These results are identical to the results for the written authorization requirement in the previous section. In both cases, the event affects small stock liquidity much more than large stock liquidity. Given these parallel results, some discussion is in order. Shorting restrictions seem to be more important for small firms' liquidity, but it is not clear why. It is possible that size is a proxy for shorting difficulty. For example, Geczy, Musto and Reed (2002) show that small stocks tend to be more difficult and more expensive to short, all else equal, and some of the evidence in Jones and Lamont (2002) is similarly suggestive. Another alternative is simply that smaller firms have greater sensitivity to liquidity shocks. For a given market-wide liquidity shock, perhaps small firms are simply affected more.

6. 1938: SEC imposes strict uptick rule

Beginning in October 1931, short sales were prohibited on downticks on the NYSE. Short sales could take place only at zero or plus ticks. For the next six years, there were other added impediments to shorting. For example, in late spring of 1932, the United States Senate published the names of those with the largest outstanding short positions in a brazen attempt to discourage shorts by shaming them as unpatriotic or immoral. But there were no new restrictions on the actual shorting transaction itself. In 1935, the SEC suggested to other exchanges that they adopt the NYSE policy on downticks. All complied, and like the NYSE in 1931, the SEC in 1935 did not promulgate a formal rule on a tick test for selling short.

Two years after that, circumstances changed. The second half of 1937 brought a severe decline to US stocks. From July 31, 1937 to December 31, 1937, the Dow Jones Industrial Average fell by almost 35%, from 185.61 to 120.85. Much of the decline took place during September and October. During these months, there were rumors that bear raids had returned, and the SEC investigated. It found that short sales were a small part of total sales during the decline, but there was concentrated shorting by a small number of Exchange members in certain stocks at certain times. These shorting episodes were associated with contemporaneous price declines. For example, the SEC found that late in the day on October 5, when prices were stabilizing after a sharp intraday decline, floor trades arrived with orders to short 2,700 shares of US Steel, about 20% of the stock's average daily volume. The Commission was concerned that "public support of United States Steel at this level could not withstand this concerted assault."[8]

As a result, the SEC formalized and tightened the earlier tick test restrictions on short sales. Among other things, Rule 10a-1 provided that, subject to certain exceptions, all short sales were required to take place on a strict uptick. The rule applied to all stocks listed on national exchanges.[9] The uptick rule would have been essentially meaningless for unlisted (over-the-counter) securities, since trades in these stocks were not publicly reported. Thus, OTC stocks were exempted. Odd lots (trades of less than one round lot of typically 100 shares) were also initially exempted. Specialists were not exempted, however.

[8] Macaulay and Durand (1951) provide a detailed investigation of shorting activity during the 1937 market break, including an interesting intraday analysis of individual trader activity in U.S. Steel.

[9] National exchanges included the NYSE, the American Stock Exchange, and most of the regional exchanges in existence at the time. See Arnold et al. (1999) for a discussion of the evolution of regional exchanges during this time period.

The rule was announced on January 24, 1938 and took effect on February 8 of that year (SEC Release 34-1548). The new rule came as a surprise to market participants, especially Exchange officials, who normally discussed pending rules changes with the Commission.

Over the next year, the SEC allowed a small number of exceptions to the uptick rule, most of which were related to arbitrage trades. For example, downtick short sales were allowed on regional exchanges if they brought that market's price in line with the primary market's price (SEC Release 34-1579, February 10, 1938). Traders with a long warrant position were permitted to hedge in the underlying stock without meeting the tick test (SEC Release 34-1645, April 8, 1938). These exceptions indicate that the Commission had not thought through all the implications of the uptick rule. At the same time, these exceptions indicate a flexible Commission that did not intend to eliminate shorting entirely.

Despite these exceptions, the strict uptick rule soon proved unworkable. Short sellers could never be second in line at a given price, for that would cause the short sale to execute on a zero tick, which was prohibited. Similarly, short sales could not be easily broken up and executed in multiple pieces, as each transaction sent to the tape would have to take place on an uptick. These and other similar technical problems made it difficult to implement the uptick rule on the floor of the exchange. On March 10, 1939, the SEC amended Rule 10a-1 to allow trades on zero-plus ticks as well as upticks (SEC Release 34-2039). The amendments took effect March 20, 1939. Except for minor changes, the 1939 version of the uptick rule remains in effect today and the relevant portion of Rule 10a-1(a)(1)(i) prohibits all short sales:

> (A) below the price at which the last sale thereof, regular way, was reported pursuant to an effective transaction reporting plan [as defined in Rule 11Aa3-1]; or (B) at such price unless such price is above the next preceding different price at which a sale of such security, regular way, was reported pursuant to an effective transaction reporting plan.

In 1938, the New York Stock Exchange collected short interest data only monthly, so it is somewhat difficult to pinpoint the effect of the uptick rule on shorting quantities. Figure 4 provides a graph of short interest and stock price levels in 1937 and 1938. Short interest was 1,249,478 shares on January 27, 1938, and fell to 1,142,482 shares at the next report on February 24, 1938. Thus, there was a decline in short interest of about 8.6% around the adoption of Rule 10a-1, but this decline is not statistically significant compared to short interest changes in surrounding months.

