The Effects of Stock Lending on Security Prices: An Experiment

by

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Abstract

Working with a sizeable (greater than $15 billion in assets) anonymous money manager, we exogenously shift the supply of lendable shares for certain stocks by randomly making available for lending 2/3 of the stocks in the manager's portfolio and withholding 1/3 of the stocks from the loan market. The lending program commenced in early September 2008 and the loans were recalled in mid-September 2008, with over $700 million of securities lent out at the peak of the study. During the lending (recall) period, returns to stocks randomly made available for lending were not lower (not greater) than returns to stocks randomly withheld from lending. Stocks randomly made available for lending experienced no differences in volatility, bid-ask spreads, or skewness than stocks randomly withheld from lending during either the lending or recall period. We find some evidence that loan supply increases volatilities and spreads for stocks with high short interest and expected loan spreads.

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I. Introduction

The impact of short selling has generated heated debates among academics, investment committees, corporate boards, and regulators for years. Interest in short selling's effects intensified recently with the sharp drop in asset prices, particularly those of financial institutions, in the summer and fall of 2008. The recent economic crisis has sparked new discussions of the consequences of allowing or restricting short selling among academics, practitioners, policy makers (such as the Securities and Exchange Commission and Congress), and the media—and these debates are not exclusive to the U.S.

One view is that short-selling helps make markets more efficient by improving price discovery and the incorporation of news. An alternative view is that short-selling distorts markets and adversely affects prices moving them further away from fundamentals. Indeed, short-sellers have often been characterized as immoral, unethical, and (recently) unpatriotic.[1]

Despite significant interest, there is relatively little convincing evidence of the impact of short selling on markets and asset prices. First, there are a variety of theories for how short sales may or may not affect asset prices. Beginning with Miller (1977), a number of authors argue that differences of opinion and short sales constraints can lead to overpricing. Others (e.g., Hong and Stein (2003) and Abreu and Brunnermeier (2001)) argue that short sales constraints can lead to excess volatility or destabilized prices (Allen and Gale (1991)). On the other hand, in a rational expectations model, Diamond and Verrecchia (1987) argue that when short sales are restricted, traders will adjust so that there is no overpricing on average, but in this case the skewness of returns may be affected.

[1] See Lamont (2004) for some choice quotes about short sellers. One example is in 1989 when Congress held hearings about the evils of short selling. During the hearings, Congressman Dennis Hastert (later speaker of the US House of Representatives), described short selling as "blatant thuggery".

Given the ambiguous theoretical predictions, the effects of short sale restrictions may be better answered empirically. A number of papers attempt to measure the empirical effects of short selling from both the demand and supply side. For example, if shorting demand is high but is impeded by shorting constraints, then holding these constraints fixed, variation in shorting demand can measure the extent of overpricing, excess volatility, or skewness. Conversely, holding demand fixed, variation in shorting supply (the availability of lendable shares of an asset), can measure the degree to which shorting is constrained across assets and the impact of those constraints.

Many of these empirical efforts (which we describe in section II) are hampered by the difficulty of identifying pure demand or supply shocks to shorting. In this paper, we conduct an actual experiment where we randomly move the supply of shares available for lending, thereby shifting exogenously the supply of lendable assets. Working with a sizeable (greater than $15 billion in assets) anonymous money manager ("the Manager"), we randomly make available for lending 2/3 of the stocks in the manager's portfolio and withhold a characteristic-matched (e.g., size, volume, short interest, Manager ownership, etc.) sample of the other 1/3 of stocks owned by the Manager.[2]

Our study provides an exogenous shock to the supply of lendable shares to help identify the supply channels driving any potential pricing effects associated with short selling. In general, supply shifts in stock lending are driven by changes in institutions' marginal cost of lending, which may be related to other factors. Here, we randomly move the supply of shares and hence can interpret our results coming directly from an exogenous relaxation of short sale constraints *without* any change in shorting demand. The experiment allows us to identify shocks

[2]During the time period we study, the Manager also restricted the lending program to stocks traded on U.S. exchanges, stocks with high loan demand, and to an amount not greater than three days of trading volume.

to supply (randomly created in real time) that isolate the relative effects of supply movements holding demand constant—an important step for developing a better understanding of the impact of shorting on prices.

The lending program commenced in early September 2008. The loans were called back in mid-September 2008 due to market conditions, in particular, the doubts that arose concerning the financial stability of significant financial intermediaries. (The Manager was not alone as a number of other institutions also suspended their securities lending programs.) Though the length of the experiment is short, the events taking place in financial markets, and particularly in the shorting market, at the time were significant. While the short period leads us to caution against claiming our results generalize, the extreme market conditions make it more likely that the supply shocks were important (compared to more normal times).

In the experiment, the demand for shorting among the randomized stocks was purposely chosen to be high (average loan spread of 2.6% equal-weighted across stocks and 7.7% loan-weighted across stocks, and average short interest as a percentage of shares outstanding of 22%) *and* approximately equal across the two groups: those whose shares were lent out and those whose shares were withheld from the lending market. In addition, the Manager, who owned an average of 5% of the shares outstanding of these stocks, had the potential to increase the shares available for lending significantly. For example, the potential loan supply provided by the Manager comprised an average of 4% of total institutional ownership, and nearly 500% of daily trading volume for the average stock in the experiment. Without knowing the total available lendable shares, these numbers imply that the potential loan supply shift was significant.

At the peak of the experiment, over $700 million of securities were lent out, comprising an average of 67% of daily trading volume for the average stock. The daily maximum shares on

loan comprised 1.6% of the total market capitalization of the stocks on average during the experiment and were as much as 5% of the total market capitalization. These numbers indicate a meaningful change to the actual supply of lendable shares during the experiment.

Despite the sizeable changes to supply and the extreme market conditions of our experiment, we do not find much of an effect from the loan supply shifts. During the lending period, raw and risk-adjusted returns to loaned stocks were not lower (statistically or economically) than returns to non-loaned stocks and stocks not available for lending. Similarly, during the recall period, returns to recalled stocks were not greater than returns to stocks not available for lending. Exogenous changes to the supply of lendable shares during this time, therefore, had little impact on returns.

We also examine the volatility, bid-ask spreads, and skewness of stocks available for lending versus those withheld from the lending market. While stocks made available for lending experienced a slight reduction in volatility relative to stocks not made available for lending, the differences are not significant. We also find similar results for bid-ask spreads: there is a slight reduction in spreads for stocks whose shares are lent out, but it is small. Finally, we find that neither during the lending nor recall periods was the skewness of returns for those stocks that were lent out any different from those whose shares were not made available to lend. Overall, changes in the supply of lendable shares had little effect on volatility, bid-ask spreads, or skewness of returns.

In addition to examining the average effects of loan supply shocks on stocks, we also examine the impact of loan supply on the cross-section of stocks to see if certain kinds of stocks are more or less affected by changes in the supply of lendable shares. Across a variety of firm characteristics, we find no evidence that the returns of stocks are affected by loan supply shocks,

with one modest exception. During the lending period, the volatility of stocks with the highest ex ante expected loan spreads rises, and in the recall period the volatility for these same stocks falls. Similarly, stocks with the most short interest experience an increase in bid-ask spread during the lending period, but do not experience any change in spread during the recall period. Hence, stocks that may be in high shorting demand appear to experience more volatility and have wider spreads when the supply of their lendable shares expands.

While we focus on the difference between the matched sample of stocks randomly made available to the loan market versus those randomly withheld in order to identify exogenous supply shocks, to highlight the importance of this experimental design for drawing inferences on short selling restrictions, we also conduct the same cross-sectional analysis for *all* stocks, regardless of whether they were made available or withheld from the lending market. When both groups of stocks are combined into one sample (which destroys the exogenous supply treatment), we find several characteristics explain returns and volatility in the lending and recall periods. However, these effects are spurious since the effects of the characteristics on returns are the same for the stocks randomly lent out (treatment group) as they are for the stocks whose shares were purposely withheld from the loan market (control group). This exercise highlights the importance of the exogenous experimental design and how erroneous conclusions can be drawn without the exogenous treatment.

Our (lack of) results on the moments of returns and spreads of the stocks whose shares experience an exogenous supply shock suggests that supply restrictions to shorting may not be an important factor for asset pricing. There are reasons to be both cautious and aggressive in interpreting these results. On the side of caution, the sample period is necessarily short and unusual. In addition, although the maximum shares loaned by the Manager represented 1.58% of

the available float for the average stock loaned, it is possible that this increase in loan supply is not large enough to affect prices or bid-ask spreads.

On the aggressive side, we fail to obtain significant results for a set of stocks with high shorting demand (as measured by high loan spreads of 2.6 to 7.7% on average and short interest of 22% of shares outstanding) over a period of tremendous uncertainty and volatility where shorting might have been expected to have had a large impact. If shorting supply shocks are important for prices, these shocks should have mattered for these particular stocks during this particular time. We also fail to find much of an effect of loan supply on the cross-section of stocks. Our conclusion that shorting supply shocks do not have much impact is consistent with several other studies that examine shorting supply movements more broadly over longer time periods and in less extreme markets (e.g., Cohen, Diether, and Malloy (2007) and Diether, Lee, and Werner (2009)).

