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Stock Price Crash Risk and the Market for Corporate Control

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Recent studies suggest that greater exposure to the market for corporate control matters for managers and shareholders since it affects firms' ex-post risk of experiencing a stock price crash. The findings though question the direction of the effect. In contrast, in this study, we are the first to examine the effects of firms' ex-ante risk of experiencing a stock price crash, a likely antecedent of which is managers' concealment of news on aspects of the market for corporate control. We find that higher crash risk leads to greater takeover target likelihood. This relationship, which is robust to duly circumventing reverse causality, depends to a significant extent on inferior managerial quality and greater managerial discretion around financial accruals, affording richer insight into the notion that correction of managerial behaviour is a stimulus for the market for corporate control, but one that depends on the likely extent of managers' concealment of news. We also concurrently find that actual takeover targets with higher crash risk generate a lower bid premium and receive more payment with stock. Overall, our findings strongly suggest that decision-making in the market for corporate control is at least partially explained by incentives linked to opportunistic prices and takeovers of lemons.

Introduction

Given information asymmetry between managers and shareholders, managers may choose to withhold news to protect their own interests (Kothari, Shu and Wysocki, 2009). Whilst managers may speculate that subsequent activities will absorb the concealed news, stockpiled news can generate extreme information asymmetry and a bubble in the firm's stock price (An, Li and Yu, 2015; Kim, Li and Zhang, 2011a, 2011b). When the stockpiled bad news exceeds a certain level, all information is released at once to the capital market, triggering a stock price crash that jeopardizes shareholder wealth (Hutton, Marcus and Tehranian, 2009; Jin and Myers, 2006). Despite growing awareness of the antecedents of this risk, research into its economic consequences is sparse. Kim, Lee and Zhu (2022) examine actual stock price crashes and conclude that these attract greater attention from investors, which ultimately improves information efficiency. In contrast, in this study, we examine the consequences of the higher risk of a stock price crash for takeover target likelihood and terms of payment in the market for corporate control.

The market for corporate control is one of the most effective external governance mechanisms for aligning the interests of managers and shareholders (Fama and Jensen, 1983; Jensen and Ruback, 1983). The inefficient management hypothesis posits that takeovers play a key role in the correction of managerial inefficiency by targeting underperforming firms and replacing incumbent managers (see Manne, 1965).[1] Mismanagement is likely to be associated with undervaluation in the capital market. Bidders are likely to target undervalued firms to benefit from a recovery in stock prices to full potential values. In addition, academic consensus is that the capital market

[1]Brar, Giamouridis and Liodakis (2009), Cremers, Nair and John (2009), Danbolt, Siganos and Tunyi (2016) and Tunyi, Ntim and Danbolt (2019) provide empirical support for this hypothesis.

discounts equity values because of information asymmetry, since it is harder for investors to evaluate the true value of opaque firms (see Chaudhry, Kontonikas and Vagenas-Nanos, 2022; Cheng, Li and Tong, 2016; Raman, Shivakumar and Tamayo, 2013). Mismanaged firms and firms with greater information asymmetry are therefore more likely to be undervalued and to offer incentives for bidders linked to opportunistic prices.

We thus begin by examining the relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood. We conjecture that firms with higher ex-ante crash risk are more likely to be selected as a takeover target compared to other firms. Firstly, managerial news hoarding behaviour can trigger a sudden and dramatic decrease in a firm's stock price. A sudden and dramatic decrease in a firm's stock price creates an incentive for a bidder linked to an opportunistic price (Berger and Ofek, 1996). Higher ex-ante crash risk is likely to exacerbate this scenario. Secondly, although bidders are likely to face greater uncertainty about expected synergies from selecting these firms as targets because they can protect themselves by offering a price below full potential value (Dong, Hirshleifer and Richardson, 2006), this uncertainty weakens the relative bargaining power of target firms in the deal negotiation process (Cumming *et al.*, 2020; Li and Tong, 2018; Luypaert and Van Caneghem, 2017). The premise of our study does not, therefore, necessitate that firms have experienced a stock price crash.

We utilize two conventional measures of firms' ex-ante risk of a stock price crash: (1) negative conditional skewness of residual weekly returns and (2) down-week to up-week volatility of residual weekly returns. For a sample of 12,331 firms during the period 1988–2018, amounting to 100,354 firm-year observations, we do indeed find that firms with higher ex-ante crash risk are more likely to be selected as takeover targets compared to other firms. This core finding is robust to the inclusion of a raft of salient controls, including proxies for information asymmetry, and is not isolated to firms that have experienced a stock price crash. Furthermore, to circumvent reverse causality and bias from omitted variables, we exploit two theoretically strong instrumental variables for firms' ex-ante crash risk: (1) headquarters state enactment of a data breach notification law and (2) hypothetical sales pressure on the stock, as mimicked by investor outflows from mutual funds that hold the stock.

We also examine whether the positive relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood depends on inferior managerial quality and greater managerial discretion around financial accruals. We conjecture that if managerial news hoarding behaviour is a likely antecedent of stock price crash risk, then the relationship should depend significantly on lower quality managers and managers that engage in higher earnings management, because these managers are likely to have more to hide. Utilizing two proxies for lower quality managers – (1) negative industry-adjusted return on assets and (2) regression-based under- or over-investment – and a proxy for higher earnings management, we find evidence consistent with this conjecture. These dependencies account for around half of the effect of firms' ex-ante crash risk on takeover target likelihood.

For actual takeover targets, we also examine the relationship between target firms' ex-ante crash risk and terms of takeover payment. We conjecture that higher crash risk target firms will generate a lower premium compared to other takeover targets. This is because their information asymmetry is likely to create greater uncertainty about the expected synergies from selecting these firms as takeover targets, which is likely to weaken their relative bargaining power in the deal negotiation process. In addition, agency conflicts between managers and shareholders are likely to be more severe in high crash risk target firms, which is likely to also weaken their relative bargaining power, because managers may be more inclined to protect their own interests at the expense of shareholder wealth. Weaker bargaining power is likely to manifest as a lower takeover premium for higher crash risk target firms.

