Does Short Selling Discipline Overinvestment?

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Abstract

We explore the disciplining effect of short selling on overinvestment. Firms with more stock lending supply have higher abnormal announcement stock returns of acquiring firms, lower subsequent abnormal capital investments, and longer spells between large investments, and higher subsequent Tobin's Q and ROA. Alleviating the endogeneity concern, our multivariate difference-in-difference analysis shows that this disciplinary force of lending supply is more effective for firms in the Regulation SHO-PILOT Program. We identify two mechanisms through which short selling disciplines managers: managers' wealth-performance sensitivity and likelihood of hostile takeovers. Additionally, the disciplinary force only exists for non-financial-constrained firms and non-all-cash M&A deals.

Keywords: short selling, empire building, governance, mergers and acquisitions, Regulation SHO-PILOT Program

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1 Introduction

Since the U.S. Securities and Exchange Commission announced short-selling bans during the 2008 financial crisis, the debate regarding the role of short sellers has been revived. On the one hand, regulators contend that short sellers might harm financial markets by driving stock prices below their fundamental values and dampen investor confidence.[1] On the other hand, a large body of literature has shown that short sellers are informed traders and that their trading activities help incorporate firm-specific information into stock prices. For instance, short selling is associated with negative future stock returns (e.g., Asquith, Pathak, and Ritter (2005); Bris, Goetzmann, and Zhu (2007); Chang, Cheng, and Yu (2007); Cohen, Diether, and Malloy (2007); Boehmer, Jones, and Zhang (2008b, 2008a); Engelberg, Reed, and Ringgenberg (2012)), negative earnings surprises (Christophe, Ferri, and Angel (2004)), and financial misrepresentation (e.g., Desai, Krishnamurthy, and Venkataraman (2006); Karpoff and Lou (2010)). In addition, Jensen (2005) argues, "Short sellers are an obvious source of potentially valuable information for the governance system..." However, little research has been conducted on this potential governance effect of short sellers. This paper fills this gap in the literature by investigating whether short sellers have a disciplining effect on overinvestment, which is one of the most severe value-destroying agency problems.[2]

The intuition that short selling can serve as an external corporate governance mechanism is as follows. Short sellers have been shown to be able to identify managerial misbehavior and unfavorable information that is not reflected in stock prices. The downward price pressure resulting from informed short selling can damage managers' personal interests through reduced stock-based compensation or an increased likelihood of a hostile takeover that might cause a loss of job for the manager.[3] As long as managers are concerned with their personal wealth or job security, the presence of an active short-selling market might deter managers from engaging in value-destroying

[1] In the order enacting the short-selling restrictions in 2008, the SEC stated that "...is in the public interest and for the protection of investors to maintain or restore fair and orderly securities markets. This emergency action should prevent short selling from being used to drive down the share prices of issuers even where there is no fundamental basis for a price decline..." Two academic studies advocate similar points of view. Goldstein and Guembel (2008) hypothesize that short sellers might manipulate stock prices, which results in bad managerial investment decisions. Henry and Koski (2010) show that the levels of pre-issue short selling volume are positively related to abnormal returns on the SEO announcement date, suggesting that short sellers engage in manipulative trading.

[2] The literature has shown that managers tend to engage in value-destroying overinvestment for private benefits (e.g., Jensen (1986); Stulz (1990); Richardson (2006); Masulis, Wang, and Xie (2007); Harford, Mansi, and Maxwell (2008); Billett, Garfinkel, and Jiang (2011)).

[3] We would present supportive evidence for these two specific mechanisms through which short selling imposes disciplinary effect on overinvestment in Section 5.

activities ex ante and thus serves as an external disciplining mechanism on managerial behavior. In particular, the effectiveness of this disciplining mechanism hinges on the value of shares available for short sellers to borrow. Short sellers have less incentive to search for weaknesses in firms if they cannot easily borrow shares to short. Hence, we use the lending supply in the short selling market to capture the amount of ammunition that short sellers can use to profit from spotting managerial value-destroying overinvestment. The higher the lending supply, the more severe the potential punishment (short-selling-induced price drops) managers might face. Relying on this measure, we test our main hypothesis that *short selling has a disciplining effect on overinvestment.*

The measures of overinvestment are debatable. Therefore, to test our hypothesis, we employ three existing measures in the literature to gauge overinvestment. Our first analysis focuses on mergers and acquisitions, which are larger and more easily observable forms of corporate investments with valuation implication. Managers have tendency to seek to build larger empires by engaging in acquisitions even if the deals are value-destroying. The literature has shown that less antitakeover provisions would mitigate value-destroying mergers and acquisitions (e.g., Masulis et al. (2007)). We examine a sample of approximately 1,000 completed U.S. domestic mergers and acquisitions between 2003 and 2012 and find that acquirers with higher lending supply in the previous year yield higher announcement returns. After controlling for a set of firm and deal characteristics, we find that a one-standard-deviation increase in lending supply (0.12) corresponds to an increase in the five-day cumulative abnormal return of 0.592% (using the column (14) of Table 2 estimate), which is more than two times of the average five-day cumulative abnormal return in our sample.

Second, managers can engage in overinvestment not only through external acquisitions but also through internal spending. We investigate the disciplining effect of lending supply on abnormal capital investments, the difference between current capital investment and average capital investment over the previous three years, which is a measure of overinvestment introduced in Titman, Wei, and Xie (2004). Controlling for a set of firm-specific variables and year and firm fixed effects, we find that firms with a higher lending supply have lower subsequent abnormal capital investment. A one-standard-deviation increase in lending supply (0.14) induces the subsequent abnormal capital investment to decrease by 55% from the sample mean (using the column (9) of Table 4 estimate, and evaluated at the average of abnormal capital investment, 0.0565).

Third, we examine whether the disciplining force of short selling affects the frequency of large investments. Billett et al. (2011) use hazard model estimation, based on Whited (2006), to gauge

overinvestment by focusing on the frequency of investment spikes (large investments) and the time between spikes.[4] We find that a firm with a higher lending supply demonstrates lower tendency to overinvest, which is indicated by a lower hazard rate and longer spells between investment spikes. In particular, we find that a one-standard-deviation increase in lending supply leads to a 20.47% decrease in the hazard rate (using the column (3) of Table 6 estimate). Collectively, these three sets of results are consistent with our hypothesis that short selling has a disciplinary effect on overinvestment.

The results on the announcement returns of acquiring firms have hinted that the disciplining effect of lending supply on corporate investment decisions is related to firm values. To formally test this value implication, we propose our second hypothesis that *lending supply is positively associated with firm value in the subsequent year as inefficient investment decision (overinvestment) is disciplined*. Our valuation measure is Tobin's Q, which is a standard measure employed by prior corporate governance studies, such as Demsetz and Lehn (1985), Morck, Shleifer, and Vishny (1988), Gompers, Ishii, and Metrick (2003), and Bebchuk, Cohen, and Ferrell (2009). The results show that firms with a higher lending supply have higher Tobin's Q in the subsequent year. A one-standard-deviation increase in lending supply is associated with an increase in the subsequent Tobin's Q of 2.8 percentage point, which represents a 7.26% increase from the mean Tobin's Q in our sample (using the column (12) of Table 7 estimate). One may concern that Tobin's Q proxies for other firm characteristic, such as growth opportunities, instead of firm value. Therefore, we also examine the effect of lending supply on firm operating performance, proxied by return on asset (ROA), and find supportive evidence.

We conduct the following tests to address the potential endogeneity concern that some unobserved firm characteristics might affect firm investment, value, and lending supply simultaneously. First, we employ a regulation change in U.S. equity markets, the Regulation SHO-PILOT program. The price test of short selling (the uptick rules) for a set of randomly selected 1,000 firms in Russell 3000 index was lifted from January 2005 to August 2007. We adopt the multivariate difference-in-difference methodology in this quasi-natural experiment setup and find that the lending supply has a stronger disciplining effect for firms that are exempt from the uptick rules compared with the

[4]Using the hazard model method, Billett et al. (2011) find that firms with more anti-takeover provisions experience shorter spell lengths between large investments, which suggests that managers at firms with less shareholder governance engage in overinvestment more frequently. Furthermore, Chang, Lin, and Ma (2012) find that firms with more intensive institutional trading have a lower hazard of over-investment, which highlights the disciplining effect of institutional trading on overinvestment.

remaining Russell 3000 index firms. It is important that our validation is based on the significant interaction term of lending supply and the difference-in-difference dummy variable because the PILOT difference-in-difference dummy itself may capture various treatment effects on the short selling activities, volatility, and stock returns that might also affect the corporate investment decisions.[5] This result provides coherent evidence that lending supply plays a role in corporate governance, and its disciplining force is more effective when short selling is less restricted.[6] Moreover, we use the residual term from the lending supply regressing on firm size, book-to-market ratio, firm age, institutional ownership ratio, and turnover ratio as the main independent variables to tease out the influence of well-known firm characteristics on our previous findings. We re-estimate all of our baseline regression models using the residual lending supply, and our main results still hold.

One might also concern that the associations between lending supply, firm value, and corporate investment are driven by price efficiency induced by realized short interest. Since ex-ante lending supply is naturally related to ex-post short interest, firms with more lagged lending supply might have better price efficiency that helps managers to make better corporate investment decisions. This "feedback explanation" is in the same spirit of Chen, Goldstein, and Jiang (2007). However, high short interest also indicates that short sellers may already trade on their negative private information regarding firm values. For example, Karpoff and Lou (2010) find that short interest increases 19 months before the revelation of financial misstatement. Hence, to differentiate the governance effect of lending supply from the feedback effect stemmed from short interest, we incorporate short interests into our analyses and re-estimate our main tests. We find that short interests are negatively related to the subsequent firm value and operational performance, positively associated with abnormal capital investment, and positively and insignificantly related to the abnormal returns for acquiring firms. These results are consistent with Karpoff and Lou's (2010) mechanism that short interest contains negative private information regarding firm performance and investment decisions. Moreover, we find that the effect of lending supply remains after controlling for short interests, which helps us rule out the alternative feedback effect explanation.

We consider two channels through which lending supply affects managerial behavior: managerial

[5]For example, Diether, Lee, and Werner (2009) find that pilot stocks have more short sales and higher trade-to-trade returns' volatility relative to control stocks. Grullon, Michenaud, and Weston (2012) find that the stock prices of treated firms decrease relative to the controlling firms.

[6]We also find that there are no statistically significant changes in lending fees for those treated firms during the PILOT program compared with the the remaining Russell 3000 index firms. This finding helps us alleviate the concern that the increases in lending fee during the PILOT program might mitigate the disciplining effect of lending supply on overinvestment.

equity-based compensation channel and threat of being a hostile takeover target channel. With regard to the former channel, we employ the scaled wealth-performance sensitivity (ScaledWPS) proposed by Edmans, Gabaix, and Landier (2009) to measure the sensitivity of managers' wealth to stock price. We argue that if the threat of downward price pressure due to short selling deters managers from overinvestment, then the effectiveness of the discipline mechanism depends on the sensitivity of managers' wealth to stock price. Indeed, we find that the associations between lending supply and the subsequent overinvestment, Tobin's Q, and ROA are stronger in firms with higher ScaledWPS. In addition, we employ the implementation of the accounting standard of FAS 123R, which requires firms to use the fair value of the stock options in the income statement after June, 2005. Hayes, Lemmon, and Qiu (2012) document that both the usage of option-based compensation and the pay-performance sensitivity of the CEO's full portfolio of both current and prior grants of shares and options decrease significantly after the adoption of FAS 123R. Due to the reduction in the usage of option-based compensation, managers' incentives are less aligned with the stock price (Hall and Liebman (1998) and Hall (1998)). We expect that the governance effect of lending supply is stronger before the implementation of FAS 123R, and find supportive evidence. These results suggest that managerial incentive is an important channel through which lending supply disciplines overinvestment.

With regard to the second channel, we investigate whether the managerial concern of being a potential hostile takeover target, which might result in job loss, is a mechanism through which short selling would deter managers from overinvesting. Takeover targets, particularly hostile takeover targets, often perform poorly before the acquisition announcements and experience substantial managerial turnover after the completion of acquisitions (Warner, Watts, and Wruck (1988); Martin and Mcconnell (1991)). We argue that managers might feel a larger threat from short sellers if they observe occurrence of hostile takeover among their industry peer firms. In other words, overinvestment might be more effectively disciplined when managerial job security is at stake because downward price pressure stemmed from short selling leads to a higher likelihood of being the hostile takeover target. The results are supportive as we find that the negative (positive) association between lending supply and the subsequent abnormal capital investment (Tobin's Q and ROA) is strengthened for firms in an industry that has experienced a hostile takeover.

To substantiate that our previous findings are based upon the disciplining mechanism of lending supply, we conduct several additional exercises. First, we examine whether the payment method

of acquisition deals would impact the disciplining effect of lending supply. We find that the effect on acquisition announcement returns is only significant in non-all-cash-financed acquisitions. This finding is consistent with the notion that managers tend to engage in value-destroying acquisitions in stock-financed deals (Shleifer and Vishny (2003); Masulis et al. (2007); Harford, Humphery-Jenner, and Powell (2012); Fu, Lin, and Officer (2013)), in which the disciplinary effect of lending supply on managerial behavior would become evident. Next, we use the HP index, as developed by Hadlock and Pierce (2010), to gauge the extent to which financial constraint levels influence the disciplining effect of lending supply. Intuitively, managers of financially constrained firms are less likely and less able to overinvest for their private benefit (Billett et al. (2011)). If the lending supply has a disciplining effect on overinvestment, it should be more effective for firms with less financial constraints (firms with a lower HP index). The results show that the disciplining effect on the abnormal announcements returns for acquiring firms, and the abnormal capital investment and investment hazard rate is stronger for firms with a lower HP index (i.e, the bottom tercile). Further, the results indicate that the positive associations between lending supply and the subsequent Tobin's Q and ROA are more pronounced for firms with a low HP index, which is consistent with our expectation. Finally, we show that the significant and positive associations between LS and subsequent firm value (operating performance) only exist for firms with subsequent ACI below the median. This result demonstrates a direct evidence that the disciplinary effect of lending supply can improve the value of firm and the operating performance of firm through reducing firm's overinvestment.

Our paper contributes to two burgeoning strands of literature. First, our study complements two contemporaneous studies of Massa, Zhang, and Zhang (2012) and Fang, Huang, and Karpoff (2013) in providing evidence regarding the disciplining effect of short selling. Massa et al. (2012) find a negative relationship between lending supply and earnings manipulation over the 2002 to 2009 period across 33 countries. Fang et al. (2013) find that discretionary accruals decrease for the treated firms in the Regulation SHO-PILOT program.[7] Unlike these two papers, we focus on overinvestment. The reason that our paper focuses on overinvestment is that we believe that overinvestment is one of the most severe value-destroying agency problems.[8] In particular, we find that the disciplinary effect of short selling improves firms value via less sub-optimal investments. On the contrary, whether earnings management destroys firm value is still an ongoing debate.[9] We also identify two potential

[7]Massa et al. (2012) also find that firms included in the Regulation SHO-PILOT program experience less accrual-based earnings manipulation from 2005 to 2007.

[8]The literature shows that overinvestment is value-destroying (e.g., Titman et al. (2004); Masulis et al. (2007); Billett et al. (2011)).