The paper proceeds as follows. Section II presents a discussion of the existing research on the impact of shorting constraints and where our paper fits in. Section III describes our sample and research design in more detail. Section IV presents the results from the experiment. Section V concludes by discussing the implications of our findings.

II. Existing Research

As discussed above, the implications from theory on the impact of short sale constraints on asset prices are ambiguous. Miller (1977) posits that the combination of differences of opinion and short sale constraints can lead to overpricing, where stock prices overweight the views of optimists. Diamond and Verrecchia (1987) argue that rational uninformed agents take

short sale constraints into account when setting prices, resulting in no overpricing. The effect of short sale constraints on stock prices is therefore an empirical question.[3]

A key empirical issue is how to measure short sale constraints. One strand of the literature uses direct measures of the cost of shorting such as the rebate rate or the spread between the rebate rate and market interest rates.[4] The existing evidence on the impact of rebate rates and loan fees on asset prices is somewhat mixed. (See D'Avolio (2002), Geczy, Musto, and Reed (2002), Ofek, Richardson, and Whitelaw (2004), and Jones and Lamont (2002).) Another strand of the empirical literature focuses on short interest as a proxy for shorting demand. The results are also somewhat mixed. (See Desai et al. (2002) for a summary.)

One of the difficulties in interpreting the results from using direct costs of shorting as a measure of shorting constraints or short interest as a proxy for shorting demand is that both the cost of shorting (price) and short interest (quantity) are determined in equilibrium—the intersection of supply and demand. For example, a high level of short interest could either mean high demand for shorting or low cost of shorting. Given the endogeneity of these measures, it is difficult to identify the exact mechanism that causes or fails to cause the observed movement in stock prices. This likely is one of the reasons the results in this literature are mixed.[5]

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[3]The extent to which shorting has an effect on prices might depend on what fraction of overall trading activity is represented by short-sales. Recent empirical evidence shows that short-selling comprises a fairly large fraction of trading volume. Boehmer, Jones, and Zhang (2008) find that short-sales represent 13 percent of NYSE (SuperDOT) share volume from 2000 to 2004, Diether, Lee, and Werner (2009) find that short sales represent 31 percent of share volume for Nasdaq-listed stocks and 24 percent of share volume for NYSE-listed stocks in 2005. The figures suggest there is potential for short-selling to have an impact on price-levels, volatility, or market liquidity such as spreads, depth, and order-imbalances.

[4]The rebate rate is the fee that the lender of the stock pays back to the borrower on the collateral the borrower leaves with the lender in order to borrow the shares. The spread between the rebate rate and cash interest is a direct cost to the short-seller known as the "loan fee."

[5] Other studies use the unwillingness or inability to short among certain investors to proxy for shorting costs or demand. For example, Almazan, Brown, Carlson, and Chapman (2000) find that only about 30% of mutual funds are allowed by their charters to sell short and only 2% actually do. Using this fact, Chen, Hong and Stein (2002) use breadth of mutual fund ownership as a proxy for shorting supply and Nagel (2005) uses residual institutional ownership as a proxy for shorting demand. They find some mild evidence of overpricing for small, growth firms.

Asquith, Pathak, and Ritter (2005), recognizing this challenge, argue that stocks with high shorting demand and low shorting supply are the most likely to face binding short sale constraints. Combining these two measures, the authors examine stocks in the highest percentile of short interest (a proxy for shorting demand) and the lowest third of institutional ownership (a proxy for shorting supply) and find these stocks underperform the market by more than 2% per month. Although these results move in a direction consistent with identifying the most binding shorting constraints, these measures cannot disentangle supply from demand effects and hence face the same interpretation problems mentioned above.

Our approach of using an experiment that randomly shocks the supply of lendable shares of certain stocks while holding constant the lendable shares of other similar stocks, identifies a pure supply shock, holding everything else constant, including shorting demand.

Some papers try to mitigate the endogeneity issue by examining changes to the market for a stock's shares that indirectly move supply or demand (and are assumed to be otherwise unrelated to direct supply or demand for the stock's shares). For example, Sorescu (2000) uses options introductions and Ofek and Richardson (2003) look at lockup expirations among internet IPOs as proxies for reducing short sale constraints for these stocks. Both papers find significant negative abnormal returns following these events. However, both the introduction of options and use of lockup provisions may be related to the demand for the stock.[6]

Cohen, Diether, and Malloy (2007) use data on loan fees and loan amounts to identify cases where a shift to shorting demand or a shift to shorting supply clearly occurred. For example, when prices (loan fees) and quantities (loan amounts) both increase, an upward shift in

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However, institutional ownership is also the outcome of supply and demand and hence it is not clear which channel—shorting demand or shorting supply—drives these results.

[6] Mayhew and Mihov (2005) also find no evidence that investors take disproportionately negative positions in newly listed options, which suggests that the introduction of options has no causal link to the relaxation of short sale constraints.

demand must have occurred, and when prices and quantities both decrease, an upward shift in supply must have occurred. However, while a shift in demand (or supply) may be identified by this empirical strategy, it does not rule out that a shift in supply (or demand) did not also occur simultaneously. Hence, the magnitude of the shift in demand or supply is unknown, making interpretation of the impact on prices difficult. Nevertheless, the authors find significant price declines associated with demand shifts, but no price response associated with supply shifts, consistent with our results on the lack of price moves following exogenous supply shocks.

Chang, Cheng, and Yu (2007) compare stocks that the Hong Kong Stock Exchange designates as eligible for shorting with stocks that are not designated eligible. However, they note that it is not possible to know whether the short sale eligibility designations are endogenous. They find large negative returns (on the order of -5%) around the two weeks after stocks become eligible for short sales. But, they do not find any significant announcement effect (i.e., when the Exchange announces which stocks will become eligible for shorting).

Perhaps closest in spirit to our experiment, Diether, Lee, and Werner (2009) study the effects of short sale price tests (the uptick rule for the NYSE and the bid price test for NASDAQ). In conjunction with the SEC, they randomly suspend these tests for 1/3 of the stocks (treated stocks) in the Russell 3000 while maintaining the tests for the remaining 2/3 (control stocks). They find that short-selling activity increases for the treated stocks, but daily returns and volatility are unaffected. These results are largely consistent with ours.

There are several notable differences, however, between their experiment and ours. First, the price tests only restrict shorting for a brief period of time (until the price test no longer binds) and make the restriction completely binding by eliminating all shorting for that period of time. Our experiment provides exogenous variation in the supply of shares across stocks maintained

over the entire lending period and allows us to compare cross-sectionally the effect of different levels of supply changes on prices. Another difference is that our experiment specifically focuses on stocks with ex ante high shorting demand and conducts the random treatment of stocks among the high and low demand stocks separately. This feature allows us to examine the effects of exogenous supply shocks on those stocks where it should matter most (e.g., where constraints should be most binding). Finally, the time periods of the two studies are quite different. Diether, Lee, and Werner (2009) conduct their experiment from February to July of 2005—a relatively low volatility environment. Our experiment takes place during the highly volatile period of early to mid September 2008. To give a sense of this difference, using Bloomberg data, the average daily level of the VIX over their sample period from February to July 2005 was 11.2% and over our sample period from September 5 to October 3, 2008 was 32.2%, almost three times higher. Despite these differences in experimental design, samples, and sample periods, the results from both studies are complementary—supply shocks to the shorting market do not seem to have any detectable pricing, volatility, or spread effects.

III. Sample Selection, Experimental Design, and Summary Statistics

We briefly describe the (anonymous) Manager with whom we conduct the experiment and detail our sample and experimental design.

A. *The Manager and Motivation for the Experiment*

The Manager invests in mid-cap and small-cap equities, both inside and outside the U.S. Historically, the Manager had not lent out the stocks it owned out of concern that doing so would lower the price of the stocks and increase their volatility. The motivation for this experiment

arose when the Manager considered the fees it would be paid for lending out its shares as many other competing managers were doing. The experiment would allow the Manager to measure and weigh the costs and benefits of lending out its shares against the perceived costs of any potential adverse price or volatility effects.

B. *Experimental Design*

The Manager made shares available for lending on September 5, 2008. We selected the sample based on the Manager's stockholdings as of June 30, 2008. At that time, the Manager owned 523 individual stocks that were (in total) worth in excess of $15 billion. We divided the stocks into two groups. The first group included stocks that the lending agent projected would have a loan spread or rebate rate of at least 10 basis points. These are the stocks we label as having high expected loan demand. There were 138 stocks in this group. We also refer to these stocks as "revenue stocks". The remaining group of 385 stocks we refer to as low demand or "non-revenue" stocks.

Within each of the two groups, we randomly selected to lend out 2/3 of the stocks and to withhold 1/3 of the stocks. There was one exception to the randomization. We made sure to lend the three stocks in the revenue stock group with the highest expected revenue in order to reduce the opportunity cost of the experiment. We include these three stocks in all or our analyses, but our results are the same if we exclude these three stocks.

Figure 1 presents the distribution of a variety of firm characteristics across the revenue stocks randomly made available to lend out and the revenue stocks randomly withheld from the loan market. We compare the stocks available for lending to those that are withheld along the following dimensions: firm equity market capitalization, market-to-book ratio, fraction of

available (non-insider) shares owned by institutions, fraction of shares outstanding held by the Manager, short interest as a fraction of shares outstanding, previous six month returns, average prior 30 day trading volume, and expected loan spread. The distribution of these characteristics across stocks within the available and not available groups are plotted in Figure 1 with the mean, median, and *p*-values for tests of the difference between the mean and median of the two groups also reported on each characteristics plot.