We also predict that stock will feature more significantly in the payment method for higher crash risk target firms compared to other takeover targets. This is because, given greater uncertainty about the expected synergies from selecting these firms as takeover targets, payment with stock safeguards bidders from overpayment by enabling them to share this risk with shareholders of the target firms, whereas bidders bear the entire risk of overpayment for payment with cash (Hansen, 1987; Luypaert and Van Caneghem, 2017; Officer, Poulsen and Stegemoller, 2009). Consistent with these conjectures, and after duly correcting for unobservable factors in takeover target selection (not least because of the significant relationship between firms' ex-ante crash risk and takeover target likelihood), we find that higher crash risk target firms generate a significantly lower premium and receive significantly more payment with stock compared to other takeover targets.

The main contributions of our study are twofold. Firstly, to the best of our knowledge, our study is the first to consider the economic consequences of firms' ex-ante risk of a stock price crash on takeover target likelihood. One important strand of the literature on the market for corporate control considers salient determinants of takeover target likelihood, including valuation (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; Piaskowska and Trojanowski, 2014). Our study extends this strand of the literature by highlighting that firms' ex-ante crash risk also plays a significant role in determining takeover target selection. Our study also affords richer insight into the notion that correction of managerial behaviour is a stimulus for the market for corporate control, but one that depends on the likely extent of managerial news hoarding behaviour. A related strand of the literature considers the casual effect of takeover threat on firms' crash risk. Yet the findings are inconclusive. Specifically, whereas Bhargava, Faircloth and Zeng (2017) find evidence to suggest that takeover threat exacerbates firms' crash risk, Balachandran *et al.* (2020) find evidence to suggest that this threat constrains firms' crash risk. Our study is different in that it addresses whether firms' ex-ante crash risk causally affects takeover target likelihood.

Secondly, our study affords richer insight into the determinants of terms of takeover payment. In this regard, our study follows a long line of studies that include Hansen (1987), Travlos (1987), Martin (1996), Officer, Poulsen and Stegemoller (2009) and Luypaert and Van Caneghem (2017). These studies find evidence to suggest that takeover payment with stock reduces bidders' risk of overpayment, but especially when target firms are relatively opaque. Our study differs from these studies by providing novel evidence that higher crash risk target firms, target firms for which bidders are likely to encounter extreme uncertainty about expected synergies, receive more takeover payment with stock and a lower premium. Collectively, our findings strongly suggest that decision-making in the market for corporate control is at least partially explained by incentives linked to opportunistic prices and takeovers of lemons.

The rest of the paper is organized as follows. The next section reviews the related literature and develops the hypotheses. The third section describes the core research design and data. The fourth section presents the basic results. The fifth section discusses enrichment and robustness. The final section concludes.

Related literature and hypothesis development

Stock price crash risk and takeover target likelihood

Managerial commitment to swiftly disclosing private information, good or bad, reduces information asymmetry and lowers a 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.[2] Yet whilst managers have incentives to disclose 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 within the firm, employment opportunities outside the firm and potential termination of employment and loss of post-retirement benefits. They conclude that an 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 of other wealth as a result of a decline in stock price following the disclosure of bad news (Kim, Li and Zhang, 2011a, 2011b).

[2]This notwithstanding, Ellahie, Hayes and Plumlee (2022) find that although the relationship between information disclosure and risk premium is negative for lower growth firms, it is positive for higher growth firms.

By extending a theoretical model of managerial control and risk-bearing when investors have limited information, Jin and Myers (2006) demonstrate that an opaque environment motivates managers to temporarily absorb negative information. Once the capital market becomes aware of the withheld information, it triggers a stock price crash. Extant empirical work documents that a firm's crash risk relates closely to the quality of its reported earnings (see Healy and Palepu, 2001). 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. In further support of this suggestion, Kim, Li and Zhang (2011a) and Zhu (2016) find a positive relationship between likely corporate tax avoidance and income-increasing discretionary financial accruals, respectively, and firms' risk of a stock price crash. In addition, Ertugrul *et al.* (2017) find that firms with lower reporting quality and more ambiguous tone in their annual reports have a higher likelihood of experiencing a collapse in the value of their equity (see also DeFond *et al.*, 2015). Similarly, Khurana, Pereira and Zhang (2018) document that whilst earnings smoothing can assist managers to hide undesirable information, it can also trigger a stock price crash once concealed negative information exceeds a certain level.

According to the above arguments and findings, managerial news hoarding behaviour increases the risk of a firm experiencing a stock price crash. Berger and Ofek (1996) contend that firms at greater risk of value destruction are more likely to be selected as takeover targets. In addition, the left-skewed and highly volatile returns of higher crash risk firms are indicative of greater uncertainty about their future performance, which exacerbates information asymmetry between insiders and outsiders. Extreme opacity and uncertainty problems make it harder for the capital market to evaluate such firms and consequently provide incentives for takeovers at opportunistic prices (Dong, Hirshleifer and Richardson, 2006). Furthermore, firms with greater information uncertainty begin from an already weakened bargaining position in the event of a takeover bid, which enhances bidders' distinct advantage in the deal negotiation process (Li and Tong, 2018). We therefore first hypothesize that, ceteris paribus, firms with higher ex-ante risk of a stock price crash have, on average, greater takeover target likelihood.

H1: Firms with a higher ex-ante risk of a stock price crash are more likely to be selected as a takeover target compared to other firms.