Evidence from the loan crowd suggests that shorts may have hurried to get their positions in place before the new rule took effect. In the week before the SEC announcement, from January 18 through January 21, only Bethlehem Steel loaned at a premium, and that premium was a modest $1 per day per 100 shares.[10] Between the announcement date and the effective date, more stocks loaned at premiums, peaking with nine stocks at premiums in the loan crowd session after the close on February 4. Once the uptick rule was in place, premiums returned toward zero. For the twenty days beginning February 8, an average of only three stocks traded at premiums. This evidence is summarized in Figure 5. Note that some days are missing because the loan crowd did not meet on Fridays. Both Friday and Saturday trades settled on the following Monday, so members trading on both Friday and Saturday could wait until Saturday to ascertain their borrowing needs.

The evidence, though hardly overwhelming, suggests that the uptick rule reduced shorting demand. What were the returns associated with the event? On the announcement day, the US stock market was little changed. The DJIA fell by a minimal 0.08%. On Feb 8, when the uptick rule became effective, the DJIA rose from 121.39 to 125.52, a rise of 3.40%. This was the second-biggest move in the calendar quarter, corresponding to a p-value of less than 0.03.

As in the case of the October 1931 policy change, the return evidence is not consistent with the rational expectations model of shorting. Diamond-Verrecchia predicts that imposing shorting restrictions should have no effect on share prices on average, but the market rose substantially as soon as shorts were restricted by the uptick rule. However, it is interesting to note that the market did not previously rise on the announcement. The sample size is clearly too small to read too much into the announcement returns, but this too is consistent with the limits-to-arbitrage view. As soon as shorts' hands are tied (and not before), market prices can become determined by optimists.

Under the hypothesis that securities with the greatest shorting demand (relative to lending supply) are affected most by the shorting restrictions, cross-sectional differences in event-day returns should be related to shorting price and quantity measures. Short interest data are available from Macaulay and Durand (1951) for only 24 active stocks, and short interest is scaled

[10] In August 1932, stock lending premiums switched from being quoted on a percentage basis to being quoted in dollars per day per round lot. During the Jan-Feb 1938 sample period, these premiums range from $1 to $3 per day per 100 shares.

by average daily trading volume over the 34-day sample period. A cross-sectional regression of event-day returns (R_{i0}) on this days of short interest variable ($S_{i,-1}$) yields:

$$R_{i0} = \underset{(0.012)}{0.050} + \underset{(0.002)}{0.000}\, S_{i,-1} + e_t.$$

As in the 1931 event, returns on the event day do not seem to be at all related to the existing short interest.

By 1938, the Wall Street Journal was no longer publishing a full list of loan rates each day. Instead, a short paragraph listed only the stocks loaning at a premium and stated that all other stocks loaned flat. Using the 30 Dow stocks, a cross-sectional regression of event-day returns on the previous-day loan premium $c_{i,-1}$ (in dollars per day per round lot) yields

$$R_{i0} = \underset{(0.003)}{0.035} - \underset{(0.008)}{0.009}\, c_{i,-1} + e_t.$$

Again, there is no evidence that the cross-section of event-day returns is related to tightness in the securities lending market. As in the 1931 event, it appears that the market as a whole responded strongly to the restrictions on shorts, but did not distinguish between stocks based on measures of shorting activity.

Table 6 reports the effect of the uptick rule on volume, volatility, and market quality measures before and after the effective date. As before, daily open-high-low-close, volume, and bid-ask data are hand-collected from the New York Times for the 30 stocks in the Dow Jones Industrial Average. Volume is reliably lower after the uptick rule is in effect, while volatility is not significantly different before vs. after.

Again the most interesting results are the liquidity measures. Volume-weighted average spreads decline 2.3 cents after the uptick rule is in place; proportional spreads decline by about 10%, from 70 basis points to 63 basis points. The null hypothesis of no change is strongly rejected, with a Newey-West t-statistic of 2.41. Average price impacts are indistinguishable on either side of the event, so overall liquidity improved with the uptick rule.

What determines a firm's liquidity change associated with the uptick rule? For the 30 Dow stocks, I regress the change in spread, both proportional and dollar, on a stock's average trading volume, log market capitalization, and loaning rate. Short interest is only available for 10 of these stocks, so that variable is excluded from the regression. For changes in dollar spread, the share price level is included on the right-hand side. The results are in Table 7. Nothing at all

is reliably different from zero. Again, the evidence indicates that the uptick rule was associated with an improvement in liquidity for the market as a whole, but the market did not distinguish between stocks based on any of the firm-specific measures employed here.

7. Meta-analysis

Both the 1931 and the 1938 tick restrictions are associated with significant declines in bid-ask spreads. The t-statistic associated with the change in proportional spreads for the 1931 event is 3.54, while the corresponding t-statistic for the 1938 event is 2.41. Assuming independence and equal weights across the events, the combined t-statistic is 4.21 and rejects at any conventional level the null hypothesis that spreads were unaffected by shorting tick restrictions. As discussed earlier, this is consistent with a model in which shorts no longer demand liquidity but instead are forced to supply it in order to take a position.

