

# Disciplinary effect of short selling: evidence from mergers and acquisitions

China Accounting and Finance Review

57

Hai Lin

School of Economics and Finance, Victoria University of Wellington,  
Wellington, New Zealand, and

Chang Yu

Housing and Health Research Programme, University of Otago,  
Wellington, New Zealand

Received 19 July 2024

Revised 5 February 2025

30 April 2025

21 July 2025

Accepted 8 October 2025

## Abstract

**Purpose** – Using Regulation SHO’s pilot program as a natural experiment, we study how removing short-selling constraints affects a firm’s mergers and acquisitions (M&A).

**Design/methodology/approach** – Difference-in-difference (DID) regressions.

**Findings** – We find that during the pilot program, firms in the pilot group significantly reduce their value-destroying M&A activities. The disciplinary effect focuses on firms with higher levels of agency problems and those with higher levels of CEO incentive pay, where equity-based compensation increases managerial sensitivity to market discipline. The impact of the pilot program on M&As does not focus on overvalued firms, indicating that stock overvaluation does not channel the impact. Finally, we show that the M&A deal quality of firms in the pilot group improves during the pilot program. The overall results indicate that the removal of short sale constraints can create an effective external monitoring system for corporate investment behavior.

**Originality/value** – Our paper contributes to the growing literature in several ways. First, our study extends Chang *et al.* (2019) to provide a different but equally important angle on how short selling disciplines M&As. Second, our results of using long-term post-acquisition stock performance supplement the study of Chang *et al.* (2019). Third, this paper extends Shi *et al.* (2021) to take advantage of the Regulation SHO’s pilot program. Therefore, we investigate the effect of short selling on M&As from a policy perspective.

**Keywords** Short selling, Mergers and acquisitions, Disciplinary effect, Pilot program, Agency problem

**Paper type** Technical paper

## 1. Introduction

Short selling is one important channel for investors to impose a disciplinary effect on a firm’s decisions. Recently, there has been increasing attention on how short sales impact corporate behaviors [1]. See, for example, Grullon, Michenaud, and Weston (2015) on capital expenditure and equity issuance; Fang, Huang, and Karpoff (2016) on earnings management; De Angelis, Grullon, and Michenaud (2017) on manager compensation packages; Chen and Wu (2021) on real activity manipulation; He, Ren, and Tian (2023) on innovations; He, Ma, and Wang (2024) on internal governance and An, Xia, and Xu (2024) on corporate risk-taking. Among various corporate behaviors, mergers and acquisitions (M&As) are the largest and most readily observable form of corporate investment (Masulis, Wang, & Xie, 2007). It is a typical kind of corporate behavior that should be investigated independently from others (Billett, Garfinkel, & Jiang, 2011). It is thus of interest to study how the change of short sales constraints influences corporate M&As.

The literature has documented that managerial incentives are one driver of M&As (Jensen, 1986; Shleifer & Vishny, 1989, 1997; Morck, Shleifer, & Vishny, 1990; Arian & Stulz, 2016).

## JEL Classification — G12, G14

© Hai Lin and Chang Yu. Published in *China Accounting and Finance Review*. Published by Emerald Publishing Limited. This article is published under the Creative Commons Attribution (CC BY 4.0) licence. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial and non-commercial purposes), subject to full attribution to the original publication and authors. The full terms of this licence may be seen at [Link to the terms of the CC BY 4.0 licence](#).



China Accounting and Finance Review  
Vol. 28 No. 1, 2026

pp. 57-88

Emerald Publishing Limited

e-ISSN: 2307-3055

p-ISSN: 1029-807X

DOI 10.1108/CAFR-07-2024-0092

Morck *et al.* (1990) find that M&A deals generally destroy firm value. Intuitively, if short sellers can uncover firms' misconduct (Karpoff & Lou, 2010) or inefficient decisions, the removal of short sale constraints should help discipline firms on their value-destroying M&As driven by managerial incentives.

In this paper, we take advantage of a randomized natural experiment initiated by the Securities and Exchange Commission (SEC) in July 2004 to address this question. The randomized experiment, known as Regulation SHO's pilot program, ranked stocks in the Russell 3,000 index by trading volume within each exchange and selected every third one into the pilot group. The SEC then removed various short sale constraints for firms in the pilot group. Therefore, there are significantly fewer short sale constraints for stocks in the pilot group. As the pilot stocks are randomly selected so that no firms could know ahead of time whether they are included in the pilot group until the program was announced, it is an exogenous shock to short selling (Fang *et al.*, 2016). By comparing the M&A behaviors of the pilot group and control (non-pilot) group, we can study whether the short selling threat has a disciplinary effect on firms to engage in value-destroying M&As.

The present paper addresses this issue mainly from a policy perspective. Since the 1930s, the uptick rule was introduced to restrict short-selling activities because stocks cannot be shorted at a decreasing price. As stock exchanges introduce the uptick rule at different times and with diverse conditions, firms deliberately switch stock exchanges to get protection from the uptick rule (Grullon *et al.*, 2015). The removal of the uptick rule has caused great controversy. Many corporate managers and government officers appeal for the reintroduction of the uptick rule, and the real effect of the uptick rule is still controversial among academics. Therefore, the present study focuses on whether the removal of the uptick rule really matters to benefit corporate investment.

We document several major findings in this paper. First, we find that the removal of short sale constraints disciplines firms from engaging in value-destroying M&As. To identify an M&A deal as value-destroying, we first follow Jensen (1986), Lang, Stulz, and Walkling (1991), Harford (1999), Chen, Chen, and Wei (2011), Arikan and Stulz (2016) and Li, Liu, and Wu (2018) to categorize cross-industry M&As as value-destroying. We find that the difference-in-difference (DID) estimate on the frequency of cross-industry M&A deals between the pilot group and the control group from the pre-to the during-pilot program,  $Pilot \times During$ , is  $-0.051$  and significant at the 5% level ( $t = -2.17$ ). This impact corresponds to a 12.69% decrease in mean M&A activity, or equivalently, a negative impact of 0.10 standard deviation. Second, we use the cumulative abnormal returns (CARs) up to 36 months after the deal completion as a measure of M&A deal quality (Rau & Vermaelen, 1998; Louis, 2004). We regard the M&A deals with a negative CAR as value-destroying. The estimate of  $Pilot \times During$  on the M&A frequency is  $-0.059$  and significant at the 5% level ( $t = -2.55$ ) for the deals with a negative CAR. This result corresponds to a 14.68% decrease in mean M&A activity, or equivalently, a negative impact of 0.11 standard deviation. The results are robust if we add various control variables to the regressions. A negative value of the DID estimate indicates that firms in the pilot group do fewer value-destroying M&As during the pilot program period relative to firms in the control group. On the other hand, the DID coefficients are not significant for all deals or non-value-destroying deals. These findings are consistent with Massa, Zhang, and Zhang (2015) and Fang *et al.* (2016) and support the hypothesis of the disciplinary effect played by short selling.

Second, we find that the disciplinary effect mainly happens for firms with higher levels of agency problems in investment. We use two measures to capture the agency problem in investment. Specifically, we employ firm age and the agency cost of free cash flow. Arikan and Stulz (2016) find that mature firms are more subject to the agency problem in investment. Meanwhile, Jensen (1986), Lang *et al.* (1991), Harford (1999), Chen *et al.* (2011), Arikan and Stulz (2016) and Li *et al.* (2018) show that firms with a higher agency cost of free cash flow have a higher level of agency problem in investment. By splitting the firm sample into two sub-groups by each measure, we run DID regressions for each sub-group. We find that the DID

coefficients of *Pilot*  $\times$  *During* are significantly negative for mature firms and firms with a high agency cost of free cash flow, while they are not significant for the other sub-groups.

Third, we find that the disciplinary effect of Regulation SHO's pilot program focuses on firms using more equity-based compensation. The managers whose incomes are more equity-based are more vulnerable to short-selling threats. We find that the coefficients of *Pilot*  $\times$  *During* are significantly negative for firms with a higher CEO incentive pay and insignificant for firms with a lower CEO incentive pay. [Mehran \(1995\)](#) shows that performance-related compensation will make managers pay attention to the stock performance as their interests are related to the share price. By imposing a believable threat to decrease the stock price, the pilot program effectively disciplines firms whose managers suffer more from a stock price decline.

Fourth, to test whether a decrease in stock overvaluation serves as a channel for the impact of the pilot program on M&A activity, we examine the change in M&A frequency among firms more likely to be overvalued. Our analysis reveals that none of the DID coefficients for *Pilot*  $\times$  *During* are significant for these firms. Therefore, we find no evidence to support the stock overvaluation channel.

Finally, the overall M&A deal quality improves for the pilot group during Regulation SHO's pilot program. By running a DID test on CARs, we find that the coefficients of *Pilot*  $\times$  *During* are positive and significant above the 10% level under various specifications. These results suggest that the overall M&A deal quality improves for the pilot group during the pilot program. By disciplining firms from engaging in value-destroying M&As, Regulation SHO's pilot program effectively improves firm investment efficiency.

Our paper contributes to the growing literature in several ways. Our paper is closely related to [Shi, Ndofor, and Hoskisson \(2021\)](#) and [Chang, Lin, and Ma \(2019\)](#), who also study the disciplinary effect of short selling on M&As. [Chang et al. \(2019\)](#) study the relationship between short-selling threat and the announcement return of M&As, while we focus on the frequency of M&As. [Chang et al. \(2019\)](#) show that a higher level of short-selling threat is related to a better stock return around the M&A announcements. It is not clear whether this impact is due to the improvement of M&A deal quality with an unchanged level of engagement or the reduced engagement in value-destroying M&As. Our study explains this question. For example, [Gantchev, Sevilir, and Shivdasani \(2020\)](#) investigate the impact of activists' interventions on M&As. They document that the announcement return of M&As increases after interventions due to fewer engagements in value-destroying M&As. Moreover, the M&A frequency is one variable used in many studies, such as [Duchin and Schmidt \(2013\)](#), [Levi, Li, and Zhang \(2014\)](#) and [Gantchev et al. \(2020\)](#). For example, [Duchin and Schmidt \(2013\)](#) show that more value-destroying M&As driven by managerial incentives happen during merger waves because the poor quality of analysts' forecasts and information environment reduces external monitoring. Our study extends [Chang et al. \(2019\)](#) to provide a different but equally important angle on how short selling disciplines M&As. Extending the studies of [Morck et al. \(1990\)](#), [Byrd and Hickman \(1992\)](#) and [Shleifer and Vishny \(1997\)](#), we show that the external financial market can significantly mitigate agency problems on top of internal corporate governance. Internal corporate governance and the external financial market interact to address agency problems to improve investment efficiency.

Second, [Chang et al. \(2019\)](#) use the short-term returns around M&A announcements to measure the deal quality, while we use the long-term post-acquisition stock performance. Both approaches have been widely used in the literature. [Bhagat, Dong, Hirshleifer, and Noah \(2005\)](#), [Chen, Harford, and Li \(2007\)](#) and [Duchin and Schmidt \(2013\)](#) discuss that short-term announcement returns are more closely linked to the M&A deals, but there exist several drawbacks of using them to measure the deal quality. The announcement returns may reflect not only the value of the M&A but also the stand-alone value of the acquirer because when a firm announces an M&A, it often simultaneously announces some other unrelated news. Moreover, the degree of the expectation of the deal, the uncertainty over the final price and resolution of the deal, and the information asymmetry between management and investors will distort the announcement returns from reflecting the true quality of the deal. [Duchin and](#)

[Schmidt \(2013\)](#) argue that due to inattention, analysts and investors process limited information about bad acquisitions around the announcements of M&As during merger waves. Our results of stock market performance thus supplement the study of [Chang et al. \(2019\)](#).

Third, this paper differs from [Shi et al. \(2021\)](#) in that [Shi et al. \(2021\)](#) use short interest as the proxy for short-selling threat, while we take advantage of the Regulation SHO's pilot program. Regulation SHO's pilot program is considered a natural experiment, so there are fewer endogeneity concerns. Moreover, we investigate the effect of short selling on M&As from a policy perspective. We are interested in whether the removal of short-selling constraints, like the uptick rule, could influence the M&As of a firm. Short-selling constraints are imposed in many countries and in several ways, for example, bans or an increase in the cost of short selling ([Beber & Pagano, 2013](#)). The Regulation SHO's pilot program removes short sale price tests, reducing the cost of short selling. Therefore, our paper helps bring insight to policymakers regarding the setup of short-selling constraints.

The rest of the paper is structured as follows. [Section 2](#) provides a literature review and develops our hypotheses. [Section 3](#) introduces our data and explains how to construct the sample. [Section 4](#) reports our empirical results. Finally, [Section 5](#) concludes this paper.

## 2. Literature review and main hypotheses

### 2.1 Literature review

**2.1.1 The SHO's pilot program.** An efficient short-selling activity is essential for a well-functioning financial market. Policymakers have been working to change short-selling regulations. The most significant one recently initiated is Regulation SHO's pilot program, which removes short sales constraints in different phases. How this program affects corporate behaviors has been an interesting research question in recent years. [Grullon et al. \(2015\)](#) find that capital expenditures and equity issuance decline for firms in the pilot group. However, this effect is concentrated in small firms. [Grullon et al. \(2015\)](#) indicate that the pilot program increases average short interest and reduces market-adjusted abnormal returns only for small firms in the pilot group. Therefore, they react to lower prices by reducing equity issuance and capital expenditures.

In a different study, [Fang et al. \(2016\)](#) investigate how Regulation SHO's pilot program disciplines firms' earnings management. They document that pilot firms' discretionary accruals and the probability of beating earnings targets decrease during the pilot program period. [Fang et al. \(2016\)](#) argue that this is because short-selling activities facilitate the flow of negative information into the stock price. They support their argument by finding that pilot firms with the most negative earnings surprises have significantly less post-earnings-announcement drift. Meanwhile, [De Angelis et al. \(2017\)](#) study how the pilot program influences corporate compensation structure. They find that to mitigate the adverse effects of short-selling threats, pilot firms grant managers more stock options to convexify their compensation payoffs.

Recent studies have continued to explore the impact of the pilot program on various aspects of corporate behavior. For example, [Wang, Wang, Wei, Zhang, and Zhou \(2022\)](#) find that the program helps constrain opportunistic insider trading by increasing the cost of poor governance behavior, especially in firms with high litigation risk and media exposure. Similarly, [He et al. \(2023\)](#) show that the pilot program has a positive real effect on corporate innovation by enhancing the quality, value and efficiency of firms' innovative activities.

**2.1.2 Value-destroying M&A.** [Masulis et al. \(2007\)](#) argue that among various corporate behaviors, M&As are the largest and most readily observable forms of corporate investment. [Billett et al. \(2011\)](#) further comment that M&A is a typical kind of corporate behavior that should be investigated independently from others. The literature has documented that most M&As are value-destroying, driven by three main motivations. The first is the CEO's overconfidence. [Roll \(1986\)](#) shows that managers of the acquiring firms are overconfident.

They believe they can better manage the target firms and increase the firm value above the market's perceptions. Therefore, they are willing to overpay the target firms. The underlying assumption for the CEO overconfidence hypothesis is that the market is efficient so that the financial market reflects all information; however, the managers are irrational due to their overconfidence. [Malmendier and Tate \(2005\)](#) and [Chikh and Filbien \(2010\)](#) document evidence for this hypothesis.