Stock price crash risk and terms of takeover payment

Extant evidence suggests that target firms with weaker governance structures and/or greater information asymmetry have lesser bargaining power in the deal negotiation process and hence generate a lower takeover premium. Target firms with a higher proportion of short-term institutional investors generate a lower takeover premium because these 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 the firm. The findings of Hartzell, Ofek and Yermack (2004) and Rossi and Volpin (2004) suggest that less effective governance mechanisms result in a lower takeover premium, because they enable managers to bargain for their personal interests rather than for shareholder wealth. Similarly, Moeller (2005) documents a negative relationship between the presence of a staggered board and takeover premium, and infers that board entrenchment weakens its monitoring function during a takeover bid. In contrast, he infers that monitoring by financial analysts motivates managers to bargain harder during the deal negotiation process, as reflected in a higher takeover premium.

Lesser information asymmetry between targets and bidders can reduce bidders' valuation uncertainty and hence enhance takeover premium. Croci, Petmezas and Travlos (2012) infer that target firms with unfavourable asymmetric information generate a lower takeover premium because of uncertainty about expected synergies. Similarly, Jindra and Moeller (2020) find that target firms with longer durations since initial public offering generate a higher takeover premium, suggesting that a longer period of listing reduces information asymmetry and hence valuation uncertainty in the event of a takeover bid. Furthermore, Farooqi, Jory and Ngo (2020) find that bidders pay a lower takeover premium for target firms whose managers engage in more earnings management.

Extant studies also argue and provide evidence to suggest that takeover payment with stock safeguards bidders against risk of overpayment (see Hansen, 1987; Martin, 1996). Travlos (1987) and Officer, Poulsen and Stegemoller (2009) contend that takeover payment with stock is optimal when target firms have high information asymmetry, because an exchange of stock means that shareholders of both the target and the bidder mutually bear the risk that expected synergies are not achieved. Luypaert and Van Caneghem (2017) find similar evidence to suggest that takeover payment with stock is more likely for opaque and hence uncertain target firms for risk-sharing purposes. Furthermore, Eckbo and Langohr (1989) find that takeover payment with cash is associated with a higher premium, implying that bidders favour cash for deals of lower risk.

According to the above arguments and findings, target firms with higher ex-ante risk of a stock price crash are more likely to be hamstrung by agency conflicts between managers and shareholders and by greater information asymmetry. This is likely to improve the bargaining position of the bidder in the deal negotiation process. Ceteris paribus, shareholders of higher crash risk target firms are more likely to generate a lower takeover premium, on average, to reach an agreement over a deal. In addition, since bidders face a greater risk of overpayment for higher crash risk target firms, ceteris paribus (more) takeover payment with stock is more likely, on average, for such firms, to enable bidders to share this risk with the shareholders of those firms. This leads to our second and third hypotheses.

H2: Target firms with a higher ex-ante risk of a stock price crash generate a lower premium compared to other takeover targets.

H3: Target firms with a higher ex-ante risk of a stock price crash receive more payment with stock compared to other takeover targets.

Core research design and data

Measures of stock price crash risk

At the core of our study is the relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood. Following Jin and Myers (2006) and Kim, Li and Zhang (2011b), we use residual weekly returns during fiscal years to compute measures of firms' ex-ante crash risk. We compute residual weekly returns using the following expanded market model:

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

where $r_{i,t}$ is the total return for firm i in week t and $r_{m,t}$ is the total return for the Center for Research in Security Prices (CRSP) value-weighted index. The lagged and lead terms are included to account for the effects of nonsynchronous trading. The residual weekly return, $W_{i,t}$, is then computed as the natural logarithm of one plus the error term, $\varepsilon_{i,t}$, for Equation (1):

$$W_{i,t} = \log(1 + \varepsilon_{i,t}) \qquad (2)$$

Following Chen, Hong and Stein (2001), our first measure of firms' ex-ante crash risk, negative conditional skewness ($NCSKEW_{i,t}$), is minus one multiplied by the skewness of residual weekly returns for firm i during fiscal year t. A higher value of $NCSKEW_{i,t}$ equates to less right- or more left-skewness in the distribution of residual weekly returns and hence to higher ex-ante crash risk. $NCSKEW_{i,t}$ is specifically computed by taking the negative of the third moment of residual weekly returns and dividing it by the standard deviation of residual weekly returns raised to the third power:

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

where n is the number of residual weekly returns.

Also following Chen, Hong and Stein (2001), asymmetric volatility of negative versus positive residual weekly returns, down-weeks to up-weeks volatility ($DUVOL_{i,t}$), is our second measure of firms' ex-ante crash risk. For firm i during fiscal year t, we define down-weeks (up-weeks) as weeks with residual returns below (above) the mean residual return. $DUVOL_{i,t}$ is then computed as the natural logarithm of the ratio of the standard deviation of residual returns for down-weeks to the standard deviation of residual returns for up-weeks. Again, a higher value of $DUVOL_{i,t}$ equates to less right- or more left-skewness in the distribution of residual returns and hence to higher ex-ante crash risk. The formula for $DUVOL_{i,t}$ is as follows:

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

where $W_{i_d,t}$ and $W_{i_u,t}$ are the residual returns for down-weeks and up-weeks, respectively, and n_d and n_u are the number of down-weeks and up-weeks, respectively.[3]

Although the premise of our study does not necessitate that firms have experienced a stock price crash, based on conventional measures for capturing actual stock price crashes, both measures of firms' ex-ante crash risk envelop firms that have experienced a stock price crash during the fiscal year of note. Therefore, we later differentiate between firms that have and have not experienced a stock price crash.

