Stock price crash risk and the market corporate control

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Abstract

In this study, we are the first to investigate effects of stock price crash risk, and hence concealment of bad news, on aspects of the market for corporate control. For a large sample of US incorporated and listed firms over the period 1988-2018, we find strong evidence to suggest that higher stock price crash risk leads to greater likelihood of firms being selected as a takeover target. Furthermore, we find that this causal effect is more pronounced for firms evidencing poorer performance, which affords richer insight into the notion that correction of managerial performance is a stimulus for the market for corporate control. We provide further novel evidence of lower acquisition premiums for takeover targets with higher stock price crash risk for deals in which stock is the sole method of payment. This supports the argument that activity in the market for corporate control is at least partially motivated by acquisitions at "bargain" prices.

Keywords: Stock price crash risk, Market for corporate control, Managerial performance, Takeover premium, Method of payment

EFM Classifications: 150, 160

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1. Introduction

Motivated by information asymmetry between management teams and shareholders, managers may withhold bad news for their own interests, such as value maintenance of their compensation packages, career development, and entrenched positions (Kothari, Shu and Wysocki, 2009). Whilst such managers speculate that subsequent corporate activities can absorb concealed bad news, stockpiled bad news can generate a bubble in the equity price and lead to extreme information asymmetry between inside managers and outside investors (Kim, Li and Zhang, 2011; An, Li and Yu, 2015). When stockpiled bad news exceeds a certain limit, all information may be simultaneously revealed to the market, thereby triggering a stock price crash that jeopardizes shareholders' value (Li and Myers, 2006; Hutton, Marcus and Tehranian, 2009). Despite growing awareness of the determinants of stock price crash risk (An, Li and Yu, 2015), research on its consequences is sparse. In this study, we make the first attempt to fill this important gap in the literature by investigating the consequences of stock price crash risk on aspects of the market for corporate control.

The market for corporate control is one of the most important external governance mechanisms for aligning the interests of managers with those of shareholders (Fama and Jensen, 1983; Jensen and Ruback, 1983). The inefficient management hypothesis (IMH) suggests that takeovers play a key role in the correction of managerial inefficiency by targeting underperforming managers (Cremers, Nair and John, 2008; Brar, Giamouridis and Liodakis, 2009; Danbolt, Siganos and Tunyi, 2016; Tunyi, Ntim and Danbolt, 2019). Furthermore, mismanagement may be associated with undervaluation of firms in the capital markets. Bidders may target such undervalued firms and discipline management teams to recover the discounted price to the potential value. In particular, the consensus is that the equity value of a firm is discounted by market participants owing to information asymmetry, which makes it difficult for outside investors to evaluate the true value of opaque firms (Cheng, Li and Tong, 2013;

Raman, Shivakumar and Tamayo, 2013). Consequently, firms with a higher level of information asymmetry are more likely to be undervalued and to therefore attract bidders to exploit the market discount as an opportunity for a bargain acquisition. We are thus motivated to begin by investigating the impact of firms' stock price crash risk on their takeover target likelihood.

For the following reasons, we conjecture that stock price crash risk can increase the likelihood that a firm becomes a takeover target. First, managerial bad news hoarding behavior may trigger a sudden and dramatic decrease in a firm's stock price when the concealed negative information exceeds a certain threshold. A sudden downward movement in a firm's stock price can provide an opportunity for participants in the market for corporate control to acquire a firm at a "bargain" price (Berger and Ofek, 1996). Second, conflicts of interests between managers and shareholders in firms with higher stock price crash risk may weaken targets' bargaining power in the acquisition process. In addition, capital market participants face a higher level of information asymmetry when assessing the value of target firms with high stock price crash risk (An, Li and Yu, 2015). This implies that bidders face higher uncertainty about future performance of such targets after completing their takeover deals. Since bidders can offer a price that is lower than the true value of the target firm when it is difficult to accurately price the firm in the capital markets (Dong, Hirshleifer and Richardson, 2006), opacity and uncertainty may further weaken the bargaining power of target shareholders in the deal negotiation process (Luypaert and Caneghem, 2017). For both reasons, firms with higher stock price crash risk are likely to make a more attractive takeover target in the market for corporate control.

Following prior studies (Hutton, Marcus and Tehranian, 2009; Kim, Li and Zhang, 2011; An, Li and Yu, 2015; Chiu, Kim and Wang, 2019; Li and Zeng, 2019), we utilize two measures of stock price crash risk – negative conditional skewness of firm - specific weekly returns and down-to-up volatility of firm-specific weekly returns – to investigate whether or not higher stock price crash risk is associated with greater takeover target likelihood. Using a sample of 12,330 firms from 1988 to 2018, generating 100,348 firm-year observations, we find that firms with higher stock price crash risk are more likely to become a takeover target. This finding therefore supports the conjecture that stock price crash risk affords a valuable acquisition opportunity for participants in the market for corporate control. The results are robust when we utilize alternative measures of stock price crash risk in the form of the number of times over the fiscal year that firms experience stock price crashes minus the number of times that they experience stock price jumps and the likelihood that a firm experiences at least one stock price crash week in a fiscal year.

We also examine the effect of firm performance on the relationship between stock price crash risk and takeover target likelihood. If poor firm performance motivates managers to withhold negative information owing to performance-related career concerns (Hutton, Marcus and Tehranian, 2009), we would expect that the influence of stock price crash risk on takeover target likelihood is more pronounced for firms evidencing poorer performance. Similarly, the theory of the market for corporate control implies that managerial performance is negatively related to takeover target likelihood, since inefficient managers are expected to be replaced by more efficient ones in an active takeover market (Tunyi, Ntim and Danbolt, 2019). In line with these arguments, we show that the impact of stock price crash risk on takeover target likelihood is indeed more pronounced for firms evidencing poorer performance.

We are subsequently motivated to investigate the impact of target firms' stock price crash risk on their takeover premiums. We conjecture that takeover targets with higher stock price crash risk are more likely to receive a lower offer premium in deals for which stock is the sole the method of payment. First, this is because information asymmetry and hence greater uncertainty is likely to weaken the bargaining power of shareholders of targets with higher crash risk in the process of deal negotiation (Luypaert and Caneghem, 2017; Li and Tong, 2018). Furthermore, because managerial bad news hoarding behavior leads to higher information asymmetry between inside managers and outside investors (An, Li and Yu, 2015), it increases the monitoring costs of corporate activities. Agency conflicts between managers and shareholders are therefore likely to be more severe in firms with higher stock price crash risk, which may further weaken bargaining power of targets in the process of deal negotiation since managers may pursue their own personal interests, such as career security and private benefits of control, at the expense of shareholder wealth. That is, higher monitoring costs and lower bargaining power may lead to lower takeover premiums for higher stock price crash risk targets. Second, this is because payment with stock is more likely to be the preferred option for participants in the market for corporate control that are intent on acquiring target firms with high stock price crash risk. Stock deals can safeguard bidders from overpayment for "lemons" by enabling them to share the risk with target shareholders, whereas for cash deals bidders bear all the risk of overpayment (Hansen, 1987; Officer, Poulsen and Stegemoller, 2009; Luypaert and Caneghem, 2017).

The contributions of our study are threefold. First, to the best of our knowledge, our paper makes the first attempt to investigate the consequences of firm-specific stock price crash risk exposure in the market for corporate control. One strand of prior literature documents the determinants of takeover likelihood, including undervaluation (Palepu, 1986), performance (Tunyi, Ntim and Danbolt, 2019), information asymmetry (Borochin, Ghosh and Huang, 2019), tangibility (Ambrose and Megginson, 1992), innovation (Wu and Chung, 2019), and human capital (Chen, Gao and Ma, 2020). We extend this strand of the existing literature by showing that a previously unexplored factor, stock price crash risk, plays not only an important role in the target selection process but also in the determination of takeover premium through the deal negotiation process. Another strand of the prior literature considers the influence of takeover protection on stock price crash risk, since the market for corporate control is viewed as an effective external governance mechanism for mitigating agency conflicts. However the findings remain inconclusive. Bhargava, Faircloth and Zeng (2017) find that stronger takeover protection induced by the staggered passage of state antitakeover laws curtails managers from participating in bad news hoarding activities, which in turn reduces stock price crash risk. In contrast, Balachandran et al. (2020) suggest that greater threat from takeover induced through pro-takeover laws constrains managers from hiding negative information, thereby avoiding future stock price crashes. Our study is different in that seeks to address whether or not stock price crash risk promotes takeover target likelihood and valuable acquisition opportunities through the deal negotiation process for participants in the market for control.

We duly address concerns of reverse causality and omitted variables to be certain beyond reasonable doubt that the main relationship that we investigate runs from stock price crash risk to takeover target likelihood. We do so by exploiting alternative instrumental variables in the form of the average stock price crash risk of other firms headquartered in the same state as the focus firm and the staggered adoption of state data breach laws. Whilst both instruments are plausibly and empirically correlated with the focus firm's stock price crash risk, there are no reasons to suspect that the average stock price crash risk of other firms headquartered in the same state as the focus firm and operating in a different industry to that of the focus firm is directly associated with the likelihood of the focus firm being selected as a takeover target. Similarly, states adopted data breach disclosure legislation to protect the safety of customers' personal information and prevent future information leakage and not to influence firms' takeover likelihood. Irrespective of the instrumental variable, we are able to conclude that a higher level of stock price crash risk induces a greater likelihood of being a takeover target, thereby suggesting a causal effect of stock price crash risk on takeover target likelihood.

Second, we contribute to the literature on the impacts of various incentives for corporate information disclosure (Healy and Palepu, 2001; Hutton, Marcus and Tehranian, 2009; Kothari, Shu and Wysocki, 2009; Kim, Li and Zhang, 2011; DeFond *et al.*, 2015). More specifically, Kothari, Shu and Wysocki (2009) demonstrate that career concerns, such as promotion, employment opportunities, and potential termination and loss of postretirement benefits (including directorships), motivate managers to withhold bad news and gamble that subsequent corporate events will allow them to assimilate bad news. From a different perspective, firm performance is closely related to managerial career development, in which the takeover market serves as an external governance mechanism for controlling managerial misconduct by targeting poorly performing firms (Manne, 1965; Jensen and Ruback, 1983; Cremers, Nair and John, 2008; Brar, Giamouridis and Liodakis, 2009; Danbolt, Siganos and Tunyi, 2016; Tunyi, Ntim and Danbolt, 2019). Our study extends this stream of literature by documenting that the relationship between stock price crash risk and takeover target likelihood is more pronounced for firms evidencing poorer performance. This supports the argument that managerial inefficiency exacerbates managers' career concerns and thus stimulates managerial incentives to withhold bad news. At the same time, it affords richer insight into the notion that correction of managerial performance is a stimulus for the market for corporate control.

Third, our study affords further insight into the choice of payment methods in mergers and acquisitions. Officer, Poulsen and Stegemoller (2009) find that use of stock payment for opaque targets eliminates the risk of overpayment and is associated with higher bidders' announcement returns. Our paper differs from this study and provides novel evidence that targets with higher stock price crash risk are more likely to receive lower takeover premiums for deals in which stock is the sole method of payment. This implies that use of stock payment protects bidders from uncertainty driven by targets' stock price crash risk. It further supports our argument that stock price crash risk affords valuable opportunities through the deal negotiation process for bidders that are intent on pursuing a "bargain" in the market for corporate control.

The rest of paper is organized as follows. Section 2 reviews prior related research and develops our hypotheses. Section 3 describes the sample and methods used for the empirical investigation. Section 4 presents our main results, whilst we discuss the results of robustness tests in Section 5. Section 6 concludes.