The second is stock overvaluation. [Shleifer and Vishny \(2003\)](#) introduce a model of M&As based on stock market misvaluations of the combining firms. Under this model, stock acquisitions are made by overvalued acquirers of relatively less overvalued targets. [Shleifer and Vishny \(2003\)](#) use this hypothesis to explain the massive M&A wave in the late 1990s. During this wave, acquirers are much more valued than the targets, even when they are in the same industry. The underlying assumption behind the stock overvaluation hypothesis is opposite to the CEO's overconfidence hypothesis: the stock overvaluation hypothesis assumes the managers are rational, but the market is inefficient so that rational managers take advantage of incorrectly valued stocks through M&As. [Rhodes-Kropf, Robinson, and Viswanathan \(2005\)](#), [Dong, Hirshleifer, Richardson, and Teoh \(2006\)](#) and [Fu, Lin, and Officer \(2013\)](#) also support the stock overvaluation hypothesis. However, the impact of such M&As on shareholders' wealth remains inconclusive. For example, [Shleifer and Vishny \(2003\)](#) argue that the shareholders' wealth of overvalued firms increases if they use overvalued shares as a tool to purchase less overvalued firms. [Fu et al. \(2013\)](#) challenge this by arguing that overvalued firms significantly overpay the targets, and these deals mainly happen in firms with governance problems.

The third is known as the managerial incentive, which is closely related to agency theory and managers' incentive compensation. According to agency theory, managerial investment decisions may reflect their interests rather than those of shareholders ([Jensen, 1986](#); [Shleifer & Vishny, 1997](#); [Arikan & Stulz, 2016](#)). Under this hypothesis, M&As are value-destroying to a firm. There are several reasons for this. First, managers seek to diversify the holdings of the firm to reduce the risk to their human capital, especially when they are not diversified ([Morck et al., 1990](#)). Second, poorly performing managers seek new business through M&As to survive ([Morck et al., 1990](#)). This argument indicates that these M&As tend to diversify to increase their growth opportunities ([Arikan & Stulz, 2016](#)). Third, [Shleifer and Vishny \(1989\)](#) argue that M&As can entrench management. They find that large firms tend to offer managers more fringe benefits and compensation. Using a sample of 326 US acquisitions between 1975 and 1987, [Morck et al. \(1990\)](#) find that the market returns to these M&As are significantly and substantially lower.

In addition to agency problems, managers' incentive compensation also affects M&As. [Minnick, Unal, and Yang \(2011\)](#) document that high pay-for-performance sensitivity helps reduce the incentives for making value-destroying acquisitions. Firms whose CEOs have higher pay-for-performance sensitivity have better abnormal returns around the announcement of M&As after controlling for various corporate governance measures and firm characteristics. [Bliss and Rosen \(2001\)](#) also find that the form of compensation affects managerial incentives in M&As. Firms whose CEOs receive more equity-based income are less likely to make an acquisition. Moreover, the influence of manager compensation on firm behavior is robust to agency problems. For example, [Bergstresser and Philippon \(2006\)](#) and [Burns, McTier, and Minnick \(2015\)](#) find that CEO compensation affects accruals and dividend payout after controlling for agency problem variables like age and free cash flow.

**2.1.3 Diversifying M&A.** We focus on the driver of managerial incentive in developing our hypothesis and test the stock overvaluation hypothesis as one robustness check. One critical question to study the impact is how to categorize an M&A as value-destroying. Besides the usual CAR measure, a majority of the literature has also used diversification as one criterion. It is closely related to M&As driven by managerial incentives ([Morck et al., 1990](#); [Arikan & Stulz, 2016](#)). [Arikan and Stulz \(2016\)](#) view diversified M&As as inefficient due to the complexity of managing firms in different industries. [Rajan, Servaes, and Zingales \(2000\)](#)

introduce a theoretical model of internal capital allocation based on power considerations. They find that if the diversity of resources and opportunities increases, funds can be transferred to the least efficient division, leading to more inefficient investments and less valuable firms. Consistent with [Rajan et al. \(2000\)](#), [Ozbas and Scharfstein \(2010\)](#) compare the investment's Q-sensitivity of diversified and focused firms and find that diversified firms tend to have a lower Q-sensitivity.

Many studies also find empirical evidence that diversification destroys firm value. For example, [Berger and Ofek \(1995\)](#) compare the sum of the stand-alone values of each business segment with the actual values of conglomerate firms and conclude that diversification destroys firm values. [Lamont and Polk \(2002\)](#) document that the exogenous shocks in diversity are negatively related to firm values, due to changes in industry investment. [Fauver, Houston, and Naranjo \(2004\)](#) and [Dos Santos, Errunza, and Miller \(2008\)](#) also document that industrial diversification leads to value discount. [Schoar \(2002\)](#) demonstrates that diversified M&As destroy firm value using plant-level data. [Malmendier and Tate \(2008\)](#) also use diversification as a proxy for value destruction.

### 2.2 Hypotheses development

[Karpoff and Lou \(2010\)](#) demonstrate that short sellers have the capability of uncovering the negative information of a firm. By imposing the pressure of a timely stock price decline, short selling can discipline firms from engaging in misconduct or other value-destroying activities. The SHO's pilot program removes short sales constraints for firms in the pilot group and makes their stocks more accessible to short sellers. With regard to M&As, such removals will increase the short-selling threat level and make those firms less likely to undertake value-destroying M&As. Following this train of thought, our primary hypothesis is that firms in the pilot group will engage less in value-destroying M&As during the pilot program period.

We use two proxies to identify value-destroying M&As. Following [Morck et al. \(1990\)](#), [Berger and Ofek \(1995\)](#), [Rajan et al. \(2000\)](#), [Lamont and Polk \(2002\)](#), [Fauver et al. \(2004\)](#), [Ozbas and Scharfstein \(2010\)](#), [Arikan and Stulz \(2016\)](#) and others, we first identify an M&A deal being value-destroying if it is a cross-industry M&A. Second, we follow [Rau and Vermaelen \(1998\)](#) and [Louis \(2004\)](#) to use a negative CAR over a period of 36 months after the deal completion to identify the value-destroying M&As. We form our first hypothesis as follows:

*H1.* When short sale constraints are removed for firms in the pilot group during the pilot program, they will engage in fewer value-destroying M&As.

[Jensen \(1986\)](#), [Shleifer and Vishny \(1997\)](#) and [Arikan and Stulz \(2016\)](#) find that investment decisions can reflect the interests of managers rather than shareholders, stemming from agency problems between the two. As a result, agency issues may prompt managers to pursue M&As that benefit themselves at the expense of shareholder value, such as those driven by managerial empire-building incentives. By exerting a disciplinary effect, short selling can help mitigate such incentives. These ideas suggest that the removal of short sale constraints should primarily reduce value-destroying M&As for firms with higher levels of agency problems.

*H2.* The disciplinary effect of the pilot program on M&As concentrates on firms with higher levels of agency problems.

The intuition behind the disciplinary effect of short selling on M&As is that when managers initiate value-destroying deals, they will face a significant downward price pressure caused by increased short sales. This channel works when managers are more vulnerable to the stock price decline caused by short sales. [Mehran \(1995\)](#) argues that the form of compensation, rather than the level of compensation, motivates managers to increase firm value. Managers with a more equity-based income will pay more attention to their firms' performance, as their interests are more tied to stock returns. On the contrary, if their compensation is irrelevant to

stock performance, managers will care less about the downward price pressure caused by short sales, which will make the disciplinary effect ineffective. Following this literature, we conjecture that the pilot program works when the managers' incomes are more tied to stock performance. In our test, we employ the CEO incentive pay used in [Adams and Ferreira \(2009\)](#) to measure managers' equity-based compensation and form the following hypothesis:

- H3. The disciplinary effect of the pilot program on M&As concentrates on firms with high CEO incentive pay.

The removal of short sale constraints has the potential to reduce stock overvaluation, which is a key driver for firms to engage in M&A activities ([Shleifer & Vishny, 2003](#); [Rhodes-Kropf et al., 2005](#); [Dong et al., 2006](#); [Fu et al., 2013](#)). However, it does not guarantee a reduction in stock overvaluation, as the effect of short sale constraints also depends on the dispersion of opinions regarding firm value ([Boehme, Danielsen, & Sorescu, 2006](#)). Recent evidence suggests that the pilot program has had a limited effect on reducing the stock overvaluation of the pilot firms ([Office of Economic Analysis, 2007](#)).

As discussed earlier, we conjecture that the removal of short sale constraints affects M&A deal quality through a disciplinary effect. If this effect is the primary channel, the impact of removing short sale constraints should not be concentrated solely on overvalued firms. We formulate our [hypothesis 4](#) as follows:

- H4. The impact of the pilot program on M&A activity should not be concentrated solely on overvalued firms.

[Chang et al. \(2019\)](#) use the short-term returns around M&A announcements to measure the deal quality and identify a disciplinary effect of short selling on value-destroying M&As. We extend their study to examine the long-term post-acquisition stock performance. Intuitively, if the pilot program effectively disciplines firms to undertake fewer value-destroying M&As, the overall quality of M&A deals should improve and their long-term post-acquisition stock returns should perform better. We formulate our final hypothesis as follows:

- H5. The pilot firms' long-term post-acquisition stock performance improves during the pilot program period.

### 3. Data

Our data comes from different sources. We start with the Russell 3,000 (R3000) list as of June 30, 2004, from the Bloomberg terminal. The SEC announced the short sale experiment on July 28, 2004. The experiment started in May 2005 and ended in July 2007. It randomly assigned one-third of the firms in the R3000 list as of June 25, 2004, to be treated. We download the allocated stocks list from the SEC website [2]. We use the remaining stocks in the R3000 list that are excluded from the experiment to construct the control group. We impose several criteria. We exclude those firms that are partly treated from our control group, since some short sales constraints do not apply to them. To do this, we follow the SEC's statement of its exclusion rules and exclude firms that were not listed on the NYSE/AMEX or Nasdaq national market and firms that went public or had spin-offs after April 30, 2004. Our initial sample includes 986 pilot stocks in the treated group and 1,966 non-pilot stocks in the control group, which is consistent with [Fang et al. \(2016\)](#).

We retrieve the data of M&As from Thomson Reuters' SDC database. Data on firm characteristics are from the Compustat database. We match the firms' information with our stock sample. Following the literature, we use several criteria to clean the data. First, we use 2001–2010 as our main sample period to cover three years before and after the program. We follow [Fang et al. \(2016\)](#) to exclude 2004 from our sample since the pilot program was announced halfway through 2004. Second, we follow [Fu et al. \(2013\)](#) to consider only M&As that are finally completed [3]. Third, consistent with [Baker and Savaşoglu \(2002\)](#), [Netter,](#)

Stegemoller, and Wintoki (2011), Harford, Jenter, and Li (2011) and Levi *et al.* (2014), we focus on the M&As with an explicit change of control. To do that, we require acquirers to own less than 50% of shares in the targets prior to the announcements of M&As and are seeking to purchase 50% or more in the deals. Furthermore, we exclude buybacks and exchange offers and do not put conditions on deal values. Netter *et al.* (2011) and Aktas, De Bodt, and Roll (2013) show that putting such restrictions will result in a small and unrepresentative sample and lead to incomplete and misleading inferences [4]. We require firms to announce at least one M&A within our sample period in order to remain in the sample. Hoechle, Schmid, Walter, and Yermack (2012) and Fang *et al.* (2016) find that the accounting rules and investment purposes are significantly different for the financial services (SIC 6000-6999) and utilities (SIC 4900-4949) industries. We exclude firms in these industries. We also require firms to have available information about control variables in the regression. In our final sample, there are 584 firms in the pilot group and 1,150 firms in the control group. We have 13,265 firm-year observations in the whole sample, with 10,440 completed deals.

Table 1 presents a descriptive summary of the sample. Panel A reports the summary statistics of firm variables used in our empirical study. We explain how we construct each variable in appendix. Our dependent variable is  $\text{Ln}_-(1 + \text{Count}_{i,t})$ , where  $\text{Count}_{i,t}$  is the total number of M&A deals announced by firm  $i$  in a given year  $t$ . We use the log transformation of M&As due to the skewness of the data. Since a firm may not engage in any M&As in a given year, we add one to  $\text{Count}_{i,t}$  to ensure the logarithm function is meaningful. To eliminate the impact of outliers, we winsorize all variables at the top and bottom 1%. We report the results of all firms, pilot firms and control firms, respectively. Following Fang *et al.* (2016) and De Angelis *et al.* (2017), we also compare the firm characteristics of the pilot group and the control group in 2003, the year immediately before the start of the pilot program. The last column reports the  $t$ -statistics of the difference. None of them is significant. The result shows that the two groups are indistinguishable from each other.

Panel B of Table 1 presents the classification of M&A deals year by year. We classify an M&A deal as cross- or within-industry. To identify an M&A as cross-industry or diversified, we employ the Fama–French’s 48 industry classifications. If the acquirer and target are in different Fama–French’s 48 industry classifications, we regard this deal as a cross-industry (diversified) deal. Otherwise, it will be considered as a within-industry deal. Among the 10,440 completed deals, 4,570 deals are classified as cross-industry (diversified) deals, while 5,870 deals are categorized as within-industry deals. We also classify M&As using CAR. Following Barber and Lyon (1997), Rau and Vermaelen (1998) and Louis (2004), we calculate a firm’s abnormal return (AR) relative to its size and market-to-book (MB) ratio benchmark. First, we rank stocks listed on the NYSE, AMEX and NASDAQ with information on both CRSP and COMPUSTAT into deciles at the end of every month based on market capitalization. Then, we sort each decile into quintiles using the MB ratio, resulting in  $10 \times 5 = 50$  portfolios. We form benchmark returns using the monthly returns of these 50 portfolios. The abnormal return is the difference between a stock’s monthly return and that of its benchmark portfolio. Following Rau and Vermaelen (1998) and Louis (2004), we use the CAR over 36 months after the deal completion to determine whether it is negative or positive. After such a classification, we have 6,933 deals with a negative CAR, 3,423 deals with a positive CAR and 10,356 deals with available CAR information [5].

#### 4. Empirical results

In this section, we report the empirical results to test our hypotheses. To run the tests, we split our sample period into three sub-periods. The three years before the pilot program (2001 to 2003) are the Pre period. The three years of the pilot program (2005 to 2007) are the During period, while the three years after the pilot program (2008 to 2010) are the After period.