Research design

Like extant studies concerned with modelling takeover target likelihood (e.g. Danbolt, Siganos and Tunyi, 2016; Palepu, 1986; Powell, 2001; Tunyi, Ntim and Danbolt, 2019), for the core of our study we rely on a pooled (firm-year) probit regression to examine how a multitude of factors relate to it, and to which we alternatively add our measures of firms' ex-ante crash risk:

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

where $Target_{i,t}$ is a dummy variable equal to one if firm i is selected as a takeover target in year t, and zero otherwise (Target (1/0)). We capture a firm's ex-ante risk of a stock price crash, $Crash\ risk_{i,t-1}$, using NCSKEW and DUVOL, during the fiscal year preceding the year of note. The vector of controls, $Controls_{i,t-1}$, comprises a raft of other salient determinants of takeover target likelihood.

We include industry-adjusted return on assets (ROAD) to account for any effect of firm performance on takeover target likelihood (see Agrawal and Jaffe, 2003). Dong, Hirshleifer and Richardson (2006) find that bidders seek financial benefits by either purchasing firms with cash at a price lower than fundamental value or paying with stock for overvalued firms. We consequently follow the logic of Rhodes-Kropf, Robinson and Viswanathan (2005) by defining firm misvaluation (TBQD) as the deviation of a firm's proxy Tobin's Q ratio from its industry year average. Following Powell and Yawson (2007), we also control for corporate liquidity (LIQ), leverage (LEV) and sales growth (SGW) to account for any effect on takeover target likelihood from a mismatch between a firm's growth prospects and its resources. Powell (1997) finds that takeover target likelihood decreases with firm size, whilst Danbolt, Siganos and Tunyi (2016) find that firm age is also negatively related to it. We therefore also control for firm size (SIZE) and age (AGE). In addition, we control for product market competition (HHI) because firms are more likely to be eliminated through takeover in the presence of more intense product market competition (Danbolt, Siganos and Tunyi, 2016). Lastly, following Amihud and Stoyanov (2017), Cain, McKeon and Solomon (2017) and Cremers, Litov and Sepe (2017), we include MSBL (1/0) to account for the effect of what is widely regarded as being the most potent state anti-takeover law – mandatory staggered board – which requires all firms incorporated in an enacting state to stagger the re-election of board members. All variable definitions are presented in the Appendix.

Sample and data

Our sample includes all publicly listed firms incorporated and headquartered in the United States at any time during the period 1988–2018, except for those primarily operating in financial and utility sectors and those with missing variables. We compute weekly stock returns for our measures of firms' ex-ante crash risk using data from CRSP, but exclude observations where a firm's stock price is lower than USD 1, as well as observations where a firm has fewer than 26 weeks of stock returns during a given fiscal year, to ensure that our results are not affected by illiquid stocks. Firms' financial data are obtained from Compustat, but excluding observations with nonpositive book values of assets and equity. Our final sample comprises 12,331 firms and 100,354 firm years. To minimize the

[3]An advantage of $DUVOL_{i,t}$ over $NCSKEW_{i,t}$ is that it does not involve the third moment and so is unaffected by the number of extreme residual weekly returns.

Table 1. Criteria for selecting takeover deals

Criterion	Deal count
Total number of US deals from Refinitiv SDC	1,140,037
(1) After only counting deals announced during the period 1988–2018	321,577
(2) After only counting deals for a publicly listed target firm	57,589
(3) After only counting deals for which the bidder is seeking to acquire at least 50% of the target firm's shares	19,479
(4) After only counting deals for which the target firm primarily operates outside of the financial sector	14,429
(5) After only counting deals for which the target firm primarily operates outside of the public utility sector	12,743
(6) After only counting deals with non-missing variables defined in the Appendix	5,150

impact of outliers, relevant variables are winsorized at the 1% and 99% levels.

We obtain data on deal characteristics from Refinitiv SDC for firms that are actually selected as takeover targets. These deal characteristics include the takeover announcement date, final offer price and payment method. For a firm to be deemed a takeover target, the announcement date must fall within our sample period and any bidder must be seeking to acquire at least 50% of its shares. If a takeover bid fails in one year, the same firm can be re-targeted in a subsequent year. Table 1 presents a detailed breakdown of how we reach the 5,150 firms that are selected as takeover targets in our final sample.

Table 2 presents descriptive statistics for the variables used in our basic analysis. For the variables in Panel A, used in our core (pooled) analysis pertaining to the relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood, the mean value of Target (1/0) is 0.052, meaning that in a given year, 5.2% of the firms in our sample are selected as a takeover target. This rate of takeover target selection is similar to that documented by Chen, Gao and Ma (2020). With respect to our measures of firms' ex-ante crash risk, NCSKEW has a mean (standard deviation) of −9.4 (80.6)% and an interquartile range from −54.4% to 31.8%. DUVOL has a mean (standard deviation) of −6.0 (37.8)% and an interquartile range from −31.3% to 17.9%. These magnitudes are similar to those documented by Kim, Li and Zhang (2011a) and Li and Zeng (2019). Although the 50th percentiles are also right-skewed, like the means, the interquartile ranges suggest a wide variation for detecting any effect of firms' ex-ante crash risk on takeover target likelihood. Interestingly, for the variables in Panel B, used in our conditional (cross-sectional) analysis pertaining to the relationship between target firms' crash risk and terms of takeover payment, the descriptive statistics for our measures of firms' ex-ante crash risk accord closely with those in Panel A.

Table 3 presents correlation matrices for the variables used in our basic analysis. Again, the matrix in Panel A corresponds to our pooled analysis, whilst that in Panel B corresponds to our cross-sectional analysis. In Panel A, our measures of firms' ex-ante crash risk are positively and significantly correlated with incidences of firms being selected as takeover targets (Target (1/0)). We are yet to account for the controls though. Indeed, many of the controls are also significantly correlated with Target (1/0), and in directions generally consistent with those documented in the extant studies noted earlier.