Through the randomization process, the stocks made available to lend versus those withheld should not differ along either observable or unobservable attributes. As the distributional plots and difference in means and medians tests in Figure 1 show among the revenue (high short demand) stocks, those randomly made available to lend do not differ from those stocks randomly withheld from the loan market in terms of their market caps, market-to-book ratio, institutional ownership, shares owned by the Manager, previous six month returns, short interest, prior 30 day average trading volume, or expected loan spread. Short interest and expected loan spread may capture the demand for borrowing the stock, which (except for maybe a slight difference in medians) exhibit no detectable differences across the two groups. Hence, the randomization process succeeds in holding constant these characteristics, including loan demand, across the two types of stocks: those made available for lending versus those withheld. Unobservable differences between the two groups are also likely to be negligible since the assignment of stocks to the lendable (treatment) and withheld (control) groups is random. The only difference between the two groups is that the treatment group lends its shares out. We therefore interpret the experiment as an exogenous supply shock to the lendable shares of the treated group—those randomly made available for lending.

Figure 2 shows the same distributional comparisons across firm characteristics for the available and not available stocks among the non-revenue (or low shorting demand) stocks. The only characteristic omitted is the expected loan spread because for non-revenue stocks these are all close to zero (that is how "non-revenue" stocks were defined). The plots and statistics in Figure 2 show that the same randomization process generates no detectable differences between the available and not available groups among the non-revenue stocks either. Although the Manager did not expect to lend out the low demand stocks, it is reassuring (for the robustness of our experimental design) that the randomization process generates no observable differences across the treatment and control groups among this sample as well.

The revenue (Figure 1) and non-revenue (Figure 2) stocks themselves are quite different along observable characteristics because they are selected based on their expected loan fees. The revenue stocks are a little smaller and have lower institutional ownership than the non-revenue stocks. However, the Manager owns a similar (and substantial) percentage of both sets of stocks, owning an average 4% and as much as 15% of the total shares outstanding in some firms. Not surprisingly, the revenue stocks have higher short interest (another proxy for demand), lower past 6-month returns, and slightly lower prior 30-day trading volume. By construction, revenue stocks have large and positive expected loan spreads while the non-revenue stocks have none.

C. *The Sample*

The Manager placed three restrictions on the shares to be lent out. First, the experiment began only with shares traded on U.S. exchanges. Second, the experiment was restricted to shares that were in high demand at the time the lending program began (i.e., revenue stocks with gross loan spreads of at least 25 basis points at the start of lending). Third, the loan size was

restricted to the lesser of (1) three times the average daily trading volume (based on the past 30 days trading activity) and (2) 5% of the outstanding shares of the issuer of the security.

Applying the first two restrictions to the 93 revenue stocks that were randomly made available for lending reduced the sample to 40 stocks. However, at the start of the lending program eight of those 40 stocks were not lent out due to insufficient loan spreads, resulting in a final sample of 32 treated stocks. Among the 45 revenue stocks that were randomly withheld from the lending market, 20 of them passed the above criteria. Hence, the primary sample we study in this paper consists of 40 revenue stocks randomly made available for lending, of which 32 were actually lent, and 20 revenue stocks randomly withheld from the lending market.[7]

Table I presents summary statistics for the 32 randomly made available and 20 randomly withheld stocks in our sample that pass the above criteria from the Manager. We report the mean and medians for a variety of characteristics for these two groups of stocks as well as the *p*-values from tests of differences in means and medians between the two groups. We find no significant differences between the two groups in terms of firm characteristics, trading activity, the Manager's ownership of the firms, or shorting demand and potential loan supply. Specifically, we find no detectable differences between market capitalizations, shares outstanding, percentage of shares owned by the Manager, market-to-book ratios, Manager holdings as a percentage of 30-day average daily trading volume, Manager holdings as a percentage of institutional ownership, potential loan as a fraction of daily trading volume, potential loan as a fraction of institutional ownership, or past returns of the stocks over the previous month before the loan program (e.g., August 2008) between the two groups. The only statistically significant differences between the two groups are that the 32 stocks actually lent out have slightly higher mean institutional

[7] In September and October 2008, the SEC restricted short sales of financial institutions. None of the 60 stocks in the sample was subject to these restrictions.

ownership than the 20 stocks withheld (but have no median differences in institutional ownership), and the 32 stocks lent out have marginally higher short interest, which may be a function of their being made available to the loan market.

Second, the characteristics of the stocks suggest that the experiment provides a potentially sizeable shock to loan supply. The stocks in the sample have a median market capitalization of less than $1 billion, consistent with the Manager as an investor in small- and mid-cap stocks. The Manager also owns a meaningful fraction of the shares of these firms, averaging 5.5% of shares outstanding. The stocks in the sample have a mean (median) market-to-book ratio of 2.8 (2.0). The stocks are also majority owned by institutional investors (average of about 84% of shares outstanding held by institutions). The stocks in the sample, both those made available and not available for lending, have meaningful short interest (mean and median greater than 15% of shares outstanding) as well. This last fact is not surprising given that these stocks are in demand for shorting, having loan spreads exceeding 25 basis points. In addition, the Manager's holdings are meaningful relative to average daily trading volume—mean (median) ratio at about five (four) times daily volume—and the potential loan from the experiment is substantial—mean (median) of 2.3 (3.0) times average daily trading volume and mean (median) of 3.7% (3.8%) of institutional ownership. These statistics suggest that the Manager's holdings and the lending program represent meaningful changes to the supply of lendable shares.

D. *The Lending Experiment and Summary Statistics*

The lending period began on September 5, 2008. At its peak, on September 17, over $700 million of securities were lent out. On September 18, 2008, the Manager asked the lending agent to call the loans back in. The last shares were returned on October 3, 2008. We examine

the effects on stocks lent out versus those randomly withheld during the "lending period" (September 5 through September 17) and "recall period" (September 18 through October 3).

Table II presents summary statistics on the loans actually made on the 32 randomly lent stocks during the lending and recall periods. The average (median) stock was on loan for 12.6 (13.5) days total—approximately 6 days during the lending period and 7 days during the recall period. The mean (median) equal-weighted average daily loan spread was 259 (81) basis points and ranged from 1.4 to 976 basis points. The mean (median) loan-weighted average daily spread was 768 (523) basis points and reached a maximum 23.1%, indicating that the more lucrative stocks represented a disproportionately larger share of loan volume.

On average, the shares on loan represented 4.34% of the short interest (median of 3.1%) and an average (median) of 67% (52%) of average daily trading volume over the prior 30 days, with the maximum reaching 212% of daily volume. Table II also shows that the average daily number of shares on loan represent almost 1% of the float on these stocks and the maximum loan level accounted for an average (median) of 1.6% (1.4%) of total market capitalization of the stocks. These amounts suggest that the shares made available for lending by the Manager represent a meaningful number of shares in many of the companies and, hence, a sizeable shock to the supply of lendable shares in the market for these companies. We also exploit the cross-sectional variation in the loan supply shock across stocks in our empirical analysis.

IV. Results

We describe the results from our experiment of moving the loan supply of shares for the treated firms versus control firms, holding shorting demand (and everything else) fixed. We examine the effects of loan supply shocks on stock average returns, volatility, bid-ask spreads,

and skewness. We present results for both the average effect from the loan shock as well as their cross-sectional effects by exploiting variation in loan supply and firm attributes.

A. *Returns*

Table III analyzes how the supply shock to lendable shares affects returns by comparing the daily returns to the 32 (treated) stocks that were randomly lent relative to the 20 (control) stocks that were randomly withheld over three periods: the month before the loan period (August 1 to September 4, 2008), the lending period (September 5 to September 17, 2008), and the recall period (September 18 to October 5, 2008). For each of these three periods the changes in returns for the randomly lent stocks are compared to the returns of the 20 withheld stocks and the differences between these two groups are reported for each period.

Specifically, we form two portfolios, one containing the 32 treated stocks and one containing the 20 control stocks, and compare the average daily portfolio returns over each period. The last two columns of Table III report the difference-in-differences between the returns of these two groups from the pre-lending to lending period and from the lending to recall period, which provide a test for whether the sudden supply changes during the lending and recall periods had any effect on returns. For robustness we form three sets of portfolios that equal weight, value weight, and weight by expected loan spread *before* the lending experiment.

If loan supply from our experiment has a pricing effect (at the amounts being lent), then we expect to see a decrease in returns during the lending period when supply is exogenously increased and a reversal or increase in returns during the recall period as the supply of shares is suddenly reduced. By examining the differences between the 32 stocks lent out and the random 20 stocks of the Manager withheld from the loan market over the same period, we difference out

other observable and unobservable variables that might affect returns, since the only difference between the two groups is the random treatment of changing the supply of lendable shares. We report raw returns, but returns adjusted for the Russell 2500 index (the index most closely related to the holdings of the Manager), and returns adjusted for industry returns using the Fama-French 48 industry portfolios yield economically and statistically identical results.[8]

The first row and first three columns of Table III indicate that the equal-weighted average return to the 32 randomly made available for lending stocks is 16 basis points and is identical to the 15 basis point average return of the 20 randomly withheld stocks in the 24 trading days preceeding the lending period. The one basis point difference is not statistically or economically significant.