**Table 1.** Descriptive summary

Variable	All firms						Pilot firms						Control firms						Diff. in 2003 t-stat			
	N	Mean	STD	25%	Median	75%	N	Mean	STD	25%	Median	75%	N	Mean	STD	25%	Median	75%				
<i>Panel A: Firm characteristics</i>																						
<i>Ln_(1 + Count)</i>	1,734	0.404	0.524	0	0	0.693	584	0.402	0.524	0	0	0.693	1,150	0.405	0.523	0	0	0.693	0.94			
<i>ROA</i>	1,734	0.107	0.129	0.070	0.120	0.172	584	0.114	0.124	0.078	0.126	0.176	1,150	0.103	0.131	0.066	0.118	0.170	1.65			
<i>MB_Ratio</i>	1,734	2.797	3.302	1.379	2.142	3.451	584	2.814	3.154	1.386	2.107	3.397	1,150	2.788	3.376	1.373	2.164	3.469	1.36			
<i>Leverage</i>	1,734	0.312	0.294	0.040	0.279	0.468	584	0.304	0.280	0.050	0.278	0.451	1,150	0.317	0.301	0.033	0.280	0.475	-0.18			
<i>Ln_MV</i>	1,734	7.063	1.636	5.935	6.911	8.036	584	7.112	1.642	5.991	6.973	8.110	1,150	7.038	1.632	5.899	6.880	8.004	0.85			
<i>Ln_Sales</i>	1,734	6.842	1.746	5.683	6.810	7.945	584	6.864	1.712	5.766	6.892	7.907	1,150	6.830	1.763	5.648	6.766	7.970	0.39			
<i>CAPEX</i>	1,734	0.078	0.149	0.020	0.035	0.067	584	0.079	0.148	0.020	0.036	0.068	1,150	0.078	0.149	0.019	0.034	0.067	1.28			
<i>RDX</i>	1,734	0.102	0.322	0	0.008	0.089	584	0.101	0.340	0	0.004	0.081	1,150	0.103	0.313	0	0.010	0.094	-0.07			
<i>Cash</i>	1,734	0.413	1.071	0.032	0.111	0.353	584	0.400	1.108	0.028	0.103	0.334	1,150	0.420	1.051	0.035	0.115	0.354	-0.43			
<hr/>																						
Year	By industry Cross						Within			Total			By CAR Negative			Positive			Total			
<i>Panel B: M&amp;A classification</i>																						
2001							560			678			1,238			845			380			1,225
2002							535			703			1,238			863			366			1,229
2003							542			737			1,279			856			416			1,272
2005							576			836			1,412			868			532			1,400
2006							596			731			1,327			842			475			1,317
2007							606			690			1,296			881			403			1,284
2008							428			603			1,031			728			298			1,026
2009							331			385			716			495			210			705
<i>(continued)</i>																						

**Table 1.** Continued

Year	By industry Cross	Within	Total	By CAR Negative	Positive	Total
2010	396	507	903	555	343	898
Pre: 2001–2003	1,637	2,118	3,755	2,564	1,162	3,726
During: 2005–2007	1,778	2,257	4,035	2,591	1,410	4,001
Post: 2008–2010	1,155	1,495	2,650	1,778	851	2,629
Total	4,570	5,870	10,440	6,933	3,423	10,356

**Note(s):** This table presents the summary statistics of the sample. Panel A reports the summary statistics of firm characteristics variables. The variables include M&A frequency ( $Ln_{(1 + Count)}$ ), return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*) and cash and short-term investment (*Cash*). For each variable, we report the number of firms, mean, standard deviation (STD), 25th percentile values, median and 75th percentile values. All variables are winsorized at 1% and 99% to mitigate the impact of outliers. Following [Fang et al. \(2016\)](#) and [De Angelis et al. \(2017\)](#), we also compare the differences of various firm characteristics between the pilot and the control group in 2003, the year immediately before the start of the pilot program and report the *t*-statistics of the difference. Panel B reports the classification of M&A deals year by year. The sample period is from January 2001 to December 2010, excluding 2004. See [appendix](#) for a detailed description of the variables

**Source(s):** Table by authors

#### 4.1 Disciplinary effect and M&A deal quality

4.1.1 *Univariate test.* We first run a univariate test to study whether Regulation SHO's pilot program has a disciplinary effect on value-destroying M&As. We use the cross-industry to capture an M&A as value-destroying and report the results in Table 2. Panel A reports the results of cross-industry deals. We separately calculate the mean of  $\ln(1 + \text{Count}_{i,t})$  during the Pre period for firms in the pilot and control groups. Their mean are 0.296 and 0.280, respectively. The difference is 0.016 with an insignificant  $t$ -value of 0.98. This result suggests

**Table 2.** Univariate test of M&As classified by diversification

	Pre	During	Difference (during-pre)
<i>Panel A. Cross-industry deals</i>			
$\ln(1 + \text{Count}_{i,t})$			
Pilot	0.296	0.278	-0.018 (-0.95)
Control	0.280	0.313	0.033** (2.39)
Difference (Pilot-Control)	0.016 (0.98)	-0.035** (-2.08)	
DID			-0.051** (-2.17)
<i>Panel B. All deals</i>			
$\ln(1 + \text{Count}_{i,t})$			
Pilot	0.417	0.425	0.007 (0.39)
Control	0.407	0.440	0.034** (2.51)
Difference (Pilot-Control)	0.011 (0.68)	-0.016 (-0.93)	
DID			-0.026 (-1.15)
<i>Panel C. Within-industry deals</i>			
$\ln(1 + \text{Count}_{i,t})$			
Pilot	0.294	0.318	0.024 (1.32)
Control	0.306	0.324	0.019 (1.44)
Difference (Pilot-Control)	-0.012 (-0.79)	-0.007 (-0.41)	
DID			0.005 (0.24)

**Note(s):** This table reports the results of the univariate test of M&As. Panels A, B, and C report the results of cross-industry, all and within-industry deals, respectively. If the acquirer and target are in different Fama-French's 48 industry classifications, we regard this deal as a cross-industry deal. A firm is classified into the pilot group if the stock is designated as a pilot stock during the program and into the control group otherwise. The frequency of a firm's M&As is measured by  $\ln(1 + \text{Count}_{i,t})$ , where  $\text{Count}_{i,t}$  is the number of deals announced by firm  $i$  in a given year  $t$ . The three years before the pilot program (2001 to 2003) is the Pre period. The three years of the pilot program (2005 to 2007) is the During period. We report the cross-sectional mean of the pilot and control group during the Pre and the During periods, the time-series mean difference (During-Pre), the cross-sectional mean difference (Pilot-Control) and their difference-in-difference (DID). In the DID panel regression, we cluster the standard errors at the firm level. \*\*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively

**Source(s):** Table by authors

there is no material difference in the M&A frequency between the pilot group and the control group before the pilot program started in 2005. In contrast, the difference in the mean of  $Ln_{-}(1 + Count_{i,t})$  between the pilot group and control group during the During period is  $-0.035$  and significant at the 5% level. This result of cross-sectional difference indicates that during the pilot program period, the pilot firms engage significantly less in cross-industry M&As compared with the control firms.

Besides the cross-sectional difference, we also report the time-series difference in  $Ln_{-}(1 + Count_{i,t})$  between the Pre and the During period in the last column of Panel A. For firms in the control group,  $Ln_{-}(1 + Count_{i,t})$  increases by 0.033, and the change is significant at the 5% level. This finding is consistent with [Alexandridis, Mavrovitis, and Travlos \(2012\)](#) and [Malmendier and Tate \(2005\)](#) that the sixth M&As wave peaked in 2006 and ended in late 2007. However, we do not find this pattern for pilot firms. For firms in the pilot group,  $Ln_{-}(1 + Count_{i,t})$  decreases by 0.018.

To test whether the changes in  $Ln_{-}(1 + Count_{i,t})$  during these two periods are significantly different between the pilot and control groups, we run a univariate DID regression,

$$Ln_{-}(1 + Count_{i,t}) = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i + \beta_3 During_t + \varepsilon_{i,t}, \quad (1)$$

where  $Pilot_i$  equals one if firm  $i$  belongs to the pilot group and zero otherwise.  $During_t$  equals one if year  $t$  belongs to the During period and zero otherwise. Our variable of interest is  $\beta_1$ , which captures the DID of the dependent variable. We cluster the standard errors at the firm level [6]. The last row of Panel A reports the results. The DID estimator is  $-0.051$  and significant at the 5% level. This result supports our [Hypothesis 1](#) that firms in the pilot group during the pilot program engage in fewer cross-industry M&As.

The impact is also economically significant. The mean and standard deviation of  $Ln_{-}(1 + Count)$  are 0.402 and 0.524, respectively, reported in Panel A of [Table 1](#). The coefficient of  $-0.051$  corresponds to a 12.69% decrease in mean, or equivalently, a negative impact of 0.10 standard deviation.

To study whether similar findings exist for other deals, we report the results of all M&A deals and within-industry deals, respectively, in Panels B and C. The results are not significant. The DID estimator using all M&As is  $-0.026$  with a  $t$  value of  $-1.15$ . The DID estimator using within-industry deals is 0.005 with a  $t$  value of 0.24. These results indicate that the pilot program does not discipline firms from all M&As but mainly from the cross-industry deals that tend to be value-destroying.

[Table 3](#) reports the results using CAR as the criterion. Panel A of [Table 3](#) reports the results using the M&As with a negative CAR. The DID estimator is  $-0.059$  and significant at the 5% level. This result means that firms in the pilot group undertake significantly fewer M&A deals with a negative CAR than firms in the control group during the pilot program period. Economically, this change corresponds to a  $-14.68\%$  decrease in mean M&A activity, or equivalently, a negative impact of 0.11 standard deviation. The pilot program has a disciplinary effect on firms to engage less in value-destroying M&As, which supports our [Hypothesis 1](#). As a comparison, Panel B reports the results using the M&As with a positive CAR. The DID estimator is 0.036 and insignificant. The different results reported in Panels A and B imply that the pilot program mainly disciplines firms from the M&A deals that have negative CARs and tend to be value-destroying.

**4.1.2 Multivariate regression.** In this section, we perform the DID regression controlling for other variables. [Harford \(1999\)](#) argues that cash reserves will impact a firm's tendency to engage in M&As. We use cash and short-term investment to account for this. Capital and research and development (R&D) expenditures are documented as determinants of M&A activity in [Lang, Ofek, and Stulz \(1996\)](#), [Faccio and Masulis \(2005\)](#), [Phillips and Zhdanov \(2013\)](#), [Bena and Li \(2014\)](#) and [Elnahas and Kim \(2017\)](#). We add these two variables into our regressions. In addition, we use size, sales, market-to book (MB) ratio, return on assets (ROA)

**Table 3.** Univariate test of M&As classified by CAR

	Pre	During	Difference (during-pre)
<i>Panel A. Negative CAR deals</i>			
<i>Ln_(1 + Count<sub>i,t</sub>)</i>			
Pilot	0.343	0.301	-0.042** (-2.23)
Control	0.321	0.338	0.017 (1.28)
Difference (Pilot-Control)	0.023 (1.42)	-0.037** (-2.20)	
DID			-0.059** (-2.55)
<i>Panel B. Positive CAR deals</i>			
<i>Ln_(1 + Count<sub>i,t</sub>)</i>			
Pilot	0.206	0.268	0.062*** (3.41)
Control	0.228	0.254	0.027** (2.01)
Difference (Pilot-Control)	-0.022 (-1.42)	0.014 (0.83)	
DID			0.036 (1.57)

**Note(s):** This table reports the results of the univariate test of M&As classified by CAR. Panels A and B report the results of negative and positive CAR deals, respectively. The CAR is calculated relative to a size and MB ratio benchmark portfolio over a period of 36 months after the completion of the M&A deal. A firm is classified into the pilot group if the stock is designated as a pilot stock during the program and into the control group otherwise. The frequency of a firm's mergers and acquisitions is measured by  $\ln(1 + \text{Count}_{i,t})$ , where  $\text{Count}_{i,t}$  is the number of deals announced by firm  $i$  in a given year  $t$ . The three years before the pilot program (2001 to 2003) is the Pre period. The three years of the pilot program (2005 to 2007) is the During period. We report the cross-sectional mean of the pilot and control group during the Pre and the During periods, the time-series mean difference (During-Pre), the cross-sectional mean difference (Pilot-Control), and their difference-in-difference (DID). In the DID panel regression, we cluster the standard errors at the firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5%, and 10% levels respectively

**Source(s):** Table by authors

and leverage as the control variables of firm characteristics. We run the following DID regression:

$$\ln_{-}(1 + \text{Count}_{i,t}) = \alpha_0 + \beta_1 \text{Pilot}_i \times \text{During}_t + \beta_2 \text{Pilot}_i \times \text{After}_t + \beta_3 \text{Pilot}_i + \beta_4 \text{During}_t + \beta_5 \text{After}_t + \beta_6 X_{i,t} + \varepsilon_{i,t} \quad (2)$$

In this regression,  $\text{After}_t$  is a dummy variable that equals one if the year is during the Post period (2008 to 2010).  $X_{i,t}$  is the set of controlling variables, including *ROA*, *MB\_Ratio*, leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*) and cash and short-term investment (*Cash*). Our variable of interest is the coefficient of  $\text{Pilot} \times \text{During}$ ,  $\beta_1$ .

Table 4 reports the regression results [7]. We run the regressions without or with fixed effects and cluster the standard errors at the firm level. Following De Angelis et al. (2017), we omit  $\text{Pilot}_i$  in the regressions with a firm fixed effect to avoid the multicollinearity of the independent variables.

Panel A of Table 4 reports the results using cross-industry as the criterion. Columns (1) to (3), (4) to (6) and (7) to (9) report the results of cross-industry deals, all deals and within-industry deals, respectively. The results show that the coefficients of  $\text{Pilot}_i \times \text{During}_t$  are

**Table 4.** Multivariate DID regression of different M&A classifications

	Cross-industry deals <i>Ln_(1 + Count)</i>			All deals <i>Ln_(1 + Count)</i>			Within-industry deals <i>Ln_(1 + Count)</i>		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Panel A: Multivariate DID regression result of M&amp;As classified by diversification</i>									
<i>Intercept</i>	-0.053 (-1.33)	-0.190*** (-1.89)	-0.190* (-1.88)	-0.116*** (-3.10)	-0.126 (-1.34)	-0.127 (-1.34)	0.021 (0.63)	-0.068 (-0.73)	-0.068 (-0.73)
<i>Pilot × During</i>	-0.056** (-2.52)	-0.058** (-2.57)	-0.057** (-2.56)	-0.031 (-1.43)	-0.035 (-1.60)	-0.035 (-1.59)	0.003 (0.12)	-0.005 (-0.24)	-0.005 (-0.23)
<i>Pilot × After</i>	-0.025 (-1.07)	-0.019 (-0.78)	-0.019 (-0.78)	-0.015 (-0.62)	-0.014 (-0.56)	-0.014 (-0.56)	0.010 (0.42)	0.004 (0.16)	0.004 (0.16)
<i>Pilot</i>	0.020 (1.06)			0.005 (0.27)			-0.017 (-1.03)		
<i>During</i>	0.003 (0.23)	0.009 (0.59)	0.009 (0.59)	-0.012 (-0.92)	0.006 (0.41)	0.006 (0.40)	-0.007 (-0.57)	0.003 (0.19)	0.003 (0.19)
<i>After</i>	-0.065*** (-4.44)	-0.044*** (-2.70)	-0.044*** (-2.70)	-0.076*** (-5.25)	-0.042** (-2.53)	-0.042** (-2.53)	-0.053*** (-3.92)	-0.021 (-1.33)	-0.021 (-1.33)
<i>ROA</i>	-0.165*** (-2.72)	0.074 (1.06)	0.074 (1.05)	-0.072 (-1.43)	0.082 (1.29)	0.082 (1.28)	-0.014 (-0.30)	0.094 (1.39)	0.094 (1.39)
<i>MB_Ratio</i>	-0.005** (-2.21)	-0.002 (-0.94)	-0.002 (-0.94)	-0.006*** (-3.84)	-0.003* (-1.76)	-0.003* (-1.75)	-0.004***p (-2.62)	-0.002 (-1.33)	-0.002 (-1.33)
<i>Leverage</i>	-0.038* (-1.68)	-0.059* (-1.86)	-0.059* (-1.86)	-0.071*** (-3.47)	-0.044 (-1.49)	-0.044 (-1.49)	-0.037* (-1.95)	-0.025 (-0.81)	-0.025 (-0.81)
<i>Ln_MV</i>	0.060*** (7.14)	0.070*** (6.15)	0.070*** (6.12)	0.010*** (12.77)	0.113*** (11.82)	0.113*** (11.79)	0.069*** (9.29)	0.097*** (10.52)	0.097*** (10.49)
<i>Ln_Sales</i>	-0.003 (-0.33)	-0.004 (-0.22)	-0.004 (-0.22)	-0.013 (-1.63)	-0.036** (-2.28)	-0.036** (-2.27)	-0.023*** (-3.18)	-0.047*** (-3.00)	-0.047*** (-3.00)
<i>CAPEX</i>	-0.209*** (-2.80)	0.256** (2.53)	0.256** (2.52)	-0.132*** (-3.05)	0.177*** (3.13)	0.177*** (3.13)	-0.001 (-0.02)	0.156*** (2.71)	0.156*** (2.70)
<i>RDX</i>	0.033 (0.76)	0.075 (1.15)	0.075 (1.14)	0.004 (0.16)	0.049* (1.69)	0.049* (1.68)	-0.030 (-0.99)	0.066* (1.73)	0.066* (1.72)