[9]Owens, Wu, and Zimmerman (2013) find that rapid changes in business model would result in unrealistically large

mechanisms to support the disciplinary force of short selling, i.e., managers wealth-performance sensitivity and likelihood of hostile takeovers. In addition, we interact the dummy variable of being treated in the Regulation SHO-PILOT program with the lending supply, which directly tests the disciplinary effect of the lending supply and does not suffer from confounding treatment effects on other aspects of stocks like short interest. Second, our paper expands the literature on the real effect of financial markets (e.g., Bond, Edmans, and Goldstein (2011) andEdmans, Goldstein, and Jiang (2012); Hau and Lai (2012)). We provide evidence that lending market condition may impact managerial real resources allocation decisions.[10]

2 Data

We obtain the securities finance data from Markit, which is a research company providing equity lending data collected from the securities lending desks. This dataset includes firm-level information regarding lendable inventory, stocks on loan and borrowing rates, covering the period from 2002 to 2011. In addition, we obtain information regarding stock prices, stock returns, and the number of shares outstanding from the Center for Research in Security Prices. Relevant accounting data are from COMPUSTAT, and information regarding institutional ownership is from the Thomson-Reuters Institutional Holdings (13F) Database.

We also obtain acquisitions samples from the U.S. Mergers and Acquisitions database provided by the Securities Data Corporation (SDC). We impose the following restrictions[11]: (1) the acquisition must be completed; (2) the acquiring firms must own less than 50% of the target firms' shares before the acquisition and more than 50% of the target firms' shares after the acquisition; (3) the deal value disclosed in the SDC database must be more than $1 million and more than 1% of the market value of the acquiring firm;[12] (4) the acquiring firm must have corresponding financial information in COMPUSTAT; (5) the acquiring firm must have daily stock return data in CRSP at least 100 days before the announcement; and (6) the acquirer must be able to find matching data in the lending supply data. The imposition of these restrictions results in a final sample of approximately 1,000 U.S. domestic mergers and acquisitions during the 2003-2012 period.

accruals and biased discretionary accruals, which implies that accruals might not be value-destroying.

[10]In addition, our empirical evidence suggests that the disciplining effect of short selling relates more to overinvestment than to the "quiet life" hypothesis (Bertrand and Mullainathan (2003)) perhaps because it is easier for short sellers to spot and target managers at firms exhibiting a tendency to overinvest than who are enjoying the quiet life.

[11]The application of these filters follows Masulis et al. (2007) and Chen et al. (2014).

[12]The market value of the acquirer is calculated as (total asset − common equity + common shares outstanding × fiscal year end stock price).

3 Main Empirical Results

3.1 Measure for Disciplinary Effect of Short Selling: Lending Supply

The key variable of interest in this study is the lending supply in the equity finance market, which captures the disciplinary effect of short selling. Following Saffi and Sigurdsson (2011) and Massa et al. (2012), we construct the lending supply (LS) as the ratio of the value of shares available for lending to a firm's market capitalization. Because abnormal capital investments are calculated annually, we compute the LS for firm i in year t based on the annual average value of shares available for lending.[13] Table A-1 presents the determinants of LS. Consistent with Saffi and Sigurdsson (2011), we find that firms with higher book-to-market ratios and liquidity tend to have higher LS. More importantly, we find that the institutional ownership ratio (IOR) is the most significant determinant of the value of loanable shares available in the equity lending market, which is intuitive because the main suppliers in the lending market are ETFs and index funds.[14] To show that our results are not driven by the level of IOR, we control for it in all our tests.

3.2 Three Ways to Gauge Overinvestment

A large literature investigates whether agency problems affect corporate investment. Jensen (1986) and Stulz (1990) suggest that managers have tendency to spend internal funds on investments that benefit managerial personal interest but harm that of shareholders when monitoring is imperfect. One pervasive reason why managers' interests may not be aligned with those of shareholders is that managers might have an excessive preference for running larger firms rather than profitable ones, which results in value-destroying overinvestment.

The existing measures of overinvestment are debatable. Therefore, to test our hypothesis, we employ three measures to gauge overinvestment: abnormal returns for acquiring firms (Masulis et al. (2007)), abnormal capital investment (Titman et al. (2004)), and hazard estimation for the probability of large investments (Billett et al. (2011)). In this way, we could provide a holistic examination of this issue.

[13] Because Markit provides weekly data after 2004 and daily data after 2006, we use the average monthly, weekly, or daily data, as applicable and as available, to estimate the annual average value of shares available for lending, which is then scaled by firm's market capitalization.

[14] DAvolio (2002) also find that institutional ownership is positively associated with loan supply.

3.2.1 Mergers and Acquisitions Returns

Because acquisitions are large and easily observable corporate investment with value implications, many empirical studies explore whether good governance would mitigate value-destroying mergers and acquisitions (e.g., Lewellen, Loderer, and Rosenfeld (1985), Morck, Shleifer, and Vishny (1990), Masulis et al. (2007), and Chen, Harford, and Lin (2014)). For example, Masulis et al. (2007) and Chen et al. (2014) find that managers are more likely to initiate acquisitions with lower abnormal announcement return, when a firm has more anti-takeover provisions and experiences exogenous decreases in analyst coverage, respectively. We also employ mergers and acquisitions, and examine whether the disciplinary effect of short selling would mitigate value-destroying mergers and acquisitions.

In particular, we conduct the following regression model:

$$CAR(-2,2)_{i,t} = a_0 + a_1 \times LS_{i,t-1} + a_2 \times X_{i,t-1} + \epsilon_{i,t} \tag{1}$$

where $LS_{i,t-1}$ refers to the measure of lending supply for firm i in year *t-1*. $CAR(-2,2)_{i,t}$ refers to the cumulative abnormal return of mergers and acquisitions for firm i in year t and is computed as the residuals of the market model based on a 5-day event window (-2,2), where day 0 is the announcement date. We first use the daily stock return during the period of (-210, -11) to estimate the market model, with the CRSP value-weighted return as the market return. Then, we use the coefficients derived from this stage to compute the residuals from the market model during the event window (-2,2). $X_{i,t-1}$ includes a set of acquirer- and deal-specific control variables. In particular, the set of acquirer-specific variables consists of the logarithm of total assets (TotAsset), compounded daily excess returns over previous year (PastStockReturn), return on asset (ROA), Tobin's Q, the ratio of PP&E to sales (FixedAsset), the ratio of R&D to total assets (R&D), non-cash working capital (NonCashWorking), the ratio of the long term debt to the total assets (Leverage), free cash flow (FreeCashFlow), and the ratio of institutional investor ownership to the total shares outstanding (IOR). Deal-specific variables include the ratio of deal value to the market value of the acquirer's total assets (RelativeDealSize), a friendly deal attitude dummy variable (FriendlyDeal), a high-tech dummy variable (High-tech), a tender offer dummy variable (TenderOffer), and a cash deal dummy variable (CashDeal).[15] In addition, we add the E-Index and the G-Index as described

[15] We follow Chen et al. (2014) in using these control variables.

in Gompers et al. (2003) and Bebchuk et al. (2009). We include two-digit industry dummies and year dummies, and we further cluster the standard errors at both firm and year levels, as suggested in Petersen (2009).

Table 1 presents the summary statistics for mergers and acquisitions sample firms. We find that the average CAR (-2,2) is 0.20% with a standard deviation of 7.41%. The mean value of LS is 0.11 with a standard deviation of 0.12. Table 2 reports the regression results of Eq.(1). Across all specifications, the coefficients for LS are positive and statistically significant, which suggests that firms with higher LS experience better market responses for their M&A announcements. In particular, column (14) suggests that a one-standard-deviation increase in LS causes an increase in the five-day cumulative abnormal return of 0.592%, which is more than two times of the average five-day cumulative abnormal return in our sample.[16] It is noteworthy that after controlling for the effects of the E-Index or the G-Index, our main findings still hold, although the sample size decreases. In addition, Masulis et al. (2007) document a strong negative relationship between acquirers' anti-takeover provisions and announcement period abnormal stock returns. Our results show that the E-Index and the G-Index exhibit the expected negative sign on the coefficients, although insignificant. This set of results implies that when managers face higher potential short selling, they are less likely to conduct value-destroying mergers and acquisitions for private benefit.

3.2.2 Abnormal Capital Investment

Self-interested managers will engage in overinvestment not only through external acquisitions but also through internal spending. Harford et al. (2008) use an index of anti-takeover provisions and insider ownership to gauge the severity of the firms' agency costs, and find that firms with weaker corporate governance structures would have greater industry-adjusted investment. Richardson (2006) also finds supportive evidence that firms with good governance structures are less likely to overinvestment. Titman et al. (2004) find that the negative association between the abnormal capital investment and the consequent abnormal stock return is more prominent when hostile takeovers are less likely to occur, which is also consistent with the notion that good governance (corporate control) would mitigate managers' tendencies to overinvest. We follow Titman et al. (2004) to measure

[16] Mitchell and Pulvino (2001) find that many arbitrageurs would trade on mergers and acquisition announcement days by short selling acquirers and buying targets. Their finding could imply a negative correlation between shares available for M&A arbitrageurs to short and abnormal announcement returns for acquiring firm. However, this argument is against us finding a positive relation between lending supply and announcement return for acquiring firms.

abnormal capital investment as the difference between the current capital investment and average capital investment over the previous three years, and examine whether high lending supply would restrain managers' overinvestment tendency.

We first calculate abnormal capital investment (ACI_t) in a given year,

$$ACI_t = \frac{CE_t}{(CE_{t-1} + CE_{t-2} + CE_{t-3})/3} - 1 \tag{2}$$

where t represents the year when the ACI is calculated and CE_t is firm capital expenditures (Compustat Data Item 128, CAPEX) scaled by the firm's total assets in year t. Then, we investigate the effect of lending supply on abnormal capital investment by performing the following regression:

$$ACI_{i,t} = a_i + a_t + a_1 \times LS_{i,t-1} + a_2 \times X_{i,t-1} + \epsilon_{i,t} \tag{3}$$

where a_i and a_t are dummies for firm and year fixed effects, respectively. $ACI_{i,t}$ is calculated according to Eq.(2). The variable of interest is the coefficient on the LS, a_1. $X_{i,t-1}$ denotes a set of control variables, including the ratio of institutional investor ownership to the total shares outstanding (IOR), total assets (TotAsset), the logarithm of book-to-market ratio (BM), cash flow (CashFlow), Tobin's Q, return on asset (ROA), the growth rate of sales (SaleGrowth), the ratio of the long term debt to the total assets (Leverage), the entrenchment index proposed in Bebchuk et al. (2009) (E-Index), and the G-Index proposed in Gompers et al. (2003). In addition, we cluster standard errors at the firm level.

Table 3 provides the sample statistics on these variables for the ACI tests.[17] The mean value of LS is 0.11 with a standard deviation of 0.14, and the mean value of ACI is 0.06 with a standard deviation of 0.80. We present the estimation results of Eq.(3) regarding the effect of lending supply on the subsequent abnormal capital investments in Table 4. The dependent variable is the subsequent ACI, which is computed according to Eq.(2). The key explanatory variable is the LS. We find that, across all specifications, the coefficients on LS have significantly negative effect on ACI, which supports the hypothesis that on average managers at firms with more LS are less likely to overinvest. It is noteworthy that these results remain qualitatively unchanged when we add the E-Index and the G-Index in the regression (although the sample size decreases dramatically). This finding indicates that the disciplining effect of lending supply is distinct from the known governance

[17] In Table 3, we provide the sample statistics for ACI, Tobin's Q, and ROA tests.

mechanism of anti-takeover provisions. In addition, this effect is economically significant. For example, in specification (9), we find that when lending supply increases by one standard deviation, the subsequent abnormal capital investment decreases by 56% from the sample mean (evaluated at the average of abnormal capital investment of 0.0565).

The results of other control variables are also noteworthy. All the coefficients on leverage are negatively significant, which is consistent with the benefits of debt in alleviating agency costs (e.g., Jensen (1986); Titman et al. (2004)). The coefficients on sales growth are positive in all specifications (though some of them are insignificant), which suggests that managers in firms with good past performance tend to overinvest (e.g., Morck et al. (1990)). In addition, the coefficients on the E-Index and the G-Index are positive (although insignificant), which indicates that firms with poor shareholder governance tend to experience higher abnormal capital investment. Overall, these results support our main hypothesis and suggest that LS has a disciplining effect on subsequent overinvestment. This effect remains strong and significant after controlling for a set of firm-specific variables that have been shown to affect corporate investments.

3.2.3 Hazard Estimation

Whited (2006) develops an empirical methodology based on hazard model estimation to alleviate concerns on measurement errors and lumpy feature of investments.[18] Based on Whited's (2006) methodology, Billett et al. (2011) examine the effect of anti-takeover provisions, the Gompers et al.'s (2003) G-Index, on managers' tendencies to overinvest. They find that low G-Index firms would experience longer time (spells) between two large investments, which suggests that good governance restrains managers from overinvesting.

We use the same setup in Billett et al. (2011) and include lending supply as the main time-varying covariate to explore whether firms with more lending supply would have higher likelihood to experience longer time between two large investments. We focus on a subsample of small firms, as Whited (2006) argues that large firms are more likely to have different business segments, which might help firms smooth investment. Hence, we define small firms as firms whose total asset value is lower than the 33rd percentile of the total assets of all firms. Additionally, to capture whether

[18] Whited (2006) examines whether external finance constraints affect the timing of large investment projects, and show that firms that are more financially constrained has higher likelihood to experience longer inactive "spells" between larger investments ("spikes").

an investment spike occurs for a firm in a certain year, we define the investment spike utilizing four different thresholds: 2 or 2.5 times the firm's own median investment/asset ratio and 2 or 2.5 times the industry median value of investment/asset ratio for that year.[19] We perform the hazard model estimation as follows:

$$\lambda_i(t) = \omega_i \lambda_0(t) exp(LS_{i,t} \cdot \gamma + x_i(t)' \cdot \beta) \tag{4}$$

where $x_i(t)$ represents a vector of covariates that identifies observable differences across individual firms and includes two-digit industry dummies, year dummies, the ratio of cash flow to assets, sales growth, the logarithm of total assets, and the leverage ratio. The variables describing firm characteristics are calculated between the current and previous spikes. The disciplining effect of lending supply predicts that the coefficient of LS (γ) should be statistically negative, which would indicate that a high LS would reduce the hazard rate and extend the duration between large investments.[20]

Table 5 reports the summary statistics for the sample firms included in the hazard model estimation. In Panel A, we summarize the mean, median, and standard deviation of firm characteristics, including the investment/assets ratio, LS, leverage ratio, cash flow, sales growth, and logarithm of total assets. The average value of the investment/assets is 0.04 with a standard deviation of 0.07. The mean value of LS is 0.06 with a standard deviation of 0.06. In Panel B, we report the mean, median, and standard deviation of spell characteristics. In particular, this sample set includes 1,219 spells, and the average spell length between two investment spikes is 3.48 years.

Table 6 presents the results of the hazard model estimation. Columns (1) and (2) show that an investment spike occurs when firms' investment rate during the year exceeds 2 or 2.5 times median value of a firm's own investment rate. Columns (3) and (4) show that an investment spike occurs when a firm's investment rate in this year exceeds 2 or 2.5 times the median value of the industry's investment rate. We find that the coefficients for LS are negative and statistically significant.[21] For example, in column (3), we find that a one-standard-deviation increase in LS results in a 20.47% decrease in the investment hazard rate. In general, these results support our main hypothesis that LS has a disciplining effect on management. Together with the findings from the previous two

[19] We require at least three observations by firm for the computation of the firm's own median investment/asset ratio or by industry-year for the computation of the industry median value of investment/asset ratio for a certain year.

[20] We discuss the detailed procedure of hazard model estimation in Appendix A.