2. Related literature and hypothesis development

2.1 Stock price crash risk

Managerial commitment to quickly disclosing private information, good or bad, reduces information asymmetry and lowers the firm's cost of capital (Kothari, Shu and Wysocki, 2009), even though there are associated costs should such disclosure reveal proprietary information about the firm's prospects to competitors. Yet whilst managers have incentives to disclose bad news early under certain circumstances, they also have incentives to withhold it under others. In particular, Kothari, Shu and Wysocki (2009) contend that managerial career concerns encompass the effects of information disclosure on managerial rewards and continuity, such as promotion, employment opportunities outside the firm, and potential termination of employment and loss of postretirement benefits. They conclude that the optimal level of disclosure from a managerial perspective is one that is less than fully transparent, especially with respect to bad news. In addition, managers incur costs arising from lower bonus payments, reduced stock option awards, and loss in other wealth as a result of stock price decline following disclosure of bad news (Kim, Li and Zhang, 2011).

By extending a theoretical model of control and risk-bearing when outside investors have limited information, Jin and Myers (2006) demonstrate that an opaque environment motivates managers to temporarily absorb negative information. However, once the market becomes aware of this withheld information, it triggers a stock price crash. Extant empirical work documents that a firm's risk of experiencing a stock price crash relates closely to the quality of its reported earnings. In particular, Hutton, Marcus and Tehranian (2009) find evidence to suggest that less transparency in a firm's reported earnings assists managers to withhold information with the intention of protecting their own interests. Ertugrul et al. (2017) find that firms with lower reporting quality and more ambiguous tone in their annual reports have a greater likelihood of experiencing a collapse in the value of their equity. Khurana, Pereira and Zhang (2018) document findings suggesting that earnings smoothing assists managers to hide undesirable information but triggers a stock price crash once concealed negative information exceeds a certain limit. Ben-Nasr and Ghouma (2018) document findings suggesting that employee welfare packages weaken corporate monitoring and motivate managers to inflate stock performance.

Other studies document findings suggesting that internal and external control mechanisms constrain firms' risk of experiencing a stock price crash. In particular, Kim, Li and Zhang (2011) find that chief financial officers' (CFOs') option incentives increase the risk of a stock price crash because such incentives motivate them to hide negative information, whereas inside debt holdings incentivize CFOs to be more conservative by refraining from excessive risk-taking and financial misreporting. Similarly, He (2015) documents a significant and negative relationship between inside debt holdings and stock price crash risk. Furthermore, Chen et al. (2017) find evidence to suggest that more effective internal control processes, such as greater risk assessment and monitoring, restrict managerial incentives to withhold negative information. In the context of external control mechanisms, DeFond et al. (2015) argue that international financial reporting standards improve corporate transparency and are effective in decreasing a firm's risk of experiencing a stock price crash by constraining managerial bad news hoarding behavior. Li and Zhan (2019) contend that competition in the product market constrains managers' misconduct, thereby limiting their opportunities for hiding negative information. In particular, the costs to managers of hoarding bad news can outweigh the benefits to them if investors utilize financial information from comparable peers for inferring performance. In this vein, Kim et al. (2016) find that comparability of financial statements effectively reduces stock price crash risk.

According to the above arguments and findings, managerial bad news hoarding behavior increases the possibility of a firm experiencing a stock price crash (Jin and Myers, 2006). Furthermore, the left skewed and highly volatile returns of such firms are indicative of greater uncertainty about their future performance (Hutton, Marcus and Tehranian, 2009; Luypaert and Caneghem, 2017). This further exacerbates information asymmetry between insiders and outsiders (An, Li and Yu, 2015). Berger and Ofek (1996) argue that firms with greater risk of value destruction are more likely to become takeover targets. In particular, extreme opacity and uncertainty problems make it difficult for capital market participants to evaluate firms with high stock price crash risk and consequently provide profit-making opportunities for potential bidders (Dong, Hirshleifer and Richardson, 2006). Collectively, those targets with higher information uncertainty begin from an already weakened position in the event of a takeover bid, which gives the bidder a distinct advantage (Li and Tong, 2018). We therefore firstly hypothesize that firms with higher stock price crash risk have a greater likelihood of becoming a takeover target:

Hypothesis 1: Firms with higher risk of experiencing a stock price crash are more likely to become a takeover target.

2.2 Managerial performance and the market for corporate control

In an active takeover market, managers are more likely to be replaced when their interests and behavior diverge from that of maximizing shareholders' value (Manne, 1965; Jensen and

Ruback, 1983). Asquith (1983) finds significant and negative cumulative abnormal returns for target shareholders prior to the announcement of both completed and failed bids. Martin and McConnell (1991) provide evidence that completed takeovers are associated with an increased likelihood of managerial turnover, but especially so when target firms underperform relative to their industry peers.

Even in the event of an unsuccessful takeover attempt, takeover activity can still be utilized to discipline underperforming managers. Denis and Denis (1995) show that takeover activity contributes to the forced removal of the top management team by the incumbent board and better performance thereafter. Cremers, Nair and John (2008) argue that a trading strategy that involves buying (selling) stocks with a high (low) probability of takeover generates significant abnormal returns. Drawing on this evidence, they conclude that takeovers contribute to the correction of management inefficiency by targeting underperforming firms. Brar, Giamouridis and Liodakis (2009) examine the performance of target firms in European cross-border takeovers and argue that underperforming firms are more likely to become takeover targets. Similarly, Danbolt, Siganos and Tunyi (2016) find evidence to suggest that inefficient managers of firms in the UK are more likely to find themselves on the receiving end of a takeover bid.

Given that firm performance determines prospects for promotion, other employment opportunities, and potential termination of position, poor performance exacerbates managerial career concerns and hence incentives for withholding bad news. As a result, we secondly conjecture that the previously hypothesized positive relationship between stock price crash risk and takeover target likelihood is more pronounced for poorly-performing firms:

Hypothesis 2: The positive relationship between stock price crash risk and takeover target likelihood is more pronounced for poorly-performing firms.

2.3 Information asymmetry, takeover premium, and the method of payment

Extant evidence suggests that target firms with weaker corporate governance, higher information asymmetry, and lower bargaining power in the deal negotiation process are more likely to receive a lower takeover premium. Targets with a higher proportion of short-term institutional investors receive a lower takeover premium since such investors have less incentive to monitor managerial opportunism (Gaspar, Massa and Matos, 2005). Specifically, short-term institutional investors frequently sell their shares when their investee firm's performance is poor, and consequently this short-term investment horizon weakens the bargaining power of target firms. Hartzell, Ofek and Yermack (2004) and Rossi and Volpin (2004) find evidence to suggest that less effective corporate governance mechanisms results in a lower takeover premium, because it allows managers to bargain for their personal interests rather than for shareholder wealth. Similarly, Moeller (2005) documents a negative relationship between presence of a staggered board and takeover premium and infers that difficulty of removing board members weakens the monitoring function of the board. In contrast, he infers that more effective monitoring by financial analysts motivates managers of target firms to bargain harder in the deal negotiation process, as reflected in higher takeover premiums.

In addition, lower information asymmetry between targets and bidders can eliminate bidders' valuation uncertainty and in turn enhance bid premiums. Croci, Petmezas and Travlos (2012) find that target firms with unfavorable asymmetric information receive lower takeover premiums owing to uncertainty of expected synergies. According to Javeria, Surendranath and Thanh (2020), bidders pay lower premiums for target firms that engage in more earnings management, which is in line with the notion that reporting quality is an important determinant of takeover premiums. Jindra and Moeller (2020) find that target firms with a longer duration since initial public offering generate higher takeover premiums, suggesting that a longer listing reduces the level of information asymmetry and hence valuation uncertainty of target firms.

Extant studies argue that payment with stock is optimal in terms of eliminating the risk of overpayment when the level of information asymmetry in the target firm is high, since an exchange of stock leads to the shareholders of both the target and the bidder mutually bearing the risk that expected synergies are not achieved (Hansen 1987; Martin 1996; Travlos 1987). Officer, Poulsen and Stegemoller (2009) contend that stock payment is optimal for extremely opaque targets since a stock purchase safeguards the shareholders of the bidder from the risk that an opaque target is not as attractive as the bidder had envisioned. Similarly, Luypaert and Van Caneghem (2017) find that for risk-sharing purposes stock payment is more likely for uncertain and opaque targets.

Collectively, targets with higher stock price crash risk are more likely to be overvalued owing to a higher level of information asymmetry, which improves the bargaining position of the bidder in the bid negotiation process (Luypaert and Caneghem, 2017; Li and Tong, 2018). In particular, shareholders of targets with higher stock price crash risk are more likely to be willing to accept a relatively lower takeover premium to reach agreement when negotiating a deal. However, bidders also face higher risk of overpayment when target firms have higher stock price crash risk. Consequently, stock payment is more likely to be preferred as it can protect bidders from overpayment for “lemons” by enabling bidders to share the risk of overpaying for firms with target shareholders, whereas for cash deals the bidder has to bear all the risk of target overvaluation (Hansen, 1987; Officer, Poulsen and Stegemoller, 2009; Luypaert and Caneghem, 2017). Eckbo and Langohr (1989) also document that cash payment is associated with higher acquisition premiums for targets. This therefore leads to our third and final hypothesis:

Hypothesis 3: Target firms with higher risk of experiencing a stock price crash attract lower takeover premiums in stock deals.

3. Research design and data

3.1 Measuring firm-specific crash risk

Following Li and Myers (2006) and Kim, Li and Zhang (2011), we use weekly returns over the fiscal year to compute our measures of firm-specific crash risk. We compute weekly returns using the following expanded market model:

$$r_{i,t} = \alpha_i + \beta_{1i} r_{m,t-2} + \beta_{2i} r_{m,t-1} + \beta_{3i} r_{m,t} + \beta_{4i} r_{m,t+1} + \beta_{5i} r_{m,t+2} + \varepsilon_{it} \quad (1)$$

where $r_{i,t}$ proxies for the return on stock *i* in week *t* and $r_{m,t}$ proxies for the return on the Center for Research in Security Prices (CRSP) value-weighted market index in week t. The lagged and lead terms are included to control for the effects of nonsynchronous trading. The weekly return for firm *i* in week *t*, $W_{i,t}$, is then computed as the natural logarithm of one plus the residual return obtained from Eq. (1):

$$W_{i,t} = \ln\left(1+\varepsilon_{i,t}\right) \quad (2)$$

Also following Li and Myers (2006) and Kim, Li and Zhang (2011a, 2011b), we define crash weeks as weeks for which weekly returns are 3.2 standard deviations lower than the mean value of weekly returns over the fiscal year. We use 3.2 standard deviations as the threshold to equate to a frequency of 0.1% in the normal distribution.

Following Chen, Hong and Stein (2001), our first crash risk measure, negative conditional return skewness ($NCSKEW$), is the negative skewness of firm-specific weekly returns over the fiscal year. A higher value of *NCSKEW* indicates higher left-skewness in the distribution of returns and hence greater risk of experiencing a stock price crash. *NCSKEW* for firm i over the fiscal year t is computed as the negative of the third moment of weekly returns over each fiscal year and dividing it by the standard deviation of weekly returns raised to the third power:

$$NCSKEW_{i,t} = -\left[n(n-1)^{3/2}\sum W_{i,t}^{3}\right] \Big/ \left[(n-1)(n-2)\left(\sum W_{i,t}^{2}\right)^{3/2}\right] \tag{3}$$

where n is the number of weekly observations over the fiscal year.