In terms of returns, the three events can also be combined to test the null hypothesis that shorting restrictions do not affect prices on average. Over the two-day implementation window 31 Mar to 1 Apr 1932, the average daily market return (as measured by the DJIA) was –3.35%. On 6 Oct 1931, when short sales could no longer be implemented on downticks, the market return was 14.87%. On 8 Feb 1938, when the uptick rule took effect, the return was 3.40%. The average across the three events is 4.97%. During the period between 1931 and 1938 excluding these days, the mean daily return is 0.01%, and the standard deviation of daily returns is 1.91%. Given the empirical distribution of returns, a bootstrap analysis finds that the chance of getting an average return of 4.97% on three randomly chosen days is about 0.001, so the evidence is strong in favor of the alternative that stock prices rise on average when shorting restrictions are implemented.

8. Extensions and future work

During the 1930's shorting in the United States became considerably more difficult. The three events studied in this paper are the most significant discrete events, but the process was generally a gradual one. Nevertheless, there are other lesser but still discrete events that could be studied. For example, in May 1932 the New York Stock Exchange mandated a minimum margin requirement of $10 per share for all short positions. This minimum naturally had the strongest effect on low-priced stocks. While there was some variation in required margins across

brokerage firms, previous minimums were generally 50% on stocks trading below $10 per share, and $5 on stocks trading between $10 and $20 per share, according to the New York Times (May 19, 1932, p. 31), so these stocks were subject to sharp increases in required margins. Many well-known stocks fell into these share price categories. At the time, the market was only two months away from its ex post nadir, and the average NYSE share price was only about $15.

Because high-priced stocks were unaffected by the change in margin requirements, they might be used as controls for market-wide changes in liquidity. The resulting cross-sectional tests for changes in liquidity might therefore have greater power than the time-series tests reported here that focus on single events in calendar time. Additional data for this exercise would need to be collected by hand.

History is also repeating itself in the Japanese markets. In the face of a prolonged slide in its economy and stock markets, Japan implemented an uptick rule in its over-the-counter market on March 6, 2002. The rule was introduced near the end of the Japanese fiscal year, and there were suspicions that the rule was intended to buoy stock prices for the sake of Japanese financial institutions calculating net capital on March 31. Of course, the restrictions imposed in the U.S. during the 1930's were designed to lift stock prices as well. Then, just prior to the fiscal year-end, the Financial Times reported on its website on March 27 that the Financial Services Agency, Japan's chief financial regulator, had pressured Japanese life insurance companies to call in any loaned securities. Finally, in August, Japan announced plans to extend the uptick rule to the more regulated system monitored by the Tokyo Stock Exchange. These events could provide an opportunity to study shorting restrictions in a more modern setting using more detailed intraday data. The Japanese experience could thus provide an additional set of data points on the link between market liquidity and shorting restrictions such as the uptick rule.

9. Conclusions

Shorting got harder in the United States during the 1930's. This paper studies three specific, discrete events that made shorting more difficult. The three separate events tell a remarkably consistent story. Average returns associated with the events are reliably positive, which is consistent with limits to arbitrage and inconsistent with a full rational expectations model. Market participants must have driven up prices thinking that restrictions on short sellers would make it more difficult for prices to impound their pessimistic beliefs.

This paper also examines liquidity around these events. Consistent with the rational expectations model of Diamond and Verrecchia (1987), when the NYSE in 1932 required all brokers to obtain written authorization from customers before lending their shares, bid-ask spreads increased. In contrast, when two different tick restrictions were put in place, the results differ. Both the downtick shorting prohibition of October 1931 and the tighter uptick rule of February 1938 are actually associated with improvements in liquidity. One possible explanation is that the tick restrictions force shorts to use less aggressive limit orders as opposed to market orders. Under the tick restrictions, shorts cannot aggressively demand liquidity and are more likely to actually supply liquidity to the market.

The liquidity results associated with the uptick rule and the downtick prohibition are important because they show that regulation can improve liquidity by constraining a certain class of market participants. However, this comes at some cost to the constrained parties, and several commentators, including Macey, Mitchell, and Netter (1989) have argued that the costs of the uptick rule far outweigh any benefits that might accrue. One of the main problems is that it is hard to quantify the costs and benefits, though it is clear that some parties would assign shorts a weight of close to zero in the social welfare function.

More importantly, some relevant institutional features have changed since the 1930's and even since Macey, Mitchell, and Netter (1989) wrote in defense of shorting after the October 1987 stock market crash. First and foremost, the minimum price increment has declined dramatically. Until 1997, the minimum tick on the NYSE was 1/8 of a point. Today the minimum tick in US markets is $0.01 or less and the number of trades is much greater, making it much easier for a potential short to trade on an uptick (but see Alexander and Peterson (2002) for some caveats). Some instruments, notably exchange-traded funds and stock index futures, are completely exempt from the uptick rule. The rule can also be avoided by trading offshore. Nevertheless, the uptick rule is still a significant impediment to shorting even in a rising market, as noted by Alexander and Peterson (1999).