(continued)

**Table 4.** Continued

	Cross-industry deals			All deals		Within-industry deals			
	<i>Ln</i> <sub>(1 + Count)</sub> (1)	(2)	(3)	<i>Ln</i> <sub>(1 + Count)</sub> (4)	(5)	(6)	<i>Ln</i> <sub>(1 + Count)</sub> (7)	(8)	(9)
<i>Cash</i>	-0.037*** (-3.04)	-0.003 (-0.24)	-0.003 (-0.24)	-0.026*** (-3.15)	-0.025*** (-2.70)	-0.025*** (-2.69)	-0.018* (-1.75)	-0.034*** (-2.82)	-0.034*** (-2.82)
Fixed effect	No	Firm	Firm & Industry	No	Firm	Firm & Industry	No	Firm	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>R</i> <sup>2</sup>	0.047	0.319	0.319	0.079	0.370	0.370	0.039	0.307	0.307
<i>Obs</i>	9,092	9,092	9,092	13,265	13,265	13,265	10,849	10,849	10,849
Pilot (control) firms	400 (754)	400 (754)	400 (754)	584 (1,150)	584 (1,150)	584 (1,150)	473 (934)	473 (934)	473 (934)

	Negative CAR deals			Positive CAR deals		
	<i>Ln</i> <sub>(1 + Count)</sub> (1)	(2)	(3)	<i>Ln</i> <sub>(1 + Count)</sub> (4)	(5)	(6)
<i>Panel B: Multivariate DID regression result of M&amp;As classified by CAR</i>						
<i>Intercept</i>	-0.184*** (-4.98)	-0.773*** (-7.57)	-0.773*** (-7.56)	0.162*** (6.19)	0.712*** (7.11)	0.712*** (7.09)
<i>Pilot</i> × <i>During</i>	-0.062*** (-2.61)	-0.067*** (-2.78)	-0.067*** (-2.78)	0.031 (1.27)	0.034 (1.41)	0.034 (1.41)
<i>Pilot</i> × <i>After</i>	-0.041 (-1.59)	-0.039 (-1.50)	-0.039 (-1.50)	0.030 (1.18)	0.031 (1.21)	0.031 (1.21)
<i>Pilot</i>	0.014 (0.77)			-0.019 (-1.16)		
<i>During</i>	-0.023 (-1.64)	-0.045*** (-3.02)	-0.045*** (-3.01)	0.021 (1.42)	0.081*** (5.01)	0.081*** (4.99)
<i>After</i>	-0.050*** (-3.37)	-0.053*** (-3.13)	-0.053*** (-3.12)	-0.054*** (-3.53)	0.011 (0.63)	0.011 (0.63)

*(continued)*

Table 4. Continued

	Negative CAR deals <i>Ln_(1 + Count)</i>			Positive CAR deals <i>Ln_(1 + Count)</i>		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>ROA</i>	0.079 (1.58)	0.235*** (3.51)	0.235*** (3.50)	-0.192*** (-3.86)	-0.159** (-2.06)	-0.159** (-2.05)
<i>MB_Ratio</i>	0.000 (0.24)	0.002 (1.05)	0.002 (1.04)	-0.012*** (-5.91)	-0.010*** (-4.96)	-0.010*** (-4.95)
<i>Leverage</i>	-0.039* (-1.84)	0.006 (0.20)	0.006 (0.20)	-0.046*** (-2.94)	-0.065** (-2.04)	-0.065** (-2.03)
<i>Ln_MV</i>	0.114*** (15.28)	0.172*** (17.11)	0.172*** (17.06)	0.003 (0.39)	-0.040*** (-3.78)	-0.040*** (-3.77)
<i>Ln_Sales</i>	-0.038*** (-5.35)	-0.021 (-1.25)	-0.021 (-1.25)	0.018*** (2.59)	-0.026 (-1.50)	-0.026 (-1.49)
<i>CAPEX</i>	-0.204*** (-5.20)	0.115* (1.71)	0.115* (1.70)	0.016 (0.53)	0.098* (1.90)	0.098* (1.89)
<i>RDX</i>	0.033 (1.18)	0.122*** (3.03)	0.122*** (3.02)	-0.024 (-0.58)	-0.008 (-0.15)	-0.008 (-0.15)
<i>Cash</i>	-0.031*** (-3.50)	-0.025** (-2.21)	-0.025** (-2.21)	-0.012 (-1.16)	-0.022* (-1.66)	-0.022* (-1.65)
Fixed effect	No	Firm	Firm & Industry	No	Firm	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes
<i>R</i> <sup>2</sup>	0.091	0.333	0.332	0.017	0.196	0.196
<i>Obs</i>	11,461	11,461	11,461	8,483	8,483	8,483
Pilot (control) firms	494 (974)	494 (974)	494 (974)	376 (715)	376 (715)	376 (715)

**Note(s):** This table reports the results of multivariate DID regressions on the number of M&As for the pilot and the control firms over the periods before, during and after Regulation SHO’s pilot program. Panel A reports the results of M&As classified by diversification, while Panel B reports the results of M&As classified by CAR. We estimate the multivariate DID panel regression as follows

$$Ln_(1 + Count_{i,t}) = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i \times After_t + \beta_3 Pilot_i + \beta_4 During_t + \beta_5 After_t + \beta_6 X_{i,t} + \varepsilon_{i,t}.$$

In this model, *Ln\_(1 + Count<sub>i,t</sub>)* is the natural logarithm of (1 + *Count<sub>i,t</sub>*), while *Count<sub>i,t</sub>* is the total number of M&As announced by firm *i* in a given year *t*. *Pilot<sub>i</sub>* equals one if firm *i* belongs to the pilot group and zero otherwise. *After<sub>t</sub>* is a dummy variable that equals one if the year is during the Post period (2007 to 2010). *X<sub>i,t</sub>* is the set of controlling variables including return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*) and cash and short-term investment (*Cash*). If we add a firm fixed effect in the panel regression, we omit *Pilot<sub>i</sub>* in that column to avoid multicollinearity. We cluster the standard errors at the firm level. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively

**Source(s):** Table by authors

significantly negative for the cross-industry deals. The findings are robust without or with fixed effects. If we do not control for fixed effects, the coefficient is  $-0.056$  with a  $t$  value of  $-2.52$ . The coefficient is  $-0.058$  with a  $t$  value of  $-2.57$  if we account for the firm fixed effect. The coefficient is  $-0.057$  with a  $t$  value of  $-2.56$  if we account for both firm and industry fixed effects. These results suggest that compared with the Pre period of 2001 to 2003, firms in the pilot group engage in fewer cross-industry M&As than firms in the control group during the pilot program period of 2005 to 2007. These results again support our [Hypothesis 1](#).

The coefficients of  $Pilot_t \times After_t$  for the cross-industry deals are  $-0.025$ ,  $-0.019$  and  $-0.019$ , respectively, without fixed effects, with a firm fixed effect and with both firm and industry fixed effects. None of them is significant. These results indicate that the difference in the cross-industry M&As before and after the pilot program is insignificant between the pilot group and the control group. After 2007, all firms are subject to the same rules, so the impact is not different.

In contrast with the results of cross-industry deals, none of the coefficients of  $Pilot_t \times During_t$  is significant for all deals or within-industry deals. Consistent with our conjecture, Panel A of [Table 4](#) demonstrates that from the Pre to During period, the pilot firms more significantly reduce their cross-industry (diversified) M&As than the control firms.

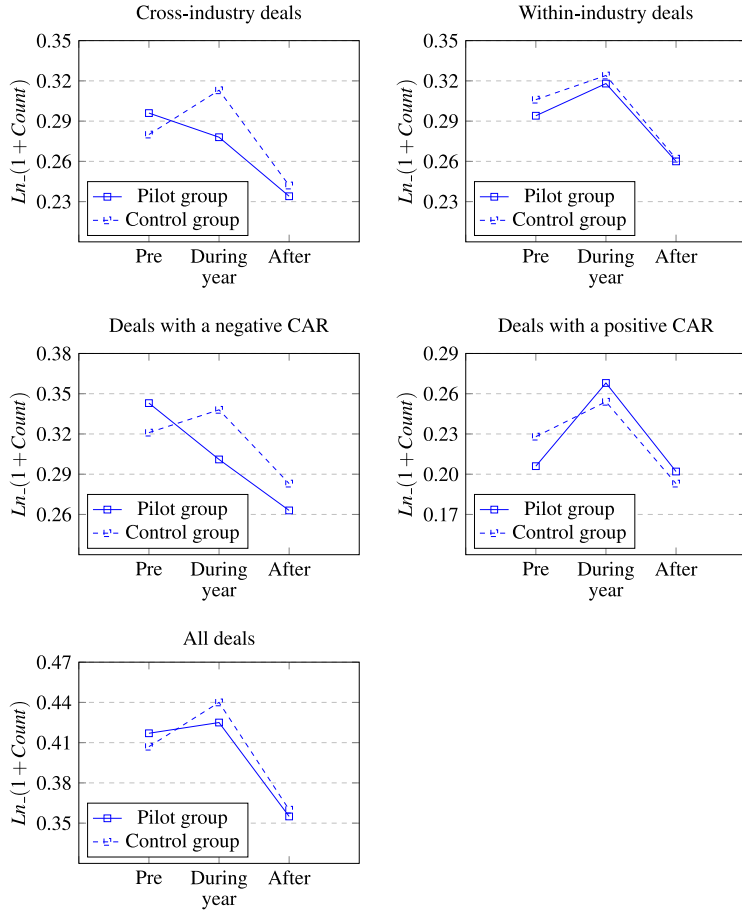
Our results for the control variables are consistent with the literature. For example, as shown in Panel A of [Table 4](#), the coefficients on  $Ln\_MV$  are significantly positive, while the coefficients on  $MB\_Ratio$  are mostly significantly negative.  $Cash$  is negatively related to M&As. These findings are consistent with [Lang and Stulz \(1994\)](#), who find that large firms are more likely to engage in M&As and that slow-growing firms seek growth opportunities through M&As.

Panel B of [Table 4](#) reports the results using CAR as the criterion. Columns (1) to (3) and columns (4) to (6) report the results of negative and positive CAR deals, respectively. The coefficients of  $Pilot_t \times During_t$  for the negative CAR deals are significantly negative at the 1% level without or with fixed effects. If we do not control for fixed effects, the coefficient is  $-0.062$  with a  $t$  value of  $-2.61$ . The coefficient is  $-0.067$  with a  $t$  value of  $-2.78$  if we account for the firm fixed effect. The coefficient is  $-0.067$  with a  $t$  value of  $-2.78$  if we account for both firm and industry fixed effects. Meanwhile, their coefficients of  $Pilot_t \times After_t$  are insignificant. Different from the deals with a negative CAR, the coefficients of  $Pilot_t \times During_t$  are insignificant for the deals with a positive CAR. Panel B of [Table 4](#) shows that the Regulation SHO's pilot program only disciplines firms from M&As with a negative CAR that tend to destroy firm values and supports our [Hypothesis 1](#).

To support our findings, we also plot the cross-sectional mean of  $Ln\_ (1 + Count)$  during the three periods for firms in the pilot group and control group, respectively, in [Figure 1](#). The top, middle and bottom panels show the results of deals split by industry (cross or within) or CAR (negative or positive) and all deals, respectively. The results clearly indicate that there is a downward trend of cross-industry and negative CAR M&A deals for the pilot group (solid line) from the Pre to the During period. We do not find this pattern for other deals. These findings also support our [Hypothesis 1](#) and show the disciplinary effect of the pilot program on M&A deal quality.

#### 4.2 Disciplinary effect and agency problem

Agency problems arise when managers do not always act in the interest of shareholders. For example, [Pan, Wang, and Weisbach \(2016\)](#) find that CEOs prefer firms to grow potentially at the expense of shareholder value maximization. [Shleifer and Vishny \(1989\)](#) demonstrate that M&As can entrench management, since large firms tend to increase the fringe benefits of managers and offer higher compensation. [Jensen \(1986\)](#) and [Arikan and Stulz \(2016\)](#) document that firms with more severe agency problems tend to make more M&As that are mostly value-destroying. The pilot program acts as a way to mitigate this problem.



**Figure 1.** M&A frequency. This graph plots the cross-sectional mean of  $Ln_{-}(1 + Count)$  during the Pre, During, and After periods for firms in the pilot group (solid line) and control group (dashed line), respectively. The top, middle, and bottom panels plot the results of deals classified by industry or CAR and all deals, respectively. Figure by authors

We use two proxies to measure a firm’s agency problem. First, we use firm age. [Arikan and Stulz \(2016\)](#) document that mature firms have more severe agency problems. As mature firms run out of their initial growing opportunities, managers seek to grow and survive through M&As and are reluctant to pay out cash flow to shareholders. Following [Hadlock and Pierce \(2010\)](#), we use the number of years the firm has been on Compustat with a non-missing stock price to measure firm age. We use the age information in 2003, immediately before the start of Regulation SHO’s pilot program, to group firms into two subsamples. We define a firm with an age above the median as a mature firm and a firm with an age below the median as a young firm. We estimate [Eq. \(2\)](#) for the two subsamples separately. In the regressions,  $Count_{i,t}$  is the number of value-destroying M&As, including either cross-industry M&As or those with a negative CAR, for firm  $i$  in year  $t$ .