Also following Chen, Hong and Stein (2001), asymmetric volatility of negative versus positive returns, down-to-up volatility (*DUVOL*), is our second crash risk measure. For firm i over the fiscal year t, we define down-weeks (up-weeks) as weeks with returns below (above) the annual mean return. *DUVOL* is computed as the natural logarithm of standard deviation in down-weeks to standard deviation in up-weeks. Again, a higher value of *DUVOL* equates to more pronounced left-skewness in the return distribution and hence to greater risk of experiencing a stock price crash.[5] The formula for *DUVOL* for firm i in year t is as follows:

$$DUVOL_{i,t} = \log\left[(n_u - 1)\sum W_{i_d,t}^{2} \Big/ (n_d - 1)\sum W_{i_u,t}^{2}\right] \tag{4}$$

where $W_{id,t}$ and $W_{iu,t}$ are the firm-specific returns for down- and up-weeks, respectively, and n_d and n_u are the number of down- and up-weeks over year *t*, respectively.

[5] *DUVOL* does not involve third moments and so is unaffected by the number of extreme returns.

3.2 Research design

Similar to previous studies (Powell, 2001; Danbolt, Siganos and Tunyi, 2016; Tunyi, Ntim and Danbolt, 2019), for the main part of our investigation, we use a probit regression to explore how a multitude of factors affect takeover target likelihood, and to which we add our variable of main interest, firm-specific crash risk:

$$\Pr\left[Target_{i,t}=1\right]=\alpha+\beta*Crashrisk_{i,t-1}+\gamma*Controls_{i,t-1}+Year_{Dummy}+Industry_{Dummy}+\varepsilon_{i,t} \quad (5)$$

where *Target* is set to one if firm i receives a takeover bid at time t, and zero otherwise. We alternatively capture the explanatory variable of main interest, $CRASH_{i,t-1}$, using $NCSKEW_{i,t-1}$ and $DUVOL_{i,t-1}$. The set of firm-specific control variables proxy for valuation (*TBQ*), performance (*ROA*), liquidity (*LIQ*), leverage (*LEV*), sales growth (*SGW*), free cash flow (*FCF*), tangibility (*TANG*), size (*SIZE*), and age (*AGE*). We also control for product market competition (*HHI*), as well as year and industry fixed effects.

Dong et al. (2006) find that bidders seek financial benefits by purchasing undervalued firms with cash at a price lower than the target's fundamental value or paying with equity for overvalued targets. We consequently employ Tobin's Q (*TBQ*) to proxy for target misvaluation. *TBQ* is defined as the market value of assets (*MVA*) to replacement cost of assets, and *MVA* is the sum of book value of debt (*BVD*) and market value of equity (*MVE*). The inefficient management hypothesis suggests that the market for corporate control disciplines managerial misconduct because firms are more likely to become takeover targets owing to poor performance (Cremers, Nair and John, 2008; Brar, Giamouridis and Liodakis, 2009; Danbolt, Siganos and Tunyi, 2016). We therefore use return on assets (*ROA*) to proxy for the effect of managerial performance on takeover likelihood. Following Agrawal and Jaffe (2003), *ROA* is defined as net income divided by total assets.

Palepu (1986) indicates that takeovers are undertaken to achieve expected synergies by exploiting mismatches between growth opportunities and available resources. Since the growth‐resource mismatch hypothesis suggests that low‐growth but resource‐rich firms, as well as high‐growth but resource‐poor firms, are more likely to become takeover targets, we also include sales growth (*SGW*), corporate liquidity (*LIQ*), and leverage ratio (*LEV*) to account for the impact of a difference between a firm's growth opportunities and its resources (Powell and Yawson, 2007). *SGW* is defined as the change in total revenues as a ratio of previous year's total revenues, and *LIQ* and *LEV* are defined as cash and short-term investments to total assets and total debt to total assets ratio respectively. The free cash flow hypothesis stipulates that takeover likelihood increases with a firm's free cash flow, which can be measured by the ratio of net cash flow from operating activities minus capital expenditures scaled by total assets (Powell and Yawson, 2007). This is because takeover activity can discipline an inefficient management team for inappropriately utilizing free cash flows. Moreover, bidders may target firms that hold excess cash flow to decrease the net cost of takeover. Consequently, we control for free cash flow (*FCF*) in our takeover likelihood model.

Ambrose and Megginson (1992) argue that a higher proportion of tangible fixed assets represents more debt servicing capacity and hence assists firms to obtain external financing. As a result, tangible fixed assets may decrease bidders' implicit takeover costs and such assets could be divested to raise capital to fund takeover transactions. We therefore also control for the impact of tangibility on takeover target likelihood, with *TANG* defined as the proportion of tangible assets to total assets. Powell (1997) argues that takeover target likelihood decreases with firm size, defined as the natural logarithm of total assets, since size-related transaction costs hinder bidders' incentives to initiate takeover bids. Firms' ability to survive increases as they become more mature since more mature firms are more endowed and knowledgeable. Consequently, firm age, defined as the natural logarithm of year of incorporation to year of takeover, may be negatively related to the likelihood of becoming a takeover target (Danbolt, Siganos and Tunyi, 2016). Finally, we also control for product market competition (*HHI*), defined as the sum of the squared market shares derived from total revenues of all listed firms in the four-digit standard industrial classification-based industry. Poorly managed firms are more likely to be eliminated through takeovers in the presence of more intense product market competition (Danbolt, Siganos and Tunyi, 2016).

3.3 Sample and data

Our sample includes all listed firms incorporated in the US over the period from 1988 to 2018 not operating in the financial or utility sectors. We collect stock return data from the CRSP to compute stock price crash risk. Firms' annual financial data are obtained from Compustat. We exclude observations where stock price is lower than 1 US dollar and those with less than 26 weeks of stock return data to ensure that our results are not affected by illiquid stocks. We also exclude observations with non-positive total assets and book values of equity. Our final sample comprises 100,348 firm-year observations. To minimize the impact of potential outliers, all continuous variables are winsorized at the 1% and 99% levels.

For firms that become a takeover target, we obtain data on deal characteristics from Securities Data Company (SDC) Platinum. These deal characteristics include announcement date, deal attitude, deal status, and percentage of shares that bidders are seeking to own after completion. For a firm to be a takeover target in the final dataset, we further apply the following criteria: (1) the announcement date must lie within the period of 01/01/1988-12/31/2018; and (2) the percentage of shares that bidders are seeking to own after the transaction must be no less than 50% (see Table 1 for full detail). Our final sample includes 4,843 firms that become a takeover target.

[Insert Table 1 around here]

Table 2 reports summary statistics for all variables in the empirical analysis. The mean value of *Target* is 0.052, meaning that on average 5.2% of the firms in our sample receive at least one takeover bid in a given year. This is comparable with the finding of Chen, Gao and Ma (2020). Regarding the measures of stock price crash risk, *NCSKEW* varies from -0.544 to 0.318, with an average value of -0.094 and a standard deviation of 0.806. Similarly, *DUVOL* has a mean (standard deviation) of -0.060 (0.378). These are similar to those reported by Kim, Li and Zhang (2011) and Li and Zeng (2019). Most of our sample firms have relatively low crash risk, albeit with a negative mean value. The mean value of our dummy variable of stock price crash risk, *CRASH*, indicates that 17.3% of sample firms have experienced a stock price crash. The mean value of *COUNT* is -0.041, which indicates that on average the number of times that stock prices experience jumps is greater than the number of times that stock prices experience crashes.

[Insert Table 2 around here]

On average liquid assets account for 18.7% of total assets in our sample firms as *LIQ* has a mean of 0.187. *LEV* has a mean (median) value of 0.206 (0.178), suggesting that liabilities generally occupy 20.6% (17.8%) of total assets. The mean value of *SGW* indicates that sales growth of our sample firms is 11.7%. The value of *SIZE* varies from 4.007 to 7.059 with a standard deviation of 2.152. This attests to the considerable variation in firm size among US incorporated and listed firms. The high standard deviation of *AGE* (12.517) also indicates large variations in firm age among our sample firms. The summary statistics of the other variables are largely consistent with those reported in prior studies (e.g. Gaspar, Massa and Matos, 2005; Gao and Ma, 2016; Wu and Chung, 2019).

Table 3 presents correlation matrices for the main regression variables. Panel A of Table 3 is for the regression variables for takeover target likelihood, whilst Panel B is for the regression variables for takeover premium. For Panel A, the two crash risk measures, *NCSKEW* and *DUVOL*, are significantly and positively correlated with the existence of a takeover bid. The correlation between *Target* and *CRASH* is also significantly positive. This finding lends initial support to our prediction, stated in Hypothesis 1, that firms with higher stock price crash risk have a higher likelihood of becoming a takeover target. Regarding control variables, the correlation matrix in Panel A indicates that firm age is negatively correlated with takeover likelihood. This implies that firm age can increase survival rate (Danbolt, Siganos and Tunyi, 2016). Firm size is also negatively correlated with takeover likelihood, which supports the argument that acquiring a larger firm will incur higher transaction costs. Consistent with the managerial inefficiency hypothesis that the market for corporate control plays an important role in disciplining inefficient management teams (Manne, 1965; Jensen and Ruback, 1983), both *ROA* and *ROE* are significantly and negatively associated with takeover likelihood.

[Insert Table 3 around here]

4. Empirical Results

4.1 Stock price crash risk and takeover target likelihood

To examine the impact of stock price crash risk on takeover target likelihood, we estimate the probit regression of Eq. (5) and present the results in Table 4. Columns (1) and (3) of Table 4 present results for the univariate relationship between stock price crash risk, measured by *NCSKEW* and *DUVOL* respectively, and takeover target likelihood after controlling for year and industry fixed effects. Columns (2) and (4) of Table 4, for *NCSKEW* and *DUVOL* respectively, present results after adding the additional controls. The results are consistent across the regressions and show that stock price crash risk is significantly and positively associated with one-year ahead takeover target likelihood (at the 1% significance level). We therefore find support for Hypothesis 1. Regarding the economic significance, the marginal effects of *NCSKEW* and *DUVOL* on takeover target likelihood in Columns (2) and (4) imply that a one standard deviation increase in *NCSKEW* and *DUVOL* increases the likelihood of a firm receiving a takeover bid by 0.26% and 0.28% respectively. Given the overall rate of takeover target likelihood for our sample, this suggests that the impact of stock price crash risk on target takeover likelihood is also economically significant.

[Insert Table 4 around here]

The significantly positive marginal effects of stock price crash risk provide support for the argument that firms with higher crash risk may be discounted by capital markets owing to greater uncertainty and information asymmetry. Specifically, opaque firms are more likely to be undervalued when outsiders have difficulties to accurately evaluate their actual firm value (Cheng, Li and Tong, 2013; Raman, Shivakumar and Tamayo, 2013; Borochin, Ghosh and Huang, 2019). This attracts bidders to exploit profit opportunities from "bargains" in the takeover market. In addition, information asymmetry and uncertainty about potential synergies can place targets in a weaker bargaining position relative to bidders in deal negotiation (Li and Tong, 2018). A stronger bargaining position may motivate bidders' participation in the takeover market.

Regarding the set of control variables, we find that *TBQ* is negatively and significantly related to takeover target likelihood. This is in line with the arguments that takeover activity may be motivated by firm misvaluation (Dong, Hirshleifer and Richardson, 2006), and that firms with lower market to book ratios are more likely to be takeover targets as acquirers may treat firms with low market-to-book ratio as bargains (Powell, 2001). Furthermore, there is also evidence of a significant positive relationship between leverage and takeover target likelihood. This supports the theoretical findings of Stulz (1988) who demonstrates that targets with more debt attract multiple acquirers since shareholders in firms with high leverage are more capable of consolidating their votes which strengthens their bargaining power in the negotiation process.