[21] The coefficients reported in this table are in exponential form. We also include the estimation for the baseline hazard. However, because we focus on the coefficients for the covariate of LS, the results of the baseline hazard rates are omitted. We also standardize the LS measure in the hazard estimation tests to make the results readable.

subsections, our first hypothesis is supported: higher lending supply (i.e., more ammunition for the short sellers) can effectively deter managers from overinvesting.

3.3 Subsequent Firm Value and Firm Operating Performance

In this section, we test our second hypothesis that LS has a positive impact on firm value and performance. Our previous results demonstrate that high LS deters managers from undertaking value-destroying investments, which reduces the agency costs otherwise incurred. We therefore argue that firms with higher LS experience higher subsequent firm value. Specifically, we perform the regression as follows:

$$IndAdj\_Tobin's\,Q_{i,t} = a_i + a_t + a_1 \times LS_{i,t-1} + a_2 \times X_{i,t-1} + \epsilon_{i,t} \tag{5}$$

where a_i and a_t are dummies for firm and year fixed effects, respectively. $LS_{i,t-1}$ refers to the measure of lending supply for firm i in year *t-1*. Following Gompers et al. (2003), we employ the industry-adjusted Tobin's Q to measure firm value. In particular, $IndAdj\_Tobin's\,Q$ refers to the ratio of the market value of assets to the book value of assets, in which the market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of the common stock and balance sheet-deferred taxes. It is adjusted for the median Tobin's Q in the same year and in the same two-digit industry classification.[22]

The set of control variables, $X_{i,t-1}$, includes the following: the ratio of institutional investor ownership to the total shares outstanding (IOR), the logarithm of the market capitalization (SIZE), the logarithm of sales (Sale), the ratio of the long term debt to the total assets (Leverage), cash flow (CashFlow), the firm's age (AGE), the ratio of the dividends paid to the book value of equity (Dividend), the ratio of R&D to total assets (R&D),[23] the ratio of PP&E to sales (FixedAsset), the ratio of capital expenditures to total assets (Capx), the logarithm of cash (Cash), the fraction of shares held by insiders (such as the CEO, CFO, COO, and the president) to the total shares outstanding (InsiderOwn), the square of InsiderOwn (InsiderOwn^2), and the ratio of net income to the book value of equity (ROE).[24] In addition, we add the E-Index and the G-Index as described

[22] We require at least 5 Tobin's Qs in an industry classification in the same year.
[23] We set Dividend and R&D to zero when a firm does not report the dividend and R&D data.
[24] The construction of the set of control variables is largely based on Kim and Lu (2011).

in Gompers et al. (2003) and Bebchuk et al. (2009). These two papers document that both the G-Index and E-Index are related to firm value. Thus, we include these two variables to control for the potential disciplining effect stemming from anti-takeover provisions. In all specifications, we cluster standard errors at the firm level.

Table 7 presents the estimates for the regression model in Eq.(5). We find a significantly positive correlation between lending supply (LS) and subsequent firm value across all specifications. In column (12), a one-standard-deviation increase in LS corresponds to an increase in the subsequent firm value of 2.8%, which represents an 7.26% increase from the mean industry-adjusted Tobin's Q in our sample. Although the sample size decreases radically, the governance effect of LS remains significant after adding the E-Index or the G-Index, as shown in columns (13) and (14). It is also noteworthy that most of the coefficients on Capx are significantly negative, which suggests a negative relationship between a firm's capital investments and subsequent firm value and is consistent with the notion that over-investment can destroy a firm's future value.

In addition, we employ ROA to examine the effect of lending supply on firm's operational performance. Following Roll, Schwartz, and Subrahmanyam (2009), we conduct the regression as follows:

$$IndAdj\_ROA_{i,t} = a_i + a_t + a_1 \times LS_{i,t-1} + a_2 \times X_{i,t-1} + \epsilon_{i,t} \tag{6}$$

where a_i, a_t are dummies for firm and year fixed effects, respectively. $LS_{i,t-1}$ refers to the lending supply for firm i in year *t-1*. $IndAdj\_ROA$ refers to the ratio of net income to the total assets and is industry adjusted by subtracting the median ROA in the corresponding two-digit industry classification in the same year.[25] The set of control variables, $X_{i,t-1}$, includes the following: the logarithm of book-to-market ratio (BM), the ratio of the institutional investors ownership to the total shares outstanding (IOR), the logarithm of market capitalization (SIZE), the ratio of capital expenditures to total assets (Capx), the ratio of the long term debt to the total assets (Leverage), the ratio of dividends paid to the book value of equity (Dividend). We also include the lagged ROA to account for serial dependence in the variable. In addition, we include the E-Index and the G-Index to control for the potential disciplining effect resulting from anti-takeover provisions. In all specifications, we cluster standard errors at the firm level.

Table 8 presents the regression results of Eq.(6). The results show a significantly positive

[25]We also require at least 5 ROAs in an industry classification in the same year.

association between lending supply (LS) and subsequent firm operating performance. The results in column (7) show that an increase in lending supply by one standard deviation (i.e., an increase of 0.1420) would cause an increase in the subsequent ROA by 0.23%, i.e., 1.10% standard deviation of the subsequent ROA. Although the sample size decreases radically, the governance effect of LS remains significant after adding the E-Index and G-Index, as shown in columns (8) and (9).

Overall, these results suggest that firms with a higher lending supply experience higher firm value and better operating performance in the following year, which is consistent with our second hypothesis.

4 Addressing Endogeneity Issue and Alternative Explanation

Major lenders in the short selling market are ETFs or index funds. These funds are by nature passive investors and unlikely to study a particular company when there could be hundreds constituent stocks in the index. Further, tracking error would be large if fund outweights or underweights a stock too much relative to index weight. Thus, our previous findings are less likely to be driven by the channel of the suppliers on the lending market. However, we conduct the following exercises to mitigate the endogeneity concern and alternative explanations.

4.1 PILOT Program

To address the potential endogeneity issue, we focus on a regulatory change in the U.S. equity markets, the Regulation SHO PILOT program (2005-2007), which eliminates the price tests for short selling with respect to a set of randomly selected firms from Russell 3000 Index. Regulation SHO was announced by the SEC in 2004. Under this regulation approximately 1,000 treated firms are randomly selected from Russell 3000 Index and their price restrictions for short selling (uptick rules) are lifted during the period from January 3, 2005 to August 6, 2007.[26] There are several contemporaneous studies that investigate the treatment effect of the PILOT program, $Treated \times PILOT$, on firms' earnings management, capital investment level, and innovations (e.g., Grullon et al. (2012); Massa et al. (2012); Fang et al. (2013); He and Tian (2014)). Unlike these papers, we are interested in the three-way interaction term, $LS_{i,t-1} \times Treated \times PILOT$, as the pure treatment effect of PILOT program is difficult to interpret due to the fact that many other stock market conditions are affected by the removal of the price tests. For example, Diether et al. (2009) find

[26]For the details of the Regulation SHO PILOT program, see also Diether et al. (2009).

that treated stocks have more short sales and higher trade-to-trade returns' volatility relative to control stocks. By focusing on the interaction term of $LS_{i,t-1} \times Treated \times PILOT$, we are able to examine whether lifting the price restriction for short selling enhances the governance effect of lending supply on overinvestment because lower short sale constraints impose a greater threat to managers.[27] In particular, we perform the following regression models:

$$\begin{aligned} DV_{i,t} = a_t + a_1 \times LS_{i,t-1} + a_2 \times LS_{i,t-1} \times Treated \times PILOT + a_3 \times LS_{i,t-1} \times Treated + \\ a_4 \times LS_{i,t-1} \times PILOT + a_5 \times Treated \times PILOT + a_6 \times PILOT + a_7 \times X_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{7}$$

where a_t is dummy for year fixed effects. $DV_{i,t}$ is the dependent variable that includes $CAR(-2,2)_{i,t}$, $ACI_{i,t}$, $IndAdj\_Tobin's\,Q_{i,t}$ and $IndAdj\_ROA_{i,t}$, respectively. $CAR(-2,2)_{i,t}$ is the 5-day cumulative abnormal stock returns of acquiring firms for mergers and acquisition announcements in the subsequent year. $ACI_{i,t}$ is calculated according to Eq.(2). $IndAdj\_Tobin's\,Q_{i,t}$ and $IndAdj\_ROA_{i,t}$ are computed according to the procedure in Section 4.3. Treated is a dummy variable that equals one for firms that are selected as Regulation SHO treated stock, and zero for the remaining Russell 3000 Index members.[28] PILOT is a time dummy variable that equals one from 2005 to 2007 and zero from 2002 to 2004. $X_{i,t-1}$ denotes a set of control variables that are same as that in column (14) of Table 2, column (9) of Table 4, column (12) of Table 7 and column (7) of Table 8. In this test, our sample period runs from 2002 until the end of the PILOT program (2007). We do not control for firm-fixed effects owing to a collinearity with Treated dummy. Standard errors are two-way clustered by both firm and year (Petersen (2009)).

Our main variable of interest is the coefficient on the three-way interaction term, a_2, which shows how lifting the price restriction for short selling affects the disciplinary effect of lending supply (LS) on subsequent abnormal corporate investment, firm values, and operating performances. Table 9 shows that the coefficient on the three-way interaction term, a_2, is significantly positive in columns (1), (3) and (4), and significantly negative in column (2).[29] These findings suggest that lifting the price restrictions for short selling reinforces the disciplinary effect of lending supply on subsequent overinvestment and increases firm values and firm performance accordingly.

[27] Grullon et al. (2012) find that on average investment falls for treated firms due to lower stock price during PILOT program. This effect is captured by the $Treated \times PILOT$ dummy variable. Therefore, our results based on the three-way interaction term, $LS_{i,t-1} \times Treated \times PILOT$, directly reflect whether the disciplining effect of lending supply is strengthened when it becomes easier to short sell.

[28] Because the SEC issued the list of stocks on July 28, 2004, we therefore employ the list of Russell 3000 Index members on June, 2004. We also thank Russell Investments for providing the list of Russell 3000 index.

[29] For the ease of the readability, we do not report regression coefficients on control variables in Tables 9, 10, 12, 13, 15, and A-3. The complete tables are presented in Internet Appendix, which is available upon request.

One may concern that lifting the price restrictions for short selling will lead to an increase in lending fees for treated stocks, which would then increase the trading cost for short sellers. This means that Regulation SHO might not effectively lower the short selling constraints for treated firms. We therefore conduct multivariate difference-in-differences (DiD) test to examine the effects of Regulation SHO on lending fees for short selling. We present the results in Table A-4. The coefficient for $PILOT \times Treated$ is the DiD estimate that indicates whether lending fees increase for treated stocks during the PILOT program period. We report the simple OLS results in column (1) and control for both year and firm fixed effects in column (2). We find that the coefficients for $PILOT \times Treated$ are statistically insignificant and positive in columns (1) and (2), which suggests that the change in lending fees for treated firms during the PILOT program is not significantly different from that of the control stocks. These findings help to alleviate the concern that the increase in lending fees during the PILOT program might mitigate the disciplinary effect of short selling on overinvestment. Overall, the results in this subsection assure us that our prior findings are not driven by potential endogeneity or omitted variable issues.

4.2 Residual of Lending Supply

In addition to the quasi-natural experiment of the PILOT program, we use the residual LS to validate our arguments. Because Saffi and Sigurdsson (2011) show that lending supply is closely related to firm size, book-to-market ratio, and turnover ratio, we estimate the residual term of LS by regressing on firm size, book-to-market ratio, firm age, institutional ownership ratio, and turnover ratio with controlling for firm and year fixed effects.[30] Because our measure of residual LS is orthogonal to these firm characteristics by construction, we argue that our previous findings do not merely reflect the effects of the firm characteristics that are known to be associated with investments and firm values.

We use residual LS to re-estimate our major regression models, namely column (14) of Table 2, column (9) of Table 4, column (12) of Table 7 and column (7) of Table 8. We present these results in Table 10. In column (1) of Table 10, we find that the coefficient on the residual LS is 0.048 at a 10% significance level, which suggests that the disciplinary effect of lending supply on value-destroying mergers and acquisitions is robust to the use of residual LS. In column (2) of Table

[30]The literature has shown that institutional ownership and equity returns are related. Therefore, we add IOR to ensure that our results are not driven by effects from institutional investors (Gompers and Metrick (2001); Yan and Zhang (2009)).

10, we find that the negative relationship between LS and the subsequent ACI still holds when we use the residual LS measure. In columns (3) and (4) of Table 10, we find a positive and significant relationship between the residual LS and subsequent Tobin's Q and ROA, which indicates that the positive associations between lending supply and subsequent firm value and firm performance are robust to using residual LS to control for possible endogeneity and many firm characteristics. Overall, the results suggest that our main findings are robust in their support for our hypothesis that lending supply has a disciplining effect on managerial misbehavior, i.e. overinvestment.

4.3 Rulling Out Alternative Explanation

One may concern that the associations between lending supply, firm value, and corporate investment are driven by realized short interest. The literature on the real effect of the stock market indicates that managers can learn valuable information from stock prices, and use this information to make better decisions (e.g., Chen, Goldstein, and Jiang (2007)). It is natural that higher ex-ante lending supply accompanies with high ex-post short interest, which leads to greater price efficiency and incorporates more private information.[31] This information could for instance help managers to investment more efficiently and lead to a better firm value. However, high short interest also indicates that negative private information related to firm value and managerial investment decision is revealed in lending market. For example, Karpoff and Lou (2010) show that short interest increases 19 months before financial misstatement. Therefore, it is important to examine whether our previous findings are driven by the impact of short interests.

To empirically rule out the effect of short interest on firm performance and managerial investment decisions, we use short interest as our main independent variable and re-estimate our main tests. We present the results in columns (1), (3), (5), and (7) of Table 11. We find that short interests are negatively related to the subsequent firm value and operational performance, positively associated with abnormal capital investment, and positively and insignificantly related to the abnormal returns for acquiring firms. These results suggest that our findings are consistent with Karpoff and Lou's (2010) mechanism that short interest contains negative private information regarding firm performance and investment decisions. Further, we control for the effect of short interest and examine whether the governance effect of lending supply remains. Columns (2), (4),

[31] In our sample, we find that the correlation between lending supply and short interest varies from 47.18% to 68.96%.

(6), and (8) of Table 11 present the results. We find that the effect of lending supply remains after controlling for short interests, which helps us to rule out the alternative story that it is because of the private information of short interest that helps managers to learn from the stock price and invest more efficiently.

5 Channels Through Which Short Selling Disciplines

In this section, we provide additional analyses of the channels through which stock lending supply restrains overinvestment. We focus on scaled managerial wealth-performance sensitivity and peer firms with another firm in the same industry being the subject of a hostile takeover attempt.

5.1 Wealth Performance Sensitivity

In this subsection, we examine whether the sensitivity of managers' wealth to stock price is a potential channel through which the short selling disciplines overinvestment. The rationale is as follows: if it is the short seller-induced stock price drop that deters managers from overinvesting, the efficiency of this mechanism depends substantially on the extent to which managers' wealth is linked to the stock price of the firm. Edmans et al. (2009) propose the scaled wealth-performance sensitivity (ScaledWPS), which captures a CEO's incentives not only from his compensation flows, such as new grants of stock options, but also from his existing shares and options. We adopt this measure to gauge the sensitivity of managers' wealth to the stock performance.[32] We expect the disciplinary effect of short selling to be more pronounced for firms with high ScaledWPS. To test this expectation, we partition the entire sample into three groups equally based on ScaledWPS and re-estimate our basic regression specifications in Tables 2, 4, 6, 7, and 8.