[Table 5](#) reports the regression results. Similar to the previous tables, we report the results without or with fixed effects and cluster the standard errors at the firm level. Columns (1), (3) and (5) of [Table 5](#) report the results of mature firms, while columns (2), (4) and (6) report the

**Table 5.** Multivariate DID regression: mature and young firms

	<i>Ln</i> _(1 + <i>Count</i> )		<i>Ln</i> _(1 + <i>Count</i> )		<i>Ln</i> _(1 + <i>Count</i> )	
	Mature (1)	Young (2)	Mature (3)	Young (4)	Mature (5)	Young (6)
<i>Intercept</i>	-0.189*** (-3.31)	-0.133*** (-3.05)	-0.532*** (-3.13)	-0.463*** (-4.09)	-0.532*** (-3.12)	-0.463*** (-4.08)
<i>Pilot</i> × <i>During</i>	-0.093*** (-2.89)	0.005 (0.16)	-0.094*** (-2.94)	-0.003 (-0.09)	-0.094*** (-2.93)	-0.003 (-0.09)
<i>Pilot</i> × <i>After</i>	-0.060 (-1.64)	0.016 (0.46)	-0.054 (-1.44)	0.023 (0.64)	0.023 (0.64)	0.023 (0.64)
<i>Pilot</i>	-0.002 (-0.07)	0.008 (0.36)				
<i>During</i>	0.016 (0.79)	-0.051*** (-2.89)	0.013 (0.62)	-0.058*** (-2.99)	0.013 (0.62)	-0.058*** (-2.98)
<i>After</i>	-0.025 (-1.12)	-0.099*** (-5.21)	-0.026 (-1.09)	-0.076*** (-3.34)	-0.026 (-1.09)	-0.076*** (-3.33)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	No	No	Firm	Firm	Firm & Industry	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes
<i>R</i> <sup>2</sup>	0.108	0.067	0.396	0.308	0.396	0.308
<i>Obs</i>	5,998	6,302	5,998	6,302	5,998	6,302
<i>Pilot</i> (control) firms	272 (479)	253 (547)	272 (479)	253 (547)	272 (479)	253 (547)
$\chi^2$	4.00**		4.76**		4.00**	

**Note(s):** This table reports the results of multivariate DID regressions on the number of M&As for the pilot and the control firms over the periods before, during and after Regulation SHO's pilot program. We categorize all firms into two groups according to firm age. We use the number of years the firm has been on Compustat with a non-missing stock price to measure firm age. We use the age information in 2003, immediately before the start of Regulation SHO's pilot program, to group firms into two subsamples. We define a firm with an age above the median as a mature firm and a firm with an age below the median as a young firm. We estimate the multivariate DID panel regression as follows

$$Ln\_ (1 + Count_{i,t}) = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i \times After_t + \beta_3 Pilot_i + \beta_4 During_t + \beta_5 After_t + \beta_6 X_{i,t} + \varepsilon_{i,t}$$

In this model,  $Ln\_ (1 + Count_{i,t})$  is the natural logarithm of  $(1 + Count_{i,t})$  while  $Count_{i,t}$  is the total number of value-destroying M&As, including either cross-industry M&As or those with a negative CAR, announced by firm  $i$  in a given year  $t$ .  $Pilot_i$  equals one if firm  $i$  belongs to the pilot group and zero otherwise.  $After_t$  is a dummy variable that equals one if the year is during the Post period (2007 to 2010).  $X_{i,t}$  is the set of controlling variables including return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*), and cash and short-term investment (*Cash*). If we add a firm fixed effect in the panel regression, we omit  $Pilot_i$  in that column to avoid multicollinearity. We cluster the standard errors at the firm level. The Chi-square test statistic ( $\chi^2$ ) indicates whether the coefficient of  $Pilot \times During$  differs significantly between the two subsamples. For simplicity, we do not report the coefficients of the control variables. \*\*\*, \*\*, and \* denote significance at the 1%, 5% and 10% level, respectively

**Source(s):** Table by authors

results of young firms. The coefficients of  $Pilot_i \times During_t$  are significantly negative for mature firms. If we do not use fixed effects, the coefficient is -0.093 with a  $t$  value of -2.89. The coefficient is -0.094 with a  $t$  value of -2.94 and -2.93 when controlling for firm fixed effects and both firm and industry fixed effects, respectively. On the other hand, none of the coefficients of  $Pilot_i \times During_t$  is significant for young firms. The Chi-square test statistics are significant at the 5% level, indicating significant differences in the coefficients of  $Pilot_i \times During_t$  between the subsamples of mature firms and young firms. These results indicate that

the disciplinary effect of Regulation SHO's pilot program on M&A deal quality concentrates on mature firms and support our [Hypothesis 2](#).

The second measure we use is the agency cost of free cash flow, which is calculated from free cash flow conditional on growth opportunities. Firms with substantial free cash flows and low growth opportunities have a higher agency cost of free cash flow and so are considered to have more severe agency problems. Following [Jensen \(1986\)](#), [Lang et al. \(1991\)](#), [Harford \(1999\)](#), [Chen et al. \(2011\)](#), [Arikan and Stulz \(2016\)](#) and [Li et al. \(2018\)](#), we construct our proxy of agency problem,  $Agency^{FCF}$ , in two steps. First, we use Tobin's q to measure a firm's growth opportunities. We sort firms by their Tobin's q's into quartiles and classify the firms in the top quartile as the high-growth-opportunities firms. For those firms, a high level of free cash flow is not an issue, so we set their  $Agency^{FCF}$  as zero. The firms not in the top quartile are low-growth-opportunities firms. We calculate their  $Agency^{FCF}$  using the scaled free cash flow,

$$Agency_{i,t}^{FCF} = \frac{INC_{i,t} - TAX_{i,t} - INTEXP_{i,t} - PEDDIV_{i,t} - COMDIV_{i,t}}{Asset_{i,t}}, \quad (3)$$

where  $INC_{i,t}$  is operating income before depreciation (Compustat item No. 13);  $TAX_{i,t}$  is total income tax (Compustat item No. 16) minus change in deferred taxes from the previous year to the current year (change in Compustat item No. 35);  $INTEXP_{i,t}$  is gross interest expense on short-and long-term debt (Compustat item No.15);  $PEDDIV_{i,t}$  (Compustat item No. 21) and  $COMDIV_{i,t}$  (Compustat item No. 19) are dividends on preferred shares and common shares, respectively. Using the measures of  $Agency^{FCF}$  in 2003, we group all firms into two subsamples. We define a firm with an  $Agency^{FCF}$  value above the median as a high- $Agency^{FCF}$  firm and a firm with an  $Agency^{FCF}$  value below the median as a low- $Agency^{FCF}$  firm. We estimate [Eq. \(2\)](#) for the two subsamples separately, where  $Count_{i,t}$  is the number of value-destroying M&As, including either cross-industry M&As or those with a negative CAR, for firm  $i$  in year  $t$ .

[Table 6](#) reports the regression results. Columns (1), (3) and (5) of [Table 6](#) report the results of high- $Agency^{FCF}$  firms, while columns (2), (4) and (6) report the results of low- $Agency^{FCF}$  firms. The coefficients of  $Pilot_i \times During_t$  are significantly negative at the 5% level for the high- $Agency^{FCF}$  firms. The results are robust without or with fixed effects. On the other hand, the coefficients are insignificant for the low- $Agency^{FCF}$  firms. The Chi-square test statistics are significant at the 5% level, indicating significant differences in the coefficients of  $Pilot_i \times During_t$  between the subsamples of high- $Agency^{FCF}$  firms and low- $Agency^{FCF}$  firms. These results suggest that the disciplinary effect of Regulation SHO's pilot program concentrates on firms with a high  $Agency^{FCF}$ , which supports our [Hypothesis 2](#).

#### 4.3 Disciplinary effect and CEO compensation

To test our [Hypothesis 3](#), we employ the measure of CEO incentive pay used in [Adams and Ferreira \(2009\)](#). The CEO incentive pay is calculated by

$$CEO\_incentive\_pay_{i,t} = 1 - \frac{Salary_{i,t} + Bonus_{i,t}}{Total\_CEO\_compensation_{i,t}}, \quad (4)$$

where  $Total\_CEO\_compensation$  is item TDC1 in the ExecuComp database, which equals the sum of salary, bonus, other annual, the total value of restricted stock granted, the total value of stock options granted calculated using the Black–Scholes option-pricing formula, long-term incentive payouts and all other totals. Intuitively,  $CEO\_incentive\_pay$  measures the percentage of the CEO's income that is sensitive to stock price performance. A higher level of  $CEO\_incentive\_pay$  means the CEO's income is more performance-related. We use the  $CEO\_incentive\_pay$  measures in 2003 to group all firms into two subsamples. Firms with a  $CEO\_incentive\_pay$  above and below the median are classified as high- and low-CEO-

**Table 6.** Multivariate DID regression: high-and low-Agency<sup>FCF</sup> firms

	Ln_(1 + Count)		Ln_(1 + Count)		Ln_(1 + Count)	
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
Intercept	0.053 (0.84)	-0.224*** (-4.12)	-0.546*** (-2.69)	-0.415*** (-3.14)	-0.547*** (-2.67)	-0.415*** (-3.13)
Pilot × During	-0.121*** (-3.35)	0.007 (0.21)	-0.108*** (-2.82)	0.005 (0.15)	-0.108*** (-2.81)	0.005 (0.15)
Pilot × After	-0.015 (-0.36)	-0.054 (-1.52)	0.005 (0.11)	-0.029 (-0.77)	0.005 (0.11)	-0.029 (-0.76)
Pilot	0.006 (0.20)	0.004 (0.17)				
During	0.007 (0.29)	-0.032* (-1.71)	-0.043 (-1.51)	-0.009 (-0.44)	-0.043 (-1.50)	-0.009 (-0.44)
After	-0.057** (-2.29)	-0.040* (-1.83)	-0.099*** (-3.10)	-0.014 (-0.58)	-0.099*** (-3.08)	-0.014 (-0.58)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	No	No	Firm	Firm	Firm & Industry	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.082	0.118	0.410	0.447	0.410	0.447
Obs	4,849	4,854	4,849	4,854	4,849	4,854
Pilot (control) firms	240 (426)	219 (447)	240 (426)	219 (447)	240 (426)	219 (447)
χ <sup>2</sup>	6.83***		4.75**		4.75**	

**Note(s):** This table reports the results of multivariate DID regressions on the number of M&As for the pilot and the control firms over the periods before, during, and after Regulation SHO’s pilot program. We categorize all firms into two groups according to agency cost of free cash flow (*Agency<sup>FCF</sup>*). We construct *Agency<sup>FCF</sup>* in two steps. First, we use Tobin’s q to measure a firm’s growth opportunities. We sort the firms by Tobin’s q into quartiles and classify the firms in the top quartile as the high-growth-opportunities firms. For those firms, a high level of free cash flow is not an issue, so we set their *Agency<sup>FCF</sup>* as zero. The firms not in the top quartile are low-growth-opportunities firms. We calculate their *Agency<sup>FCF</sup>* using the scaled free cash flow

$$Agency_{i,t}^{FCF} = \frac{INC_{i,t} - TAX_{i,t} - INTEXP_{i,t} - PEDDIV_{i,t} - COMDIV_{i,t}}{Asset_{i,t}}$$

where *INC<sub>i,t</sub>* is operating income before depreciation (Compustat item No. 13); *TAX<sub>i,t</sub>* is total income tax (Compustat item No. 16) minus change in deferred taxes from the previous year to the current year (change in Compustat item No. 35); *INTEXP<sub>i,t</sub>* is gross interest expense on short-and long-term debt (Compustat item No.15); *PEDDIV<sub>i,t</sub>* (Compustat item No. 21) and *COMDIV<sub>i,t</sub>* (Compustat item No. 19) are dividends on preferred shares and common shares, respectively. Using the measures of *Agency<sup>FCF</sup>* at 2003, we group all firms into two subsamples. We define a firm with an *Agency<sup>FCF</sup>* value above the median as a high-*Agency<sup>FCF</sup>* firm and a firm with an *Agency<sup>FCF</sup>* value below the median as a low-*Agency<sup>FCF</sup>* firm

We estimate the multivariate DID panel regression as follows

$$Ln\_ (1 + Count_{i,t}) = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i \times After_t + \beta_3 Pilot_i + \beta_4 During_t + \beta_5 After_t + \beta_6 X_{i,t} + \varepsilon_{i,t}$$

In this model, *Ln\_(1 + Count<sub>i,t</sub>)* is the natural logarithm of (1 + *Count<sub>i,t</sub>*), while *Count<sub>i,t</sub>* is the total number of value-destroying M&As, including either cross-industry M&As or those with a negative CAR, announced by firm *i* in a given year *t*. *Pilot<sub>i</sub>* equals one if firm *i* belongs to the pilot group and zero otherwise. *After<sub>t</sub>* is a dummy variable that equals one if the year is during the Post period (2007 to 2010). *X<sub>i,t</sub>* is the set of controlling variables including return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*) and cash and short-term investment (*Cash*). If we add a firm fixed effect in the panel regression, we omit *Pilot<sub>i</sub>* in that column to avoid multicollinearity. We cluster the standard errors at the firm level. The Chi-square test statistic (χ<sup>2</sup>) indicates whether the coefficient of *Pilot × During* differs significantly between the two subsamples. For simplicity, we do not report the coefficients of the control variables. \*\*\*, \*\*, and ~ denote significance at the 1%, 5% and 10% level, respectively

**Source(s):** Table by authors

incentive-pay firms, respectively. We use the number of value-destroying M&As as the dependent variable to estimate Eq. (2) for the two subsamples separately and report the results in Table 7.

Columns (1), (3) and (5) of Table 7 report the results of high-CEO-incentive-pay firms, while columns (2), (4) and (6) report the results of low-CEO-incentive-pay firms. For the high-CEO-incentive-pay firms, the coefficients of  $Pilot_i \times During_t$  are negative and significant. If we do not use fixed effects, the coefficient is  $-0.101$  with a  $t$  value of  $-2.24$ . The coefficient is  $-0.089$  with a  $t$  value of  $-1.84$  and  $-1.83$  when controlling for firm fixed effects and both firm and industry fixed effects, respectively. Different from the results of high-CEO-incentive-pay firms, the coefficients of  $Pilot_i \times During_t$  are insignificant for low-CEO-incentive-pay firms. The Chi-square test statistics are significant at the 10% level or above, indicating significant differences in the coefficients of  $Pilot_i \times During_t$  between the two subsamples. The results support our Hypothesis 3 that Regulation SHO's pilot program disciplines the M&A activities of firms whose CEO compensation is more dependent on stock price performance.

Although the literature has shown that the impact of managerial compensation is robust to agency problems, it is still possible that the two independent sorts using agency problems or CEO compensation variables generate overlapping samples. For example, most of the firms in the high-CEO-incentive pay group are mature firms or have a high  $Agency^{FCF}$ . The significant results of the high-CEO-incentive pay group are also due to the fact that those firms have severe agency problems. Under this scenario, it will be hard to disentangle the impact of managerial compensation from the agency problem. To address this concern, we report the distribution of firms in the high-CEO-incentive pay group according to age or  $Agency^{FCF}$  in Panel B of Table 7. The results indicate that the firms in the high-CEO-incentive pay group are equally distributed in terms of age or  $Agency^{FCF}$ . The percentage of firms that belong to the mature or high  $Agency^{FCF}$  group is close to 50%. The last column reports the statistics on whether the ratios of two groups sorted by age (mature vs. young) or  $Agency^{FCF}$  (high vs. low) are different from 50% jointly. The results are both insignificant. These results suggest that the significant impact in the high-CEO-incentive pay group is not relevant to the agency problem of those firms and document the influence of managerial compensation independent of the agency problem.