From a different perspective, the negative relationship between tangibility (*TANG*) and takeover target likelihood in our results supports the idea that higher tangibility of target firms increase the implicit costs of the bidding process and thus has a dampening effect on takeover target likelihood (Ambrose and Megginson, 1992). Consistent with prior literature (Palepu, 1986; Gorton, Kahl and Rosen, 2005), we also find that firm size has a negative and significant impact on takeover target likelihood, suggesting that bidding for a large firm incurs a higher level of transaction costs. Finally, we also find that firm age is negatively and statistically correlated with takeover target likelihood. This may be because firm age is characterized as endowments and liability to learn by doing (Bhattacharjee et al., 2009) and because likelihood of firms' survival increases as firms get older and gain more experience.

4.2 Firm performance, stock price crash risk, and takeover target likelihood

Previous studies show that CEO forced turnovers result from poor firm performance (Weisbach, 1998; Taylor, 2010; Jenter and Lewellen, 2021). Poor firm performance may deteriorate managers' career concerns and hence motivate them to withhold bad news for an extended period, whilst gambling future corporate activities may absorb the concealed bad news. Such managerial behavior leads to higher risk of a stock price crash once the withheld negative information is no longer suppressible (Healy and Palepu, 2001; Hutton, Marcus and Tehranian, 2009; Kothari, Shu and Wysocki, 2009; J. Kim, Li and Zhang, 2011; DeFond *et al.*, 2015).The theory of the market for corporate control also predicts that managers are more likely to be replaced by a more efficient management team in an active takeover market when they do not make corporate decisions in the best interests of shareholders and firm value maximization (Manne, 1965; Jensen and Ruback, 1983). Furthermore, Manne (1965) and

Agrawal and Jaffe (2003) argue that stock and accounting performance is employed to determine managers' compensation and career development. In other words, poorer firm performance may push managers to conceal negative information to avoid being replaced in the takeover market and retain their compensation.

To investigate a moderating role of firm performance on the impact of stock price crash risk on takeover target likelihood, we use the following modified probit regression model:

$$\Pr\left[Target_{i,t} = 1\right] = F\begin{pmatrix} \alpha + \beta_1 * Crashrisk_{i,t-1} + \beta_2 * ManagerialPerformance_{i,t-1} \\ +\beta_3 * Crashrisk_{i,t-1} * Managerialperformance_{i,t-1} + \\ \gamma * Controls_{i,t-1} + Year_{Dummy} + Industry_{Dummy} + \varepsilon_{i,t} \end{pmatrix} \quad (6)$$

Following previous studies (Weisbach, 1998; Agrawal and Jaffe, 2003; Taylor, 2010; Jenter and Lewellen, 2021), we employ two proxies for managerial performance – return on asset (*ROA*) and return on equity (*ROE*). We then construct two dummy variables *Low_ROA* and *Low_ROE* that equal 1 if a firm's *ROA* and *ROE* respectively are below the median industry value in a given year and zero otherwise. *Low_ROA* and *Low_ROE* therefore become our proxies for managerial inefficiency.

We estimate Eq. (6) and present the results in Table 5. The results show that the impact of stock price crash risk on takeover target likelihood depends on firm performance. The marginal effects of the two stock price crash risk measures are still positive and significant at the 1% level across all columns. Stock price crash risk therefore continues to evidence a positive effect on a firm's likelihood of being selected as takeover target. Furthermore, the marginal effects of the interaction terms between the two crash risk measures, *NCSKEW* and *DUVOL*, and *Low_ROA* are positive and significant at 5% and 1% significance level in Columns (1) and (2) of Table 5 respectively. Similarly, in Columns (3) and (4) of Table 5, the marginal effects of the interaction terms between the two crash risk measures, *NCSKEW* and *DUVOL*, and *Low_ROE* are also significant and positive. These suggest that the positive effect of stock price crash risk on takeover target likelihood is more prominent for firms with inefficient management. We therefore find support for Hypothesis 2. Specifically, a one standard deviation increase in *NCSKEW* (*DUVOL*) leads to 0.36% (0.43%) higher rate of takeover target likelihood for firms with lower ROA relative to those with higher ROA. Similarly, a one standard deviation increase in *NCSKEW* (*DUVOL*) leads to 0.31% (0.37%) higher takeover target likelihood for firms with lower ROE relative to those with higher ROE. This supports the argument that poor firm performance especially motivates managers to conceal negative information which in turn increases stock price crash risk (Hutton, Marcus and Tehranian, 2009).

[Insert Table 5 around here]

4.3 Stock price crash risk and takeover premium

Motivated by the argument that opacity and uncertainty about future performance weakens targets' bargaining power in the deal negotiation process and consequently reduces takeover premium (Luypaert and Caneghem, 2017; Li and Tong, 2018), we next investigate the impact of targets' stock price crash risk on takeover premium. To specifically test the hypothesized relationship between targets' crash risk and merger premiums for different payment methods, as formally stated in H3, we estimate the following regression:

$$\begin{aligned} Premium_i &= \alpha + \beta_1 * Crashrisk_{i,t-1} + \beta_2 * Crashrisk_{i,t-1} * Stock\_Payment_i \\ &+ \beta_3 * Stock\_Payment_i + \theta_n * Controls_{n,i,t-1} + Year_{Dummy} + Industry_{Dummy} + \varepsilon_i \end{aligned} \quad (7)$$

where *Premium* is either *premium(-20)* or *premium(-63)*, which are defined as the offer price from SDC Platinum relative to the target's stock price 20 or 63 trading days prior to the merger announcement respectively minus one. *Crashrisk* is as previously defined and *Stock_Payment* is a dummy variable equal to one if the deal is paid for solely with stock, and zero otherwise.

Controls are also as previously defined, except that we now add deal characteristics including *Tender offer, Target termination fee*, *Same industry, Lockup*, and *Hostile offer*.

Tender offer is a dummy variable equal to one if the bid is structured as a tender offer. *Target termination fee* is a dummy variable equal to one if the deal involves a target termination fee, and zero otherwise. Termination fees are used by target managers to facilitate bidders' engagement by ensuring that the bidder is compensated for the revelation of valuable private information released during merger negotiations. Therefore, target termination fees are associated with lower takeover premiums (Officer, 2003). *Same industry* is a dummy variable equal to one if the target and bidder come from the same industry, and zero otherwise. Takeovers involving firms from different industries are likely to generate lower returns for bidder shareholders since investors may expect bidders with a diversified strategy to bid more aggressively and consequently pay a higher takeover premium than bidders adhering to a focused strategy (Chen, Gao and Ma, 2020). *Lockup* is a dummy variable equals to one if the deal includes a lockup of target or acquirer shares. Asset lockups have a similar effect to offering a termination fee. The difference between a lockup and a termination fee is that in a lockup the incumbent acquirer is provided with a call option on the common shares or assets of the target firm, exercisable only if the target initiates termination to pursue a merger with another bidder. Offering the option of a lockup improves targets' bargaining power and is associated with higher takeover premiums (Burch, 2001). SDC Platinum classifies deals with unsolicited and hostile attitudes as hostile offers and so this is how we define our dummy variable *Hostile offer*. Hostile takeover bids are viewed as a threat to at least some of the stakeholders in target firms. However defensive measures taken by target firms' management can strengthen targets' bargaining powers and increase takeover premiums (Schwert, 2000).

We present the results of univariate tests for the difference in takeover premiums between stock and cash deals after sorting deals into quartiles based on targets' crash risk exposure in

Panel A of Table 6. Quartile 1 (*Q1*) contains deals for targets with the lowest crash risk exposure, whilst Quartile 4 (*Q4*) contains deals for targets with the highest crash risk exposure. The results in the last column suggest that the mean difference in premiums for stock deals between highest and lowest cash risk exposure is negative and statistically significant whilst that for cash deals is insignificant. In other words, takeover premiums decrease with target firms' crash risk exposure but only for stock deals. These findings imply that stock payment may be used by bidders to eliminate the risk of overpayment when the targets' stock price crash risk is higher.

[Insert Table 6 around here]

Panel B of Table 6 presents the regression results for Eq. (7). Columns (1) and (2) of Panel B contain the results when *NCSKEW* is the crash risk measure, whilst Columns (3) and (4) present the results when stock price crash risk is measured by *DUVOL*. The coefficient on *Stock_Payment* is negative and statistically significant at the 5% level. It is apparent that the coefficients of the interaction term between crash risk measures and stock payment are negatively and significantly related to both takeover premium measures to at least the 5% level across all regressions. This indicates that as stock price crash risk increases, takeover premium decreases for stock deals. We therefore find support for Hypothesis 3. In terms of economic significance, a one standard deviation increase in *NCSKEW* is associated with a 7.3 percentage points lower offer premium measured by *Premium(-20)* for stock deals relative to deals with other payment methods. This compares to an unconditional mean premium of 59.8% for our sample. These results support our expectation that targets with higher crash risk tend to have a lower acquisition premium for stock deals owing to opacity and uncertainty of expected synergies. This is in line with the arguments that managerial bad news hoarding behavior of target firms may lead to overvalued stocks before the stockpiled bad news is released to capital markets (Kothari, Shu and Wysocki, 2009), and that utilizing stock payment can protect bidders from overpayment for "lemons" (Hansen, 1987; Officer, Poulsen and Stegemoller, 2009; Luypaert and Caneghem, 2017).

5. Robustness checks

5.1 Alternative measures of stock price crash risk and takeover target likelihood

Following previous studies (Kim, Li and Zhang, 2011; Li and Zeng, 2019), we conduct robustness checks using alternative measures of stock price crash risk in the form of the number of times that firms experience stock price crashes minus the number of times that firms experience stock price jumps over the fiscal year (*COUNT*) and the likelihood that a firm experiences at least one price crash week in the fiscal year (*CRASH*). The results are presented in Table 7. Columns (1) and (2) of Table 7 present the results for *CRASH*, whilst Columns (3) and (4) present the results for *COUNT*. Otherwise the specifications are unchanged from our baseline regression in Eq. 5. Consistent with the results of our baseline regression, the results presented in Table 7 show that the marginal effects of stock price crash risk are positively and significantly related to takeover target likelihood across all regressions.

[Insert Table 7 around here]

5.2 Endogeneity in the analysis of takeover target likelihood

Our Eq. 5 baseline regression results will lead to biased inferences if they are affected by endogeneity in the form of reverse causality and omitted variables. First, the market for corporate control either potentially constrains or potentially motivates managerial bad news hoarding behavior, thereby leading to future stock price crashes. Using enactment of takeover laws across 12 countries, Balachandran et al. (2020) find that increased takeover threat can enhance external governance and consequently mitigate managerial bad news hoarding behavior and reduce stock price crash risk. However, using state antitakeover laws as an exogenous shock to investigate the impact of takeover protection on stock price crash risk, Bhargava, Faircloth and Zeng (2017) find that increased takeover threat may exacerbate managerial career concerns and motivate managers to withhold bad news, which increases stock price crash risk. These conflicting findings suggest that takeover threat affects firm-specific stock price crash risk, whereas our results suggest that firm-specific stock price crash risk affects the likelihood of a firm becoming a takeover target. In other words, stock price crash risk and takeover target selection may be endogenously determined.