Columns (1) and (2) of Table 12 show that the positive association between the lending supply and the acquiring firms' announcement period abnormal stock returns appears to only be significant in the top tercile ScaledWPS subsample. These results suggest that when managers' wealth is more closely linked with stock price, the disciplinary mechanism of lending supply is more effective in terms of deterring managers from conducting value-destroying acquisitions.

In columns (3) and (4) of Table 12, we re-estimate specification (9) of Table 4 on subsamples of firms partitioned by ScaledWPS. Column (3) shows that when firms' ScaledWPS is in the top

[32]ScaledWPS represents the dollar change in CEO wealth for a 100% change in firm value, scaled by annual flow compensation.

tercile of the sample, the coefficient estimates for LS is -0.4448 (t-statistics=2.06). In contrast, the coefficient estimate for LS is -0.2347 (t-statistics=1.50) for firms with bottom tercile ScaledWPS.

Next, we focus our analysis of the effect of lending supply on the firm value. Columns (5) and (6) of Table 12 include the results of the sample with ScaledWPS in the top and bottom tercile, respectively. We find that the coefficient on the LS in the top tercile is 0.55 at a 10% significance level, which is 3 times higher the value of the sample as a whole.[33] The coefficient on the subsample with ScaledWPS in the bottom tercile is insignificant, which provides supportive evidence that the disciplinary effect of LS on overinvestment is more pronounced when firms' ScaledWPS is high. We present the ScaledWPS subsample results for firm operating performance (ROA) in columns (7) and (8) of Table 12. Similarly, we find that the effect of LS is significantly positive in firms with ScaledWPS in the top tercile. In contrast, the coefficient on LS in the lowest tercile subgroup is insignificant.

Finally, the subsample results of the hazard model estimation are presented in columns (1) and (2) of Table A-2. In the high ScaledWPS subsample, the coefficient of LS is -1.48 with a t-value of 3.24, whereas the coefficient of LS in the low ScaledWPS subsample is insignificant (although with the right sign). Overall, these results confirm our expectation that the governance effect of short selling is largely driven by firms with higher managerial wealth sensitivity to stock price.

In addition, we employ the change in the accounting standards regarding the way to expense option-based compensation, the issuance of FAS 123R by Financial Accounting Standards Board (FASB), to capture the exogenous changes in the usage of option-based compensation. In 2004, the FASB issued FAS 123R, which is a revised version of FAS 123.[34] FAS 123R requires firms to use the fair value of the stock options in the income statement, and is effective after June, 2005. Evidently, the adoption of FAS 123R would increase firms' accounting costs to issue option-based compensation. Hayes et al. (2012) document that firms care about the accounting costs of stock options and dramatically reduce their usage of stock options after the implementation of FAS 123R. Therefore, we exploit the adoption of FAS 123R as another measure for managerial incentive. Due to less usage of option-based compensation, managers' incentives are less aligned with to the stock

[33] A lower significance level in this test might be due to a decrease in sample size from merging with the ScaledWPS dataset.

[34] Although FAS 123 (issued in 1995) has encouraged firms to measure the compensation costs based on the fair value, i.e., the Black-Scholes value of the option, the statement still allows firms to record compensation expense using intrinsic value and disclose the fair value in the footnote. Therefore, before 2005, firms are allowed to decide the method to expense stock options, and many firms were using the intrinsic value method (the market price of the stock minus the exercise price of the option).

price performance (Hall and Liebman (1998) and Hall (1998)).[35] We expect a stronger governance effect of lending supply before the implementation of FAS 123R.

We display the results in Table A-3. In this test, we focus on the period from 2002 to 2008 surrounding the adoption of FAS 123R. Pre-123R is a dummy variable that equals one from 2002 to 2004, and zero for time during 2006 to 2008. We exclude the year of 2005, as this year is when FAS 123R was issued by the FASB. In column (2), we focus on the 5-day abnormal returns for mergers and acquisition announcements, and find the interaction term LS and Pre-123R exhibits the expected positive and significant sign on the coefficient. In column (4), we find the coefficient on the interaction term between LS and Pre-123R is negative and significant, which suggests that the disciplining effect of short selling on the abnormal capital investments is stronger before the adoption of 123R. In columns (5) and (6), we focus on firms value (Tobin's Q), and find that the coefficient on the interaction term of LS×Pre-123R has the right positive sign though insignificant, which is consistent with our prediction. In columsn (7) and (8), we focus on operating performance (ROA), and find that the coefficients on the interaction term of LS×Pre-123R are positive with a 5% significance level, suggesting the positive relation between LS and ROA is stronger before the implementation of FAS 123R.

5.2 Industry Peers of Hostile Takeover Attempt

In this subsection, we explore whether the managerial concern of being a potential target of hostile takeover, which might result in job loss, is a potential channel through which short selling restrains managers from overinvestment. In particular, we focus on firms whose industry peer has been targeted in a hostile takeover attempt. The literature has shown that hostile takeover targets have poor performance before the acquisition announcement, and would experience significant managerial turnover (job loss) after the acquisition announcement (Warner et al. (1988); Martin and Mcconnell (1991)). We argue that if one firm in a particular industry experienced a hostile takeover attempt, then overinvestment at firms in the same industry would be more effectively disciplined by short seller. The intuition is that after the hostile takeover attempt, managers might be more afraid of the short seller-induced stock price drop because they are concerned the increased likelihood to be

[35]Hayes et al. (2012) also find that the pay-performance sensitivity of the CEO's full portfolio of both current and prior grants of shares and options decreases significantly after the adoption of FAS 123R. Based on Alex Edmans's data set, we also find that ScaledWPS decreases significantly after the implementation of FAS 123R.

the hostile takeover targets.[36] Thus, we expect that a hostile takeover attempt will reinforce the disciplinary effect of lending supply for other firms in the same industry. To explore this prediction, we conduct the regression models as follows:

$$DV_{i,t} = a_i + a_t + a_1 \times LS_{i,t-1} + a_2 \times LS_{i,t-1} \times PHT + a_3 \times PHT + a_4 \times X_{i,t-1} + \epsilon_{i,t} \tag{8}$$

where a_i, a_t are dummies for firm and year fixed effects, respectively. $DV_{i,t}$ is the dependent variable that includes $ACI_{i,t}$, $IndAdj\_Tobin's\,Q_{i,t}$, $IndAdj\_ROA_{i,t}$. $ACI_{i,t}$ is calculated according to Eq.(2). $IndAdj\_Tobin's\,Q$ refers to the ratio of the market value of assets to the book value of assets, in which the market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of the common stock and balance sheet-deferred taxes. It is adjusted for the median Tobin's Q in the same year and in the same two-digit industry classification. $IndAdj\_ROA$ refers to the ratio of net income to the total assets and is industry adjusted by subtracting the median ROA in the corresponding two-digit industry classification in the same year.[37] $LS_{i,t-1}$ refers to the lending supply for firm i in year *t-1*. PHT is a dummy variable which equals one if the firm is in an industry (12 Fama-French industries) that has experienced at least one hostile takeover attempt over last two years. The variable of interest is the coefficient on the interaction term of LS×PHT, a_2. $X_{i,t-1}$ denotes a set of control variables. For the ACI regression, the set of control variable is same to the specification 9 of Table 4. For $IndAdj\_Tobin's\,Q$ ($IndAdj\_ROA$) regression, the set of control variable is same to the specification 12 (7) of Table 7 (8). We also control for both firm and year fixed effects, and cluster standard errors at the firm level.

Columns (1), (3), and (5) of Table 13 show the estimates for the basic regressions. The coefficients on LS×PHT, a_2, are reported in columns (2), (4), and (6) of Table 13. We find that a_2 is negative (positive) and significant in column (2) ((4) and (6)). These results demonstrate that the negative (positive) association between LS and the subsequent ACI (Tobin's Q and ROA) is strengthened when another firm in the industry has been the target of a hostile takeover attempt. This is consistent with our prediction: a hostile takeover for one firm in a particular industry will reinforce the disciplinary effect of lending supply for other firms in the same industry.

[36]The literature has also shown that hostile takeover attempt has important spillover effects for the other firms in the same industry. In particular, those industry peer firms would respond to control threats by altering investment and financing decisions (Servaes and Tamayo (2013)).

[37]After merging with the dataset of the abnormal returns for the acquiring firm, the number of observations drops dramatically, we therefore do not include this set of test.

6 Additional Supporting Evidence

In this section, we provide further supporting evidence to attribute our earlier findings to the disciplining effect of short selling on managerial decisions. In particular, we focus on the payment method for acquisition and the severity of firms financial constraints.

6.1 Payment Method of Acquisition

Fu et al. (2013) find that the stock prices of stock-financed bidders are more over-valued than those of cash-financed bidders, and cash-financed deals do not generate average negative cumulative abnormal returns during the announcement period. These results are consistent with the argument in Jensen (2005) that value-destroying acquisitions driven by over-valued stock prices might reflect the agency costs associated with stock over-valuation. In this subsection, we divide the mergers and acquisitions sample into two subsamples based on whether the method of the deal payment is 100% cash, according to the SDC database. We expect that the disciplining effect of LS plays a less important role when acquirers use an all-cash method to pay because lower agency costs are associated with cash-financed acquisitions. Columns (1), (2), and (3) in Table 14 present the results. In column (3), we only include acquisitions using all cash as the payment. Column (2) refers to the rest of the deals that use at least some stock as payment method. We find that the positive association between LS and CAR(-2,2) only exists in non-all-cash deals. In particular, a one-standard-deviation increase in LS results in an increase in the five-day abnormal stock announcement returns of acquiring firms of 1.57%, which is almost three times as much as that of column (1) (the entire sample). This finding suggests that the disciplining effect of lending supply is more prominent in stock-financed acquisitions, through which managers are more likely to take advantage of overvalued stocks to engage in value-destroying acquisitions.

6.2 Financial Constraints

In this subsection, we examine how financial constraints affect the disciplining effect of lending supply. It is intuitive that managers at non-financially-constrained firms are more likely to overinvest because they have more resources to exploit. Therefore, we expect that the disciplinary effect of lending supply on overinvestment would be stronger for less financially constrained firms that

are more vulnerable to this type of agency problem. In particular, we employ the HP Index, as introduced in Hadlock and Pierce (2010), to gauge the extent to which a firm is financially constrained.[38] We compute the HP index as follows:

$$HP_{i,t} = -0.727 \times Size_{i,t} - 0.043 \times Size_{i,t}^2 - 0.040 \times Age_{i,t} \tag{9}$$

where Size equals the logarithm of the total assets and Age is the number of years since the first date that the company's total assets data appeared in COMPUSTAT. Following the literature, we winsorize Size at the (logarithm of) \$4.5 billion and winsorize Age at thirty-five years. The higher the HP Index is, the more financially constrained the firm is because young and small firms are more likely to be financially constrained.

With respect to the tests of the abnormal announcement stock returns for acquiring firms, we re-estimate the specification of column (14) in Table 2. We display the results regarding the subsamples of firms partitioned by HP index in columns (1) and (2). In column (2), we find that the coefficient on LS for firms in the bottom tercile is 0.13 at a 1% significance level, which is almost two times greater than that in column (14) of Table 2 (the baseline regression for M&A tests). Next, we focus on the tests of abnormal capital investment, and re-estimate the specification of column (9) of Table 4. We display the results of subsamples of firms partitioned by HP index value in columns (3) and (4) of Table 15. Focusing on the result in column (4), which includes firms with an HP Index value in the bottom tercile, the coefficient for LS is -0.36 at a 1% significance level, which is almost two times greater than that in column (9) of Table 4 (the baseline regression for ACI test). These results confirm our expectation that the disciplining effect of short selling on overinvestment is largely driven by firms with fewer financial constraints.

We further investigate the relationship between LS and the subsequent Tobin's Q and ROA in different HP Index groups. Column (6) of Table 15 shows that the coefficient for LS is 0.26 with t-statistics of 3.00, indicating the positive association between LS and Tobin's Q is significant at the 1% level for the subgroup with an HP index value in the bottom tercile of the sample (less financially constrained). In contrast, the effect of LS on the subsequent firm value is insignificant for firms with an HP Index in the top tercile of the sample. In columns (7) and (8) of Table 15, our results show that the coefficient on LS is significantly positive for firms with an HP Index in the

[38] Hadlock and Pierce (2010) find that firm size and age are useful predictors of firms' financial constraints and propose the measure of HP index accordingly.

bottom tercile of the sample. In contrast, the effect of LS on subsequent firm operating performance is insignificant for the subgroup with an HP Index in the top tercile of the sample.

In the hazard model estimation, we divide our sample into three subsamples of firms partitioned by HP index value and test whether the hazard rate is higher in firms with a low HP index. Columns (3) and (4) in Table A-2 present the results. For the low HP subsample, the coefficient on LS is -2.00 with a t-statistics of 4.90, whereas the coefficient on LS in the high HP subsample is insignificant (although with the right sign). This result suggests that firms with fewer financial constraints (low HP group) would be more likely to experience more frequent large investments. In general, these findings provide additional support for our hypothesis and reinforce the disciplinary interpretation of our results.

6.3 LS improves Tobin's Q and ROA through disciplining overinvestment

Although our results about the positive association between lending supply and announcement returns for acquiring firms suggest that the disciplining effect of lending supply on overinvestment results in high firm value, we extend our analysis to abnormal capital investment tests. We examine whether firm value and operating performance are improved by those firms that have lower abnormal capital investments in the subsequent year. We split our sample into two subsamples, above and below the median of the subsequent ACI value, and re-run the main regressions of Tobin's Q and ROA. We present the results in Table A-5.

In columns (1) and (2), we use the subsequent Tobin's Q as dependent variable. We find that the positive association between LS and Tobin's Q is only statistically significant for firms that have ACI below the median. Similarly, when we use the subsequent ROA as dependent variable (columns (3) and (4)), we find that the positive and significant relation between LS and ROA only exists in subsample where firms have lower ACI (below the median) in the subsequent year. The fact that firms with below-median ACI have significant and positive association between LS and firm value (operating performance) demonstrates a direct evidence that the disciplinary effect of lending supply can improve the value of firm and the operating performance of firm through reducing firm's overinvestment.

7 Conclusion

In this paper, we examine the disciplinary effect of lending supply in the equity finance market with respect to deterring managers from conducting overinvestment. Employing lending supply data from 2002 to 2011, we document a positive association between the lending supply and the mergers and acquisitions announcement returns of acquiring firms, which suggests that a higher level of lending supply also deters managers from conducting value-destroying acquisitions. We also find that firms with a higher lending supply are less likely to experience abnormal capital investment in the subsequent year. In addition, we find that firms with a higher lending supply have a low hazard rate and long spells between two adjacent investment spikes. Furthermore, we document a positive relationship between lending supply and subsequent firm value, proxided by Tobin's Q. We find that firms with a higher lending supply experience higher operating performance, proxided by ROA, in the following year. Firm value and operating performance improve because the effective threat of short selling discourages managers from engaging in overinvestment.

To mitigate endogeneity concerns, we employ SEC Regulation SHO, which eliminates the price restriction of short selling for a set of randomly selected firms. The multivariate difference-in-difference results indicate that the lending supply has a stronger discipline effect for firms that are exempted from short selling price restrictions. This result provides coherent evidence that short selling plays a role in corporate governance, and its disciplinary force is more effective when shorting is less restricted. In addition, we use the residual LS regressing on firm size, book-to-market ratio, firm age, institutional ownership ratio and turnover ratio as an alternative measure of short selling disciplinary force and find that our main results still hold. This result indicates that our findings are robust to controlling for those firm characteristics and support our hypothesis that lending supply has a disciplining effect on overinvestment. Moreover, our results hold when we control for the short interest which helps to rule out the alternative explanation of "feedback effect."