#### 4.4 Disciplinary effect or overvaluation

The increase of short-selling pressure to impose a disciplinary effect is the underlying assumption of our empirical setting. In other words, short selling disciplines a firm to engage less in value-destroying M&As. To test whether the pilot program increases the level of short-selling pressure on a firm's value-destroying M&A activities, we study the change in short-selling activities between the Pre and the During period for both pilot firms and control firms. Unreported results demonstrate that compared with control firms, the short-selling activities of firms in the pilot group significantly increase around the announcements of cross-industry M&As or the deals with a negative CAR during the pilot program (During) period. These findings indicate that the short-selling threat imposed by the pilot program not only exists but also happens. An increased short-selling activity is a channel to prevent a firm from making value-destroying M&A decisions [8].

Removing short sales constraints might reduce a firm's stock overvaluation, discouraging M&As. Shleifer and Vishny (2003), Rhodes-Kropf *et al.* (2005), Dong *et al.* (2006) and Fu *et al.* (2013) show that overvaluation could also drive firms to engage in M&As to exploit their stock overvaluation. Miller (1977) argues that short sale constraints are a reason for overvaluation. Regulation SHO's pilot program removes the various constraints of short sales for firms in the pilot group, which makes it possible that those stocks are less overvalued. Such a decrease in stock overvaluations reduces the incentive for firms to undertake M&As. However, Boehme *et al.* (2006) show that the impact of short sales constraints on stock

**Table 7.** Multivariate DID regression: high- and low-CEO-incentive-pay firms

	Ln <sub>t</sub> (1 + Count)		Ln <sub>t</sub> (1 + Count)		Ln <sub>t</sub> (1 + Count)	
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
<i>Panel A: Multivariate DID regression: High- and low-CEO-incentive-pay firms</i>						
Intercept	-0.141* (-1.69)	-0.217*** (-3.08)	-1.067*** (-3.91)	-0.348 (-1.59)	-1.074*** (-3.90)	-0.347 (-1.58)
Pilot × During	0.101** (-2.24)	0.019 (0.45)	-0.089* (-1.84)	0.018 (0.43)	-0.089* (-1.83)	0.018 (0.43)
Pilot × After	-0.079 (-1.65)	0.028 (0.68)	-0.071 (-1.33)	0.043 (1.01)	-0.071 (-1.32)	0.043 (1.01)
Pilot	0.065* (1.81)	-0.060* (-1.92)				
During	-0.002 (-0.09)	-0.044* (-1.67)	-0.023 (-0.78)	-0.062** (-2.18)	-0.023 (-0.78)	-0.062** (-2.17)
After	-0.030 (-1.00)	-0.100*** (-4.09)	-0.068* (-1.90)	-0.086*** (-2.95)	-0.068* (-1.89)	-0.086*** (-2.93)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	No	No	Firm	Firm	Firm & Industry	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes
R <sup>2</sup>	0.076	0.096	0.440	0.437	0.440	0.437
Obs	3,794	3,796	3,794	3,796	3,794	3,796
Pilot (control) firms	157 (333)	186 (304)	157 (333)	186 (304)	157 (333)	186 (304)
χ <sup>2</sup>	3.85**		2.81*		2.81*	

	Proportion	Chi-square statistics
<i>Panel B: The proportion of firms by age (mature vs. young) or Agency<sup>FCF</sup> (high vs. low) in the high-CEO-incentive-pay group</i>		
Mature firms	46.53%	
Young firms	53.47%	
Difference from 50%		0.401
High-Agency <sup>FCF</sup> firms	45.84%	
Low-Agency <sup>FCF</sup> firms	54.16%	
Difference from 50%		0.561

**Note(s):** This table reports the results of multivariate DID regressions on the number of M&As for the pilot and the control firms over the periods before, during and after Regulation SHO’s pilot program. Panel A reports the multivariate DID regression for high- and low-CEO-incentive-pay firms. The CEO incentive pay is calculated by

$$CEO\_incentive\_pay_{i,t} = 1 - \frac{Salary_{i,t} + Bonus_{i,t}}{Total\_CEO\_compensation_{i,t}}$$

where *Total\_CEO\_compensation* is item TDC1 in the ExecuComp database, which equals the sum of salary, bonus, other annual, the total value of restricted stock granted, the total value of stock options granted calculated using the Black-Scholes option-pricing formula, long-term incentive payouts, and all other totals. We use the *CEO\_incentive\_pay* measures in 2003 to group all firms into two subsamples. Firms with *CEO\_incentive\_pay* above and below the median are classified as high- and low-CEO-incentive-pay firms, respectively

We estimate the multivariate DID panel regression as follows

$$Ln(1 + Count_{i,t}) = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i \times After_t + \beta_3 Pilot_i + \beta_4 During_t + \beta_5 After_t + \beta_6 X_{i,t} + \varepsilon_{i,t}$$

In this model, *Ln(1 + Count<sub>i,t</sub>)* is the natural logarithm of (1 + *Count<sub>i,t</sub>*), while *Count<sub>i,t</sub>* is the total number of value-destroying M&As, including either cross-industry M&As or those with a negative CAR, announced by firm *i* in a given year *t*. *Pilot<sub>i</sub>* equals one if firm *i* belongs to the pilot group and zero otherwise. *After<sub>t</sub>* is a dummy variable that equals one if the year is during the Post period (2007 to 2010). *X<sub>i,t</sub>* is the set of controlling variables including return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*), and cash and short-term investment (*Cash*). If we add a firm fixed effect in the panel regression, we omit *Pilot<sub>i</sub>*; in that column to avoid multicollinearity. We cluster the standard errors at the firm level. The Chi-square test statistic (χ<sup>2</sup>) indicates whether the coefficient of *Pilot × During* differs significantly between the two subsamples. For simplicity, we do not report the coefficients of the control variables. In Panel B, we report the proportion of firms by age (mature vs. young) or *Agency<sup>FCF</sup>* (high vs. low) in the high-CEO-incentive-pay group. We also report the Chi-square statistics to test whether the two groups have proportions different from 50% jointly. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% level, respectively

**Source(s):** Table by authors

overvaluation also depends on the dispersion of firm value opinions. As a result, the removal of short sales constraints does not always reduce stock overvaluation.

The [Office of Economic Analysis \(2007\)](#) run an economic analysis of the short sales restrictions under the Regulation SHO pilot program. They find that the pilot and control stocks had similar returns over the first six months of the pilot program period. This finding indicates that the pilot program has a limited effect in reducing the overvaluation of the pilot firms. We supplement their analysis using another method. If the reduction of overvaluation is a potential channel for the pilot firms to undertake fewer M&As, this effect concentrates on those firms that are more likely to be overvalued before the pilot program started. To test this hypothesis, we follow [Akbulut \(2013\)](#) and [Hirshleifer, Teoh, and Yu \(2011\)](#) to use the market-to-book (MB) ratio or accruals as a measure of stock overvaluation and divide the firms into two subsamples. The accruals are calculated as follows:

$$Accruals_{i,t} = \frac{Earnings_{i,t} - CFO_{i,t}}{Average\_Total\_Assets_{i,t}},$$

where  $Earnings_{i,t}$  is earnings before extraordinary items (Compustat item No. 123),  $CFO_{i,t}$  is cash flow from operating activities (Compustat item No. 308), and  $Average\_Total\_Assets_{i,t}$  is the average of the firm's total assets in the current and previous year. We use the information about the MB ratio or accruals in 2003 to group the firms. We define a firm with an MB ratio (accruals) above its median as a high-MB-ratio (-accruals) firm. These firms are more likely to be overvalued and will be affected by the pilot program if the overvaluation channel exists. We estimate [Eq. \(2\)](#) for the high-MB-ratio subsample and the high-accruals subsample, respectively.

[Table 8](#) reports the results. The left columns report the results of high-MB-ratio firms, while the right columns report those of high-accruals firms. We cluster the standard errors at the firm level. For the high-MB-ratio firms, the coefficient of  $Pilot \times During$  is  $-0.049$  without fixed effects and  $-0.057$  with either a firm fixed effect or both firm and industry fixed effects. For the high-accruals firms, the coefficient of  $Pilot \times During$  is  $-0.037$  and  $-0.031$  without and with fixed effects, respectively. None of these coefficients is significant above the 10% level. These findings indicate that stock overvaluation does not channel the pilot program on a firm's M&A engagement and support the results in the [Office of Economic Analysis \(2007\)](#) as well as [Hypothesis 4](#).

#### 4.5 M&A deal quality

In this section, we compare the overall M&A deal quality of the Pre and the During period and test [Hypothesis 5](#). We use the cumulative abnormal return (CAR) relative to a size and MB ratio benchmark during a time window of 36 months after the deal's completion as the measure of the deal quality. We perform the DID test for the CARs using a pooled OLS regression under various sample specifications and adjust the standard errors to be heteroscedasticity-consistent:

$$CAR_{i,t} = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i + \beta_3 During_t + \varepsilon_{i,t}. \quad (5)$$

[Table 9](#) reports the regression results. We use three different samples. In the first sample, we use all deals. Since the CARs of many deals are overlapping, the results might be biased. Moreover, not all deals are able to generate economically meaningful CAR. To address these concerns, we also use two other smaller samples in the regression. In the second sample, we first follow [Loughran and Vijh \(1997\)](#) to exclude the observations that occurred within three years of a previous acquisition by the same firm. We then follow [Moeller, Schlingemann, and Stulz \(2005\)](#) and [Harford, Humphery-Jenner, and Powell \(2012\)](#) and require the deal value to be more than one million and worth at least 1% of the acquirer's market value of assets. In the

Table 8. Overvaluation analysis

	High-MB-ratio firms $\ln_-(1 + \text{Count})$			High-accruals firms $\ln_-(1 + \text{Count})$		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Intercept</i>	-0.170*** (-3.16)	-0.037 (-0.31)	-0.037 (-0.31)	-0.082 (-1.55)	-0.189 (-1.25)	-0.189 (-1.24)
<i>Pilot × During</i>	-0.049 (-1.57)	-0.057* (-1.78)	-0.057* (-1.77)	-0.037 (-1.17)	-0.031 (-0.95)	-0.031 (-0.94)
<i>Pilot × After</i>	-0.022 (-0.62)	-0.036 (-1.02)	-0.036 (-1.01)	-0.015 (-0.41)	-0.002 (-0.05)	-0.002 (-0.05)
<i>Pilot</i>	0.019 (0.73)			-0.021 (-0.80)		
<i>During</i>	0.013 (0.73)	0.049** (2.39)	0.049** (2.38)	-0.028 (-1.52)	-0.020 (-0.97)	-0.020 (-0.97)
<i>After</i>	-0.045** (-2.20)	0.010 (0.42)	0.010 (0.42)	-0.090*** (-4.14)	-0.067*** (-2.76)	-0.067*** (-2.75)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	No	Firm	Firm & Industry	No	Firm	Firm & Industry
Cluster standard error	Yes	Yes	Yes	Yes	Yes	Yes
$R^2$	0.093	0.392	0.391	0.078	0.370	0.370
<i>Obs</i>	6,493	6,493	6,493	6,539	6,539	6,539
<i>Pilot (control) firms</i>	277 (567)	277 (567)	277 (567)	291 (554)	291 (554)	291 (554)

**Note(s):** This table reports the results of multivariate DID regressions on the number of M&As for the pilot and the control firms over the periods before, during, and after Regulation SHO's pilot program. The left and right columns report the results of high-MB-ratio and high-accruals firms, respectively. Firms with a high MB ratio or accruals are more likely to be overvalued. The accruals are calculated as follows

$$\text{Accruals}_{i,t} = \frac{\text{Earnings}_{i,t} - \text{CFO}_{i,t}}{\text{Average\_Total\_Assets}_{i,t}}$$

where  $\text{Earnings}_{i,t}$  is earnings before extraordinary items (Compustat item No. 123) and  $\text{CFO}_{i,t}$  is cash flow from operating activities (Compustat item No. 308). We use the information about the MB ratio and accruals in 2003, immediately before the start of Regulation SHO's pilot program, to group firms into two subsamples. We define a firm with an MB ratio (accruals) above the median as a high-MB-ratio (-accruals) firm. We estimate the multivariate DID panel regression as follows

$$\ln_-(1 + \text{Count}_{i,t}) = \alpha_0 + \beta_1 \text{Pilot}_i \times \text{During}_t + \beta_2 \text{Pilot}_i \times \text{After}_t + \beta_3 \text{Pilot}_i + \beta_4 \text{During}_t + \beta_5 \text{After}_t + \beta_6 X_{i,t} + \varepsilon_{i,t}$$

In this model,  $\ln_-(1 + \text{Count}_{i,t})$  is the natural logarithm of  $(1 + \text{Count}_{i,t})$ , while  $\text{Count}_{i,t}$  is the total number of M&As announced by firm  $i$  in a given year  $t$ .  $\text{Pilot}_i$  equals one if firm  $i$  belongs to the pilot group and zero otherwise.  $\text{After}_t$  is a dummy variable that equals one if the year is during the Post period (2007 to 2010).  $X_{i,t}$  is the set of controlling variables including return on assets (*ROA*), market-to-book ratio (*MB\_Ratio*), leverage (*Leverage*), size (*Ln\_MV*), sales (*Ln\_Sales*), capital expenditures (*CAPEX*), R&D expenditures (*RDX*), and cash and short-term investment (*Cash*). If we add a firm fixed effect in the panel regression, we omit  $\text{Pilot}_i$  in that column to avoid multicollinearity. We cluster the standard errors at the firm level. For simplicity, we do not report the coefficients of the control variables. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% level, respectively

**Source(s):** Table by authors

third sample, we also exclude the observations that occurred within three years of a previous acquisition by the same firm and then use a higher deal value criterion than that used in the second sample. Consistent with Duchin and Schmidt (2013), we require the deal value to be more than 10 million and worth at least 5% of the acquirer's market value of assets.