Second, unobserved firm-specific determinants of takeover target likelihood may also affect stock price crash risk, such as human capital. Human capital may be one of the main determinants of target selection (Chen, Gao and Ma, 2020). In addition, Liu and Ni (2019) find that human capital outflows lead to higher risk of stock price crash. In other words, the estimated marginal effects of stock price crash risk on takeover target likelihood may be biased owing to omitted variables.

To address these issues, we adopt the average value of *NCSKEW* of other firms in the same headquarters state as an instrumental variable in a two-stage least squares (2SLS) regression.[6] Gao et al. (2011, p. 133) suggest that "geographic proximity facilitates observational learning even without direct contact. Simple exposure to the strategies of other firms may prompt firms to adopt similar strategies and to align their activities with those of other firms in the local geographic community". Previous studies demonstrate that unethical behavior is geographically contagious among financial advisors and corporations (Kedia, Koh and Rajgopal, 2015; Dimmock, Gerken and Graham, 2018; Parsons, Sulaeman and Titman,

[6] In this section, we rely on a linear probability model in order to utilize all relevant diagnostics relating to our use of an instrumental variable. Nonetheless, our results and inferences are robust to alternatively relying on a two-stage probit regression in order to maintain consistency with the baseline regression and hence a specification more suited to a limited dependent variable.

2018). Specifically, Kedia, Koh and Rajgopal (2015) find that firms are more likely to engage in earnings management activities when a greater number of local firms have announced restatements. These imply that the average level of stock price crash risk for other firms in their neighborhoods is closely correlated with an individual firm's stock price crash risk. However, average value of crash risk for other firms in the state should not directly affect the likelihood of an individual firm being selected as a takeover target. To reinforce satisfaction of the exclusion condition, we exclude same-state firms in the same industry as the focus firm, since takeover activity has a tendency to occur in industry waves (Harford, 2003). Therefore, the average value of other firms' crash risk in the state plausibly satisfies both the relevance and exclusion conditions of a valid instrument in looking for any causal relationship running from stock price crash risk to takeover target selection.

The 2SLS regression is as follows:

First stage:

$$Crashrisk_{i,t-1} = \alpha + \beta * IV_{t-1} + \gamma * Controls_{i,t-1} + Year_{Dummy} + Industry_{Dummy} + \varepsilon_{i,t-1} \quad (8)$$

Second stage:

$$T\arg et_{i,t} = \alpha + \beta * Crashrisk_{i,t-1} + \gamma * Controls_{i,t-1} + Year_{Dummy} + Industry_{Dummy} + \varepsilon_{i,t} \quad (9)$$

Table 8 presents the results for this 2SLS regression. IV_{t-1} is measured by AVE_NCSKEW_{t-1}. The results of Durbin-Wu-Hausman tests in Columns (1) and (3) of Table 8 suggest that stock price crash risk in the baseline regression is not sufficiently exogenous as to not require being instrumented. The Cragg-Donald F-statistics are 21.820 and 22.255 for the first stage regressions of the two measures of stock price crash risk and exceed the 16.38 Stock-Yogo nominal 10% critical value. This suggests that our instrumental variable is sufficiently strong as to satisfy the relevance condition. The results in Columns (1) and (3) also show that AVE_NCSKEW_{t-1} is positively and significantly correlated with $NCSKEW_{t-1}$ and $DUVOL_{t-1}$ in the first stage. We also find that the instrumented $NCSKEW_{t-1}$ and $DUVOL_{t-1}$ are positively and significantly related to the likelihood of a firm becoming a takeover target in Columns (2) and (4) of Table 8. This is consistent with our baseline regression results. We therefore conclude that the effect of stock price crash risk on takeover target likelihood is robust to endogeneity concerns, thereby also suggesting a causal effect of stock price crash risk on takeover target likelihood.

[Insert Table 8 around here]

In addition, we alternatively use the staggered adoption of state data breach laws as an instrumental variable for stock price crash risk. The rationale behind use of these laws as an instrumental variable is that they were enacted to safeguard customers' personal information by requiring firms to notify individuals whose personal information is lost or stolen as a result of a cyberattack. After the adoption of data breach notification laws, firms headquartered in the relevant state have to disclose data breaches publicly and bear the associated costs. The data breach laws deteriorate managers' career concerns and therefore give managers incentives to withhold bad financial information, which in turn increases stock price crash risk (Obaydin, Xu and Zurbruegg, 2021). As such, the staggered adoption of data breach disclosure legislation satisfies the relevance condition. On the other hand, the exogenous adoption of data breach laws is intended to protect customers' interests and is not therefore directly related to the expected likelihood that an individual firm is selected as takeover target. Consequently, the exclusion restriction is also satisfied.

According to the first stage results in Columns (1) and (3) of Panel A of Table 9, the adoption of data breach laws (*DBNL*) is positively and significantly related to *NCSKEW* and *DUVOL* at the 1% significance level.[7] This is line with our expectation that data breach laws

[7] We present results across two panels in Table 9. Panel A presents results for our entire sample period, whereas Panel B presents results for an abridged sample period to avoid having a too long a lead up to

are associated with higher stock price crash risk. As for the previous 2SLS regression, the results of Durbin-Wu-Hausman tests suggest that our measures of stock price crash risk are insufficiently exogenous as to not require being instrumented. Furthermore, the alternative instrumental variable is sufficiently strong as to satisfy the relevance condition, since Cragg-Donald F-statistics exceed the 16.38 Stock-Yogo nominal 10% critical value. In the second stage, the impact of instrumented *NCSKEW* and *DUVOL* on the likelihood that an individual firm is selected as a takeover target is significantly positive in both Columns (2) and (4) of Table 9. This supports our results for the other instrumental variable, thereby reinforcing the suggestion of a causal effect of stock price crash risk on takeover target likelihood. In other words, irrespective of the instrumental variable, but both of which have strong theoretical and empirical validity, we are able to conclude that a higher level of stock price crash risk induces a greater likelihood of being a takeover target.

[Insert Table 9 around here]

5.3 Sample selection bias in the analysis of takeover premium

Firms are not randomly selected as takeover targets in the market for corporate control, and unobservable factors are likely to affect both takeover target likelihood and acquisition premiums (e.g. private information held the bidder). This is of particular concern to our study because stock price crash risk is so far shown to be a determinant of both takeover target likelihood and, conditional on being selected as a takeover target, acquisition premium. Following Gaspar, Massa and Matos (2005) and Fich, Harford and Tran (2015), we therefore adopt a Heckman two-stage approach to correct for sample selection bias in the analysis of takeover premium. In the first stage, we estimate a probit regression to model takeover target

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the first state adoption of a data breach law. The results in Panel B are little different from those in Panel A. Hence we only focus on those Panel A.

likelihood. This model is equivalent to our baseline regression in Eq. 5, except that we add to it an exclusion restriction in the form of the staggered state recognition of the Inevitable Disclosure Doctrine (IDD).

The rationale behind IDD being a plausible exclusion restriction is that it is intended to protect firms' trade secrets by preventing departing employees from joining a rival firm. The IDD therefore effectively results in the retention of important human capital, such as inventors, technical employees, and core executives in the top management team, which makes it impossible for rivals to poach employees who have knowledge of firm-specific trade secrets. The staggered recognition of IDD leads to labor market illiquidity, which makes firms situated in the state that recognizes the IDD more attractive as a takeover target. However, IDD is an exogenous shock to the state and so it does not directly affect either the expected synergies from a specific deal or the negotiation process for that deal. Indeed, Chen, Gao and Ma (2020) find that although the staggered recognition of IDD increases the likelihood of a firm being a takeover target, it does not also affect the takeover premium. It is therefore likely to satisfy the requirements of an exclusion restriction.

Following Klasa et al. (2018), we set a dummy variable, *IDD*, equals to one if the IDD is recognized in a firm's headquarters state in year *t*, and zero otherwise. Details about the years when 21 states adopted the IDD are provided in Appendix B. We compute the inverse Mill's ratio (*lambda*) from the first stage and then add it to the second stage, duly correcting standard errors, to control for unobservable factors that may affect both takeover target likelihood and acquisition premium.

Table 10 presents the results for the relationship between stock price crash risk and takeover premium after correcting for sample selection bias. In Columns (1) and (4) of Table 10, the first stage results continue to show that stock price crash risk is positively and significantly correlated with the likelihood that a firm receives a takeover bid. In addition, the significant and positive relationship between IDD and takeover target likelihood is consistent with the notion that human capital is an important motive for mergers and acquisitions (Chen, Gao and Ma, 2020). In Columns (2), (3), (5), and (6) of Table 10, we find that targets' stock price crash risk is still negatively and significantly associated with takeover premium for stock deals. These second stage results in Table 10 therefore suggest that our original results are unlikely to be affected by sample selection bias. Indeed, *lambda* is insignificant across all regressions. In other words, we are still able to infer from these results that targets with higher crash risk exposure attract lower takeover premiums in stock deals, possibly because they have lower bargaining power and because payment with stock eliminates potential risk of overpayment given targets' high crash risk exposure.

[Insert Table 10 around here]

6. Conclusion

In this study, we examine the effects of firms' stock price crash risk, and hence concealment of bad news, on aspects of the market for corporate control. Specifically, for an extensive sample of firms and years, we investigate whether or not firms' stock price crash risk affects their likelihood of becoming a takeover target and whether or not any effect is at least partially conditional on their performance. For firms that become a takeover target, we also investigate whether or not target firms' stock price crash risk affects their takeover premium and, in particular, whether or not any effect depends on the method of payment.

We find that firms with a higher level of stock price crash risk are more likely to become a takeover target and that this effect is more pronounced for firms evidencing poorer performance. In addition, we find that target firms with higher stock price crash risk are more likely to receive a lower takeover premium in deals for which the method of payment is solely in the form of stock. Both effects are not only statistically significant but also economically material. Moreover, our findings are robust to alternative measures of stock price crash risk and to addressing endogeneity concerns and correcting for sample selection bias.

Collectively, our findings support the notion that firms with higher stock price crash risk are undervalued owing to information asymmetry and uncertainty, which attracts participants in the market for corporate control to acquire them at a "bargain" price. Our findings also suggest that managerial incentives to conceal negative information depend in part on poor firm performance, which in turn increases the likelihood of a takeover and thereby strengthens support for the notion that correction of managerial performance is a stimulus for the market for corporate control. Finally, our findings suggest that because target firms with higher stock price crash risk are more likely to suffer from severe information asymmetry and agency conflicts between managers and shareholders, it weakens shareholders' bargaining power during the acquisition process and creates a tendency for bidders to protect themselves from overpayment by paying solely in the form of stock.

Our study makes important contributions to a growing body of literature on stock price crash risk by providing for the first-time insight into how firms' stock price crash risk affects their takeover target likelihood and the deal negotiation process upon their becoming a takeover target. In particular, we provide the first evidence to suggest that higher stock price crash risk causes greater takeover target likelihood, whereas prior literature is inconclusive about whether or not greater exposure to the market for corporate control causes higher stock price crash risk.

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Table 1. M&As deal selection.

Criteria	Count
The original number of U.S. deals from SDC	1,140,037
(1) Including deals that announcement date lies over 01/01/1988-12/31/2018	321,577
(2) Including deals that targets are publicly listed	57,589
(3) Including deals that acquirors seek to own no less than 50 percent of shares after transactions	19,479
(4) After excluding deals that targets operate in financial sectors	14,429
(5) After excluding deals that targets operate in the public utility industries	12,743
(6) After excluding deals that cannot be merged in our panel dataset	5,588
The final number of deals	4,843

Source: M&A sector, SDC

Table 2. Summary statistics.