Importantly, we identify two channels through which short selling disciplines managerial behavior. We find that the disciplinary effect is more prominent for firms with high managers' wealth-performance sensitivity (ScaledWPS) but is insignificant for firms with low ScaledWPS. Because the effectiveness of the lending supply largely depends on the sensitivity of managers' wealth to stock price, this result helps attribute our findings to the disciplining effect of short selling on managerial misbehavior. Further, we find that the lending supply would discipline overinvestment more

effectively for firms in the industry in which a hostile takeover occurred. This result shows that the effectiveness of the disciplinary force of short selling depends on to what extent managers are worried about their job security, which reinforces our disciplinary interpretation.

In addition, we find that the disciplinary effect is stronger for stock-financed mergers and acquisition deals and for firms with fewer financial constraints. These results indicate that managers tend to conduct value-destroying overinvestment via stock-financed acquisition deals and in less financially constrained firms in which the disciplining effect of lending supply on managerial behavior would manifest.

Appendix A: Hazard Model Estimation for Corporate Investment

This appendix describes the methodology for estimating a hazard model of corporate investment. We adopt and follow the approach of Whited (2006). Specifically, following Meyer (1990), Whited (2006) uses nonparametric specifications, including unobservable heterogeneity and time-varying explanatory variables and defines the proportional hazard form as follows:

$$\lambda_i(t) = \omega_i \lambda_0(t) exp(x_i(t)'\beta) \tag{A.1}$$

A hazard model contains two parts. The first part, denoted as $\lambda_0(t)$, is the baseline hazard function, which is a function of time duration. The second part is $exp(x_i(t)'\beta)$, which is a function of explanatory variables. $x_i(t)$ represents a vector of covariates that identifies observable differences across individual firms. β is the vector of coefficients of those covariates, which allows the hazard rates to move upward or downward according to different covariate values. t represents the length of a spell, i.e., the duration between two investment spikes. ω_i is a random variable and represents unobservable heterogeneity; it is assumed to follow a Gamma distribution with unit mean and variance, σ^2.[39]

The maximum likelihood method is employed to estimate the coefficients. Denote T_i as the actual length of time between investment spikes and the censoring time as C_i for firm i. Define $\delta_i = 1$ if $T_i \leq C_i$ and 0 otherwise. Let $h_i = min(T_i, C_i)$. The log-likelihood function is as follows:

$$L(\gamma, \beta) = \sum_{i=1}^{N} ln\{[1 + \sigma^2 \sum_{t=0}^{h_i - 1} exp(x_i(t)'\beta + \gamma(t))]^{-1/\sigma^2} - \delta_i [1 + \sigma^2 \sum_{t=0}^{h_i} exp(x_i(t)'\beta + \gamma(t))]^{-(1/\sigma^2)} \tag{A.2}$$

where

$$\gamma(t) = ln(\int_{t}^{t+1} \lambda_0(s) ds) \tag{A.3}$$

and σ represents the variance of the gamma distribution. The estimation method selects the shape of the hazard to maximize the likelihood of observed durations in the sample.

[39] The hazard model method also allows for right censoring data. For example, if a firm experiences an investment spike in 2003 and the firm's data ended in 2006, then the length of the firm's final spell would be censored to three years.

Appendix B: Variable Definitions

Lending Supply (LS)	The ratio of the value of shares available for lending to the firm market capitalization.
ACI	The difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)).
IndAdj_Tobin's Q	The ratio of the market value of assets and the book value of assets, in which the market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of common stock and balance sheet-deferred taxes. It is also adjusted for the median Q in the same year and in the same two-digit industry classification.
IndAdj_ROA	The ratio of net income to the total assets, and subtracting the median ROA in the same year and in the same two-digit industry classification.
IOR	The ratio of the institutional investors ownership to total shares outstanding.
TotAsset	The logarithm of total assets.
Leverage	The ratio of the long term debt to total assets.
ROA	The ratio of net income to total assets.
Tobin's Q	The ratio of market value of assets to the book value of assets. (Market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of common stock and balance sheet-deferred taxes.)
BM	The logarithm of the ratio of the book value of equity divided by the market value of equity.
SaleGrowth	The changes in sales scaled by lagged sales.
CashFlow	The sum of income before extraordinary items and depreciation and amortization, scaled by total assets.
R&D	The ratio of R&D expenditure and total assets.
FixedAsset	The ratio of property, plant, and equipment (PP&E) to sales.
Dividend	The ratio of dividends paid to the book value of equity.
Sale	The logarithm of sales.
AGE	Derived from the first date of the company total assets data appeared in COMPUSTAT (in logarithm).
Capx	The ratio of capital expenditure to total assets.
Cash	The logarithm of cash.
Turnover	The ratio of the annual trading volume to total shares outstanding.
PastRet	The logarithm of compound monthly stock returns in the previous year.
Lending fee	The value weighted average fee for all new trades on the most recent business day (in percentage).
HP Index	Computed based on the methodology described in Hadlock and Pierce (2010).
ScaledWPS	Following Edmans, Gabaix, and Landier (2009), we employ scaled wealth-performance sensitivity to capture the sensitivity of manager's wealth to the stock price. It is the dollar change in the CEO's wealth for a 100% change in the stock price, scaled by annual pay.
InsiderOwn	The fraction of shares held by insiders, such as CEO, CFO, COO, and the president, to total shares outstanding.
InsiderOwn^2	The square of InsiderOwn.
ROE	The ratio of net income to book value of equity.
E_index	The entrenchment index of Bebchuck, Cohen and Ferrell (2009).
G_Index	The governance index of Gompers, Ishii and Metrick (2003).
PastStockReturns	Compounded daily stock returns over previous year of the merger and acquisition (in logarithm).
High-tech	A dummy variable equals one when both acquirer and target are from high-tech industries (from SDC), and zero otherwise.
RelativeDealSize	The ratio of the deal value (from SDC) and the firm's market value of total assets.
TenderOffer	A dummy variable equals one when the deal involves a tender offer, and zero otherwise.
FriendlyDeal	A dummy variable equals one when the deal attitude is friendly, and zero otherwise.
FreeCashFlow	The difference between operating income before depreciation and the summation of the interest expense, income taxes, and capital expenditure, scaled by total asset.
NonCashWorking	The difference between the current assets and the sum of the current liabilities and cash and cash equivalents, scaled by total assets.
CashDeal	A dummy variable equals one when the pay method is 100% cash.

Table 1. Summary Statistics: Analysis of mergers and acquisitions
The sample consists of domestic mergers and acquisitions from 2003-2012. CAR(-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). LS is the ratio of the value of shares available for lending to the firm market capitalization, which covers the period of 2002 to 2011. TotAsset is a logarithm of total assets. PastStockReturn is the compounded daily stock returns over previous year of the merger and acquisition (in logarithm). ROA is the ratio of net income to total assets. Tobin's Q is the ratio of the book value of assets minus the book value of equity plus the market value of equity to the book value of total assets. FixedAsset is the ratio of property, plant, and equipment (PP&E) to sales. R&D is the ratio of R&D expenditure to total assets. NonCashWorking is the difference between the current assets and the summation of the current liabilities and cash and cash equivalents, scaled by total assets. Leverage is the ratio of long-term debt to total assets. FreeCashFlow is the difference between operating income before depreciation and the sum of interest expense, income taxes, and capital expenditure, scaled by total asset. RelativeDealSize is the ratio of the deal value (from SDC) and the firm's market value of total assets. FriendDeal is a dummy which equals to one if the attitude is friendly (SDC), and zero otherwise. High-tech is a dummy variable that equals one when both acquirer and target are from the high-tech industries (from SDC), and zero otherwise. TenderOffer is a dummy variable equals one when the deal involves a tender offer, and zero otherwise. CashDeal is a dummy variable that equals one if the deal is all cash financed, and zero otherwise. IOR is the ratio of institutional investor ownership to the total shares outstanding. ScaledWPS is the sensitivity of the manager's wealth to the stock price, which is measured as the dollar change in the CEO's wealth for a 100% change in the stock price, scaled by annual pay. The E_index is the entrenchment index of Bebchuck, Cohen and Ferrell (2009). The G_Index is the governance index of Gompers, Ishii and Metrick (2003). The detailed definitions of these variables are reported in Appendix B.

	N	Mean	Median	Std. Dev
CAR(-2,2)	1018	0.0020	0.0031	0.0741
LS	1018	0.1106	0.0714	0.1222
TotAsset	1018	6.8782	6.8251	1.8304
PastStockReturn	1017	0.0905	0.1307	0.4496
ROA	1018	0.0368	0.0533	0.1616
Tobin's Q	1018	-1.1029	-0.7570	1.3634
FixedAsset	1018	0.2286	0.1460	0.2197
R&D	1018	0.0416	0.0038	0.0738
NonCashWorking	974	0.2331	0.2102	0.2122
Leverage	1013	0.1902	0.1566	0.1780
FreeCashFlow	1018	0.0294	0.0390	0.1222
RelativeDealSize	1018	0.1772	0.0843	0.2389
FriendlyDeal	1018	0.9882	1.0000	0.1080
High-tech	1018	0.4273	0.0000	0.4949
TenderOffer	1018	0.0766	0.0000	0.2661
CashDeal	1018	0.4008	0.0000	0.4903
IOR	1018	0.6553	0.7321	0.2773
ScaledWPS	541	61.5683	6.6914	642.0740
E_Index	375	2.5653	3.0000	1.1283
G_Index	327	9.3639	9.0000	2.3807

Table 2. Lending Supply (LS) and the Subsequent Mergers and Acquisition abnormal returns of acquirer firms

The dependent variable is CAR(-2,2), which is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). Lending Supply (LS) is the ratio of the value of shares available for lending to the firm market capitalization. TotalAsset is a logarithm of total assets. PastStockReturns is the compounded daily stock returns over the previous year of the merger and acquisition. ROA is the ratio of net income to total assets. Tobin's Q is the ratio of market value of assets to the book value of assets. FixedAsset is the ratio of property, plant, and equipment (PP&E) to sales. R&D is the ratio of R&D expenditures to total assets. NonCashWorking is the difference between current assets and the sum of current liabilities and cash and cash equivalents, scaled by total assets. Leverage is the ratio of long-term debt to total assets. FreeCashFlow is the difference between operating income before depreciation and the sum of interest expense, income taxes, and capital expenditures, scaled by total asset. RelativeDealSize is the ratio of the deal value (from SDC) and the firm's market value of total assets. FriendDeal is a dummy that equals to one if the attitude is friendly (SDC), and zero otherwise. High-tech is a dummy variable equals one when both acquirer and target are from the high-tech industries (from SDC), and zero otherwise. TenderOffer is a dummy variable equals one when the deal involves a tender offer, and zero otherwise. CashDeal is a dummy variable which equals one if the deal is all cash financed, and zero otherwise. IOR is the ratio of the institutional investors' ownership to total shares outstanding. The E_index is the entrenchment index of Bebchuck, Cohen and Ferrell (2009). The G_Index is the governance index of Gompers, Ishii and Metrick (2003). Detailed definitions of these variables are reported in Appendix B. Year dummies and two digit industry dummies are used to control for year and industry effects, while their coefficients are omitted. Following Petersen (2009), standard errors are two-way clustered by both firm and year. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	CAR(-2,2)															
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
LS	0.0481	0.0468	0.0454	0.0494	0.0523	0.0557	0.0551	0.0528	0.0558	0.0553	0.0559	0.0559	0.0561	0.0493	0.0934	0.0423
	(2.26)**	(1.99)**	(2.01)**	(2.15)**	(2.45)**	(2.31)**	(2.32)**	(2.19)**	(2.54)**	(2.47)**	(2.44)**	(2.44)**	(2.59)***	(2.15)**	(2.06)**	(1.91)*
TotAsset	-0.0039	-0.0040	-0.0044	-0.0046	-0.0048	-0.0044	-0.0044	-0.0045	-0.0047	-0.0047	-0.0046	-0.0046	-0.0049	-0.0051	-0.0021	-0.0031
	(2.92)***	(2.97)***	(3.57)***	(3.70)***	(3.81)***	(4.16)***	(4.03)***	(4.18)***	(4.26)***	(4.26)***	(4.19)***	(4.37)***	(4.58)***	(4.88)***	(0.56)	(0.85)
PastStockReturn	0.0193	0.0191	0.0203	0.0210	0.0203	0.0202	0.0205	0.0194	0.0197	0.0196	0.0194	0.0194	0.0191	0.0189	0.0034	0.0011
	(2.67)***	(2.54)**	(2.77)***	(2.80)***	(2.81)***	(2.52)**	(2.55)**	(2.60)***	(2.74)***	(2.73)***	(2.75)***	(2.75)***	(2.69)***	(2.63)***	(0.34)	(0.06)
ROA		0.0068	0.0068	0.0068	-0.0077	-0.0088	-0.0094	-0.0260	-0.0265	-0.0264	-0.0264	-0.0264	-0.0258	-0.0259	-0.0669	0.0290
		(0.36)	(0.37)	(0.36)	(0.43)	(0.50)	(0.53)	(1.01)	(1.03)	(1.03)	(1.03)	(1.03)	(0.99)	(1.00)	(1.63)	(0.74)
Tobin's Q			0.0020	0.0015	-0.0007	-0.0010	-0.0009	-0.0013	-0.0009	-0.0009	-0.0010	-0.0010	-0.0010	-0.0009	-0.0057	0.0020
			(2.24)**	(1.84)*	(0.61)	(1.04)	(0.61)	(1.03)	(0.67)	(0.66)	(0.66)	(0.65)	(0.67)	(0.62)	(4.31)***	(0.47)
FixedAsset				0.0582	0.0507	0.0531	0.0535	0.0567	0.0573	0.0574	0.0553	0.0553	0.0549	0.0555	0.0505	-0.0098
				(3.00)***	(2.48)**	(2.27)**	(2.26)**	(2.26)**	(2.31)**	(2.31)**	(2.37)**	(2.36)**	(2.32)**	(2.29)**	(1.37)	(0.56)
R&D					-0.1174	-0.1219	-0.1241	-0.1182	-0.1154	-0.1154	-0.1104	-0.1104	-0.1066	-0.1063	-0.0601	-0.0039
					(2.95)***	(2.89)***	(2.90)***	(2.55)**	(2.47)**	(2.46)**	(2.34)**	(2.34)**	(2.30)**	(2.32)**	(0.69)	(0.05)
NonCashWorking						0.0066	0.0065	0.0063	0.0063	0.0064	0.0062	0.0062	0.0051	0.0046	-0.0053	-0.0059
						(0.46)	(0.42)	(0.41)	(0.40)	(0.40)	(0.39)	(0.39)	(0.33)	(0.30)	(0.22)	(0.29)
Leverage							-0.0032	-0.0024	-0.0029	-0.0028	-0.0031	-0.0031	-0.0025	-0.0025	0.0214	-0.0123
							(0.18)	(0.14)	(0.17)	(0.16)	(0.18)	(0.19)	(0.15)	(0.15)	(0.84)	(0.35)
FreeCashFlow								0.0356	0.0365	0.0365	0.0366	0.0367	0.0341	0.0339	-0.0198	0.0185
								(0.66)	(0.67)	(0.67)	(0.68)	(0.67)	(0.62)	(0.62)	(0.41)	(0.24)
RelativeDealSize									-0.0120	-0.0114	-0.0116	-0.0116	-0.0083	-0.0083	-0.0547	-0.0647
									(0.73)	(0.70)	(0.72)	(0.73)	(0.53)	(0.53)	(2.05)**	(2.27)**
FriendlyDeal										0.0123	0.0132	0.0132	0.0130	0.0131	-0.0194	-0.0178
										(0.65)	(0.67)	(0.68)	(0.66)	(0.67)	(0.56)	(0.48)
High-tech											0.0044	0.0044	0.0055	0.0054	0.0002	0.0002
											(0.53)	(0.54)	(0.68)	(0.67)	(0.02)	(0.02)
TenderOffer												-0.0002	-0.0026	-0.0025	0.0157	0.0218
												(0.02)	(0.24)	(0.23)	(1.44)	(2.63)***
CashDeal													0.0078	0.0077	0.0041	-0.0023
													(1.89)*	(1.91)*	(0.59)	(0.32)
IOR														0.0042	-0.0042	-0.0130
														(0.45)	(0.23)	(0.63)
E_Index															-0.0020	
															(0.86)	
G_Index																-0.0004
																(0.26)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	1017	1017	1017	1017	1017	973	968	968	968	968	968	968	968	968	360	318
R^2	0.0800	0.0802	0.0811	0.0903	0.0973	0.1055	0.1060	0.1076	0.1089	0.1092	0.1095	0.1095	0.1115	0.1116	0.2522	0.2711