As a result, the SEC is actively considering modifications to, or even repeal of, the uptick rule (for example, see SEC Release No. 34-42037, October 20, 1999, a concept release with a call for comments). In that policy context, the results presented here may be relevant. Because the uptick rule no longer constrains shorting as much as it once did, any liquidity effects are

likely to be much more modest than the ones identified in the 1930's. However, it would not be surprising if repeal were to lead to some reduction in individual stock liquidity.

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Table 1
Selected events related to U.S. shorting in the 1930's

Description	Announcement Date	Effective Date
NYSE bans short selling for two days	21 Sep 1931	21 Sep 1931
NYSE requires daily short interest reports		21 Sep 1931
NYSE reports daily in-and-out shorting		26 Sep 1931
NYSE de facto bans shorting on downticks	6 Oct 1931	6 Oct 1931
NYSE requires written authorization from account holder to lend securities	18 Feb 1932	1 Apr 1932
NYSE increases margins on shorts for low-priced stocks	18 May 1932	19 May 1932
NYSE ends daily short interest reports		19 Sep 1932
SEC mandates strict uptick rule	24 Jan 1938	8 Feb 1938
Strict uptick rule becomes a zero-plus uptick rule	10 Mar1939	20 Mar 1939

Table 2
The effect of requiring written authorization for lending shares, 1 Apr 1932

The sample consists of the 30 Dow Jones Industrial Average stocks from 21 Mar 1932 to 12 Apr 1932, except for stock loan rates, which are reported for 114 stocks. Reported figures are time-series averages of (weighted) cross-sectional means. All measures except volume and lending data are volume-weighted based on a stock's reported NYSE trading volume over the entire period (event days –9 to 9, inclusive). Volume figures are per stock. Newey-West standard errors are in parentheses.

	Pre-event [-9,-1]	Post-event [0,9]	Difference
Avg. Spread ($)	0.198	0.229	0.031
	(0.007)	(0.008)	(0.010)
Avg. Spread (%)	0.586	0.780	0.194
	(0.031)	(0.037)	(0.043)
Avg. Price Impact	2.703	3.139	0.436
(bp per 1000 shares)	(0.948)	(0.591)	(0.776)
Avg. Daily Volume	9.454	15.451	5.997
(thousands of shares)	(1.031)	(1.151)	(1.384)
Avg. Daily Volume	0.296	0.407	0.110
($ in millions)	(0.026)	(0.029)	(0.035)
Avg. Intraday Range ($)	0.822	1.114	0.291
	(0.050)	(0.050)	(0.067)
Avg. Daily | Ri | (in %)	2.445	3.093	0.648
	(0.523)	(0.437)	(0.701)
Stocks lending at a premium	9.429	26.889	17.460
	(1.624)	(1.752)	(2.166)
Average rate for stocks	-0.024	-0.039	-0.015
lending at a premium	(0.009)	(0.010)	(0.012)

Table 3
The cross-section of liquidity changes around April 1, 1932

Cross-sectional regressions for the 30 Dow Jones Industrial Average stocks. The pre-event period is 21 Mar 1932 to 31 Mar 1932, and the post-event period is 1 Apr 1932 to 12 Apr 1932. ΔPSPRD is the change in a stock's average proportional spread pre- vs. post-event, in percent. ΔDSPRD is defined analogously for a stock's spread in dollars. VOLU is the average daily volume in millions of shares for the stock over the whole sample period, LNCAP is the log of the firm's market capitalization as of 31 Mar 1932, LOANR is the daily stock lending rate on March 31 (premiums are negative numbers), and PRC is the share price on March 31. Standard errors are in parentheses.

Independent Variables	ΔPSPRD	ΔPSPRD	ΔDSPRD
Intercept	4.859	4.375	0.226
	(1.347)	(1.069)	(0.185)
VOLU	6.247		-0.260
	(10.407)		(1.385)
LNCAP	-0.382	-0.334	-0.019
	(0.121)	(0.091)	(0.017)
LOANR	0.077		-0.184
	(0.967)		(0.133)
PRC			0.000
			(0.001)
R^2	33.4%	32.4%	15.2%

Table 4
The effect of prohibiting downtick short sales beginning 6 Oct 1931

The sample consists of the 30 Dow Jones Industrial Average stocks from 25 Sep 1931 to 31 Oct 1931, except for shorting figures, which refer to all NYSE stocks. Reported figures are time-series averages of (weighted) cross-sectional means. All measures except volume and shorting data are volume-weighted based on a stock's reported NYSE trading volume over the entire period (event days –20 to 20, inclusive). Volume figures are per stock. Newey-West standard errors are in parentheses.