The next three columns of Table III report the equal-weighted average daily returns over the lending period. The returns to stocks available for lending are negative but less so than the returns for stocks not available for lending over the lending period (-26 versus -72 basis points), though the difference is statistically insignificant. This result highlights the importance of the experiment. Without the random control group of stocks, we might have erroneously concluded that the -26 basis points for the lent stocks, representing a 42 basis point decline from the pre-lending to the lending period, indicates price pressure from increased shorting supply. However, because the control group of stocks experienced a similar (and even greater) decline in returns, without any change in loan supply, the negative returns must have been driven by other factors unrelated to loan supply. In fact, the difference-in-differences estimate is positive 46 basis points over the lending period (statistically insignificant) which has the wrong sign for a price pressure story. This estimate implies that returns in general fell over the lending period for these type of

[8] If the treated firms are otherwise identical to the non-treated firms there is no need to adjust returns at all for risk, since the two groups should have identical risk characteristics. That fact that the results are unaffected by any risk adjustment confirms that our randomized experimental design achieves its objective.

stocks, but they fell less for stocks whose supply of lendable shares exogenously increased. There is no evidence, therefore, of negative price pressure during the lending period from the additional shares made available for lending.

The next three columns of Table III report the difference in returns between the available and non-available stocks over the recall period. The returns to stocks available for lending that were lent out average -69 basis points while the returns to stocks not made available average -27 basis points. The even more negative returns of lent stocks over the recall period when loan supply is decreasing is also inconsistent with a price pressure story that predicts positive return effects when loans are called back. Moreover, as the difference-in-differences test from the lending to the recall period indicates, the negative effect on returns is even larger (though statistically no different) for the control group of stocks whose supply of lendable shares was unaffected. Hence, there is no significant evidence that pressure from lending and then recalling the shares of the available stocks had any adverse pricing effects.

The next two rows of Table III repeat the analysis using value-weighted and expected loan spread-weighted portfolios. The value-weighted portfolio results do find a slightly more negative price response of the treated stocks during the lending period, but it is statistically not different from the response of the control stocks. During the recall period, both the treatment and control stocks experience negative returns and the difference from the lending to the recall period is actually larger for the control stocks, which is inconsistent with loan supply shocks affecting prices. Once again, none of these differences are significant.

For the expected loan spread-weighted results, two significant differences emerge: during the lending period available stocks had more positive returns than the control group and

during the recall period they had more negative returns— again, the wrong sign from a price pressure story.[9]

B. *Volatility*

Panel A of Table IV reports the cross-sectional average of the standard deviations or volatilities of the stocks made available for lending and the stocks withheld from the loan market over the pre-loan program, lending, and recall periods. Volatilities for each stock are computed from daily returns over the specified period. For "stocks on loan," volatilities are computed only for the days in which the stock is actually on loan (e.g., when a supply shift occurred). We report equal, value, and expected loan spread weighted cross-sectional averages. The "difference" columns represent a difference in means test with standard errors in brackets.

To the extent that short sale constraints are important for price discovery, we would expect lower volatility for the stocks made available for lending than for those not made available for lending over the lending period. We would then expect to see a reversal over the recall period. On the other hand, if short sales are destabilizing, we would expect the opposite pattern.

Panel A of Table IV indicates that the volatilities of the stocks available for lending are slightly lower (by 56, 41, and 134 basis points using equal, value, and expected loan spread weights, respectively) on average than those stocks not available for lending over the twenty-four trading days before the lending period. None of these differences are significant, however.

[9] We also examined the average daily returns to the non-revenue stocks based on whether they were supposed to be available or not available to be lent. Unlike the revenue stocks, the vast majority of these stocks were not lent out even if available. (Four were lent out because they became revenue producing between June and September.) The returns to the two groups of stocks are virtually identical over the lending and recall periods as well.

During the lending period, the volatility of the available stocks rises slightly, which is consistent with a destabilizing force from additional short selling. However, the control stocks experience an even greater rise in volatility, indicating that increasing volatility for these stocks is not coming from additional shorting. The difference-in-differences between the available and not available stocks from the pre-lending through the lending period is negative, since the available stocks experience a much smaller volatility increase than the control stocks. Although the differences are not statistically significant, this result suggests that additional short selling muted volatility, consistent with the notion that shorting improves price discovery. However, in addition to being statistically insignificant, these differences are also economically small—82 basis points difference for equal-weighted averages, 54 basis points for the value-weighted average difference, and only 7 basis points difference when weighting by expected loan spread (a proxy for initial shorting demand). These numbers indicate very little if any effect on volatility from loan supply shocks.

From the lending period to the recall period, the volatility of returns to available stocks continues to increase by 2.41%, but the volatility for non-available stocks, which experience no shock to lending supply, also increases by1.92%, and this difference is not statistically significant. Hence, the increase in volatility from the lending to the recall period appears to be driven mostly by other market conditions that affected similar types of stocks at the time. This result, again, highlights the importance of conducting a randomized experiment. Without having a control group of (identical) stocks to examine, it would be easy to conclude erroneously that volatility had risen during the recall period because of decreasing loan supply. The difference-in-differences estimate of the changes in volatility from the lending and recall periods between available and not available stocks is an insignificant 50 basis points for the equal-weighted

averages, -31 basis points for the value-weighted averages, and 1 basis point for the expected loan spread-weighted averages. None of these differences are statistically or economically significant and the fact that the different averages oscillate around zero suggests there is no effect on volatility from loan supply shocks.

C. *Skewness*

Panel B of Table IV reports results from the analogous analysis using estimates of individual stock return skewness (estimated using daily returns) over the lending and recall periods. If shorting constraints are binding, negative news may not be adequately incorporated into prices, which may lead to overpricing (e.g., Miller (1977)) or no mispricing (e.g., Diamond and Verrechia (1987)) according to theory. However, even in the case of no mispricing of the stock, the distribution of returns may be affected, resulting in positive skewness for stock returns. Therefore, if shorting constraints are important, we expect to see negative changes to skewness during the lending period and a reversal (positive changes) in the recall period. Across all three averages (equal, value, and expected loan spread-weighted) there are no detectable differences in skewness changes for the available stocks during either the lending or recall periods relative to the non-available stocks. The difference-in-differences estimates are negligible and suggest that our shorting supply shocks do not alter the distribution of returns.

D. *Bid-Ask Spreads*

Panel C of Table IV repeats the analysis using individual stock bid-ask spreads. To the extent that short sale constraints are important for price discovery, we expect lower bid-ask spreads for the stocks available for lending than for those not available for lending over the

lending period and a reversal over the recall period. To the extent that short sales are destabilizing, we would expect to see the opposite pattern.

Panel C of Table IV indicates that bid-ask spreads increase by only 3-5 basis points for the available stocks from the pre-lending to the lending period, which is indistinguishable from zero. However, for stocks withheld from the loan market, bid-ask spreads increase by 3-10 basis points over the lending period, which is also not significantly different from zero and not significantly different from the 3-5 basis point increase for available stocks. Going from the lending period to the recall period, bid-ask spreads for the available stocks increase significantly by 46, 32, and 35 basis points for the equal, value, and expected loan spread-weighted averages, respectively, but this increase is far less than the 114, 55, and 31 basis point increase in spreads for stocks not available for lending for the equal, value, and expected loan spread-weighted averages, respectively. The difference-in-differences estimates from the pre-lending to the lending period are negligible at only a few basis points. The difference-in-differences estimates from the lending to the recall periods are negative and significant. So, although bid-ask spreads increased from the lending to the recall period for the stocks lent out (e.g., who experienced a supply shock), the effect is even larger for the control group of stocks. This result indicates that something else, other than loan supply, was moving the spreads and once again highlights the insights from the experiment. Given the lack of consistency between the lending and recall period results, we conclude there is little evidence of an adverse information effect caused by changes in the available supply of lendable shares.

E. *Cross-sectional Results*

The results in Tables III and IV on returns, volatility, skewness, and bid-ask spreads are for the average stock in the treatment and control groups. It may be the case, however, that the insignificant results we obtain for the average stock in each group are masking important cross-sectional information. Certain kinds of stocks or certain loan amounts may have more or less of an effect on the various outcome variables we analyze. To examine the impact of cross-sectional information, we estimate cross-sectional regressions that examine the interaction of various stock and the Manager's holding characteristics with the treatment and control of availability of lendable shares.

Panel A of Table V reports results from regressions of the change in returns, volatility, skewness, and bid-ask spread from the pre-lending to lending periods, on a set of cross-sectional characteristics of the holdings. The regressions include both stocks available and not available for lending. We include as independent variables in the multivariate regressions: the stock's short interest (as a percentage of shares outstanding), the maximum potential share loan as a percentage of institutional ownership, and the expected loan spread estimated at the end of June 2008. In each regression, we also include a dummy variable equal to one if the stock is available and a variable that interacts each independent variable with the available dummy variable.

If short sales constraints are important, the interaction terms in the regressions between the availability dummy and the holdings characteristics will be significant. The first column of Panel A of Table V reports results for return differences between the lending period and pre-lending period as the dependent variable. All of the coefficients on the available dummy and the interaction terms are insignificant. Hence, there seems to be no effect on prices from shorting

supply on the average stock nor on stocks with the most extreme short interest, potential loan amount (e.g., largest supply shocks) or expected loan spreads (e.g., highest shorting demand).