Basic results

Stock price crash risk and takeover target likelihood

To initially examine the relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood, we estimate Equation (5) as a single-stage regression and present the results in Table 4. Columns (1) and (4) present univariate results for the relationship between firms' ex-ante crash risk, measured by NCSKEW and DUVOL, respectively, and takeover target likelihood, but with the addition of industry and year dummies. Columns (2) and (5) present multivariate results for NCSKEW and DUVOL, respectively, after also adding all controls noted earlier.

The results, which are very stable across all regressions, show that firms' ex-ante crash risk is positively and significantly related to takeover target likelihood. All marginal effects for NCSKEW and DUVOL are statistically significant to at least the 1% level. Regarding economic significance, the marginal effects in columns (2) and (5) imply that, ceteris paribus, an increase of one standard deviation in NCSKEW and DUVOL

Table 2. Descriptive statistics

Panel A: Pooled dataset – for modelling takeover target likelihood

Variable	Mean	Standard deviation	25th percentile	50th percentile	75th percentile	Observations
Target (1/0)	0.052	0.221	0.000	0.000	0.000	100,354
NCSKEW	−0.094	0.806	−0.544	−0.116	0.318	100,354
DUVOL	−0.060	0.378	−0.313	−0.070	0.179	100,354
COUNT	−0.041	0.619	0.000	0.000	0.000	100,354
CRASH (1/0)	0.173	0.378	0.000	0.000	0.000	100,354
ROAD	−0.032	0.176	−0.064	0.000	0.056	100,354
TBQD	−0.010	2.325	−1.131	−0.492	0.291	100,354
LIQ	0.187	0.213	0.029	0.102	0.273	100,354
LEV	0.202	0.216	0.013	0.133	0.323	100,354
SGW	0.117	0.335	−0.019	0.085	0.221	100,354
TANG	0.281	0.233	0.095	0.211	0.410	100,354
SIZE	5.603	2.152	4.007	5.445	7.058	100,354
AGE	14.107	12.517	4.000	10.000	20.000	100,354
HHI	0.084	0.081	0.039	0.057	0.095	100,354
MSBL (1/0)	0.051	0.220	0.000	0.000	0.000	100,354
IDDL (1/0)	0.423	0.494	0.000	0.000	1.000	100,354

Panel B: Cross-sectional dataset – for modelling takeover premium and takeover payment method

Variable	Mean	Standard deviation	25th percentile	50th percentile	75th percentile	Observations
NCSKEW	−0.067	0.829	−0.540	−0.113	0.355	5,150
DUVOL	−0.048	0.381	−0.303	−0.066	0.196	5,150
COUNT	−0.031	0.639	0.000	0.000	0.000	5,150
CRASH (1/0)	0.187	0.390	0.000	0.000	0.000	5,150
ROAD	−0.036	0.170	−0.070	−0.002	0.050	5,150
TBQD	−0.404	2.065	−1.356	−0.739	−0.080	5,150
LIQ	0.192	0.216	0.025	0.103	0.295	5,150
LEV	0.207	0.219	0.008	0.139	0.344	5,150
SGW	0.109	0.317	−0.019	0.082	0.212	5,150
TANG	0.255	0.225	0.080	0.182	0.360	5,150
SIZE	5.200	1.761	3.966	5.050	6.352	5,150
AGE	12.511	11.453	4.000	9.000	18.000	5,150
HHI	0.083	0.080	0.041	0.056	0.091	5,150
MSBL (1/0)	0.062	0.241	0.000	0.000	0.000	5,150
Premium (−84)	0.574	1.024	0.000	0.398	0.878	5,150
CAR (−84, 126)	0.316	0.557	0.050	0.298	0.586	5,150
Stock proportion	0.251	0.408	0.000	0.000	0.509	5,150
Stock payment (1/0)	0.189	0.392	0.000	0.000	0.000	5,150
Cash payment (1/0)	0.492	0.500	0.000	0.000	1.000	5,150
Tender offer (1/0)	0.233	0.423	0.000	0.000	0.000	5,150
Target termination fee (1/0)	0.548	0.498	0.000	1.000	1.000	5,150
Same industry (1/0)	0.454	0.498	0.000	0.000	1.000	5,150
Lockup (1/0)	0.048	0.215	0.000	0.000	0.000	5,150
Hostile offer (1/0)	0.083	0.275	0.000	0.000	0.000	5,150

This table presents descriptive statistics for the variables used in the main analysis. Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1 in Panel A and as only applies for all variables in Panel B. Pooled (firm-year) observations in Panel A are for non-missing variables defined in the Appendix. Target (1/0) is measured at time t, all variables common to both panels are measured at time t − 1, and all other variables in Panel B are measured at time t.

increases the likelihood of a firm being selected as a takeover target by 0.3 percentage points, for both measures of firms' ex-ante crash risk. Given the overall rate at which firms are selected as takeover targets for our sample period, together with the multitude of other variables in Table 4 that affect takeover target likelihood, this suggests that the relationship between firms' ex-ante crash