The results show a significant improvement in the pilot firms' stock performance during the pilot program period. When we use all deals, the coefficient of  $\text{Pilot} \times \text{During}$  is 5.819 with a  $t$  value of 2.25. This positive and significant coefficient indicates that overall, the M&A deal quality is better for firms in the pilot group during the pilot program period. The improvement is

**Table 9.** Post-acquisition stock performance

	CAR Sample 1	Sample 2	Sample 3
<i>Intercept</i>	-18.382*** (-16.42)	-16.903*** (-6.14)	-12.689*** (-3.68)
<i>Pilot × During</i>	5.785** (2.24)	11.987* (1.74)	16.531* (1.75)
<i>Pilot</i>	-3.438* (-1.83)	-2.619 (-0.56)	-1.745 (-0.29)
<i>During</i>	3.240** (2.12)	4.372 (1.13)	4.671 (0.93)
<i>R</i> <sup>2</sup>	0.003	0.007	0.012
<i>Obs</i>	7,727	1,591	925
<i>Pilot (control) firms</i>	554 (1,092)	419 (783)	269 (513)

**Note(s):** This table reports the results of pooled OLS DID regression on the post-acquisition stock performance for the pilot and the control firms over the periods before and during Regulation SHO’s pilot program. We use the CAR relative to a size and MB ratio benchmark during a time window of 36 months after the deal completion as the measure of post-acquisition performance

$$CAR_{i,t} = \alpha_0 + \beta_1 Pilot_i \times During_t + \beta_2 Pilot_i + \beta_3 During_t + \varepsilon_{i,t}$$

$CAR_{i,t}$  is firm  $i$ ’s CAR relative to a size and MB ratio benchmark during a time window of 36 months after the deal completion.  $Pilot_i$  equals one if firm  $i$  belongs to the pilot group and zero otherwise.  $During_t$  is a dummy variable that equals one if the year is during the During period (2005 to 2007). We use three different samples. In the first sample, we use all deals. In the second sample, we first follow [Loughran and Vijh \(1997\)](#) to exclude the observations that occurred within three years of a previous acquisition by the same firm. We then follow [Moeller et al. \(2005\)](#) and [Harford et al. \(2012\)](#) and require the deal value to be more than 1 million and worth at least 1% of the acquirer’s market value of assets. In the third sample, we also exclude the observations that occurred within three years of a previous acquisition by the same firm and then use a higher deal value criterion than that used in the second sample. Consistent with [Duchin and Schmidt \(2013\)](#), we require that the deal value be more than 10 million and worth at least 5% of the acquirer’s market value of assets. We adjust the standard errors to be heteroscedasticity-consistent. \*\*\*, \*\*, and \* denote significance at the 1%, 5%, and 10% level, respectively

**Source(s):** Table by authors

also economically significant. Compared with the mean CAR of -16.998% for all deals, the result of 5.819 corresponds to a 34.23% increase in post-acquisition stock returns. When we use the sub-samples with larger deal values, the coefficients of  $Pilot \times During$  are only significant at the 10% level due to a smaller number of observations. However, their values are much larger. The coefficients of  $Pilot \times During$  for the second and third samples are 11.987 and 16.531, respectively, and correspond to a 70.52% and 97.25% increase in post-acquisition stock returns.

Our results in [Table 9](#) imply that by imposing a believable threat of an increased level of short-selling activity, Regulation SHO’s pilot program has a disciplinary effect on M&As, thereby improving M&A deal quality with better stock market performance. This finding supports [Hypothesis 5](#) and provides evidence that a stock market with fewer frictions could have a social benefit.

#### 4.6 Implications for other markets

Our analysis focuses on the US market. An interesting question is whether the findings can be generalized to other markets. A necessary condition for short selling to impose a disciplinary effect is that short sellers can detect negative information and enhance the information transmission process. Empirical evidence suggests that this mechanism is not unique to the USA. For instance, [Saffi and Sigurdsson \(2011\)](#) use data from 26 markets and show that short selling improves price efficiency, and that relaxing short sale constraints does not lead to price instability or extreme negative returns. Similarly, [Chang, Luo, and Ren \(2014\)](#) provide

consistent evidence using data from China. These findings suggest that the disciplinary effect of short selling on M&A is likely present not only in the USA but also in other markets.

Moreover, we find that the disciplinary effect on value-destroying M&As is more pronounced in firms with more severe agency problems. Given that agency problems tend to be more prevalent in firms in other markets – particularly in developing countries – due to weaker institutional environments and governance structures (Mi & Wang, 2000; He & Luo, 2018), the disciplinary effect of short selling on M&A may be even stronger in such settings.

Recently, a growing body of literature has examined the effects of short selling in international markets. For example, Lu, Wang, and Li (2024) find that the relaxation of short-selling regulations enhances corporate governance by reducing financial fraud in China. Yang, Xue, and Liu (2023) demonstrate that the introduction of short selling in China's A-share market allows investors to participate in corporate governance through short-selling positions. An *et al.* (2024) utilize large cross-country samples and find that short-selling pressure encourages riskier but value-enhancing corporate investments, with effects moderated by institutional environments such as shareholder protection and transparency. He *et al.* (2024) find that participation in a short-selling program significantly improves the internal governance of state-owned enterprises (SOEs) in China and leads to a substantial reduction in government control. Other studies in the Chinese context include Bao, Li, and Jiang (2024), who investigate the influence on firms' employment growth, and Meng, Li, Chan, and Gao (2020), who study the impact on firms' financial constraints. Future research can extend the analysis by conducting similar natural experiments or exploiting regulatory changes in other markets to further test the external validity of our findings.

## 5. Conclusions

Using Regulation SHO's pilot program as a natural experiment, we study how the short-selling mechanism has a disciplinary effect that improves M&A deal quality. We find that firms in the pilot group significantly reduce their engagement in value-destroying M&As during the pilot program period. Moreover, the impact concentrates on firms with severe agency problems and firms whose CEO payments are vulnerable to a stock price decrease. On the other hand, we do not find a significant change in the frequency of M&As for the firms that are more likely to be overvalued. Stock overvaluation does not channel the impact. Due to the disciplinary effect, firms in the pilot group engage in fewer value-destroying M&As during the pilot program period. This change improves the overall M&A deal quality.

However, there are still some limitations to the results presented in this paper. For instance, as discussed earlier, using short-term announcement returns to measure deal quality has several drawbacks (Bhagat *et al.*, 2005; Chen *et al.*, 2007; Duchin & Schmidt, 2013). Similarly, post-acquisition stock performance is also not a perfect measure. The long-term stock performance following M&As can be influenced by unrelated events, introducing noise into the measure. Nevertheless, as we have employed cross-industry M&As as a proxy for value-destroying M&As and obtained consistent results, this limitation is considered minimal. Although we have included comprehensive control variables in our model, it is impossible to account for all potential confounding factors. However, by incorporating both firm and industry fixed effects and leveraging SHO's pilot program as a natural experiment, we can mitigate this concern.

Our findings have several practical and policy implications. Reducing frictions in equity markets – particularly through the relaxation of short-selling constraints – can enhance market discipline and promote more efficient corporate decision-making. This has important implications for policymakers, especially in developing markets where short selling remains heavily restricted or prohibited. Establishing a well-regulated short-selling framework could strengthen external monitoring mechanisms and improve the quality of corporate investments, such as M&A.

Future research could build on this work in several ways. First, more in-depth data on M&A deal structures and negotiation dynamics could shed light on how short sellers influence specific stages of the decision-making process. Second, expanding the analysis to other institutional settings – such as countries with different governance frameworks or less developed capital markets – would provide valuable insights into the generalizability of the disciplinary effect.

#### Notes

1. In January 2021, millions of retail investors rallied on the online community, leading to the short squeeze of Gamestop's stock and other securities with a large short position. The short squeeze caused tremendous losses for short sellers like hedge funds. This event has drawn the world's attention to short selling activities and brought the debate on the real consequences of short selling activities.
2. <https://www.sec.gov/spotlight/shopilot.htm>
3. We find that in our data, 90% of deals announced are finally completed, so there is a limited difference between using announced deals and completed deals.
4. [Netter et al. \(2011\)](#) find that if researchers require the target to be more than 1% of the acquirer's size, then only 22.1% of the US deals from 1992 to 2009 are left. If we further require the target to be valued more than \$50 million, then only 2.4% of the deals remain.
5. There are fewer observations of M&A deals with available CAR information since some firms are delisted within 36 months after a deal completion, and we do not have the required stock return information to calculate their CARs.
6. We do not consider year fixed effects. M&As come in waves, so the year dummies largely overlap with *During*.
7. The number of firm-year observations (*Obs.*) reported in [Table 4](#) is different among the scenarios, since we require a firm to announce at least one M&A that meets those criteria within our sample period to remain in the sample.
8. The results are available upon request.

#### Supplementary material

The supplementary material for this article can be found online.

#### References

- Adams, R. B., & Ferreira, D. (2009). Women in the boardroom and their impact on governance and performance. *Journal of Financial Economics*, 94(2), 291–309, doi: [10.1016/j.jfineco.2008.10.007](https://doi.org/10.1016/j.jfineco.2008.10.007).
- Akbulut, M. E. (2013). Do overvaluation-driven stock acquisitions really benefit acquirer shareholders?. *Journal of Financial and Quantitative Analysis*, 48(4), 1025–1055, doi: [10.1017/s0022109013000379](https://doi.org/10.1017/s0022109013000379).
- Aktas, N., De Bodt, E., & Roll, R. (2013). Learning from repetitive acquisitions: Evidence from the time between deals. *Journal of Financial Economics*, 108(1), 99–117, doi: [10.1016/j.jfineco.2012.10.010](https://doi.org/10.1016/j.jfineco.2012.10.010).
- Alexandridis, G., Mavrovitis, C. F., & Travlos, N. G. (2012). How have mergers and acquisitions changed? Evidence from the sixth merger wave. *The European Journal of Finance*, 18(8), 663–688, doi: [10.1080/1351847x.2011.628401](https://doi.org/10.1080/1351847x.2011.628401).
- An, Z., Xia, Y., & Xu, Z. (2024). Short-selling threat and corporate risk-taking: International evidence. SSRN 4921290.
- Arikan, A. M., & Stulz, R. M. (2016). Corporate acquisitions, diversification, and the firm's life cycle. *The Journal of Finance*, 71(1), 139–194, doi: [10.1111/jofi.12362](https://doi.org/10.1111/jofi.12362).

- Baker, M., & Savaşoglu, S. (2002). Limited arbitrage in mergers and acquisitions. *Journal of Financial Economics*, 64(1), 91–115, doi: [10.1016/s0304-405x\(02\)00072-7](https://doi.org/10.1016/s0304-405x(02)00072-7).
- Bao, H., Li, Y., & Jiang, J. (2024). The employment effects of short selling: Evidence from China. *The European Journal of Finance*, 30(13), 1490–1519, doi: [10.1080/1351847x.2024.2308633](https://doi.org/10.1080/1351847x.2024.2308633).
- Barber, B. M., & Lyon, J. D. (1997). Detecting long-run abnormal stock returns: The empirical power and specification of test statistics. *Journal of Financial Economics*, 43(3), 341–372, doi: [10.1016/s0304-405x\(96\)00890-2](https://doi.org/10.1016/s0304-405x(96)00890-2).
- Beber, A., & Pagano, M. (2013). Short-selling bans around the world: Evidence from the 2007–09 crisis. *The Journal of Finance*, 68(1), 343–381, doi: [10.1111/j.1540-6261.2012.01802.x](https://doi.org/10.1111/j.1540-6261.2012.01802.x).
- Bena, J., & Li, K. (2014). Corporate innovations and mergers and acquisitions. *The Journal of Finance*, 69(5), 1923–1960, doi: [10.1111/jofi.12059](https://doi.org/10.1111/jofi.12059).
- Berger, P. G., & Ofek, E. (1995). Diversification's effect on firm value. *Journal of Financial Economics*, 37(1), 39–65, doi: [10.1016/0304-405x\(94\)00798-6](https://doi.org/10.1016/0304-405x(94)00798-6).
- Bergstresser, D., & Philippon, T. (2006). CEO incentives and earnings management. *Journal of Financial Economics*, 80(3), 511–529, doi: [10.1016/j.jfineco.2004.10.011](https://doi.org/10.1016/j.jfineco.2004.10.011).
- Bhagat, S., Dong, M., Hirshleifer, D., & Noah, R. (2005). Do tender offers create value? New methods and evidence. *Journal of Financial Economics*, 76(1), 3–60, doi: [10.1016/j.jfineco.2004.05.002](https://doi.org/10.1016/j.jfineco.2004.05.002).
- Billett, M. T., Garfinkel, J. A., & Jiang, Y. (2011). The influence of governance on investment: Evidence from a hazard model. *Journal of Financial Economics*, 102(3), 643–670, doi: [10.1016/j.jfineco.2011.07.004](https://doi.org/10.1016/j.jfineco.2011.07.004).
- Bliss, R. T., & Rosen, R. J. (2001). CEO compensation and bank mergers. *Journal of Financial Economics*, 61(1), 107–138, doi: [10.1016/s0304-405x\(01\)00057-5](https://doi.org/10.1016/s0304-405x(01)00057-5).
- Boehme, R. D., Danielsen, B. R., & Sorescu, S. M. (2006). Short-sale constraints, differences of opinion, and overvaluation. *Journal of Financial and Quantitative Analysis*, 41(2), 455–487, doi: [10.1017/s0022109000002143](https://doi.org/10.1017/s0022109000002143).
- Burns, N., McTier, B. C., & Minnick, K. (2015). Equity-incentive compensation and payout policy in Europe. *Journal of Corporate Finance*, 30, 85–97, doi: [10.1016/j.jcorpfin.2014.10.019](https://doi.org/10.1016/j.jcorpfin.2014.10.019).
- Byrd, J. W., & Hickman, K. A. (1992). Do outside directors monitor managers?: Evidence from tender offer bids. *Journal of Financial Economics*, 32(2), 195–221, doi: [10.1016/0304-405x\(92\)90018-s](https://doi.org/10.1016/0304-405x(92)90018-s).
- Chang, E. C., Luo, Y., & Ren, J. (2014). Short-selling, margin-trading, and price efficiency: Evidence from the Chinese market. *Journal of Banking and Finance*, 48, 411–424, doi: [10.1016/j.jbankfin.2013.10.002](https://doi.org/10.1016/j.jbankfin.2013.10.002).
- Chang, E. C., Lin, T.-C., & Ma, X. (2019). Does short-selling threat discipline managers in mergers and acquisitions decisions?. *Journal of Accounting and Economics*, 68(1), 101223, doi: [10.1016/j.jacceco.2018.12.002](https://doi.org/10.1016/j.jacceco.2018.12.002).
- Chen, H. A., & Wu, Q. (2021). Short selling threat and real activity manipulation: Evidence from a natural experiment. *Advances in Accounting*, 52, 100514, doi: [10.1016/j.adiaac.2021.100514](https://doi.org/10.1016/j.adiaac.2021.100514).
- Chen, X., Harford, J., & Li, K. (2007). Monitoring: Which institutions matter?. *Journal of Financial Economics*, 86(2), 279–305, doi: [10.1016/j.jfineco.2006.09.005](https://doi.org/10.1016/j.jfineco.2006.09.005).
- Chen, K. C., Chen, Z., & Wei, K. J. (2011). Agency costs of free cash flow and the effect of shareholder rights on the implied cost of equity capital. *Journal of Financial and Quantitative Analysis*, 46(1), 171–207, doi: [10.1017/s0022109010000591](https://doi.org/10.1017/s0022109010000591).
- Chikh, S., & Filbien, J.-Y. (2010). Acquisitions and CEO power: Evidence from French networks. *Journal of Corporate Finance*, 17(5), 1221–1236, doi: [10.1016/j.jcorpfin.2011.06.007](https://doi.org/10.1016/j.jcorpfin.2011.06.007).
- De Angelis, D., Grullon, G., & Michenaud, S. (2017). The effects of short-selling threats on incentive contracts: Evidence from an experiment. *The Review of Financial Studies*, 30(5), 1627–1659, doi: [10.1093/rfs/hhw105](https://doi.org/10.1093/rfs/hhw105).
- Dong, M., Hirshleifer, D., Richardson, S., & Teoh, S. H. (2006). Does investor misvaluation drive the takeover market?. *The Journal of Finance*, 61(2), 725–762, doi: [10.1111/j.1540-6261.2006.00853.x](https://doi.org/10.1111/j.1540-6261.2006.00853.x).