Table 3. Summary Statistics: Analysis of abnormal capital investments, firm value, and firm operating performance Lending Supply (LS) is the ratio of the value of shares available for lending to the firm market capitalization. Abnormal corporate investment (ACI) is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). Firm value is proxied by industry-adjusted Tobin's Q, IndAdj_Tobin's Q. This measure refers to the ratio of the market value of assets and the book value of assets, in which the market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of common stock and balance sheet-deferred taxes. It is also adjusted for the median Q in the same year and in the same two-digit industry. Firm operating performance is proxied by industry-adjusted ROA, IndAdj_ROA. This measure refers to the ratio of net income to the total assets, after subtracting the median ROA in the same year and within the same two-digit industry classification. IOR is the ratio of the institutional ownership to total shares outstanding. TotAsset is the logarithm of total assets. BM is the logarithm of the book-to-market ratio. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. Tobin's Q is the ratio of the book value of assets minus the book value of equity plus market value of equity to the book value of total assets. ROA is the ratio of net income to total assets. SalesGrowth refers to the changes in sales scaled by lagged sales. Leverage is the ratio of long term debt to total assets. The HP Index is computed based on the methodology described in Hadlock and Pierce (2010). ScalesWPS is the dollar change in the CEO's wealth for a 100% change in the stock price, scaled by annual pay (Edmans, Gabaix, and Landier (2009)). Sale is the logarithm of sales. Age is derived from the date the companies total asset data first appeared in Compustat (in logarithm). R&D is the ratio of R&D expenditures to total assets. FixedAsset is the ratio of PP&E and total sales. Cash is logarithm of cash. InsiderOwn is the fraction of shares held by insiders, such as the CEO, CFO, CO and the president, to total shares outstanding. InsiderOwn^2 is the square of InsiderOwn. ROE is the ratio of net income to book value of equity. MktSize is the logarithm of market capitalization. Dividend is the ratio of dividends paid to the book value of equity. Capx is the ratio of capital expenditure to total assets. The E_Index is the entrenchment index of Bebchuk et al. (2009). The G_Index is the governance index of Gompers et al. (2003). Detailed definitions of these variables are reported in Appendix B.

Variables	N	Mean	Median	Std. Dev
LS	24930	0.1110	0.0648	0.1420
ACI	24291	0.0565	-0.1010	0.7997
IndAdj_Tobin's Q	23867	-0.3858	-0.4563	1.3419
IndAdj_ROA	24706	-0.049	0.0000	0.2103
IOR	24995	0.5768	0.6255	0.3016
TotalAsset	24995	6.2558	6.1942	2.0235
BM	24925	-0.7856	-0.7089	0.8617
CashFlow	24959	0.0239	0.0722	0.2149
Tobin's Q	24991	1.9447	1.4990	1.3299
ROA	24995	-0.0166	0.0360	0.2184
SalesGrowth	24702	0.1560	0.0839	0.4473
Leverage	24888	0.1863	0.1428	0.1904
HP Index	23496	-7.1846	-6.7695	2.9006
ScaledWPS (in thousands)	11581	0.0280	0.0065	0.0856
Sale	23682	6.0795	6.1532	2.1099
Age	23825	2.6486	2.6391	0.8769
R&D	23686	0.0043	0.0000	0.0284
FixedAsset	23672	0.8672	0.3750	1.5271
Cash	23868	0.3734	0.0596	1.1243
InsiderOwn	23862	0.0629	0.0178	0.1106
InsiderOwn^2	23862	0.0162	0.0003	0.0563
ROE	23870	0.0376	0.0880	0.3955
MktSize	24407	6.2297	6.2425	2.0045
Dividend	24665	0.0237	0.0000	0.4367
Capx	24680	0.0472	0.0287	0.0568
E-Index	7565	2.4726	3.0000	1.2505
G-Index	7678	9.0619	9.0000	2.6278

Table 4. Lending Supply and Subsequent Abnormal Capital Investment

This table reports the regression results for Eq.(3). The dependent variable is ACI, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). LS is the ratio of the value of shares available for lending to the firm's market capitalization, which covers the period from 2002 to 2011. IOR is the ratio of institutional ownership to the total shares outstanding. TotAsset is the logarithm of total asset. BM is the logarithm of the book-to-market ratio. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. Tobin's Q is the ratio of market value of assets and the book value of assets. ROA is the ratio of net income to total assets. SaleGrowth is the change in sales scaled by lagged sales. Leverage is the ratio of long-term debt to total assets. The E_Index is the entrenchment index of Bebchuk et al. (2009). The G_ Index is the governance index of Gompers et al. (2003). Detailed definitions of these variables are reported in Appendix B. All regressions control for year and firm fixed effects, whose coefficient estimates are suppressed. Heteroskedasticity-consistent standard errors are clustered at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Subsequent Abnormal Capital Investment (ACI)										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
LS	-0.2392	-0.2261	-0.2276	-0.2282	-0.2334	-0.2371	-0.2367	-0.2370	-0.2234	-0.2521	-0.2147
	(3.85)***	(3.61)***	(3.63)***	(3.64)***	(3.73)***	(3.79)***	(3.78)***	(3.79)***	(3.57)***	(2.50)**	(2.30)**
IOR		0.3351	0.5130	0.5140	0.5037	0.4898	0.4902	0.4902	0.4466	0.3139	0.2115
		(4.20)***	(6.17)***	(6.16)***	(6.10)***	(5.90)***	(5.91)***	(5.91)***	(5.35)***	(2.36)**	(1.69)*
TotAsset			-0.1827	-0.1827	-0.1597	-0.1424	-0.1428	-0.1428	-0.1220	-0.2205	-0.2353
			(6.50)***	(6.49)***	(5.71)***	(4.98)***	(5.00)***	(5.00)***	(4.23)***	(5.31)***	(5.73)***
BM				0.0026	-0.0147	0.0176	0.0185	0.0185	0.0162	-0.1468	-0.1390
				(0.18)	(0.94)	(0.93)	(0.97)	(0.97)	(0.85)	(5.43)***	(5.09)***
Cash Flow					-0.1810	-0.1590	-0.1727	-0.1730	-0.2164	-0.4408	-0.1186
					(2.39)**	(2.09)**	(2.27)**	(2.27)**	(2.84)***	(1.15)	(0.26)
Tobin's Q						0.0397	0.0404	0.0404	0.0343	0.0173	0.0143
						(2.59)***	(2.63)***	(2.63)***	(2.23)**	(0.96)	(0.76)
ROA							0.0136	0.0136	0.0124	0.1345	-0.2662
							(3.24)***	(3.24)***	(3.51)***	(0.40)	(0.62)
SaleGrowth								0.0002	0.0002	0.1563	0.1664
								(0.42)	(0.43)	(3.56)***	(3.62)***
Leverage									-0.5625	-0.4789	-0.6274
									(5.75)***	(3.21)***	(4.08)***
E_Index										0.0137	
										(0.53)	
G_Index											0.0204
											(1.20)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No.	22645	22645	22645	22645	22645	22645	22645	22645	22645	7375	7494
R^2	0.2481	0.2494	0.2532	0.2532	0.2547	0.2554	0.2554	0.2555	0.2583	0.3576	0.3311

Table 5. Summary Statistics: Analysis for hazard model
This table reports descriptive statistics for sample firms in the hazard model test. The Investment/Asset measure used for the hazard estimation is the calculated as (data30-data107)/data6. Lending Supply (LS) is the ratio of the value of shares available for lending to the firm's market capitalization. Leverage is the ratio of long term debt to total assets. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. SaleGrowth is the changes in sales scaled by lagged sales. TotAsset is the logarithm of total assets. A firm is included if its real assets are below the 33rd percentile of the real assets of the firms in the first year that the firm appears in our sample. Avg. spell length measures the average number of years that the firm's investment rate does not go beyond the pre-defined investment threshold. We employ two times the firm's median investment rate as the investment trigger. Fraction censored refers to the percentage of right censored spells in the sample. Length censored (uncensored) refers to the number of censored (uncensored) years in which a firm remains inactive.

	N	Mean	Median	Std. Dev
Panel A: Firm Characteristics				
Investment/Asset	4319	0.0388	0.0200	0.0666
LS	4506	0.0602	0.0415	0.0624
Leverage	4505	0.1045	0.0542	0.1284
CashFlow	4507	-0.0472	0.0422	0.2626
SalesGrowth	4498	0.2764	0.1214	0.7070
TotAsset	4507	3.7855	3.8964	1.0073
Panel B: Spell Characteristics				
Avg. spell length	1219	3.4807	3.0000	2.2210
Fraction censored	1219	0.5193	0	0
Length censored	633	4.6951	4.0000	2.1781
Length uncensored	586	2.6177	2.0000	1.8297

Table 6. Semi-parametric hazard model estimates: effects of Lending Supply (LS)
Following Whited (2006) and Billet et al. (2011), we include firms whose real assets are below the 33rd percentile of the real assets in the first year that the firm appears in sample. The Investment/Asset measure used for the hazard estimation is the calculated as (data30-data107)/data6. LS is the ratio of the value of shares available for lending to the firm market capitalization, which covers the period from 2002 to 2011. Leverage is the ratio of long term debt and total asset. SalesGrowth is the changes in sales scaled by lagged sales. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. TotAsset is the logarithm of total assets. A spike is defined as an investment rate exceeding a threshold, and the thresholds are pre-defined as 2 and 2.5 times the firm median investment rate (or firms' industry's median contemporaneous investment rate). The number of years since the last spike is also included, although coefficients are omitted. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Firm		Industry	
	(1) 2 times	(2) 2.5 times	(3) 2 times	(4) 2.5 times
LS	-0.6855	-0.7959	-0.2290	-0.2006
	(7.93)***	(7.18)***	(4.28)***	(4.45)***
Leverage	-1.5821	-1.7582	0.4493	0.1618
	(3.69)***	(3.45)***	(1.28)	(0.52)
SalesGrowth	0.1802	0.1558	0.0526	0.0344
	(3.34)***	(3.70)***	(1.05)	(0.71)
CashFlow	-0.2329	-0.2247	1.2772	1.0472
	(1.25)	(1.08)	(5.90)***	(5.74)***
TotAsset	0.0022	-0.1037	0.0174	0.0383
	(0.04)	(1.57)	(0.34)	(0.84)
obs	4495	4498	4498	4494
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
log likelihood	-1575.49	-1240.28	-2104.28	-1782.66

Table 7. Lending Supply (LS) and Subsequent Firm Value

Firm value is proxied by IndAdj_Tobin's Q. It refers to the ratio of the market value of assets to the book value of assets, in which the market value of assets is defined as the difference between the sum of the book value of assets and the market value of common stock and the sum of the book value of the common stock and balance sheet-deferred taxes. It is also adjusted for the median Tobin's Q in the same year and in the same two-digit industry classification. Lending Supply (LS) is the measure of shares that are available for lending. IOR is the ratio of institutional investor ownership to total shares outstanding. Size is the logarithm of market capitalization. Sale is the logarithm of the sale. Leverage is the ratio of long-term debt to total assets. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. Age is derived from the date the company's total asset data first appeared in Compustat. Dividend is the ratio of dividends paid to the book value of equity. ROE is the ratio of net income to the book value of equity. R&D is the ratio of R&D expenditures to total assets. FixedAsset is the ratio of PP&E to sales. Capx is the ratio of capital expenditures to total assets. Cash is the logarithm of cash. InsiderOwn equals to the fraction of shares held by insiders, such as CEO, CFO, CO, and the president, to the total shares outstanding. InsiderOwn^2 is the square of InsiderOwn. ROE is the ratio of net income to total equity. The E_Index is the entrenchment index of Bebchuk et al. (2009). The G_Index is the governance index of Gompers et al. (2003). Detailed definitions of these variables are reported in Appendix B. All regressions control for year and firm fixed effects, whose coefficient estimates are suppressed. Heteroskedasticity-consistent standard errors are clustered at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Subsequent Firm Values													
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
LS	0.1750	0.1886	0.1697	0.1987	0.1887	0.2104	0.2145	0.2119	0.2096	0.1999	0.1955	0.1975	0.3674	0.2705
	(2.22)**	(2.38)**	(2.16)**	(2.53)**	(2.37)**	(2.62)***	(2.65)***	(2.61)***	(2.57)**	(2.45)**	(2.40)**	(2.43)**	(3.39)***	(2.95)***
IOR	-0.5758	-0.3150	-0.2301	-0.2397	-0.2341	-0.1515	-0.1621	-0.1462	-0.1452	-0.1543	-0.1377	-0.1386	0.0173	0.0428
	(5.76)***	(2.97)***	(2.19)**	(2.30)**	(2.24)**	(1.43)	(1.52)	(1.38)	(1.37)	(1.46)	(1.30)	(1.31)	(0.11)	(0.29)
Size		-0.1001	-0.0324	-0.0483	-0.0498	-0.0613	-0.0601	-0.0469	-0.0484	-0.0457	-0.0452	-0.0455	0.0566	0.0689
		(4.91)***	(1.59)	(2.31)**	(2.38)**	(2.90)***	(2.81)***	(2.14)**	(2.17)**	(2.05)**	(2.03)**	(2.05)**	(1.72)*	(2.15)**
Sale			-0.2445	-0.2297	-0.2199	-0.1913	-0.1935	-0.2522	-0.2547	-0.2480	-0.2471	-0.2484	-0.4388	-0.4433
			(5.94)***	(5.55)***	(5.26)***	(4.55)***	(4.56)***	(5.11)***	(5.13)***	(5.02)***	(5.01)***	(5.04)***	(5.80)***	(6.31)***
Leverage				-0.5575	-0.5828	-0.5369	-0.5396	-0.4988	-0.4965	-0.4920	-0.4989	-0.4887	-0.3335	-0.3884
				(4.84)***	(4.95)***	(4.55)***	(4.51)***	(4.14)***	(4.10)***	(4.06)***	(4.12)***	(4.02)***	(2.28)**	(2.69)***
CashFlow					-0.1146	-0.1334	-0.1060	-0.1097	-0.1121	-0.1095	-0.1125	-0.2062	0.3824	-0.0307
					(1.06)	(1.25)	(0.98)	(1.01)	(1.03)	(1.01)	(1.03)	(1.46)	(1.75)*	(0.15)
Age						-0.3635	-0.3602	-0.3405	-0.3376	-0.3517	-0.3421	-0.3375	-0.1945	-0.1968
						(4.71)***	(4.63)***	(4.35)***	(4.32)***	(4.50)***	(4.36)***	(4.30)***	(1.31)	(1.39)
Dividend							0.0445	0.0159	0.0162	0.0057	0.0084	0.0064	-0.4335	-0.2575
							(0.15)	(0.06)	(0.06)	(0.02)	(0.03)	(0.02)	(1.20)	(0.93)
R&D								0.0750	0.0523	0.1065	0.0862	0.0501	195.6496	118.4486
								(0.08)	(0.05)	(0.11)	(0.09)	(0.05)	(2.38)**	(1.77)*
FixedAsset								-0.0574	-0.0574	-0.0571	-0.0561	-0.0562	-0.2295	-0.2628
								(2.09)**	(2.09)**	(2.08)**	(2.04)**	(2.05)**	(3.38)***	(4.23)***
Capx									0.1025	0.0710	0.0760	0.0730	-0.0876	-0.2248
									(0.31)	(0.22)	(0.23)	(0.22)	(0.21)	(0.54)
Cash										-0.0722	-0.0725	-0.0730	-0.0070	-0.0119
										(3.28)***	(3.31)***	(3.33)***	(0.67)	(1.04)
InsiderOwn											0.4655	0.4575	0.6070	0.8890
											(1.47)	(1.45)	(0.92)	(1.38)
InsiderOwn^2											-0.3703	-0.3578	-0.0914	-0.3566
											(0.59)	(0.58)	(0.05)	(0.21)
ROE												0.0669	-0.0269	0.0125
												(1.20)	(0.28)	(0.12)
E_index													0.0034	
													(0.11)	
G_Index														0.0110
														(0.54)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No.	22861	22253	22087	22004	21968	21955	21787	21776	21752	21750	21750	21750	6791	6831
R^2	0.7055	0.7063	0.7114	0.7127	0.7127	0.7140	0.7140	0.7144	0.7146	0.7150	0.7152	0.7153	0.8002	0.8039