Table 3. Correlation matrices

Panel A: Pooled dataset – for modelling takeover target likelihood

Variable	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(1) Target (1/0)	–	1.00															
(2) NCSKEW	1.04	**0.01**	1.00														
(3) DUVOL	1.04	**0.01**	**0.96**	1.00													
(4) COUNT	1.02	0.00	**0.79**	**0.72**	1.00												
(5) CRASH (1/0)	1.02	**0.01**	**0.62**	**0.56**	**0.73**	1.00											
(6) ROAD	1.35	−0.01	**0.06**	**0.06**	**0.05**	**0.01**	1.00										
(7) TBQD	1.27	**−0.04**	**−0.02**	**−0.02**	**−0.01**	**−0.04**	**−0.04**	1.00									
(8) LIQ	1.95	0.00	**−0.01**	**−0.01**	**−0.01**	**0.02**	**−0.36**	**0.26**	1.00								
(9) LEV	1.57	0.01	0.00	0.01	**−0.01**	0.00	**0.05**	**−0.26**	**−0.47**	1.00							
(10) SGW	1.19	−0.01	0.00	0.00	0.01	**−0.02**	**0.06**	**0.31**	**0.04**	**−0.07**	1.00						
(11) TANG	2.44	**−0.03**	0.00	0.00	0.00	**−0.05**	**0.16**	**−0.09**	**−0.42**	**0.33**	**−0.02**	1.00					
(12) SIZE	1.81	**−0.04**	**0.14**	**0.15**	**0.11**	**0.05**	**0.35**	**−0.07**	**−0.26**	**0.22**	**−0.04**	**0.22**	1.00				
(13) AGE	1.39	**−0.03**	**0.02**	**0.03**	**0.02**	**0.02**	**0.18**	**−0.12**	**−0.20**	**0.06**	**−0.16**	**0.04**	**0.38**	1.00			
(14) HHI	3.10	0.00	**−0.01**	**−0.01**	**−0.01**	**−0.01**	**0.06**	0.00	**−0.18**	**0.14**	**−0.01**	**0.13**	0.00	**0.03**	1.00		
(15) MSBL (1/0)	1.07	**0.01**	0.00	0.00	0.00	0.01	**−0.06**	**0.02**	**0.12**	**−0.08**	0.00	**−0.09**	**−0.05**	**−0.02**	**−0.05**	1.00	
(16) IDDL (1/0)	1.13	**0.02**	−0.01	**−0.01**	0.00	**0.01**	0.00	**−0.02**	**−0.03**	0.01	**−0.01**	**−0.10**	**−0.07**	**0.13**	**−0.01**	**0.18**	1.00

Panel B: Cross-sectional dataset – for modelling takeover premium and takeover payment method

Variable	VIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) NCSKEW	1.06	1.00												
(2) DUVOL	1.07	**0.96**	1.00											
(3) COUNT	1.05	**0.80**	**0.73**	1.00										
(4) CRASH (1/0)	1.06	**0.64**	**0.58**	**0.74**	1.00									
(5) ROAD	1.34	0.03	0.03	0.03	0.01	1.00								
(6) TBQD	1.36	−0.01	−0.01	−0.01	**−0.04**	**0.07**	1.00							
(7) LIQ	1.99	0.03	0.02	0.01	0.02	**−0.35**	**0.16**	1.00						
(8) LEV	1.71	−0.02	−0.02	−0.02	−0.01	**0.06**	**−0.20**	**−0.50**	1.00					
(9) SGW	1.33	0.02	0.02	**0.03**	0.00	**0.09**	**0.39**	0.01	**−0.07**	1.00				
(10) TANG	2.72	**−0.06**	**−0.05**	**−0.05**	**−0.08**	**0.14**	**−0.06**	**−0.42**	**0.35**	0.00	1.00			
(11) SIZE	1.76	**0.14**	**0.14**	**0.12**	**0.09**	**0.30**	0.02	**−0.23**	**0.23**	0.00	**0.16**	1.00		
(12) AGE	1.38	−0.03	−0.02	−0.01	−0.01	**0.17**	**−0.09**	**−0.20**	**0.09**	**−0.17**	**0.07**	**0.36**	1.00	
(13) HHI	3.38	−0.02	−0.02	−0.01	0.00	**0.06**	0.01	**−0.18**	**0.16**	0.00	**0.10**	−0.02	**0.04**	1.00
(14) MSBL (1/0)	1.04	0.01	0.01	0.02	0.01	**−0.06**	0.01	**0.13**	**−0.08**	−0.02	**−0.08**	**−0.03**	**−0.03**	**−0.06**
(15) Premium (−84)	–	**−0.04**	**−0.05**	**−0.03**	−0.02	0.00	0.01	0.01	**0.15**	**0.03**	0.00	0.00	−0.02	**−0.06**
(16) CAR (−84, 126)	–	**−0.07**	**−0.06**	**−0.04**	**−0.04**	**−0.07**	**−0.07**	**0.09**	−0.02	**−0.03**	**−0.08**	**−0.17**	**−0.07**	**−0.05**
(17) Stock proportion	–	0.01	0.01	0.01	**−0.04**	**−0.04**	**0.15**	**0.08**	**−0.11**	**0.14**	0.02	−0.02	**−0.11**	**−0.03**
(18) Stock payment (1/0)	1.54	0.00	0.00	0.00	**−0.04**	**−0.05**	**0.15**	**0.10**	**−0.13**	**0.13**	**−0.03**	**−0.09**	**−0.13**	−0.01
(19) Cash payment (1/0)	1.59	0.00	0.00	0.00	**0.04**	**0.05**	**−0.08**	**0.07**	**−0.12**	**−0.09**	**−0.12**	**−0.03**	**0.07**	−0.02
(20) Tender offer (1/0)	1.23	0.02	0.02	0.00	0.02	**0.03**	**−0.03**	0.00	−0.02	−0.01	**−0.03**	0.00	−0.02	**−0.04**
(21) Target termination fee (1/0)	1.49	**0.06**	**0.05**	**0.03**	0.02	**0.03**	**0.05**	**0.12**	**−0.15**	**0.05**	**−0.10**	**0.19**	**0.04**	**−0.16**
(22) Same industry (1/0)	1.20	0.01	0.01	0.00	−0.02	**−0.05**	0.02	**0.11**	**−0.08**	**0.04**	0.00	**0.04**	**−0.05**	**−0.18**
(23) Lockup (1/0)	1.14	0.00	0.00	**0.03**	0.00	0.01	**0.11**	**0.03**	**−0.07**	**0.09**	**−0.04**	−0.01	**−0.06**	−0.02
(24) Hostile offer (1/0)	1.16	−0.01	0.00	0.00	−0.01	**0.04**	**−0.04**	**−0.04**	0.02	−0.02	**0.04**	**0.06**	**0.12**	0.02