The next three columns of Panel A of Table V repeat the analysis for volatility, skewness, and bid-ask spread changes over the lending period as dependent variables. Only two significant results emerge: volatility rises for stocks experiencing a loan supply increase with the highest expected loan spreads and bid-ask spreads rise for stocks with more short interest. Both findings are consistent with increased shorting activity possibly having a destabilizing influence on stocks with extreme shorting demand (as proxied by high short interest and high loan spreads).

Panel B of Table V repeats the regressions over the recall period, using changes in returns, volatility, skewness, and bid-ask spreads from the lending to recall period as dependent variables. Here, none of the interaction terms are significant. However, there is some evidence of a reversal of the lending period effects on volatility for stocks with the largest expected loan spread, consistent with Panel A. The bid-ask spread effect on high short interest stocks is not reversed over the recall period, however.

Panels C and D of Table V repeat the analyses in Panels A and B, but use only the 32 lent stocks. These regressions do not control for the exogenous treatment of stocks, and hence, are useful for demonstrating the importance of the experimental design. Over the lending period, Panel C indicates a significant negative relation between returns and the potential loan as a percentage of institutional ownership, which is reversed in Panel D over the recall period. Likewise, high short interest stocks have lower volatility during the lending period that reverses in the recall period. Without the control group of stocks we would erroneously conclude there are negative price effects associated with shorting and an impact on volatility as well. However, with the control group in Panels A and B we find none of these effects. Put differently, the fact

that these variables are significant among the lent stocks in determining returns and volatility cannot be driven by loan supply shocks since similar effects are also exhibited across the same characteristics for the group of control stocks whose loan supply was not altered. Contrasting the results from Panels A and B versus Panels C and D of Table V highlights once again the importance of our experimental design and the identification of exogenous supply shocks.

V. Summary and Discussion

This paper reports the results of an experiment in which 2/3 of the stocks in a large money manager's portfolio were randomly made available for lending while a size and characteristic matched sample of 1/3 of the stocks were randomly withheld from lending. We find no evidence that during either the lending or recall periods, returns, volatilities, skewness, or bid-ask spreads to stocks available for lending are any different from those of stocks not available for lending.

The results of our matched experiment with exogenous changes in loan supply indicate no adverse effect of stock lending on security prices, their distribution, or spreads for the average stocks. We find only mild evidence that volatilities and spreads for stocks with the highest shorting demand are affected by loan supply shocks. The results from our experiment are consistent with those of Diether et al. (2009), who use a (very different) randomized experimental design for loan supply movements in a much different setting. The two sets of results are complementary.

We highlight in several places the difficulty in interpreting results without controlling for exogenous selection. We find several significant results when we ignore the randomization from the experiment and find that these results become insignificant (and often change sign), when we

impose the exogenous treatment from the randomization. These findings emphasize the importance of the exogenous experimental design.

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Table I:
Summary Statistics of Randomly Lent and Randomly Withheld Stocks

Reported are the means and medians across a variety of firm characteristics for the set of stocks randomly lent out versus randomly withheld from the loan market. The 32 stocks owned by The Manager that were randomly made available to be lent out in the stock loan market are compared against the matched sample of 20 randomly withheld stocks from the loan market that The Manager also owns along dimensions of size (market cap), shares owned by the manager, market-to-book ratio, institutional ownership, short interest, potential loan size, and average returns in August 2008. The *p*-values from tests for differences in means and medians between the two groups are also reported in the last column of the table.

	Randomly made available to lend	Randomly withheld from lending market	Test for difference (*p* -value)
Market cap ($M)			
Mean	1367.1	945.2	(0.21)
Median	985.9	568.2	(0.39)
%shares owned by manager			
Mean	5.5	4.8	(0.45)
Median	4.8	4.4	(0.78)
Market-to-book ratio			
Mean	2.8	2.5	(0.75)
Median	2.0	1.5	(0.41)
Institutional ownership (%)			
Mean	83.7	63.7	(0.02)
Median	100.0	61.7	(0.19)
Short interest (%)			
Mean	22.1	15.6	(0.06)
Median	20.1	16.2	(0.05)
Manager holdings as % of 30-day volume			
Mean	486.4	655.2	(0.38)
Median	370.2	472.5	(0.78)
Manager holdings as % of institutional ownership			
Mean	8.1	11.0	(0.40)
Median	5.5	6.8	(0.69)
Potential loan as % of 30-day volume			
Mean	229.3	216.7	(0.65)
Median	300.0	300.0	N/A
Potential loan as % of institutional ownership			
Mean	3.7	4.7	(0.21)
Median	3.8	3.9	(0.86)
Average daily return, August 2008 (bps)			
Mean	12.5	13.1	(0.95)
Median	19.3	13.6	(0.39)
Average daily Russell 2500-adjusted return, August 2008			
Mean	5.8	6.4	(0.95)
Median	12.5	6.9	(0.39)
Average daily industry-adjusted return, August 2008 (bps)			
Mean	5.5	9.1	(0.74)
Median	11.8	10.4	(0.64)
Number of stocks	*32*	*20*	

Table II:
Summary Statistics of Randomly Lent Stocks During the Loan Experiment

Reported are summary statistics on actual lending activity and loan spreads for the 32 stocks owned by The Manager that were randomly made available to be lent out in the stock loan market during the loan experiment.

	Mean	Median	deviation	Minimum	Maximum
Loan period (days)	12.59	13.50	4.77	1	19
Lending period (days)	6.06	6.00	2.34	1	9
Recall period (days)	6.53	7.00	2.91	0	12
Average daily spread (bps)	258.53	80.93	312.10	1.41	976.06
Loan-weighted average daily spread (bps)	767.62	523.30	784.33	63.35	2311.12
Average number lent shares/30-day average trading volume (%)	66.97	51.94	54.74	1.06	212.26
Average daily loan market value ($M)	11.11	7.33	11.16	0.07	39.09
Average daily % of market cap on loan (%)	0.90	0.74	0.76	0.02	2.81
Max. daily dollar value of shares on loan ($M)	19.71	11.99	18.66	0.10	75.78
Max. daily % of market cap on loan (%)	1.58	1.44	1.21	0.03	5.01

Table III:
Return Differences of Available and Not Available to Lend Stocks over Lending and Recall Periods

Reported are the average daily returns (in percent) for the portfolio of the 32 stocks randomly made available to lend and the portfolio of 20 stocks randomly withheld or not available to lend. Average daily returns for both portfolios are reported over the "pre-lending period" (August 1 to September 4, 2008), the "lending period" (September 5 to September 17, 2008), and the "recall period" (September 18 to October 3, 2008). The difference between the two portfolio returns (available for lending vs. not available) are also reported for each period. The last two columns report the differences-in-differences between the pre-lending and lending period return difference of available for lending and withheld/not available stocks and the return difference from the lending and recall period of the return difference between the two portfolios. Three sets of portfolio weights are used: equal-weighting, value-weighting (by beginning of month market capitalization), and expected loan spread weighting (using the expected loan spread on each stock prior to the lending period and at the time of randomization into the either the available or not available to lend group). Standard errors for the portfolio returns are reported in brackets and means significantly different from zero at the 95% confidence level are highlighted in bold.

	Pre-period			**Lending period**			**Recall period**			**Diff-in-Diff**	
	Available	Not available	Difference	Available	Not available	Difference	Available	Not available	Difference	Lend - Pre	Recall - Lend
Equal-weight portfolio	0.16	0.15	0.01	-0.26	-0.72	0.47	-0.69	-0.27	-0.42	0.46	-0.89
	[0.47]	[0.47]	[0.26]	[0.86]	[1.05]	[0.37]	[1.50]	[1.49]	[0.50]	[0.49]	[0.66]
Value-weight portfolio	0.14	0.01	0.13	-0.19	0.09	-0.28	-0.70	0.01	-0.71	-0.41	-0.43
	[0.48]	[0.40]	[0.29]	[0.86]	[0.94]	[0.47]	[1.47]	[1.46]	[0.77]	[0.56]	[0.98]
Expected loan spread-weight portfolio	0.23	-0.09	0.32	0.31	-0.80	**1.11**	-0.85	-0.55	-0.29	0.79	**-1.40**
	[0.52]	[0.60]	[0.41]	[0.84]	[0.93]	[0.28]	[1.59]	[1.58]	[0.49]	[0.69]	[0.62]

Table IV:

Volatility, Skewness, and Bid-Ask Spread Differences of Available and Not Available Stocks over Lending and Recall Periods

Reported are the cross-sectional averages of daily estimates of individual stock volatility (Panel A), skewness (Panel B), and bid-ask spreads (Panel C) for the 32 stocks randomly made available to lend and the 20 stocks randomly withheld or not available to lend separately. For each of the 32 individual stocks in the available group and the 20 stocks in the unavailable group, the volatility and skewness of daily returns as well as the time-series average of the daily bid-ask spread are calculated over the "pre-lending period" (August 1 to September 4, 2008), the "lending period" (September 5 to September 17, 2008), and the "recall period" (September 18 to October 3, 2008). The cross-sectional average of the individual stock volatility, skewness, and bid-ask spread measures are then reported separately for the available and non-available group of stocks over each of these periods. The difference between the cross-sectional averages between the two groups (available for lending vs. not available) are also reported for each period. The last two columns report the differences-in-differences between the pre-lending and lending periods between the group of stocks made available for lending and those not available. Three sets of cross-sectional averages are reported: equal-weighting, value-weighting (by beginning of month market capitalization), and expected loan spread weighting (using the expected loan spread on each stock prior to the lending period and at the time of randomization into the either the available or not available to lend group). Standard errors are reported in brackets and means significantly different from zero at the 95% confidence level are highlighted in bold.