Variable	Obs.	Mean	Std. Dev.	25^{th}	Median	75^{th}
Target	100,348	0.052	0.221	0.000	0.000	0.000
NCSKEW	100,348	-0.094	0.806	-0.544	-0.116	0.318
DUVOL	100,348	-0.060	0.378	-0.313	-0.070	0.179
CRASH	100,348	0.173	0.378	0.000	0.000	0.000
COUNT	100,348	-0.041	0.619	0.000	0.000	0.000
TBQ	100,348	2.433	2.574	1.102	1.606	2.635
ROA	100,348	-0.018	0.200	-0.029	0.034	0.077
ROE	100,348	-0.035	0.315	-0.039	0.045	0.102
LIQ	100,348	0.187	0.213	0.029	0.102	0.273
LEV	100,348	0.206	0.187	0.023	0.178	0.334
SGW	100,348	0.117	0.335	-0.019	0.085	0.221
TANG	100,348	0.281	0.233	0.095	0.211	0.410
SIZE	100,348	5.603	2.152	4.007	5.445	7.059
AGE	100,348	14.108	12.517	4.000	10.000	20.000
HHI	100,348	0.084	0.081	0.039	0.057	0.095
AVE_NCSKEW	100,348	-0.104	0.036	-0.121	-0.098	-0.078
DBNL	100,348	0.265	0.441	0.000	0.000	1.000
IDD	100,348	0.423	0.494	0.000	0.000	1.000
Premium(-20)	4,843	0.598	1.424	0.164	0.415	0.761
Premium(-63)	4,843	0.635	1.333	0.134	0.453	0.867
Stock_Payment	4,843	0.202	0.401	0.000	0.000	0.000
Tender_offer	4,843	0.248	0.432	0.000	0.000	0.000
Target_termination_fee	4,843	0.582	0.493	0.000	1.000	1.000
Same_industry	4,843	0.464	0.499	0.000	0.000	1.000
Lockup	4,843	0.051	0.221	0.000	0.000	0.000
Hostile_offer	4,843	0.083	0.275	0.000	0.000	0.000

This table reports the summary statistics for all variables used in our empirical tests. Our main sample consists of 100,348 firm–year observations over the period 1988–2018 with available crash risk and other variable information. Number of observations, mean, standard deviation, 25th percentile, median, and 75th percentile are reported from left to right, in sequence for each variable. Detailed definitions of all variables are described in Appendix A. All continuous variables are winsorized at the 1% and 99% levels.

Table 3. Correlation matrix.

Panel A: Panel dataset

Variable	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1) Target	-	1.00																	
(2) NCSKEW	1.04	**0.01**	1.00																
(3) DUVOL	1.04	**0.01**	**0.96**	1.00															
(4) CRASH	1.02	**0.01**	**0.62**	**0.56**	1.00														
(5) COUNT	1.02	0.00	**0.79**	**0.72**	**0.73**	1.00													
(6) TBQ	1.34	**-0.03**	**-0.02**	**-0.03**	**-0.03**	**-0.02**	1.00												
(7) ROA	1.28	**-0.01**	**0.03**	**0.03**	0.00	**0.03**	**-0.07**	1.00											
(8) ROE	1.24	**-0.02**	**0.03**	**0.03**	-0.01	**0.03**	**-0.06**	**0.95**	1.00										
(9) LIQ	1.9	0.00	**-0.01**	**-0.01**	**0.02**	**-0.01**	**0.35**	**-0.29**	**-0.23**	1.00									
(10) LEV	1.53	0.00	0.00	0.00	**-0.01**	**-0.01**	**-0.19**	**0.01**	-0.01	**-0.46**	1.00								
(11) SGW	1.2	-0.01	0.00	0.00	**-0.02**	0.01	**0.34**	**0.07**	**0.08**	**0.04**	0.00	1.00							
(12) TANG	2.44	**-0.03**	0.00	0.00	**-0.05**	0.00	**-0.18**	**0.11**	**0.10**	**-0.42**	**0.35**	**-0.02**	1.00						
(13) SIZE	1.79	**-0.04**	**0.14**	**0.15**	**0.05**	**0.11**	**-0.13**	**0.31**	**0.30**	**-0.26**	**0.26**	**-0.04**	**0.22**	1.00					
(14) AGE	1.35	**-0.03**	**0.02**	**0.03**	**0.02**	**0.02**	**-0.16**	**0.19**	**0.18**	**-0.20**	**0.04**	**-0.16**	**0.04**	**0.38**	1.00				
(15) HHI	3.1	0.00	**-0.01**	**-0.01**	**-0.01**	**-0.01**	**-0.09**	**0.08**	**0.07**	**-0.18**	**0.10**	**-0.01**	**0.13**	0.00	**0.03**	1.00			
(16) AVE_NCSKEW	1.06	**0.01**	**0.03**	**0.03**	**0.01**	**0.02**	**-0.01**	**0.02**	**0.02**	**-0.02**	0.01	-0.01	**0.06**	**0.07**	**0.01**	0.00	1.00		
(17) DBNL	2.59	**0.01**	**0.06**	**0.06**	**0.09**	**0.04**	**-0.01**	**-0.01**	0.00	**0.11**	**-0.06**	**-0.07**	**-0.12**	**0.20**	**0.22**	**-0.03**	**0.04**	1.00	
(18) IDD	1.25	**0.02**	-0.01	**-0.01**	**0.01**	0.00	0.00	**-0.01**	0.00	**-0.03**	0.00	**-0.01**	**-0.10**	**-0.07**	**0.13**	**-0.01**	**-0.15**	**0.04**	1.00

Panel B: Cross-sectional dataset

Variable	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Premium(-20)	-	1.00											
(2) Premium(-63)	-	**0.75**	1.00										
(3) NCSKEW	1.26	0.00	-0.01	1.00									
(4) DUVOL	0.78	0.01	-0.01	**0.96**	1.00								
(5) CRASH	1.28	0.01	0.00	**0.62**	**0.56**	1.00							
(6) COUNT	1.27	0.00	-0.01	**0.79**	**0.72**	**0.73**	1.00						
(7) Stock_Payment	0.8	**-0.03**	**-0.03**	-0.01	-0.01	**-0.05**	0.00	1.00					
(8) Tender_offer	0.85	0.01	0.02	0.02	0.01	0.02	0.00	**-0.25**	1.00				
(9) Target_termination_fee	0.68	**0.05**	**0.09**	**0.05**	**0.04**	0.02	**0.03**	**0.04**	**0.07**	1.00			
(10) Same_industry	0.84	0.01	**0.04**	0.01	0.00	-0.02	0.00	**0.17**	**0.04**	**0.11**	1.00		
(11) Lockup	0.87	**0.03**	**0.06**	0.00	0.00	0.00	0.03	**0.19**	0.00	**0.08**	**0.07**	1.00	
(12) Hostile_offer	0.85	-0.02	**-0.04**	-0.01	0.00	-0.01	0.00	**-0.09**	0.00	**-0.31**	**-0.05**	**-0.07**	1.00

This table reports the Pearson correlation matrix. The figures in **bold** are significant at the 5% level or above. Detailed definitions of all variables are described in Appendix A.

Table 4. The impact of stock price crash risk on takeover likelihood

Dependent Variable= Target (1/0)				
	NCSKEW		DUVOL	
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$	0.0027***	0.0032***		
	(0.0008)	(0.0008)		
$DUVOL_{t-1}$			0.0061***	0.0073***
			(0.0017)	(0.0017)
TBQ_{t-1}		-0.0038***		-0.0038***
		(0.0004)		(0.0004)
ROA_{t-1}		0.0007		0.0008
		(0.0035)		(0.0035)
LIQ_{t-1}		0.0013		0.0014
		(0.0041)		(0.0041)
LEV_{t-1}		0.0195***		0.0195***
		(0.0042)		(0.0042)
SGW_{t-1}		-0.0010		-0.0009
		(0.0020)		(0.0020)
$TANG_{t-1}$		-0.0158***		-0.0159***
		(0.0044)		(0.0044)
$SIZE_{t-1}$		-0.0030***		-0.0030***
		(0.0004)		(0.0004)
AGE_{t-1}		-0.0003***		-0.0003***
		(0.0001)		(0.0001)
HHI_{t-1}		0.0085		0.0084
		(0.0148)		(0.0148)
CONSTANT	0.0448***	0.0436***	0.0448***	0.0436***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
No. of Obs.	100,348	100,348	100,348	100,348
Pseudo-R^2	0.0320	0.0395	0.0320	0.0395

This table reports the regression results of the relationship between stock price crash risk and takeover likelihood in the probit model, where our main independent variable, stock price crash risk is calculated by NCSKEW in Columns (1) and (2), while Columns (3) and (4) adopt the DUVOL as crash risk. All independent variables are one-year lagged. We report marginal effects with standard errors in parentheses below. Standard errors are clustered at the firm level. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Table 5. The impact of managerial performance

Dependent variable=Target (1/0)				
	ROA		ROE	
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$	0.0030***		0.0030***	
	(0.0008)		(0.0008)	
$DUVOL_{t-1}$		0.0069***		0.0069***
		(0.0017)		(0.0017)
Low_ROA_{t-1}	0.0008	0.0008		
	(0.0018)	(0.0018)		
Low_ROE_{t-1}			0.0011	0.0011
			(0.0018)	(0.0018)
$NCSKEW_{t-1}*Low\_ROA_{t-1}$	0.0045**			
	(0.0020)			
$DUVOL_{t-1}*Low\_ROA_{t-1}$		0.0113***		
		(0.0043)		
$NCSKEW_{t-1}*Low\_ROE_{t-1}$			0.0039**	
			(0.0020)	
$DUVOL_{t-1}*Low\_ROE_{t-1}$				0.0097**
				(0.0041)
TBQ_{t-1}	-0.0037***	-0.0037***	-0.0037***	-0.0037***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
LIQ_{t-1}	0.0007	0.0007	0.0006	0.0006
	(0.0041)	(0.0041)	(0.0041)	(0.0040)
LEV_{t-1}	0.0189***	0.0189***	0.0188***	0.0188***
	(0.0042)	(0.0042)	(0.0042)	(0.0042)
SGW_{t-1}	-0.0008	-0.0008	-0.0008	-0.0008
	(0.0020)	(0.0020)	(0.0020)	(0.0020)
$TANG_{t-1}$	-0.0158***	-0.0158***	-0.0157***	-0.0158***
	(0.0044)	(0.0044)	(0.0044)	(0.0044)
$SIZE_{t-1}$	-0.0029***	-0.0029***	-0.0029***	-0.0029***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
AGE_{t-1}	-0.0003***	-0.0003***	-0.0003***	-0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
HHI_{t-1}	0.0084	0.0084	0.0085	0.0084
	(0.0148)	(0.0148)	(0.0148)	(0.0148)
CONSTANT	0.0436***	0.0436***	0.0436***	0.0436***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
No. of Obs.	100,348	100,348	100,348	100,348
Pseudo-R2	0.0396	0.0397	0.0396	0.0396

This table reports the regression results that investigate how targets' managerial performance affects the relationship between stock price crash risk and takeover likelihood. We use the firm's ROA and ROE to measure managerial performance. The dummy variables: *Low_ROA* and *Low_ROE* equal to one if the value of *ROA* and *ROE* exceeds the sample median in each individual year, and zero otherwise. The sample covers firm-year observations with non-missing values for all variables during the sample period between 1988 and 2018. All independent variables are one-year lagged. We report marginal effects with standard errors in parentheses below. Standard errors are clustered at the firm level. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Table 6. Target firms' crash risk exposure and takeover premium