Panel B: Cross-sectional dataset – for modelling takeover premium and takeover payment method

Variable	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(14) MSBL (1/0)	1.00										
(15) Premium (−84)	0.01	1.00									
(16) CAR (−84, 126)	0.00	**0.46**	1.00								
(17) Stock proportion	0.01	**0.06**	0.00	1.00							
(18) Stock payment (1/0)	0.02	0.02	−0.01	**0.89**	1.00						

Table 3. (Continued)

Panel B: Cross-sectional dataset – for modelling takeover premium and takeover payment method

Variable	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(19) Cash payment (1/0)	0.02	**−0.11**	**0.06**	**−0.61**	**−0.48**	1.00					
(20) Tender offer (1/0)	0.01	**0.07**	**0.12**	**−0.28**	**−0.23**	**0.28**	1.00				
(21) Target termination fee (1/0)	**0.06**	**0.20**	**0.14**	**0.13**	**0.07**	**0.05**	**0.10**	1.00			
(22) Same industry (1/0)	0.01	**0.07**	**0.06**	**0.22**	**0.17**	**−0.13**	**0.05**	**0.13**	1.00		
(23) Lockup (1/0)	**0.04**	**0.08**	**0.05**	**0.21**	**0.20**	**−0.12**	0.01	**0.09**	**0.07**	1.00	
(24) Hostile offer (1/0)	**−0.03**	**−0.06**	**−0.06**	**−0.10**	**−0.08**	**0.06**	0.00	**−0.28**	**−0.05**	**−0.06**	1.00

This table presents correlation matrices for the variables used in the main analysis. Variance inflation factors (VIFs) are also shown for the explanatory variables. Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1 in Panel A and as only applies for all variables in Panel B. Pooled (firm-year) observations in Panel A are for non-missing variables defined in the Appendix. Observations for both panels are as per those for the descriptive statistics in Table 2. Target (1/0) is measured at time t, all variables common to both panels are measured at time t − 1, and all other variables in Panel B are measured at time t. Pearson correlations in bold denote statistical significance at the 5% level or more.

risk and takeover target likelihood is economically meaningful. Setting aside until later concerns around reverse causality and bias from omitted variables, these results provide initial support for H1.

More broadly, these results provide support for the argument that firms with a higher risk of a stock price crash get discounted in the capital market, because of greater information asymmetry and hence uncertainty. Extremely opaque firms are more likely to be undervalued because of the difficulty faced by investors in accurately evaluating their true value (Borochin, Ghosh and Huang, 2019; Cheng, Li and Tong, 2016; Raman, Shivakumar and Tamayo, 2013). This is likely to incentivize bidders to favour such firms as takeover targets, to exploit valuable opportunities linked to opportunistic prices. In addition, in the event of being targeted, uncertainty about expected synergies gives higher crash risk firms a weaker bargaining hand compared to bidders (Li and Tong, 2018). A stronger bargaining hand is also likely to incentivize bidders' participation in the takeover market.

Stock price crash risk and terms of takeover payment

Motivated by the inferences of Luypaert and Van Caneghem (2017) and Li and Tong (2018) that opacity and uncertainty about expected synergies weaken target firms' bargaining power and consequently reduce takeover premium, we next examine the relationship between target firms' ex-ante risk of a stock price crash and takeover premium. To test for a negative relationship between target firms' ex-ante crash risk and takeover premium, as formally stated in H2, we estimate the following multivariate cross-sectional ordinary least squares (OLS) regression:

$$Premium_i = \alpha + \beta \times Crash\,risk_{i,t-1} + \theta \times Controls_{i,t-1} + Industry_{dummies} + Year_{dummies} + \varepsilon_i \quad (6)$$

where Premium_i, for target firm i, is either Premium (−84) or CAR (−84, 126), our alternative measures of takeover premium, which are defined in the Appendix as the final offer price relative to the target firm's stock price 84 trading days before takeover announcement, minus one, and the target firm's cumulative abnormal return from 84 trading days before to 126 trading days after takeover announcement, respectively. Both measures, therefore, account for any premium generated during the runup to takeover announcement. Again, we capture a firm's ex-ante crash risk alternatively using NCSKEW and DUVOL, during the fiscal year preceding the year of takeover announcement. The vector of controls comprises the earlier, other salient determinants of takeover target likelihood, but with the addition now of deal characteristics commonly included in extant studies of takeover premium – Stock payment (1/0), Cash payment (1/0), Tender offer (1/0), Target termination fee (1/0), Same industry (1/0), Lockup (1/0) and Hostile offer (1/0) – to account for any competing effect on takeover premium. Definitions for these additional controls are also presented in the Appendix, and descriptive