	Pre-period			**Lending period**			**Recall period**			Diff-in-Diff	
	Available	Not available	Difference	Available	Not available	Difference	Available	Not available	Difference	Lend-Pre	Recall-Lend
Panel A: Volatility											
Equal-weight	3.84	4.40	-0.56	4.07	5.44	**-1.37**	6.48	7.36	-0.88	-0.82	0.50
	[0.23]	[0.29]	[0.37]	[0.26]	[0.48]	[0.50]	[0.39]	[0.72]	[0.75]	[0.49]	[0.85]
Value-weight	3.68	4.09	-0.41	4.00	4.95	-0.95	5.99	7.25	-1.26	-0.54	-0.31
	[0.68]	[0.94]	[1.14]	[0.71]	[1.34]	[1.39]	[1.02]	[1.90]	[1.98]	[0.70]	[1.05]
Expected loan spread-weight	3.66	5.00	-1.34	3.95	5.37	-1.42	6.60	8.01	-1.41	-0.07	0.01
	[0.82]	[1.80]	[1.76]	[1.10]	[1.67]	[1.92]	[1.53]	[2.69]	[2.87]	[0.94]	[1.88]
Panel B: Skewness											
Equal-weight	0.12	0.06	0.06	-0.01	-0.16	0.15	0.63	0.53	0.10	0.09	-0.06
	[0.14]	[0.23]	[0.26]	[0.11]	[0.14]	[0.18]	[0.12]	[0.14]	[0.19]	[0.34]	[0.21]
Value-weight	0.11	0.17	-0.05	-0.21	-0.24	0.03	0.55	0.45	0.10	0.08	0.07
	[0.22]	[0.21]	[0.33]	[0.14]	[0.18]	[0.23]	[0.11]	[0.19]	[0.21]	[0.48]	[0.33]
Expected loan spread-weight	3.66	5.00	-1.34	3.95	5.37	-1.42	6.60	8.01	-1.41	-0.07	0.01
	[0.82]	[1.80]	[1.76]	[1.10]	[1.67]	[1.92]	[1.53]	[2.69]	[2.87]	[0.94]	[1.88]
Panel C: Bid-Ask Spread											
Equal-weight	0.18	0.28	**-0.10**	0.21	0.36	-0.15	0.67	1.50	**-0.83**	-0.04	**-0.68**
	[0.02]	[0.05]	[0.05]	[0.02]	[0.10]	[0.08]	[0.17]	[0.33]	[0.33]	[0.04]	[0.30]
Value-weight	0.16	0.18	-0.03	0.19	0.21	-0.02	0.41	0.76	**-0.35**	0.00	**-0.33**
	0.03	0.04	[0.05]	0.03	0.05	[0.06]	0.06	0.15	[0.14]	[0.03]	[0.12]
Expected loan spread-weight	0.17	0.35	-0.18	0.22	0.45	-0.23	0.57	1.76	-1.19	-0.05	-0.96
	[0.04]	[0.14]	[0.12]	[0.05]	[0.23]	[0.19]	[0.19]	[0.76]	[0.64]	[0.09]	[0.52]

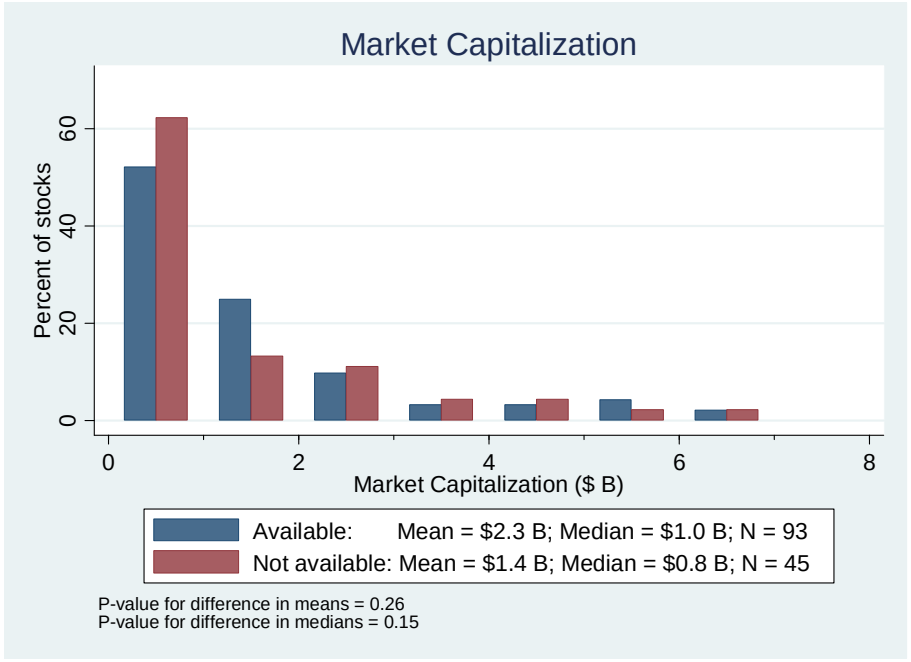
Table V:
Cross-Sectional Regressions

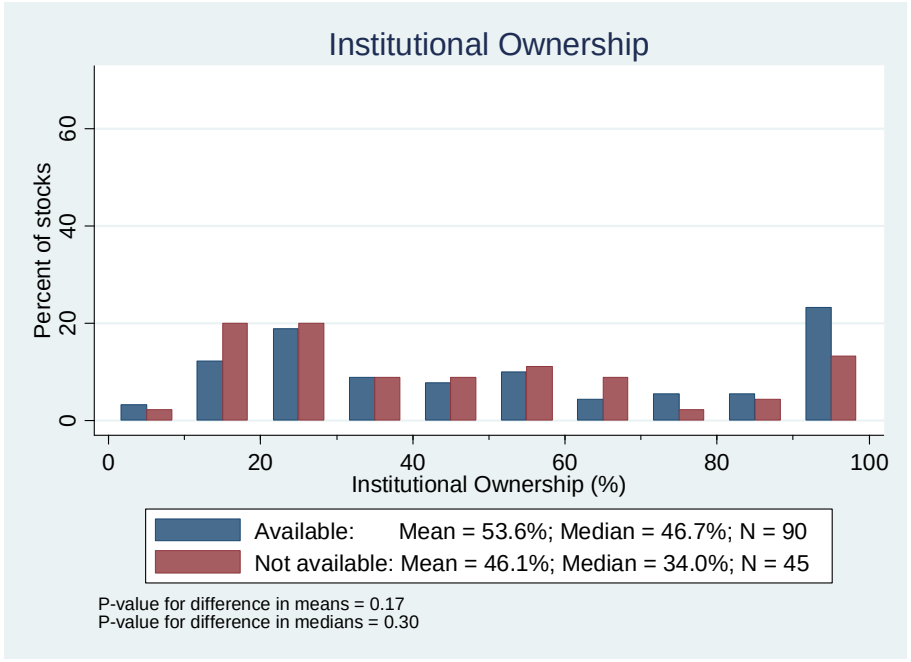
Reported are results from cross-sectional regressions of changes in the averages of daily estimates of individual stock returns, volatility, skewness, and bid-ask spreads from the pre-lending to lending period (Panel A) and from the lending to recall period (Panel B) for the 32 stocks randomly made available to lend and the 20 stocks randomly withheld or not available to lend separately. The "pre-lending period" is from August 1 to September 4, 2008, the "lending period" from September 5 to September 17, 2008, and the "recall period" is from September 18 to October 3, 2008. Cross-sectional regressions are run with changes in returns, volatility, skewness, and bid-ask spreads over the relevant periods on several cross-sectional characteristics of the stocks, with a dummy variable for available stocks interacted with each characteristic. Panels C and D repeat the regressions using only the 32 available for lending stocks (and omitting the available dummies). Standard errors are reported in brackets and coefficients significantly different from zero at the 90 and 95% confidence levels are indicated with a * and **, respectively.