- Dos Santos, M. B., Errunza, V. R., & Miller, D. P. (2008). Does corporate international diversification destroy value? Evidence from cross-border mergers and acquisitions. *Journal of Banking and Finance*, 32(12), 2716–2724, doi: [10.1016/j.jbankfin.2008.07.010](https://doi.org/10.1016/j.jbankfin.2008.07.010).
- Duchin, R., & Schmidt, B. (2013). Riding the merger wave: Uncertainty, reduced monitoring, and bad acquisitions. *Journal of Financial Economics*, 107(1), 69–88, doi: [10.1016/j.jfineco.2012.07.003](https://doi.org/10.1016/j.jfineco.2012.07.003).
- Elnahas, A. M., & Kim, D. (2017). CEO political ideology and mergers and acquisitions decisions. *Journal of Corporate Finance*, 45, 162–175, doi: [10.1016/j.jcorpfin.2017.04.013](https://doi.org/10.1016/j.jcorpfin.2017.04.013).
- Faccio, M., & Masulis, R. W. (2005). The choice of payment method in European mergers and acquisitions. *The Journal of Finance*, 60(3), 1345–1388, doi: [10.1111/j.1540-6261.2005.00764.x](https://doi.org/10.1111/j.1540-6261.2005.00764.x).
- Fang, V. W., Huang, A. H., & Karpoff, J. M. (2016). Short selling and earnings management: A controlled experiment. *The Journal of Finance*, 71(3), 1251–1294, doi: [10.1111/jofi.12369](https://doi.org/10.1111/jofi.12369).
- Fauver, L., Houston, J. F., & Naranjo, A. (2004). Cross-country evidence on the value of corporate industrial and international diversification. *Journal of Corporate Finance*, 10(5), 729–752, doi: [10.1016/s0929-1199\(03\)00027-0](https://doi.org/10.1016/s0929-1199(03)00027-0).
- Fu, F., Lin, L., & Officer, M. S. (2013). Acquisitions driven by stock overvaluation: Are they good deals?. *Journal of Financial Economics*, 109(1), 24–39, doi: [10.1016/j.jfineco.2013.02.013](https://doi.org/10.1016/j.jfineco.2013.02.013).
- Gantchev, N., Sevilir, M., & Shivdasani, A. (2020). Activism and empire building. *Journal of Financial Economics*, 138(2), 526–548, doi: [10.1016/j.jfineco.2020.06.001](https://doi.org/10.1016/j.jfineco.2020.06.001).
- Grullon, G., Michenaud, S., & Weston, J. P. (2015). The real effects of short-selling constraints. *The Review of Financial Studies*, 28(6), 1737–1767, doi: [10.1093/rfs/hhv013](https://doi.org/10.1093/rfs/hhv013).
- Hadlock, C. J., & Pierce, J. R. (2010). New evidence on measuring financial constraints: Moving beyond the KZ index. *The Review of Financial Studies*, 23(5), 1909–1940, doi: [10.1093/rfs/hhq009](https://doi.org/10.1093/rfs/hhq009).
- Harford, J. (1999). Corporate cash reserves and acquisitions. *The Journal of Finance*, 54(6), 1969–1997, doi: [10.1111/0022-1082.00179](https://doi.org/10.1111/0022-1082.00179).
- Harford, J., Jenter, D., & Li, K. (2011). Institutional cross-holdings and their effect on acquisition decisions. *Journal of Financial Economics*, 99(1), 27–39, doi: [10.1016/j.jfineco.2010.08.008](https://doi.org/10.1016/j.jfineco.2010.08.008).
- Harford, J., Humphery-Jenner, M., & Powell, R. (2012). The sources of value destruction in acquisitions by entrenched managers. *Journal of Financial Economics*, 106(2), 247–261, doi: [10.1016/j.jfineco.2012.05.016](https://doi.org/10.1016/j.jfineco.2012.05.016).
- He, W., & Luo, J.-H. (2018). Agency problems in firms with an even number of directors: Evidence from China. *Journal of Banking and Finance*, 93, 139–150, doi: [10.1016/j.jbankfin.2018.06.006](https://doi.org/10.1016/j.jbankfin.2018.06.006).
- He, J., Ren, X., & Tian, X. (2023). Do short sellers affect corporate innovation? Evidence from a policy experiment. *The Review of Corporate Finance Studies*, 14(1), 125–165, doi: [10.1093/rcfs/cfad007](https://doi.org/10.1093/rcfs/cfad007).
- He, P., Ma, L., & Wang, K. (2024). Financial market efficiency and the governance role of government.
- Hirshleifer, D., Teoh, S. H., & Yu, J. J. (2011). Short arbitrage, return asymmetry, and the accrual anomaly. *The Review of Financial Studies*, 24(7), 2429–2461, doi: [10.1093/rfs/hhr012](https://doi.org/10.1093/rfs/hhr012).
- Hoechle, D., Schmid, M., Walter, I., & Yermack, D. (2012). How much of the diversification discount can be explained by poor corporate governance?. *Journal of Financial Economics*, 103(1), 41–60, doi: [10.1016/j.jfineco.2011.03.025](https://doi.org/10.1016/j.jfineco.2011.03.025).
- Jensen, M. C. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *The American Economic Review*, 76, 323–329.
- Karpoff, J. M., & Lou, X. (2010). Short sellers and financial misconduct. *The Journal of Finance*, 65(5), 1879–1913, doi: [10.1111/j.1540-6261.2010.01597.x](https://doi.org/10.1111/j.1540-6261.2010.01597.x).
- Lamont, O. A., & Polk, C. (2002). Does diversification destroy value? Evidence from the industry shocks. *Journal of Financial Economics*, 63(1), 51–77, doi: [10.1016/s0304-405x\(01\)00089-7](https://doi.org/10.1016/s0304-405x(01)00089-7).

- Lang, L., & Stulz, R. (1994). Tobin's q, corporate diversification, and firm performance. *Journal of Political Economy*, 102(6), 1248–1280, doi: [10.1086/261970](https://doi.org/10.1086/261970).
- Lang, L. H., Stulz, R., & Walkling, R. A. (1991). A test of the free cash flow hypothesis: The case of bidder returns. *Journal of Financial Economics*, 29(2), 315–335, doi: [10.1016/0304-405x\(91\)90005-5](https://doi.org/10.1016/0304-405x(91)90005-5).
- Lang, L., Ofek, E., & Stulz, R. (1996). Leverage, investment, and firm growth. *Journal of Financial Economics*, 40(1), 3–29, doi: [10.1016/0304-405x\(95\)00842-3](https://doi.org/10.1016/0304-405x(95)00842-3).
- Levi, M., Li, K., & Zhang, F. (2014). Director gender and mergers and acquisitions. *Journal of Corporate Finance*, 28, 185–200, doi: [10.1016/j.jcorpfin.2013.11.005](https://doi.org/10.1016/j.jcorpfin.2013.11.005).
- Li, K., Liu, T., & Wu, J. (2018). Vote avoidance and shareholder voting in mergers and acquisitions. *The Review of Financial Studies*, 31(8), 3176–3211, doi: [10.1093/rfs/hhy065](https://doi.org/10.1093/rfs/hhy065).
- Loughran, T., & Vijh, A. M. (1997). Do long-term shareholders benefit from corporate acquisitions?. *The Journal of Finance*, 52(5), 1765–1790, doi: [10.2307/2329464](https://doi.org/10.2307/2329464).
- Louis, H. (2004). Earnings management and the market performance of acquiring firms. *Journal of Financial Economics*, 74(1), 121–148, doi: [10.1016/j.jfineco.2003.08.004](https://doi.org/10.1016/j.jfineco.2003.08.004).
- Lu, P., Wang, Y., & Li, B. (2024). Short selling and corporate financial fraud: Empirical evidence from China. *International Review of Economics and Finance*, 89, 1569–1582, doi: [10.1016/j.iref.2023.09.011](https://doi.org/10.1016/j.iref.2023.09.011).
- Malmendier, U., & Tate, G. (2005). CEO overconfidence and corporate investment. *The Journal of Finance*, 60(6), 2661–2700, doi: [10.1111/j.1540-6261.2005.00813.x](https://doi.org/10.1111/j.1540-6261.2005.00813.x).
- Malmendier, U., & Tate, G. (2008). Who makes acquisitions? CEO overconfidence and the market's reaction. *Journal of Financial Economics*, 89(1), 20–43, doi: [10.1016/j.jfineco.2007.07.002](https://doi.org/10.1016/j.jfineco.2007.07.002).
- Massa, M., Zhang, B., & Zhang, H. (2015). The invisible hand of short selling: Does short selling discipline earnings management?. *The Review of Financial Studies*, 28(6), 1701–1736, doi: [10.1093/rfs/hhu147](https://doi.org/10.1093/rfs/hhu147).
- Masulis, R. W., Wang, C., & Xie, F. (2007). Corporate governance and acquirer returns. *The Journal of Finance*, 62(4), 1851–1889, doi: [10.1111/j.1540-6261.2007.01259.x](https://doi.org/10.1111/j.1540-6261.2007.01259.x).
- Mehran, H. (1995). Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics*, 38(2), 163–184, doi: [10.1016/0304-405x\(94\)00809-f](https://doi.org/10.1016/0304-405x(94)00809-f).
- Meng, Q., Li, X., Chan, K. C., & Gao, S. (2020). Does short selling affect a firm's financial constraints?. *Journal of Corporate Finance*, 60, 101531, doi: [10.1016/j.jcorpfin.2019.101531](https://doi.org/10.1016/j.jcorpfin.2019.101531).
- Mi, Z., & Wang, X. (2000). Agency cost and the crisis of China's SOE. *China Economic Review*, 11(3), 297–317, doi: [10.1016/s1043-951x\(00\)00023-7](https://doi.org/10.1016/s1043-951x(00)00023-7).
- Miller, E. M. (1977). Risk, uncertainty, and divergence of opinion. *The Journal of Finance*, 32(4), 1151–1168, doi: [10.1111/j.1540-6261.1977.tb03317.x](https://doi.org/10.1111/j.1540-6261.1977.tb03317.x).
- Minnick, K., Unal, H., & Yang, L. (2011). Pay for performance? CEO compensation and acquirer returns in BHCs. *The Review of Financial Studies*, 24(2), 439–472, doi: [10.1093/rfs/hhq107](https://doi.org/10.1093/rfs/hhq107).
- Moeller, S. B., Schlingemann, F. P., & Stulz, R. M. (2005). Wealth destruction on a massive scale? A study of acquiring-firm returns in the recent merger wave. *The Journal of Finance*, 60(2), 757–782, doi: [10.1111/j.1540-6261.2005.00745.x](https://doi.org/10.1111/j.1540-6261.2005.00745.x).
- Morck, R., Shleifer, A., & Vishny, R. (1990). Do managerial objectives drive bad acquisitions?. *The Journal of Finance*, 45(1), 31–48, doi: [10.1111/j.1540-6261.1990.tb05079.x](https://doi.org/10.1111/j.1540-6261.1990.tb05079.x).
- Netter, J., Stegemoller, M., & Wintoki, M. B. (2011). Implications of data screens on merger and acquisition analysis: A large sample study of mergers and acquisitions from 1992 to 2009. *The Review of Financial Studies*, 24(7), 2316–2357, doi: [10.1093/rfs/hhr010](https://doi.org/10.1093/rfs/hhr010).
- Office of Economic Analysis (2007). Economic analysis of the short sale price restrictions under the Regulation SHO pilot. Securities and Exchange Commission Working Paper.
- Ozbas, O., & Scharfstein, D. S. (2010). Evidence on the dark side of internal capital markets. *The Review of Financial Studies*, 23(2), 581–599, doi: [10.1093/rfs/hhp071](https://doi.org/10.1093/rfs/hhp071).

- Pan, Y., Wang, T. Y., & Weisbach, M. S. (2016). CEO investment cycles. *The Review of Financial Studies*, 29(11), 2955–2999, doi: [10.1093/rfs/hhw033](https://doi.org/10.1093/rfs/hhw033).
- Phillips, G. M., & Zhdanov, A. (2013). R&D and the incentives from merger and acquisition activity. *The Review of Financial Studies*, 26, 34–78.
- Rajan, R., Servaes, H., & Zingales, L. (2000). The cost of diversity: The diversification discount and inefficient investment. *The Journal of Finance*, 55(1), 35–80, doi: [10.1111/0022-1082.00200](https://doi.org/10.1111/0022-1082.00200).
- Rau, P. R., & Vermaelen, T. (1998). Glamour, value and the post-acquisition performance of acquiring firms. *Journal of Financial Economics*, 49(2), 223–253, doi: [10.1016/s0304-405x\(98\)00023-3](https://doi.org/10.1016/s0304-405x(98)00023-3).
- Rhodes-Kropf, M., Robinson, D. T., & Viswanathan, S. (2005). Valuation waves and merger activity: The empirical evidence. *Journal of Financial Economics*, 77(3), 561–603, doi: [10.1016/j.jfineco.2004.06.015](https://doi.org/10.1016/j.jfineco.2004.06.015).
- Roll, R. (1986). The hubris hypothesis of corporate takeovers. *Journal of Business*, 59(2), 197–216, doi: [10.1086/296325](https://doi.org/10.1086/296325).
- Saffi, P. A., & Sigurdsson, K. (2011). Price efficiency and short selling. *The Review of Financial Studies*, 24(3), 821–852, doi: [10.1093/rfs/hhq124](https://doi.org/10.1093/rfs/hhq124).
- Schoar, A. (2002). Effects of corporate diversification on productivity. *The Journal of Finance*, 57(6), 2379–2403, doi: [10.1111/1540-6261.00500](https://doi.org/10.1111/1540-6261.00500).
- Shi, W., Ndofor, H. A., & Hoskisson, R. E. (2021). Disciplining role of short sellers: Evidence from M&A activity. *Journal of Management*, 47, 1103–1133.
- Shleifer, A., & Vishny, R. W. (1989). Management entrenchment: The case of manager-specific investments. *Journal of Financial Economics*, 25(1), 123–139, doi: [10.1016/0304-405x\(89\)90099-8](https://doi.org/10.1016/0304-405x(89)90099-8).
- Shleifer, A., & Vishny, R. W. (1997). A survey of corporate governance. *The Journal of Finance*, 52(2), 737–783, doi: [10.1111/j.1540-6261.1997.tb04820.x](https://doi.org/10.1111/j.1540-6261.1997.tb04820.x).
- Shleifer, A., & Vishny, R. W. (2003). Stock market driven acquisitions. *Journal of Financial Economics*, 70(3), 295–311, doi: [10.1016/s0304-405x\(03\)00211-3](https://doi.org/10.1016/s0304-405x(03)00211-3).
- Wang, K., Wang, R., Wei, K. C. J., Zhang, B., & Zhou, Y. (2022). Insider sales under the threat of short sellers: New hypothesis and new tests. *The Accounting Review*, 97(2), 427–451, doi: [10.2308/tar-2018-0196](https://doi.org/10.2308/tar-2018-0196).
- Yang, J., Xue, Y., & Liu, Y. (2023). Short selling, managerial alignment and corporate misconduct. *Pacific-Basin Finance Journal*, 77, 101895, doi: [10.1016/j.pacfin.2022.101895](https://doi.org/10.1016/j.pacfin.2022.101895).

**Corresponding author**

Hai Lin can be contacted at: [hai.lin@vuw.ac.nz](mailto:hai.lin@vuw.ac.nz)