Table 8. Lending Supply (LS) and the Subsequent firm operating performance
The dependent variable is firm operating performance, which is proxied by IndAdj_ROA. It is the ratio of net income to the total assets, and subtracting the median ROA in the same year and in the same two-digit industry classification. LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. BM is the logarithm of the ratio of the book value of equity divided by the market value of equity. IOR the ratio of institutional investors' ownership to the total shares outstanding. Size is the logarithm of market capitalization. LagROA is the lagged industry-adjusted ROA to account for serial dependence in the variable. Capx is the ratio of capital expenditures to total assets. Leverage is long-term debt scaled by total assets. Dividend is the ratio of dividends paid to the book value of equity. The E_Index is the entrenchment index of Bebchuk et al. (2009). The G_Index is the governance index of Gompers et al. (2003). Detailed definitions of these variables are reported in Appendix B. All regressions control for year and firm fixed effects, whose coefficient estimates are omitted. Heteroskedasticity-consistent standard errors are clustered at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Subsequent Firm Operating Performance (ROA)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LS	0.0081	0.0121	0.0118	0.0153	0.0155	0.0165	0.0164	0.0251	0.0281
	(1.09)	(1.64)	(1.60)	(2.07)**	(2.08)**	(2.22)**	(2.21)**	(3.01)***	(2.89)***
BM	-0.0444	-0.0448	-0.0451	-0.0470	-0.0471	-0.0490	-0.0488	-0.0426	-0.0431
	(14.81)***	(15.07)***	(11.70)***	(11.68)***	(11.68)***	(11.86)***	(11.64)***	(8.93)***	(9.16)***
IOR		-0.0356	-0.0350	-0.0352	-0.0351	-0.0333	-0.0332	-0.0573	-0.0620
		(3.39)***	(3.29)***	(3.39)***	(3.39)***	(3.19)***	(3.19)***	(3.58)***	(3.80)***
Size			-0.0005	-0.0047	-0.0046	-0.0066	-0.0066	-0.0021	-0.0002
			(0.15)	(1.21)	(1.18)	(1.65)*	(1.62)	(0.44)	(0.05)
LagROA				0.0630	0.0629	0.0619	0.0618	0.0001	0.0049
				(2.67)***	(2.67)***	(2.63)***	(2.63)***	(0.00)	(0.17)
Capx					-0.0099	-0.0133	-0.0133	0.0134	0.0132
					(0.30)	(0.40)	(0.40)	(0.35)	(0.35)
Leverage						-0.0384	-0.0386	-0.0323	-0.0350
						(2.62)***	(2.63)***	(2.11)**	(2.24)**
Dividend							0.0087	-0.0451	-0.0290
							(0.48)	(1.02)	(0.58)
E_index								-0.0006	
								(0.19)	
G_Index									0.0004
									(0.20)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No.	24320	24320	24320	24320	24273	24264	24264	6933	7543
R^2	0.7214	0.7218	0.7218	0.7242	0.7242	0.7244	0.7244	0.6219	0.6202

Table 9. The impact of Regulation SHO on the governance effect of lending supply
This table presents the impact of the changes in short-selling regulation on the governance effect of lending supply (LS) on CAR(-2,2), ACI, Tobin's Q and ROA. The Regulation SHO is announced by SEC in 2004. The SEC randomly selects a sample of Russell 3000 index firms as treated securities and formally removes their price restrictions for short selling on January, 3, 2005. We employ Eq.(7), and report the results in this table. The sample is from 2002 till the end of the PILOT program (2007). Treated is a dummy variable that equals to one for firms that are selected as Regulation SHO treated stock, and zero for the remaining Russell 3000 index members. PILOT is a time dummy variable that equals one from 2005 to 2007 and zero from 2002 to 2004. In column (1), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) of acquiring firms for the mergers and acquisition announcements in the subsequent year. CAR (-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In column (2), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In column (3), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In column (4), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In all specifications, we control for year fixed effects. We do not control for firm-fixed effects owing to a collinearity with Treated dummy. Standard errors are two-way clustered by both firm and year (Petersen (2009)). *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) CAR (-2,2)	(2) ACI	(3) Tobin's Q	(4) ROA
LS	0.2515	-2.8607	3.0111	0.1931
	(1.90)*	(2.87)***	(4.37)***	(5.14)***
LS × Treated × PILOT	2.3854	-2.2159	1.2762	0.5355
	(4.43)***	(2.80)***	(1.82)*	(2.13)**
LS × Treated	-2.5459	2.0787	-1.0825	-0.4922
	(4.97)***	(4.56)***	(1.40)	(1.99)**
LS × PILOT	-0.3020	2.5079	-2.8792	-0.1983
	(3.13)***	(2.54)**	(4.45)***	(4.77)***
Treated × PILOT	-0.0061	0.0651	-0.0345	-0.0058
	(0.20)	(1.83)*	(0.48)	(1.42)
Treated	0.0539	-0.0434	0.0683	-0.0007
	(2.62)***	(2.82)***	(1.41)	(1.23)
PILOT	-0.0048	0.1967	-0.0595	0.0072
	(0.67)	(5.57)***	(0.73)	(0.87)
Control Variables	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y
Obs.	456	7725	6995	7995
R^2	0.1222	0.0442	0.2955	0.4973

Table 10. Re-estimation of main regressions with residual LS

This table presents the results using residual LS to re-test our major regression models. Residual LS is estimated by regressing LS on contemporaneous firm size, book-to-market ratio, firm age, institutional ownership ratio, and turnover ratio with firm and year fixed effects included. LS is the ratio of the value of shares available for lending to the firm's market capitalization over the 2002–2011 period. In column (1), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) for acquirer firms in the subsequent year. CAR (-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In column (2), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In column (3), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In column (4), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In column (1), both industry and year fixed effects are controlled, and standard errors are two-way clustered by both firm and year (Petersen (2009)). In columns (2), (3) and (4), we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) CAR (-2,2)	(2) ACI	(3) Tobin's Q	(4) ROA
Residual LS	0.0476	-0.1370	0.1516	0.0168
	(1.81)*	(2.06)**	(1.92)*	(2.04)**
Firm Charateristics	Y	Y	Y	Y
Deal Characteristics	Y	N	N	N
Year Dummies	Y	Y	Y	Y
Firm Dummies	N	Y	Y	Y
Industry Dummies	Y	N	N	N
Obs.	915	23298	20978	23595
R^2	0.1206	0.2580	0.7206	0.7356

Table 11. Ruling out the effect of short interest

This table reports the results of using short interest as our main explanatory variable and the results of governance effect of lending supply after controlling for the effect of short interest. ShortInterest is computed using total value of stock on loan scaled by market capitalization. In columns (1) and (2), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) for acquirer firms in the subsequent year. CAR (-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In columns (3) and (4), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In columns (5) and (6), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In columns (7) and (8), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In columns (1) and (2), both industry and year fixed effects are controlled, and standard errors are two-way clustered by both firm and year (Petersen (2009)). In columns (3) - (8), we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	(1) CAR	(2) CAR	(3) ACI	(4) ACI	(5) Tobin's Q	(6) Tobin's Q	(7) ROA	(8) ROA
LS		0.0396**		-0.2518***		0.3432***		0.0512***
		(2.41)		(2.93)		(3.36)		(3.66)
ShortInterest	0.0410	0.0103	0.0729	0.1843	-0.4533**	-0.9579***	-0.0082	-0.0786**
	(0.46)	(0.12)	(0.48)	(1.17)	(2.25)	(3.78)	(0.30)	(2.43)
Firm Characteristics	Y	Y	Y	Y	Y	Y	Y	Y
Deal Characteristics	Y	Y	N	N	N	N	N	N
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
Firm Dummies	N	N	Y	Y	Y	Y	Y	Y
Industry Dummies	Y	Y	N	N	N	N	N	N
Obs.	973	973	23287	23269	20820	20820	24255	24255
R^2	0.1211	0.1221	0.2522	0.2526	0.7167	0.7170	0.7248	0.7252

Table 12. The impact of ScaledWPS on the governance effect of lending supply

This table reports the results regarding the impact of ScaledWPS on the governance effect of lending supply. Following Edmans, Gabaix, and Landier (2009), we employ scaled wealth-performance sensitivity to capture the sensitivity of the manager's wealth to the stock price (ScaledWPS), which is measured as the dollar change in the CEO's wealth caused by a 100% change in the stock price, scaled by annual pay. A firm is defined as a high (low) ScaledWPS firm if its ScaledWPS is above (below) the 67th (33rd) percentile of the ScaledWPS of the sample. In columns (1) and (2), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) for acquirer firms in the subsequent year. CAR (-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In columns (3) and (4), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In columns (5) and (6), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In columns (7) and (8), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In columns (1) and (2), both industry and year fixed effects are controlled, and standard errors are two-way clustered by both firm and year (Petersen (2009)). In columns (3) - (8), we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Subsamples of ScaledWPS							
	CAR(-2,2)		ACI		Tobin's Q		ROA	
	(1) High	(2) Low	(3) High	(4) Low	(5) High	(6) Low	(7) High	(8) Low
LS	0.2299	0.1123	-0.4448	-0.2347	0.5536	0.0306	0.0374	0.0142
	(1.80)*	(0.97)	(2.06)**	(1.50)	(1.71)*	(0.30)	(2.12)**	(1.25)
Firm Characteristics	Y	Y	Y	Y	Y	Y	Y	Y
Deal Characteristics	Y	Y	N	N	N	N	N	N
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
Firm Dummies	N	N	Y	Y	Y	Y	Y	Y
Industry Dummies	Y	Y	N	N	N	N	N	N
Obs.	178	179	3720	3648	3429	3400	3793	3794
R^2	0.4181	0.3783	0.4021	0.4241	0.8186	0.7874	0.7323	0.6296

Table 13. The impact of Peer Hostile Takeover (PHT) on the governance effect of lending supply
This table displays the results of the impact of Peer Hostile Takeover (PHT) on the governance effect of lending supply. PHT is a dummy variable which equals one if the firm is in an industry (12 Fama-French industries) that has experienced at least one hostile takeover attempt over last two years. In columns (1) and (2), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In columns (3) and (4), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In columns (5) and (6), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In all regressions, we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	The impact of Peer Hostile Takeover					
	(1) ACI	(2) ACI	(3) Tobin's Q	(4) Tobin's Q	(5) ROA	(6) ROA
LS	-0.2234	-0.2117	0.1975	0.1884	0.0164	0.0144
	(3.57)***	(3.40)***	(2.43)**	(2.32)**	(2.21)**	(1.88)*
LS×PHT		-0.4735		0.7277		0.0331
		(1.72)*		(2.08)**		(1.75)*
PHT		0.1149		-0.0082		-0.0032
		(2.33)**		(0.11)		(0.49)
Control Variables	Y	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y	Y
Firm Dummies	Y	Y	Y	Y	Y	Y
No.	22645	22645	21750	21750	24264	24264
R^2	0.2583	0.2587	0.7153	0.7154	0.7244	0.7245

Table 14. The impact of the payment method of the acquisition deals on the governance effect of lending supply
The dependent variable is CAR(-2,2), which is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). Lending Supply (LS) is the ratio of the value of shares available for lending to firm market capitalization. AllCashDeal represents those deals that use 100% cash for payment as reported in SDC. NonAllCashDeal refers to the complement sample. Detailed definitions of these variables are reported in Appendix B. Year dummies and two-digit industry dummies are also used to control for year and industry effects, while their coefficients are omitted. Following Petersen (2009), standard errors are two-way clustered by both firm and year. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	CAR(-2,2)		
	(1) All Samples	(2) NonAllCashDeal	(3)AllCashDeal
LS	0.0493	0.1285	-0.0676
	(2.15)**	(3.31)***	(1.52)
TotAsset	-0.0051	-0.0066	-0.0053
	(4.88)***	(3.43)***	(2.58)**
PastStockReturn	0.0189	0.0266	0.0120
	(2.63)***	(2.79)***	(0.63)
ROA	-0.0259	-0.0192	-0.0589
	(1.00)	(0.68)	(1.82)*
Tobin's Q	-0.0009	0.0020	-0.0014
	(0.62)	(0.63)	(0.26)
FixedAsset	0.0555	0.0645	0.0240
	(2.29)**	(2.38)**	(0.65)
R&D	-0.1063	-0.0938	-0.0772
	(2.32)**	(1.30)	(0.73)
NonCashWorking	0.0046	0.0071	-0.0021
	(0.30)	(0.33)	(0.07)
Leverage	-0.0025	-0.0167	-0.0033
	(0.15)	(0.65)	(0.16)
FreeCashFlow	0.0339	0.0149	0.1864
	(0.62)	(0.25)	(1.75)*
RelativeDealSize	-0.0083	-0.0211	0.0398
	(0.53)	(1.25)	(1.05)
FriendlyDeal	0.0131	-0.0049	0.0061
	(0.67)	(0.16)	(0.49)
High-tech	0.0054	0.0134	0.0033
	(0.67)	(1.46)	(0.33)
TenderOffer	-0.0025	-0.0127	-0.0032
	(0.23)	(0.45)	(0.37)
CashDeal	0.0077		
	(1.91)*		
IOR	0.0042	-0.0111	0.0372
	(0.45)	(0.97)	(1.99)**
Year Dummies	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes
Obs.	968	582	386
R^2	0.1116	0.1459	0.2367