Dependent variable = differences in	Return	Volatility	Skewness	Bid-ask spread
Panel A: Lending period - pre-period				
Short interest	0.03	-0.08**	-0.03	-0.01**
	[0.04]	[0.03]	[0.02]	[0.00]
Potential loan to inst. own. (%)	0.12	0.14	-0.24**	-0.01
	[0.14]	[0.12]	[0.09]	[0.01]
Expected loan spread	0.11	-11.2	3.56	0.54
	[8.07]	[6.82]	[5.03]	[0.61]
Short interest * Available	-0.02	0.03	0.03	0.01**
	[0.05]	[0.04]	[0.03]	[0.00]
Potential loan to inst. own. (%) * Available	-0.39	0.06	0.25	0.01
	[0.27]	[0.23]	[0.17]	[0.02]
Expected loan spread * Available	1.46	16.09**	-6.08	-0.45
	[9.23]	[7.80]	[5.75]	[0.70]
Available	2.17	-1.75	-1.25	-0.24*
	[1.66]	[1.40]	[1.03]	[0.13]
N	51	51	51	51
R-squared	0.11	0.30	0.18	0.18
Panel B: Recall period - lending period				
Short interest	-0.09**	0.07	0	-0.04*
	[0.03]	[0.06]	[0.02]	[0.02]
Potential loan to inst. own. (%)	-0.28**	-0.33	0.01	-0.10
	[0.13]	[0.22]	[0.06]	[0.08]
Expected loan spread	2.32	15.25	-4.73	4.02
	[7.15]	[12.51]	[3.31]	[4.57]
Short interest * Available	0.04	-0.04	0	0.03
	[0.05]	[0.08]	[0.02]	[0.03]
Potential loan to inst. own. (%) * Available	0.35	0.53	-0.05	0.07
	[0.24]	[0.42]	[0.11]	[0.15]
Expected loan spread * Available	-5.55	-14.06	6.18	-4.65
	[8.17]	[14.30]	[3.78]	[5.23]
Available	-2.54*	-0.77	-0.11	-1.18
	[1.47]	[2.56]	[0.68]	[0.94]
N	51	51	51	51
R-squared	0.33	0.13	0.08	0.19

Dependent variable = differences in	Return	Volatility	Skewness	Bid-ask spread
Panel C: Lending period - pre-period for available stocks only				
Short interest	0.01	-0.06*	0.00	0.00
	[0.03]	[0.03]	[0.02]	[0.00]
Potential loan to inst. own. (%)	-0.27*	0.20	0.01	-0.00
	[0.16]	[0.17]	[0.15]	[0.01]
Expected loan spread	1.57	4.89	-2.52	0.09
	[3.08]	[3.25]	[2.86]	[0.26]
Constant	0.24	0.37	-0.01	-0.01
	[0.90]	[0.95]	[0.84]	[0.07]
N	31	31	31	31
R-squared	0.18	0.18	0.04	0.04
Panel D: Recall period - lending period for available stocks only				
Short interest	-0.05**	0.04	0.00	-0.01
	[0.02]	[0.05]	[0.02]	[0.02]
Potential loan to inst. own. (%)	0.06	0.19	-0.05	-0.03
	[0.14]	[0.29]	[0.10]	[0.12]
Expected loan spread	-3.22	1.19	1.45	-0.62
	[2.74]	[5.78]	[2.01]	[2.36]
Constant	0.53	0.95	0.78	0.86
	[0.80]	[1.69]	[0.59]	[0.69]
N	31	31	31	31
R-squared	0.30	0.04	0.04	0.02

Figure 1: Distribution of revenue stocks characteristics after randomization.





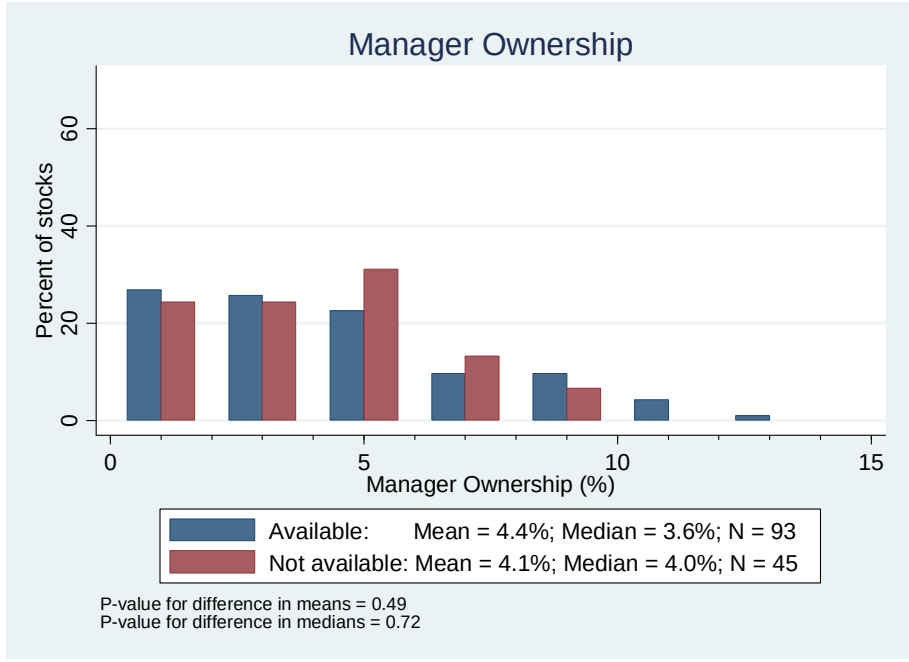
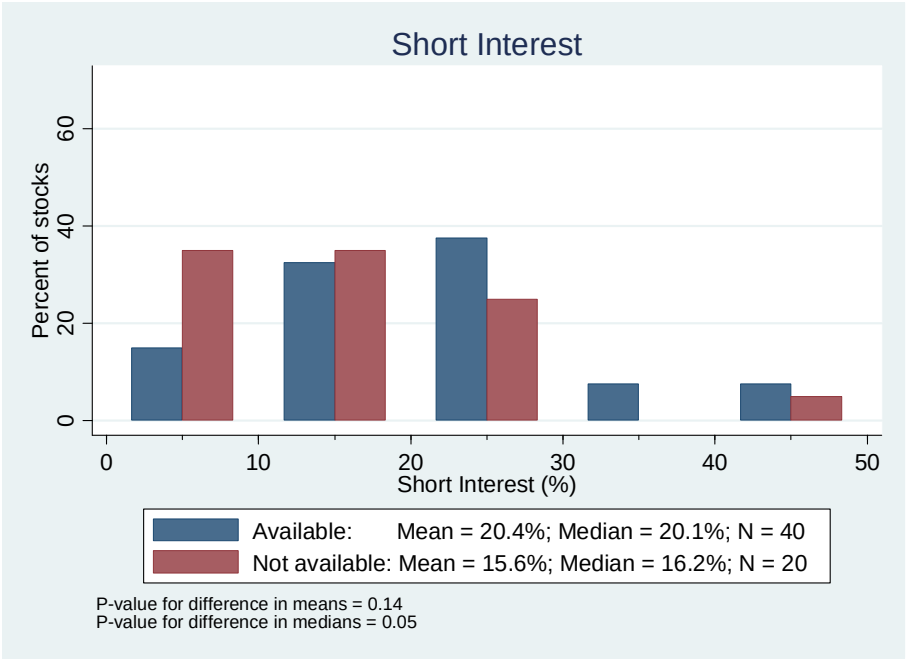
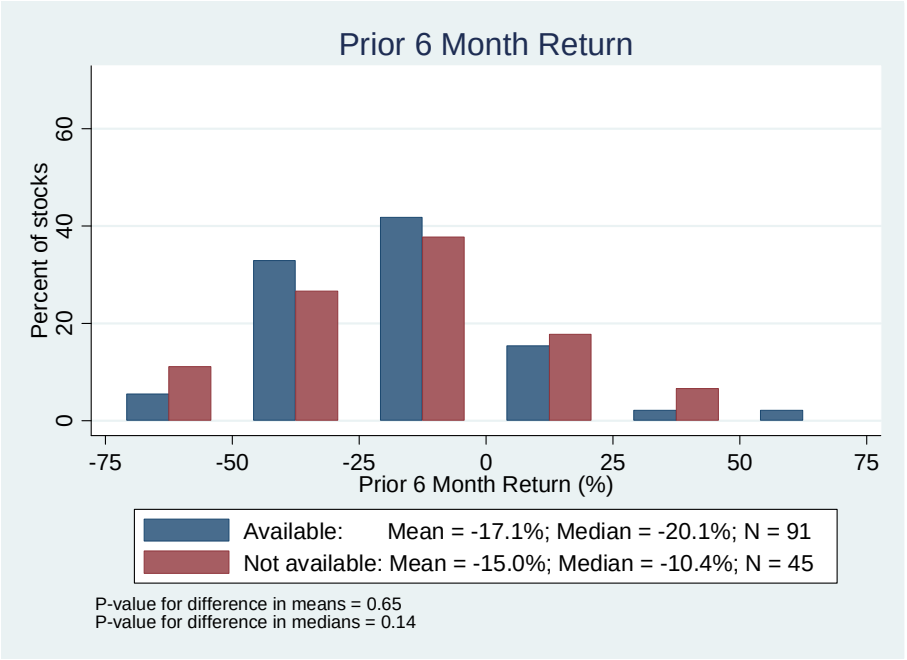
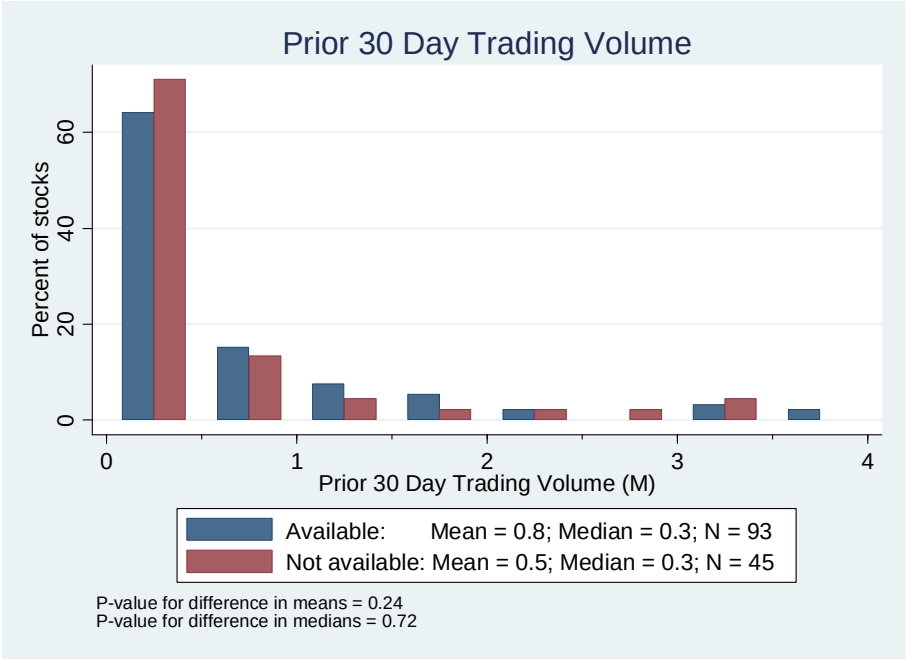


Figure 1 (continued): Distribution of revenue stocks characteristics after randomization.