	Pre-event [-9,-1]	Post-event [0,20]	Difference
Avg. Spread ($)	0.323	0.262	-0.061
	(0.014)	(0.010)	(0.016)
Avg. Spread (%)	0.730	0.592	-0.138
	(0.032)	(0.021)	(0.039)
Avg. Price Impact	4.324	6.132	1.809
(bp per 1000 shares)	(1.837)	(0.955)	(2.135)
Avg. Daily Volume	22.750	16.059	-6.691
(thousands of shares)	(3.392)	(2.095)	(4.013)
Avg. Daily Volume	0.843	0.626	-0.217
($ in millions)	(0.125)	(0.075)	(0.148)
Avg. Intraday Range ($)	1.942	1.786	-0.156
	(0.258)	(0.182)	(0.305)
Avg. Daily | Ri | (in %)	3.949	4.149	0.199
	(0.950)	(0.424)	(1.116)
Avg. Aggregate Short Int.	2.822	2.319	-0.503
(millions of shares)	(0.066)	(0.039)	(0.078)
Avg. Daily In-and-Out	4.488	4.144	-0.344
Shorting (% of total volume)	(0.425)	(0.256)	(0.499)

Table 5
The cross-section of liquidity changes around the 1931 downtick shorting prohibition

Cross-sectional regressions for the 30 Dow Jones Industrial Average stocks. The pre-event period is 24 Sep 1931 to 5 Oct 1931, and the post-event period is 6 Oct 1931 to 31 Oct 1931. ΔPSPRD is the change in a stock's average proportional spread pre- vs. post-event, in percent. ΔDSPRD is defined analogously for a stock's spread in dollars. VOLU is the average daily volume in millions of shares for the stock over the whole sample period, LNCAP is the log of the firm's market capitalization as of 31 Dec 1931, SIDAYS is short interest in the stock as of October 5 divided by VOLU, LOANR is the daily stock lending rate on October 5 (premiums are negative numbers), and PRC is the share price on October 5. Standard errors are in parentheses.

Independent Variables	ΔPSPRD	ΔPSPRD	ΔDSPRD
Intercept	-1.857 (0.681)	-1.846 (0.558)	-0.539 (0.328)
VOLU	-0.068 (4.515)		-2.390 (2.308)
LNCAP	0.144 (0.062)	0.139 (0.048)	0.054 (0.032)
SIDAYS	-0.038 (0.053)		-0.007 (0.024)
LOANR	-2.361 (5.476)		-4.130 (3.137)
PRC			-0.003 (0.002)
R^2	25.0%	23.3%	13.9%

Table 6
1938 SEC adoption of strict uptick rule for short sales

The sample consists of the 30 Dow Jones Industrial Average stocks from 24 Jan 1938 to 4 Mar 1938. The rule was announced on 24 Jan 1938 (event day –13) and became effective on 8 Feb 1938 (event day zero). Reported figures are time-series averages of (weighted) cross-sectional means. All measures except volume are volume-weighted based on a stock's reported NYSE trading volume over the entire period (event days –13 to 20, inclusive). Volume figures are per stock. Newey-West standard errors are in parentheses.

	Pre-event [-13, -1]	Post-event [0,20]	Change
Avg. Spread ($)	0.441	0.418	-0.023
	(0.010)	(0.012)	(0.017)
Avg. Spread (%)	0.704	0.634	-0.070
	(0.018)	(0.020)	(0.029)
Avg. Price Impact	3.856	2.588	-1.268
(bp per 1000 shares)	(0.684)	(0.735)	(1.090)
Avg. Daily Volume	4.769	3.456	-1.312
(thousands of shares)	(0.583)	(0.301)	(0.598)
Avg. Daily Volume	0.242	0.182	-0.059
($ in millions)	(0.029)	(0.016)	(0.030)
Avg. Daily | Ri | (in %)	1.924	1.435	-0.489
	(0.275)	(0.172)	(0.308)

Table 7
The cross-section of liquidity around the 1938 uptick rule

Cross-sectional regressions for the 30 Dow Jones Industrial Average stocks. The pre-event period is 24 Jan 1938 to 7 Feb 1938, and the post-event period is 8 Feb 1938 to 4 Mar 1938. ΔPSPRD is the change in a stock's average proportional spread pre- vs. post-event, in percent. ΔDSPRD is defined analogously for a stock's spread in dollars. VOLU is the average daily volume in millions of shares for the stock over the whole sample period, LNCAP is the log of the firm's market capitalization as of 31 Dec 1937, LOANR is the daily premium on a stock as of February 3 per round lot in dollars (premiums are negative numbers), and PRC is the share price on February 7. Standard errors are in parentheses.

Independent Variables	ΔPSPRD	ΔPSPRD	ΔDSPRD
Intercept	-0.153	-0.509	0.722
	(0.934)	(0.869)	(0.872)
VOLU	0.001		22.038
	(0.002)		(18.782)
LNCAP	-0.007	0.028	-0.090
	(0.078)	(0.070)	(0.075)
LOANR	-0.139		0.095
	(0.214)		(0.225)
PRC			0.005
			(0.002)
R^2	5.4%	0.6%	15.4%