Table 15. The impact of HP Index on the governance effect of lending supply
The HP index is calculated based on the methodology described in Hadlock and Pierce (2010). A firm is defined as a high (low) HP Index firm if its HP Index is above (below) the 67th (33rd) percentile of the HP Index of the sample. In columns (1) and (2), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) for acquirer firms in the subsequent year. CAR (-2,2) is the cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In columns (3) and (4), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In columns (5) and (6), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In columns (7) and (8), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In columns (1) and (2), both industry and year fixed effects are controlled, and standard errors are two-way clustered by both firm and year (Petersen (2009)). In columns (3) - (8), we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Subsamples of HP Index							
	CAR(-2,2)		ACI		Tobin's Q		ROA	
	(1) High	(2) Low	(3) High	(4) Low	(5) High	(6) Low	(7) High	(8) Low
LS	-0.0676	0.1285	-0.2542	-0.3607	0.0850	0.2561	0.0086	0.0183
	(1.52)	(3.31)***	(1.40)	(4.41)***	(0.31)	(3.00)***	(0.33)	(2.39)**
Control Variables	Y	Y	Y	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
Firm Dummies	N	N	Y	Y	Y	Y	Y	Y
Industry Dummies	Y	Y	N	N	N	N	N	N
Obs.	386	582	7473	7473	6924	7374	7957	8032
R^2	0.2367	0.1459	0.2845	0.3559	0.7439	0.7275	0.7541	0.5810

Table A-1. Determinants of Lending Supply (LS)

This table presents the determinants of Lending Supply (LS). LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Size is the logarithm of the firm's market capitalization. BM is the logarithm of the ratio of the book value of equity to the market value of equity. IOR is the ratio of institutional investors' ownership to the total shares outstanding. Age is the date the company's total assets data first appeared in COMPUSTAT (in logarithm). Leverage is the ratio of long-term debt to total assets. InsiderOwn is the fraction of shares held by insiders, such as CEO, CFO, CO, and president, to total shares outstanding. Idio_Vol is the measure of idiosyncratic volatility based on the Fama French three-factor model. PastRet is the logarithm of compounded monthly stock returns in the previous year. Illiq is the measure of illiquidity as proposed in Amihud (2002). CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. Dividend is the ratio of dividends paid to the book value of equity. R&D is the ratio of R&D to total assets. ROE is the return on equity. AnalystsCov is the number of analysts covering the firm. AnalystsDisp is the standard deviation of analysts forecasts scaled by the absolute mean forecasts. Columns (1), (2), and (3) use the contemporaneous LS as a dependent variable. Columns (4), (5), and (6) use the subsequent LS as dependent variable. Year and two-digit industry dummies are also used to control for year and industry effects, while their coefficients are omitted. Following Petersen (2009), standard errors are two-way clustered by both firm and month. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Lending Supply					
	$LS_{i,t}$			$LS_{i,t-1}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Size	-0.0166	-0.0270	-0.0463	-0.0041	-0.0111	-0.0245
	(2.18)**	(2.29)**	(2.02)**	(0.96)	(1.68)*	(2.52)**
BM	0.0019	-0.0071	-0.0154	0.0071	0.0009	-0.0035
	(0.62)	(1.63)	(1.49)	(2.34)**	(0.17)	(0.40)
IOR	0.2298	0.2171	0.1459	0.2370	0.2260	0.1775
	(3.61)***	(3.72)***	(3.20)***	(5.81)***	(6.07)***	(4.41)***
Age	0.0096	0.0057	0.0040	0.0086	0.0063	0.0087
	(3.63)***	(2.35)**	(1.60)	(1.91)*	(1.79)*	(1.45)
Leverage	0.0125	-0.0192	-0.0181	-0.0188	-0.0413	-0.0394
	(0.55)	(1.82)*	(1.49)	(2.09)**	(3.43)***	(2.29)**
InsiderOwn	0.0007	-0.0005	-0.0207	0.0071	0.0046	-0.0159
	(0.11)	(0.08)	(1.06)	(0.97)	(0.71)	(1.18)
Idio_Vol	-0.0832	-0.1039	0.2048	0.1500	0.1753	1.5059
	(0.35)	(0.53)	(1.05)	(0.77)	(0.79)	(0.90)
PastRet	0.0010	0.0017	0.0045			
	(0.38)	(0.52)	(0.84)			
Illiq	0.0003	-0.0007	0.0016	-0.0046	-0.0055	-0.0023
	(0.19)	(0.64)	(0.74)	(3.77)***	(4.13)***	(2.50)**
CashFlow		-0.0507	-0.0157		-0.0206	0.0038
		(1.95)*	(0.49)		(1.65)*	(0.19)
Dividend		0.0001	0.0003		0.0016	0.0023
		(0.12)	(0.31)		(2.21)**	(2.01)**
R&D		0.0000	0.4495		0.0001	0.1312
		(0.00)	(1.55)		(2.14)**	(0.37)
PP&E		0.0049	0.0002		0.0068	0.0037
		(0.79)	(0.04)		(2.12)**	(0.60)
ROE		-0.0000	-0.0171		-0.0001	-0.0060
		(0.54)	(1.27)		(1.81)*	(1.41)
Sale		0.0162	0.0246		0.0118	0.0175
		(2.28)**	(1.92)*		(2.44)**	(1.85)*
AnalystsCov			0.0016			-0.0002
			(2.09)**			(0.30)
AnalystsDisp			0.1305			0.3857
			(0.91)			(5.66)***
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No.	18154	18014	7004	18734	18582	7108
R^2	0.5210	0.5355	0.6409	0.4596	0.4759	0.5065

Table A-2. Semi-parametric hazard model estimates: the effects of ScaledWPS and HP Index
LS is the ratio of the value of shares available for lending to the firm's market capitalization, which covers the period from 2002 to 2011. Following Whited (2006) and Billet et al. (2011), we include firms whose real assets are below the 33rd percentile of the real assets in the first year that the firm appears in the sample. Following Edmans, Gabaix, and Landier (2009), ScaledWPS is the measure of scaled wealth performance sensitivity, the dollar change in wealth for a one-percentage-point change in firm value, divided by annual pay. We construct the HP index by using the methodology described in Hadlock and Pierce (2010). A firm is defined as a high (low) ScaledWPS firm if its average ScaledWPS is above (below) the 67th (33rd) percentile of the average ScaledWPS. A firm is defined as a high (low) HP Index firm if its average HP Index is above (below) the 67th (33rd) percentile of the average HP Index. The Investment/Asset measure used for the hazard estimation is the calculated as (data30-data107)/data6. SaleGrowth is the changes in sales scaled by lagged sales. CashFlow is the sum of income before extraordinary items and depreciation and amortization, scaled by total assets. TotAsset is the logarithm of total assets. A spike is defined as an investment rate exceeds a threshold, and the threshold is pre-defined in terms of two times the firm median investment rate. The number of years since the last spike has also been included, although coefficients are omitted. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Hazard Estimation			
	ScaledWPS		HP Index	
	(1) High	(2) Low	(3) High	(4) Low
LS	-1.4811	-0.7517	-0.3357	-2.0079
	(3.24)***	(1.08)	(0.82)	(4.90)***
Leverage	-3.1972	-5.2735	-1.4845	-1.7967
	(1.19)	(0.57)	(1.03)	(1.32)
SalesGrowth	3.0355	0.6021	0.5643	0.8081
	(1.,98)**	(0.18)	(1.68)*	(0.62)
CashFlow	-0.0354	0.4593	-0.6589	4.4938
	(0.03)	(0.11)	(0.80)	(1.06)
TotAsset	-1.5784	-0.3675	-0.2471	-1.5936
	(2.95)***	(0.32)	(0.71)	(4.30)***
obs	532	462	1088	1551
Year Dummies	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes
log likelihood	-300.78	-178.85	-188.55	-511.11

Table A-3. The impact of FAS 123R on the governance effect of lending supply
This table contains the results regarding the impact of FAS 123R on governance effect of lending supply. In 2004, the FASB issued FAS 123R, which is a revised version of FAS 123. FAS 123R requires firms to use the fair value of the stock options in the income statement, and is effective after June, 2005. Pre-123R is a dummy variable that equals one from 2002 to 2004, and zero for time during 2006 to 2008. We exclude the year of 2005, as this year is when FAS 123R was issued by the Financial Accounting Standards Board (FASB). In columns (1) and (2), the dependent variable is the 5-day cumulative abnormal stock returns (CAR (-2,2)) for acquirer firms in the subsequent year. CAR is the five-day cumulative abnormal return calculated using a market model estimated over the period [-210, -11] relative to the announcement date (day 0). We include the same control variables used in column (14) of Table 2 but their coefficients are not reported. In columns (3) and (4), the dependent variable is abnormal capital investment, which is the difference between the current year's capital investment and the average levels of capital investment measured over the last three years (Eq.(2)). We include the same control variables used in column (9) of Table 4 but their coefficients are not reported. In columns (5) and (6), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7 but their coefficients are not reported. In columns (7) and (8), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8 but their coefficients are not reported. LS is the ratio of the value of shares available for lending to firm market capitalization. Detailed definitions of these variables are reported in Appendix B. The table with complete coefficients are presented in Internet Appendix, which is available upon request. In columns (1) and (2), industry and year fixed effects are controlled, and standard errors are two-way clustered by both firm and year (Petersen (2009)). In columns (3) - (8), we control for firm and year fixed effect and heteroskedasticity-consistent standard errors are clustered at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	The impact of FAS 123R on governance effect of lending supply							
	(1) CAR	(2) CAR	(3) ACI	(4) ACI	(5) Tobin's Q	(6) Tobin's Q	(7) ROA	(8) ROA
LS	0.0512	0.0531	-0.3211	-0.3448	0.2607	0.2653	0.0260	0.0233
	(1.75)*	(1.84)*	(2.92)***	(3.13)***	(2.55)**	(2.60)***	(2.55)**	(2.26)**
LS × Pre-FAS		0.3724		-1.1834		1.3466		0.0751
		(1.68)*		(1.99)**		(1.00)		(2.09)**
Pre-FAS		0.0245		0.0004		-0.4123		-0.0050
		(3.52)***		(0.01)		(5.02)***		(0.43)
Control Variables	Y	Y	Y	Y	Y	Y	Y	Y
Year Dummies	Y	Y	Y	Y	Y	Y	Y	Y
Firm Dummies	N	N	Y	Y	Y	Y	Y	Y
Industry Dummies	Y	Y	N	N	N	N	N	N
Obs.	594	594	14561	14561	14602	14602	16299	16299
R^2	0.1749	0.1755	0.3384	0.3389	0.7355	0.7355	0.7498	0.7500

Table A-4. Multivariate DiD test regarding the effects of Regulation SHO on short seller's lending fees.
This table reports the results of the multivariate difference-in-differences (DiD) test regarding the effects of Regulation SHO on lending fees. Lending fee is the value-weighted average fee for all new trades on the most recent business day (in percentage). The sample runs from 2002 until the end of the PILOT program (2007). Treated is a dummy variable that equals to one for firms that are selected as Regulation SHO treated stock, and zero for the remaining Russell 3000 index members. PILOT is a time dummy that equals one from 2005 to 2007, and zero for years from 2002 to 2004. Size is the logarithm of market capitalization. IOR is the ratio of the institutional investors ownership to total shares outstanding. Turnover is the ratio of the annual trading volume to total shares outstanding. Age is the date of the company's total assets data first appeared in COMPUSTAT (in logarithm). BM is the logarithm of the ratio of the book value of equity divided by the market value of equity. PastRet is the logarithm of compounded monthly stock returns in the previous year. In column (2), we control for both year and firm fixed effects, while coefficients are omitted. Note that the coefficient on Treated is dropped in column (2) because it is correlated with the firm fixed effects. Heteroskedasticity-consistent standard errors are clustered at the firm level. Detailed definitions of these variables are reported in Appendix B. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Multivariate DiD test of lending fee	
	(1)	(2)
Treated	-0.0541	
	(1.28)	
PILOT	0.2118	0.0917
	(7.37)***	(1.83)*
PILOT × Treated	0.0215	0.0376
	(0.36)	(0.65)
Size	-0.0720	-0.2943
	(4.69)***	(4.87)***
IOR	-0.6746	0.2421
	(6.16)***	(0.94)
Turnover	0.0813	0.0525
	(6.87)***	(2.06)**
Age	0.0182	0.3655
	(0.64)	(1.64)
BM	-0.1212	-0.1121
	(2.84)***	(2.11)**
PastRet	-0.1686	-0.1266
	(6.51)***	(3.96)***
Year Dummies	No	Yes
Firm Dummies	No	Yes
Obs.	5467	5467
R^2	0.1153	0.6764

Table A-5. LS improves Tobin's Q and ROA through disciplining overinvestment
This table provides regression results on whether subsequent ACI is related to the associations between LS, firm value and operating performance. In columns (1) and (2), the dependent variable is the industry-adjusted Tobin's Q in the subsequent year. We include the same control variables used in column (12) of Table 7. In columns (3) and (4), the dependent variable is the industry-adjusted ROA in the subsequent year. We include the same control variables used in column (7) of Table 8. Firms that have subsequent ACI being larger (smaller) than the median are included in columns of (1) and (3) ((2) and (4)). LS is the ratio of the value of shares available for lending to firm market capitalization over the 2002–2011 period. Detailed definitions of these variables are reported in Appendix B. In all model specifications, we control for both year and firm fixed effects, and cluster standard errors at the firm level. *t-values* are in parentheses. *,**, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

	Dependent Variable: Subsequent Tobin's Q		Dependent Variable: Subsequent ROA	
	(1) Subsequent ACI Above Median	(2) Subsequent ACI Below Median	(3) Subsequent ACI Above Median	(4) Subsequent ACI Below Median
LS	0.1872	0.2559	0.0194	0.0475
	(1.38)	(1.82)*	(1.05)	(2.15)**
IOR	-0.1351	-0.0992	-0.0220	-0.0505
	(0.81)	(0.51)	(1.34)	(2.58)**
Size	-0.1101	0.0159	-0.0048	-0.0064
	(2.72)***	(0.45)	(0.77)	(1.16)
Leverage	-0.7335	-0.3619	-0.0288	-0.0338
	(3.42)***	(1.78)*	(1.33)	(1.36)
ROA			0.0009	0.0905
			(0.03)	(2.12)**
BM			-0.0440	-0.0484
			(5.86)***	(7.78)***
Tobin's Q				
R&D	-0.3766	-0.3296		
	(0.21)	(0.19)		
FixedAsset	-0.0520	-0.0718		
	(1.09)	(1.46)		
CashFlow	-0.3400	-0.0829		
	(1.38)	(0.35)		
SaleGrowth				
Dividend	0.0499	-0.1750	-0.0167	0.0219
	(0.13)	(0.35)	(0.43)	(0.56)
Capx	-0.7348	1.0416	0.0101	0.0780
	(1.35)	(0.96)	(0.16)	(1.08)
Sale	-0.1700	-0.3396		
	(2.07)**	(4.12)***		
Age	-0.2779	-0.3915		
	(2.01)**	(3.20)***		
Cash	-0.0544	-0.0757		
	(1.34)	(2.46)**		
InsiderOwn	0.4345	0.8678		
	(0.84)	(1.57)		
InsiderOwn^2	-0.3533	-1.1536		
	(0.35)	(1.02)		
ROE	0.0852	0.0384		
	(0.81)	(0.40)		
Year Dummies	Y	Y	Y	Y
Firm Dummies	Y	Y	Y	Y
Obs.	10517	10519	11224	11193
R^2	0.7775	0.7644	0.7817	0.7710

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