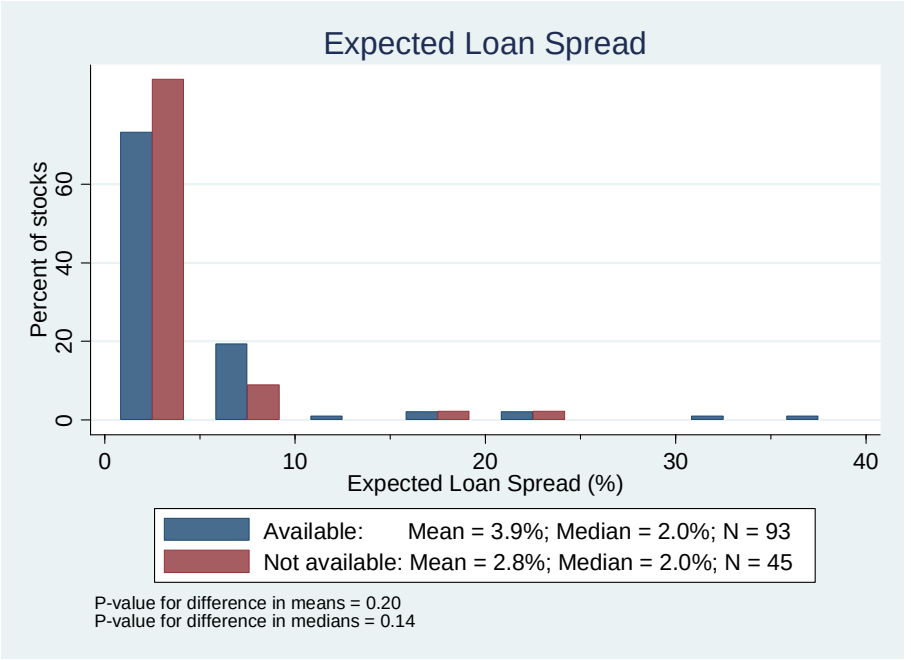
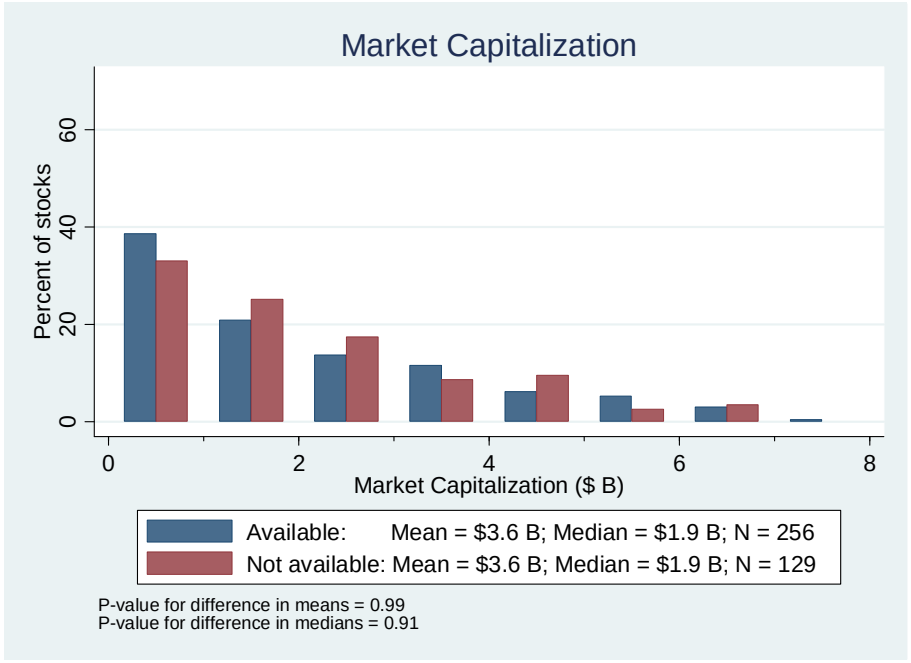
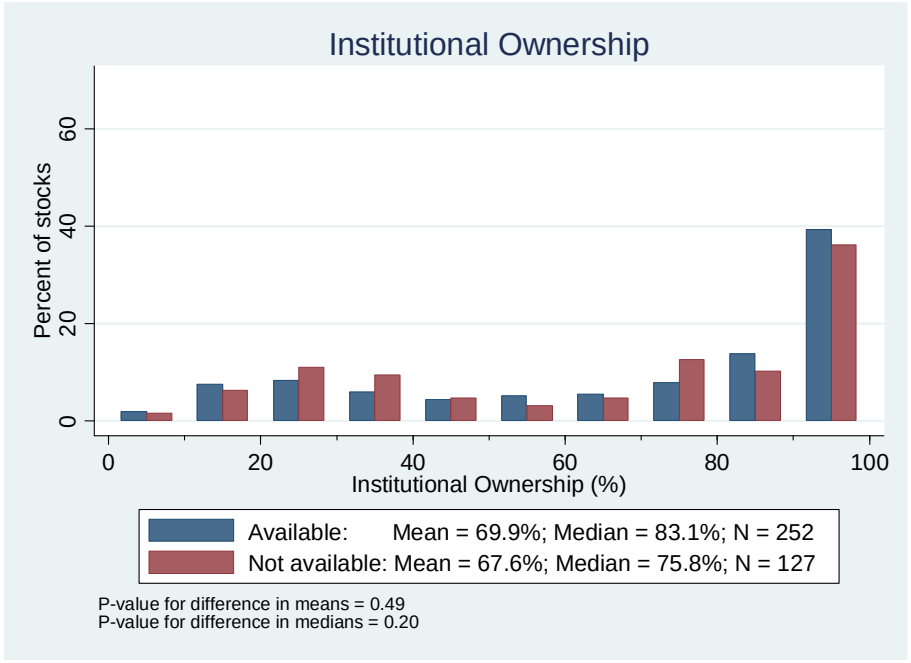


Figure 2: Distribution of non-revenue stocks characteristics after randomization.





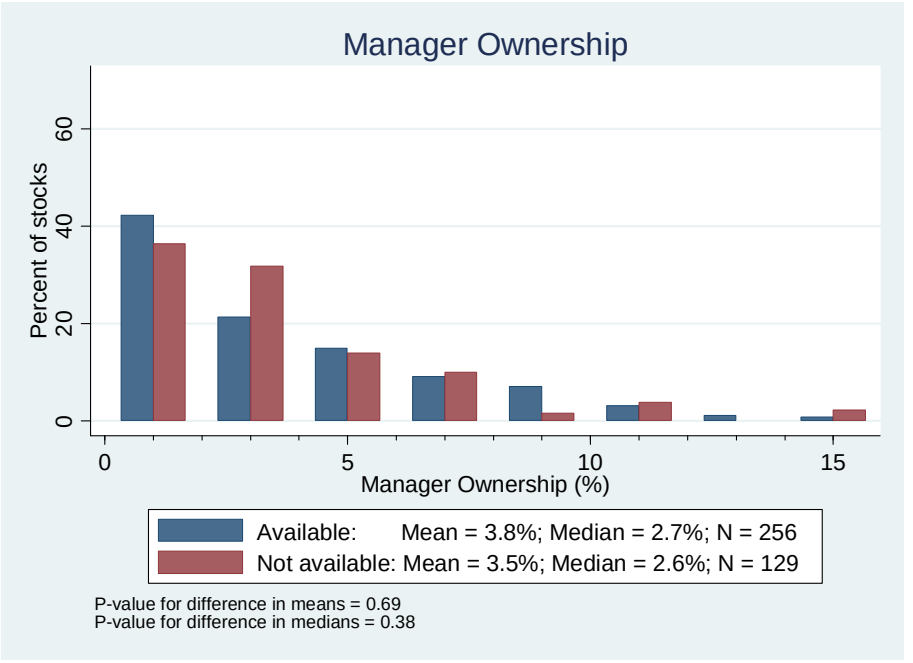


Figure 2 (continued): Distribution of non-revenue stocks characteristics after randomization.