Figure 1. Selected Daily Loan Rates, Mar-Apr 1932

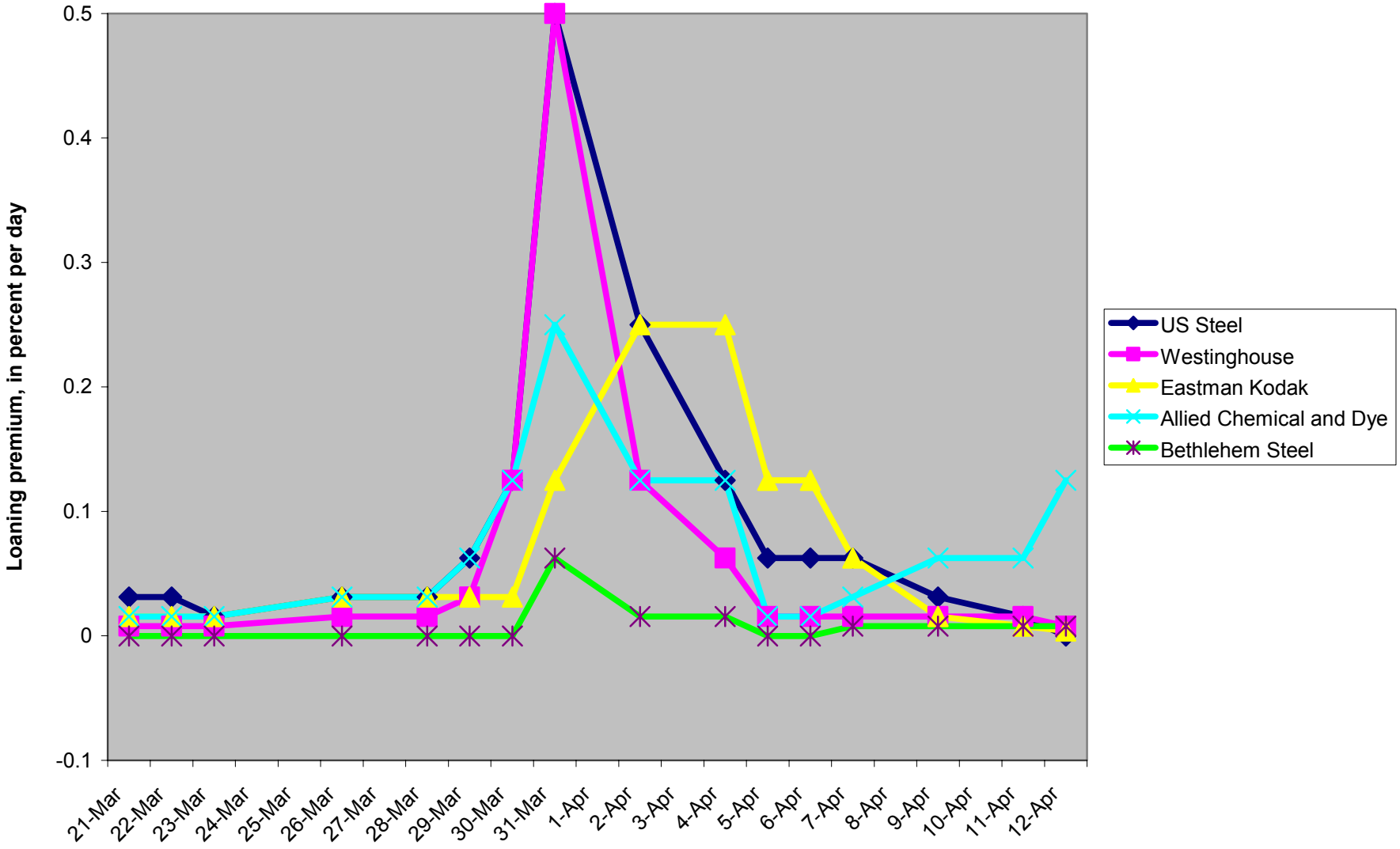

Figure 2. Selected Shorting Statistics, 1931-1932