Panel A: Univariate results

	Q1		Q4		Q4 - Q1
	Mean	Median	Mean	Median	Mean difference
Premium(-20)	0.6429	0.4145	0.6667	0.4203	0.0240
Premium(-20)_CASH	0.4174	0.3590	0.5193	0.3524	0.1020
Premium(-20)_STOCK	0.6332	0.4883	0.4707	0.4324	-0.1620**
Premium(-63)	0.7027	0.4857	0.6520	0.4413	0.0510
Premium(-63)_CASH	0.4727	0.4118	0.5055	0.3734	0.0330
Premium(-63)_STOCK	0.7779	0.4775	0.4503	0.3882	-0.3280**

Panel B: Multivariate results

	NCSKEW		DUVOL	
Dependent variable=	Premium(-20)	Premium(-63)	Premium(-20)	Premium(-63)
	(1)	(2)	(3)	(4)
NCSKEW$_{t-1}$	0.0128	0.0159		
	(0.0338)	(0.0226)		
DUVOL $_{t-1}$			0.0792	0.0627
			(0.0599)	(0.0487)
Stock_Payment	-0.1464**	-0.1857**	-0.1511**	-0.1931**
	(0.0687)	(0.0904)	(0.0693)	(0.0898)
NCSKEW$_{t-1}$ **Stock_Payment*	-0.0907**	-0.1691***		
	(0.0341)	(0.0609)		
DUVOL $_{t-1}$**Stock_Payment*			-0.2223***	-0.4007***
			(0.0815)	(0.1498)
TBQ $_{t-1}$	-0.0253***	-0.0231**	-0.0252***	-0.0231**
	(0.0088)	(0.0106)	(0.0088)	(0.0106)
ROA $_{t-1}$	-0.2189*	-0.1931	-0.2172*	-0.1922
	(0.1107)	(0.1272)	(0.1096)	(0.1263)
LIQ $_{t-1}$	0.1460	0.2764*	0.1430	0.2719*
	(0.1231)	(0.1478)	(0.1230)	(0.1474)
LEV $_{t-1}$	1.1681***	1.2768***	1.1699***	1.2757***
	(0.2391)	(0.1914)	(0.2401)	(0.1925)
SGW $_{t-1}$	0.0473	0.0636	0.0460	0.0618
	(0.0546)	(0.0595)	(0.0548)	(0.0594)
TANG $_{t-1}$	-0.2742**	-0.1577	-0.2714**	-0.1549
	(0.1332)	(0.2038)	(0.1332)	(0.2047)
SIZE $_{t-1}$	-0.0170	-0.0452**	-0.0186	-0.0458**
	(0.0185)	(0.0220)	(0.0182)	(0.0219)
AGE $_{t-1}$	0.0000	-0.0002	0.0001	-0.0001
	(0.0025)	(0.0017)	(0.0025)	(0.0017)
HHI $_{t-1}$	-0.3598	-0.4523	-0.3569	-0.4462
	(0.4943)	(0.3615)	(0.4931)	(0.3594)
Tender_offer	-0.0343	-0.0252	-0.0352	-0.0258
	(0.0409)	(0.0537)	(0.0415)	(0.0539)
Target_termination_fee	0.1822***	0.3175***	0.1824***	0.3177***
	(0.0672)	(0.0430)	(0.0670)	(0.0428)
Same_industry	0.0432	0.0846*	0.0442	0.0855*
	(0.0467)	(0.0501)	(0.0466)	(0.0502)
Lockup	0.2024***	0.2583***	0.2021***	0.2572***
	(0.0540)	(0.0818)	(0.0538)	(0.0820)
Hostile_offer	-0.0273	0.0187	-0.0282	0.0178
	(0.0798)	(0.0432)	(0.0796)	(0.0433)
CONSTANT	0.2574	0.4587***	0.2665	0.4632***
	(0.2022)	(0.1303)	(0.2008)	(0.1297)
YEAR FE	YES	YES	YES	YES

INDUSTRY FE	YES	YES	YES	YES
No. of Obs.	4,843	4,843	4,843	4,843
R-squared	0.0598	0.0796	0.0600	0.0799

This table reports the regression results that investigate whether the relationship between stock price crash risk and takeover premium is heterogenous across different payment methods. *Premium (-20)* and *Premium (-63)* are measured by the offer price obtained from SDC relative to target stock price 20 and 63 trading days prior to the merger announcement respectively. All independent variables are one-year lagged. We report coefficients with standard errors in parentheses below. Standard errors are clustered at the industry level. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Table 7. Robustness checks: impact of stock price crash risk on takeover likelihood

Dependent Variable= Target (1/0)				
	CRASH		COUNT	
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$	0.0053***	0.0047***		
	(0.0017)	(0.0016)		
$DUVOL_{t-1}$			0.0020*	0.0027***
			(0.0011)	(0.0010)
TBQ_{t-1}		-0.0038***		-0.0038***
		(0.0004)		(0.0004)
ROA_{t-1}		0.0007		0.0006
		(0.0035)		(0.0035)
LIQ_{t-1}		0.0014		0.0014
		(0.0041)		(0.0041)
LEV_{t-1}		0.0192***		0.0193***
		(0.0042)		(0.0042)
SGW_{t-1}		-0.0009		-0.0009
		(0.0020)		(0.0020)
$TANG_{t-1}$		-0.0157***		-0.0159***
		(0.0044)		(0.0044)
$SIZE_{t-1}$		-0.0028***		-0.0029***
		(0.0004)		(0.0004)
AGE_{t-1}		-0.0003***		-0.0003***
		(0.0001)		(0.0001)
HHI_{t-1}		0.0086		0.0086
		(0.0148)		(0.0148)
CONSTANT	0.0448***	0.0436***	0.0448***	0.0436***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
No. of Obs.	100,348	100,348	100,348	100,348
Pseudo-R^2	0.0319	0.0392	0.0318	0.0392

This table shows the robustness results for our baseline regression, where our main independent variable, stock price crash risk is calculated by *CRASH* and *COUNT*. All independent variables are one-year lagged. We report marginal effects with standard errors in parentheses below. Standard errors are clustered at the firm level. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

Table 8. 2SLS Instrumental Variable Approach: AVE_NCSKEW

	NCSKEW		DUVOL	
	1st stage	2nd stage	1st stage	2nd stage
Dependent variable=	$NCSKEW_{t-1}$	Target(1/0)	$DUVOL_{t-1}$	Target(1/0)
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$		0.1711**		
		(0.0753)		
$DUVOL_{t-1}$				0.3616**
				(0.1584)
AVE_NCSKEW_{t-1}	0.3296***		0.1559***	
	(0.0803)		(0.0371)	
TBQ_{t-1}	-0.0083***	-0.0023***	-0.0039***	-0.0023***
	(0.0012)	(0.0007)	(0.0006)	(0.0007)
ROA_{t-1}	-0.0241	0.0028	-0.0131*	0.0035
	(0.0160)	(0.0052)	(0.0073)	(0.0053)
LIQ_{t-1}	0.0080	-0.0005	-0.0033	0.0021
	(0.0183)	(0.0056)	(0.0084)	(0.0056)
LEV_{t-1}	-0.1350***	0.0427***	-0.0667***	0.0437***
	(0.0179)	(0.0117)	(0.0084)	(0.0120)
SGW_{t-1}	0.0195**	-0.0049	0.0057	-0.0036
	(0.0089)	(0.0030)	(0.0041)	(0.0028)
$TANG_{t-1}$	-0.0359**	-0.0099*	-0.0105	-0.0123**
	(0.0181)	(0.0060)	(0.0085)	(0.0056)
$SIZE_{t-1}$	0.0642***	-0.0137***	0.0302***	-0.0137***
	(0.0018)	(0.0049)	(0.0008)	(0.0048)
AGE_{t-1}	-0.0030***	0.0002	-0.0013***	0.0002
	(0.0003)	(0.0002)	(0.0001)	(0.0002)
HHI_{t-1}	0.0258	0.0055	0.0269	0.0002
	(0.0608)	(0.0197)	(0.0282)	(0.0199)
CONSTANT	-0.5871***	0.2096***	-0.3051***	0.2194***
	(0.0723)	(0.0521)	(0.0342)	(0.0558)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
Durbin-Wu-Hausman	7.245***		7.229***	
Cragg-Donald Wald F statistic	21.820		22.255	
Stock-Yogo size of nominal 10% Wald	16.38		16.38	
No. of Obs.	100,348	100,348	100,348	100,348
R-squared	0.0362	0.3436	0.0404	0.3357

This table reports the 2sls instrumental variable regression results of the relationship between stock price crash risk and takeover likelihood. The sample covers firm-year observations with non-missing values for all variables during the sample period between 1988 and 2018. The IV denotes the average value of crash risk: *NCSKEW* of other firms across the state. All independent variables are one-year lagged. We report coefficients with standard errors in parentheses below. Standard errors are clustered at the firm level. ***, **, and * denote significance at 1%, 5%, and 10% respective.

Table 9. 2SLS Instrumental Variable Approach: Data Breach Notification Law (*DBNL*)

Panel A. Sample period from 1989 to 2018

	NCSKEW		DUVOL	
	1st stage	2nd stage	1st stage	2nd stage
Dependent variable=	$NCSKEW_{t-1}$	Target(1/0)	$DUVOL_{t-1}$	Target(1/0)
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$		0.3698***		
		(0.0541)		
$DUVOL_{t-1}$				0.8447***
				(0.1278)
DBNL	0.0807***		0.0353***	
	(0.0102)		(0.0047)	
TBQ_{t-1}	-0.0085***	-0.0007	-0.0040***	-0.0004
	(0.0012)	(0.0007)	(0.0006)	(0.0007)
ROA_{t-1}	-0.0212	0.0076	-0.0118	0.0098
	(0.0160)	(0.0072)	(0.0073)	(0.0075)
LIQ_{t-1}	0.0040	-0.0023	-0.0050	0.0034
	(0.0182)	(0.0081)	(0.0084)	(0.0084)
LEV_{t-1}	-0.1388***	0.0697***	-0.0685***	0.0762***
	(0.0179)	(0.0109)	(0.0084)	(0.0120)
SGW_{t-1}	0.0189**	-0.0087**	0.0054	-0.0063
	(0.0089)	(0.0041)	(0.0041)	(0.0041)
$TANG_{t-1}$	-0.0294	-0.0033	-0.0075	-0.0078
	(0.0180)	(0.0082)	(0.0085)	(0.0085)
$SIZE_{t-1}$	0.0658***	-0.0266***	0.0309***	-0.0283***
	(0.0018)	(0.0036)	(0.0008)	(0.0040)
AGE_{t-1}	-0.0033***	0.0008***	-0.0014***	0.0008***
	(0.0003)	(0.0002)	(0.0001)	(0.0002)
HHI_{t-1}	0.0291	-0.0002	0.0285	-0.0135
	(0.0607)	(0.0284)	(0.0281)	(0.0296)
CONSTANT	-0.6298***	0.3353***	-0.3254***	0.3773***
	(0.0696)	(0.0456)	(0.0328)	(0.0521)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
Durbin-Wu-Hausman	175.671***		175.770***	
Cragg-Donald Wald F statistic	78.63		68.66	
Stock-Yogo size of nominal 10% Wald	16.38		16.38	
No. of Obs.	100,348	100,348	100,348	100,348
R-squared	0.0367	0.3634	0.0409	0.3798