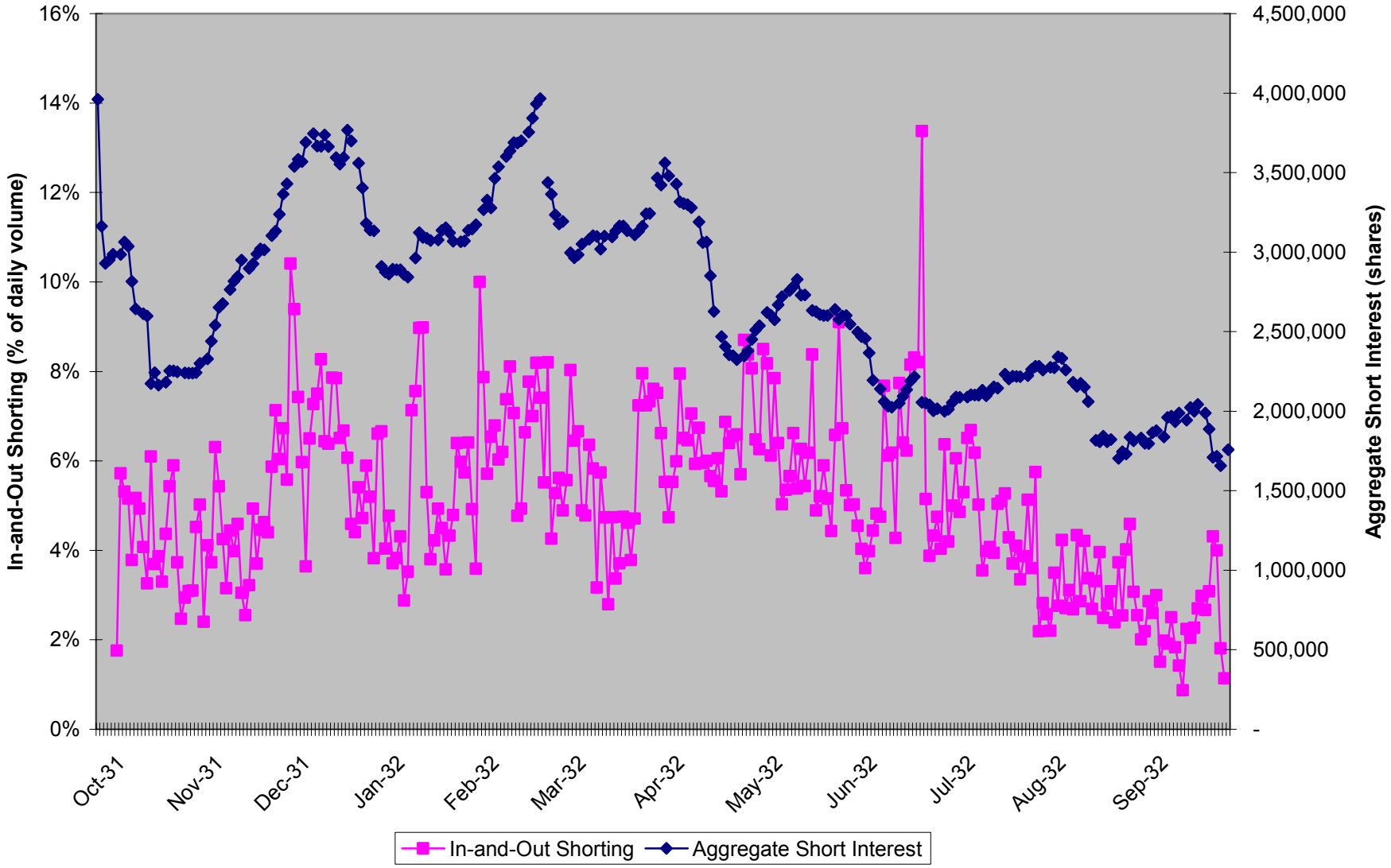

Figure 3. Dow Jones Industrial Average and Aggregate Short Interest, 1931

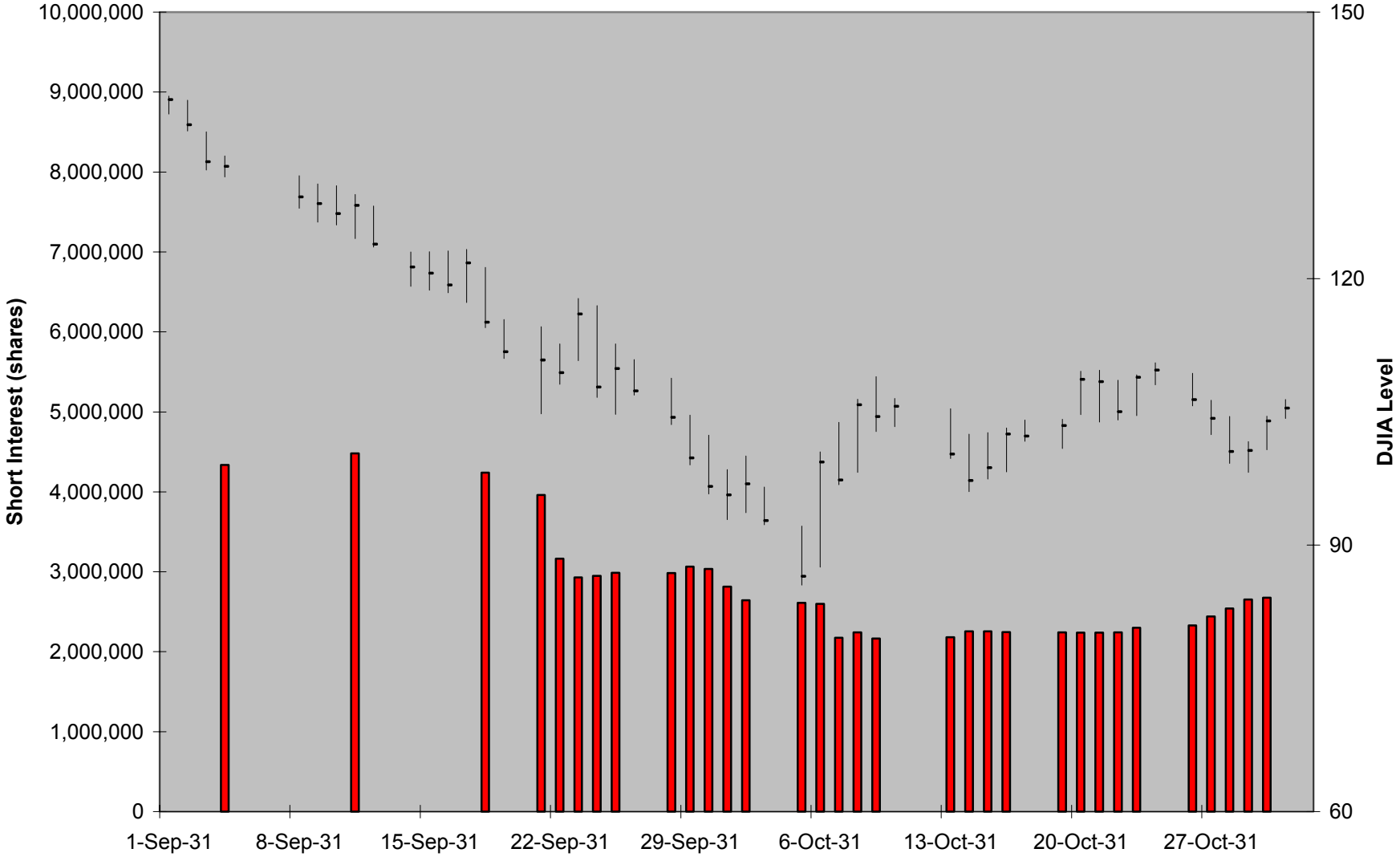