Panel B. Sample period from 2001 to 2018

	NCSKEW		DUVOL	
	1st stage	2nd stage	1st stage	2nd stage
Dependent variable=	$NCSKEW_{t-1}$	Target(1/0)	$DUVOL_{t-1}$	Target(1/0)
	(1)	(2)	(3)	(4)
$NCSKEW_{t-1}$		0.3809***		
		(0.0587)		
$DUVOL_{t-1}$				0.8622***
				(0.1364)
DBNL	0.0781***		0.0345***	
	(0.0105)		(0.0048)	
TBQ_{t-1}	-0.0172***	0.0019	-0.0079***	0.0022
	(0.0020)	(0.0013)	(0.0009)	(0.0014)
ROA_{t-1}	-0.0297	0.0129	-0.0146	0.0142
	(0.0238)	(0.0107)	(0.0107)	(0.0108)
LIQ_{t-1}	0.0523**	-0.0139	0.0163	-0.0081

	(0.0254)	(0.0118)	(0.0114)	(0.0118)
LEV_{t-1}	-0.1054***	0.0652***	-0.0497***	0.0678***
	(0.0268)	(0.0133)	(0.0123)	(0.0139)
SGW_{t-1}	-0.0030	-0.0027	-0.0038	-0.0007
	(0.0137)	(0.0059)	(0.0061)	(0.0060)
$TANG_{t-1}$	-0.0598**	0.0119	-0.0233*	0.0092
	(0.0270)	(0.0123)	(0.0125)	(0.0126)
$SIZE_{t-1}$	0.0622***	-0.0271***	0.0295***	-0.0289***
	(0.0025)	(0.0037)	(0.0011)	(0.0040)
AGE_{t-1}	-0.0020***	0.0004***	-0.0008***	0.0004**
	(0.0003)	(0.0002)	(0.0002)	(0.0002)
HHI_{t-1}	0.0083	-0.0439	0.0339	-0.0700
	(0.1574)	(0.0714)	(0.0732)	(0.0745)
CONSTANT	-0.3841***	0.2490***	-0.2018***	0.2767***
	(0.1266)	(0.0635)	(0.0589)	(0.0671)
YEAR FE	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES
Durbin-Wu-Hausman	165.574***		165.832***	
Cragg-Donald Wald F statistic	63.735		58.597	
Stock-Yogo size of nominal 10% Wald	16.38		16.38	
No. of Obs.	51,685	51,685	51,685	51,685
R-squared	0.0281	0.3766	0.0318	0.3798

This table reports the 2sls instrumental variable regression results of the relationship between stock price crash risk and takeover likelihood. The instrumental variable: *DBNL* is an indicator variable that equals to one if a firm's headquarter office is in a state that has adopted a data breach notification law, and zero otherwise. All independent variables are one-year lagged. We report coefficients with standard errors in parentheses below. Standard errors are clustered at the firm level. We identify information on firms' historical headquarter state based on Edgar electronic fillings from Bill McNonald's website (https://sraf.nd.edu/data/).

Table 10. Heckman test: Stock price crash risk and takeover premium

	NCSKEW			DUVOL		
Dependent variable=	Target(1/0)	Premium(-20)	Premium(-63)	Target(1/0)	Premium(-20)	Premium(-63)
	(1)	(2)	(3)	(4)	(5)	(6)
IDD	0.0447***			0.0447***		
	(0.0148)			(0.0148)		
$NCSKEW_{t-1}$	0.0347***	0.0388	0.0099			
	(0.0084)	(0.0344)	(0.0418)			
$DUVOL_{t-1}$				0.0786***	0.1376*	0.0500
				(0.0180)	(0.0769)	(0.0949)
Stock_Payment		-0.1473**	-0.1855**		-0.1520**	-0.1929**
		(0.0690)	(0.0908)		(0.0695)	(0.0902)
$NCSKEW_{t-1}$ *Stock_Payment*		-0.0895**	-0.1693***			
		(0.0346)	(0.0612)			
$DUVOL_{t-1}$*Stock_Payment*					-0.2204***	-0.4012***
					(0.0818)	(0.1503)
TBQ_{t-1}	-0.0407***	-0.0566	-0.0158	-0.0407***	-0.0563	-0.0163
	(0.0040)	(0.0351)	(0.0415)	(0.0040)	(0.0346)	(0.0413)
ROA_{t-1}	0.0060	-0.2100*	-0.1951	0.0063	-0.2081*	-0.1942
	(0.0381)	(0.1110)	(0.1286)	(0.0381)	(0.1100)	(0.1278)
LIQ_{t-1}	0.0204	0.1561	0.2741*	0.0209	0.1535	0.2696*
	(0.0440)	(0.1211)	(0.1461)	(0.0440)	(0.1211)	(0.1459)
LEV_{t-1}	0.2065***	1.3255***	1.2404***	0.2070***	1.3267***	1.2415***
	(0.0456)	(0.3273)	(0.3191)	(0.0456)	(0.3270)	(0.3200)
SGW_{t-1}	-0.0108	0.0388	0.0656	-0.0105	0.0378	0.0636
	(0.0214)	(0.0516)	(0.0605)	(0.0214)	(0.0519)	(0.0603)
$TANG_{t-1}$	-0.1651***	-0.4040**	-0.1277	-0.1658***	-0.4010**	-0.1266
	(0.0479)	(0.1892)	(0.2611)	(0.0479)	(0.1877)	(0.2616)
$SIZE_{t-1}$	-0.0308***	-0.0408	-0.0397	-0.0309***	-0.0423	-0.0406
	(0.0045)	(0.0321)	(0.0424)	(0.0045)	(0.0322)	(0.0425)
AGE_{t-1}	-0.0032***	-0.0023	0.0004	-0.0032***	-0.0022	0.0004
	(0.0007)	(0.0036)	(0.0026)	(0.0007)	(0.0035)	(0.0026)
HHI_{t-1}	0.0975	-0.3007	-0.4659	0.0966	-0.2990	-0.4588
	(0.1605)	(0.4964)	(0.3656)	(0.1605)	(0.4952)	(0.3630)
Tender_offer		-0.0347	-0.0251		-0.0356	-0.0257

		(0.0410)	(0.0539)		(0.0416)	(0.0541)
Target_termination_fee		0.1815***	0.3176***		0.1817***	0.3178***
		(0.0675)	(0.0434)		(0.0672)	(0.0432)
Same_industry		0.0424	0.0848*		0.0434	0.0857*
		(0.0466)	(0.0505)		(0.0466)	(0.0506)
Lockup		0.2034***	0.2580***		0.2030***	0.2570***
		(0.0547)	(0.0822)		(0.0546)	(0.0824)
Hostile_offer		-0.0288	0.0190		-0.0297	0.0181
		(0.0805)	(0.0440)		(0.0803)	(0.0441)
lambda		0.8879	-0.2052		0.8827	-0.1927
		(0.8898)	(1.0832)		(0.8788)	(1.0789)
CONSTANT	-1.1472***	-1.1833	0.7916	-1.1442***	-1.1635	0.7754
	(0.1417)	(1.4962)	(1.7627)	(0.1418)	(1.4728)	(1.7525)
YEAR FE	YES	YES	YES	YES	YES	YES
INDUSTRY FE	YES	YES	YES	YES	YES	YES
No. of Obs.	100,348	4,843	4,843	100,348	4,843	4,843
Pseudo-R^2	0.0397	-	-	0.0397	-	-
R-squared	-	0.0599	0.0796	-	0.0601	0.0799

This table reports the results for the Heckman two stage sample selection bias test. Our main independent variable, stock price crash risk is measured by *NCSKEW* and *DUVOL*. Target equals to one if an individual firm receives takeover bid at an individual year otherwise zero. *IDD* is the exclusion restriction, which equals to one if an individual firm's headquarter state adopt the inevitable disclosure doctrine otherwise zero. *Premium (-20)* and *Premium (-63)* are measured by the offer price obtained from SDC relative to target stock price 20 and 63 trading days prior to the merger announcement respectively. All independent variables are one-year lagged. We report coefficients with standard errors in parentheses below. Standard errors are clustered at the industry. ***, **, and * denote significance at 1%, 5%, and 10% respectively.

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Appendix A. Variable Definitions.

Variables	Descriptions
Target	Dummy variable that equals to one if an individual firm receives a takeover bid in a given year, and 0 otherwise.
NCSKEW	Negative skewness of firm-specific weekly return over the fiscal year.
DUVOL	Natural logarithm of the ratio of the standard deviations of down-week to up-week firm-specific weekly return.
CRASH	Dummy variable that equals to one for one or more firm-specific weekly return exceeding 3.4 standard deviations below the mean firm-specific weekly returns over the fiscal year, and 0 otherwise.
COUNT	Number of times that firms experience stock price crash minus the number of times that firm-specific stock price experiences jump over the fiscal year.
TBQ	Book value of total assets minus book value of equity plus market value of equity, divided by book value of total assets.
ROA	Net income over total assets.
ROE	Ratio of net income to book value of equity
LIQ	Cash and short-term investments over total assets.
LEV	Total debt over total assets.
SGW	The annual growth rate of total revenues.
TANG	Book value of total assets minus book value of equity plus market value of equity, divided by book value of total assets.
SIZE	Natural logarithm of total assets.
AGE	Number of years since the firm is incorporated.
HHI	Sum of the squared market shares derived from total revenues of all listed firms in the four-digit SIC industry.
AVE_NCSKEW	Average NCSKEW of all other firms that are not within same industry in the state.
DBNL	Dummy variable that equals to one if a firm's headquarter office is in a state that has adopted a data breach notification law, and zero otherwise.
IDD	Dummy variable equals to one if the Inevitable Disclosure Doctrine is adopted in the individual state at an individual year and otherwise it equals to zero.
Premium(-20)	The offer price obtained from SDC relative to target stock price 20 trading days prior to the merger announcement.
Premium(-63)	The offer price obtained from SDC relative to target stock price 63 trading days prior to the merger announcement.
Stock_Payment	Dummy variable equals to one if the deal is financed by 100 percentage of stock payment, otherwise zero.
Tender offer	Dummy variable equals to one if the deal is defined as tender offer in SDC, otherwise it equals to zero.
Target termination fee	Dummy variable equals to one if the deal involves target termination fee, otherwise it equals to zero.
Same Industry	Dummy variable equals to one if target and bidder comes from the same industry, otherwise it equals to zero.
Lock up	Dummy variable equals to one if the deal includes a lockup of target or acquirer shares, otherwise it equals to zero.

Hostile offer	Dummy variable equals to one if a deal is hostile otherwise zero. SDC database classify deals with unsolicited and hostile attitudes as hostile offer.
Low_ROA	Dummy variable equals to one if a firm's return on assets is below 20th percentile of the sample, and otherwise zero.
Low_ROE	Dummy variable equals to one if a firm's return on equity is below 20th percentile of the sample, and otherwise zero.

Appendix B. List of the Adoption Years of the IDD

State	Adoption Year
New York	1919
Florida	1960 (reversed in 2001)
Delaware	1964
Michigan	1966 (reversed in 2002)
North Carolina	1976
Pennsylvania	1982
Minnesota	1986
New Jersey	1987
Illinois	1989
Texas	1993 (reversed in 2003)
Massachusetts	1994
Indiana	1995
Connecticut	1996
Iowa	1996
Arkansas	1997
Washington	1997
Georgia	1998
Utah	1998
Missouri	2000
Ohio	2000
Kansas	2006

This table shows the years of all the U.S. state courts adopted the Inevitable Disclosure Doctrine (IDD). The data is collected from Klasa *et al.* (2018).