Figure 4. Short Interest and Stock Prices, 1937-1938

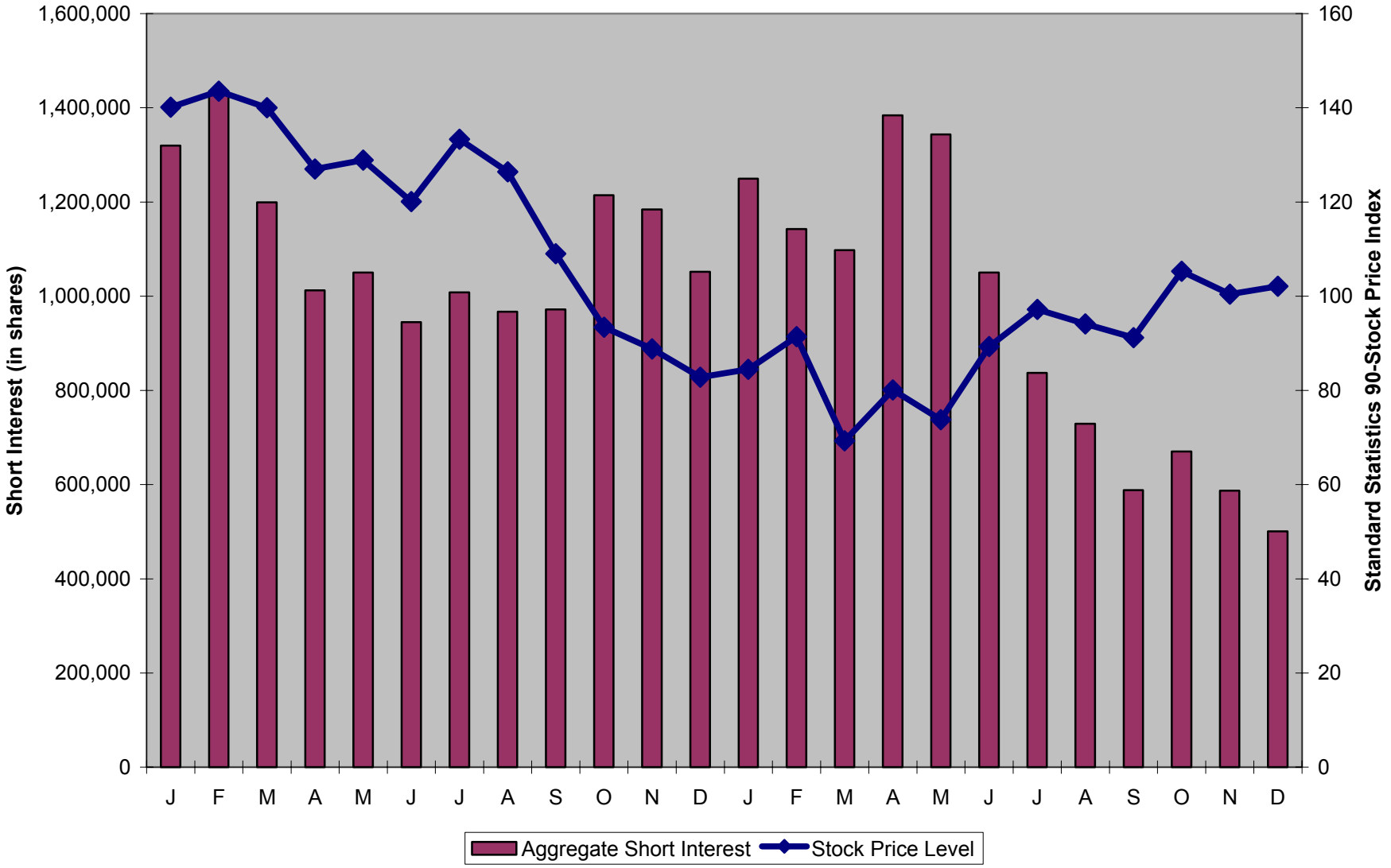

Figure 5. Stock Loan and Stock Price Behavior, Jan-Feb 1938