Table 4. Relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood

	Dependent variable = Target (1/0)					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
$NCSKEW_{t-1}$	0.0029***	0.0035***	0.0035***			
	(0.0009)	(0.0009)	(0.0009)			
$DUVOL_{t-1}$				0.0066***	0.0080***	0.0080***
				(0.0018)	(0.0018)	(0.0018)
$ROAD_{t-1}$		0.0169***	0.0166***		0.0169***	0.0166***
		(0.0048)	(0.0048)		(0.0048)	(0.0048)
$TBQD_{t-1}$		−0.0040***	−0.0040***		−0.0040***	−0.0040***
		(0.0004)	(0.0004)		(0.0004)	(0.0004)
LIQ_{t-1}		0.0061	0.0068		0.0062	0.0069
		(0.0046)	(0.0046)		(0.0046)	(0.0046)
LEV_{t-1}		0.0260***	0.0257***		0.0260***	0.0257***
		(0.0040)	(0.0040)		(0.0040)	(0.0040)
SGW_{t-1}		−0.0016	−0.0016		−0.0015	−0.0016
		(0.0022)	(0.0022)		(0.0022)	(0.0022)
$TANG_{t-1}$		−0.0178***	−0.0173***		−0.0179***	−0.0174***
		(0.0049)	(0.0049)		(0.0049)	(0.0049)
$SIZE_{t-1}$		−0.0037***	−0.0036***		−0.0037***	−0.0036***
		(0.0005)	(0.0005)		(0.0005)	(0.0005)
AGE_{t-1}		−0.0003***	−0.0003***		−0.0003***	−0.0003***
		(0.0001)	(0.0001)		(0.0001)	(0.0001)
HHI_{t-1}		0.0075	0.0080		0.0075	0.0079
		(0.0164)	(0.0164)		(0.0164)	(0.0164)
MSBL $(1/0)_{t-1}$		0.0076**	0.0059*		0.0076**	0.0060*
		(0.0030)	(0.0031)		(0.0030)	(0.0031)
IDDL $(1/0)_{t-1}$			0.0039**			0.0039**
			(0.0015)			(0.0015)
Constant	0.0516***	0.0516***	0.0516***	0.0516***	0.0516***	0.0516***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
χ^2 statistic	945.77***	1265.19***	1273.47***	946.86***	1266.54***	1274.87***
Pseudo R^2 statistic	3.20%	4.03%	4.05%	3.20%	4.04%	4.05%
Observations	100,354	100,354	100,354	100,354	100,354	100,354

This table presents univariate and multivariate pooled (firm-year) probit regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)). Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1. Variables are measured at time t unless otherwise indicated. The alternative measures of firms' ex-ante (t − 1) risk of a stock price crash are NCSKEW and DUVOL. Variable definitions are presented in the Appendix. Industry dummies use primary two-digit standard industrial classification codes. Robust standard errors clustered at the firm level are shown in parentheses beneath marginal effects for one-unit changes in each of the explanatory variables.
***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

statistics and simple correlations with our alternative measures of takeover premium are presented in Panel B of Tables 2 and 3, respectively. The descriptive statistics for Premium (−84) and CAR (−84, 126) are similar to those documented by Chow, Klassen and Liu (2016) and Eaton *et al.* (2022), respectively.

Table 5 presents the results from estimating the regression in Equation (6), but after applying a Heckman correction for takeover target selection. This is because firms are unlikely to be randomly selected as takeover targets and because unobservable factors, such as private information held by bidders about expected synergies, are likely to affect both takeover target likelihood and takeover premium. Crucially, these unobservable factors might also be correlated with observable factors that affect both takeover target likelihood and takeover premium. This is especially important for our study, because firms' ex-ante crash risk is positively and significantly related to takeover

Table 5. Relationship between takeover premium and target firms' ex-ante risk of a stock price crash

	Dependent variable			
Explanatory variables	Premium (−84) (1)	CAR (−84, 126) (2)	Premium (−84) (3)	CAR (−84, 126) (4)
$NCSKEW_{t-1}$	−0.0667**	−0.0434**		
	(0.0302)	(0.0193)		
$DUVOL_{t-1}$			−0.1416**	−0.0853**
			(0.0695)	(0.0386)
$ROAD_{t-1}$	0.1564	0.0235	0.1576	0.0236
	(0.1968)	(0.1280)	(0.1961)	(0.1275)
$TBQD_{t-1}$	0.0203	−0.0119	0.0201	−0.0118
	(0.0370)	(0.0197)	(0.0370)	(0.0197)
LIQ_{t-1}	0.4563***	0.1092**	0.4567***	0.1091**
	(0.1090)	(0.0517)	(0.1087)	(0.0522)
LEV_{t-1}	1.1702***	0.1683	1.1709***	0.1680
	(0.2317)	(0.1038)	(0.2312)	(0.1041)
SGW_{t-1}	0.0694	0.0053	0.0688	0.0049
	(0.0521)	(0.0308)	(0.0524)	(0.0309)
$TANG_{t-1}$	−0.0327	0.0379	−0.0306	0.0401
	(0.1411)	(0.0995)	(0.1408)	(0.0995)
$SIZE_{t-1}$	−0.0477	−0.0563***	−0.0480	−0.0566***
	(0.0311)	(0.0159)	(0.0312)	(0.0158)
AGE_{t-1}	0.0023	0.0004	0.0023	0.0004
	(0.0022)	(0.0015)	(0.0022)	(0.0015)
HHI_{t-1}	−0.0526	0.1528	−0.0550	0.1506
	(0.3771)	(0.2403)	(0.3797)	(0.2424)
MSBL $(1/0)_{t-1}$	−0.0234	−0.0583	−0.0240	−0.0590
	(0.0773)	(0.0465)	(0.0773)	(0.0464)
Stock payment (1/0)	−0.1563**	−0.0141	−0.1558**	−0.0138
	(0.0635)	(0.0250)	(0.0636)	(0.0250)
Cash payment (1/0)	0.2848***	0.0283*	0.2847***	0.0285*
	(0.0410)	(0.0154)	(0.0411)	(0.0155)
Tender offer (1/0)	0.1453***	0.0993***	0.1446***	0.0986***
	(0.0398)	(0.0171)	(0.0394)	(0.0169)
Target termination fee (1/0)	0.4877***	0.1952***	0.4873***	0.1950***
	(0.0285)	(0.0145)	(0.0285)	(0.0145)
Same industry (1/0)	0.0648**	0.0434***	0.0647**	0.0434***
	(0.0279)	(0.0142)	(0.0281)	(0.0142)
Lockup (1/0)	0.2724***	0.1226**	0.2714***	0.1219**
	(0.0574)	(0.0571)	(0.0568)	(0.0567)
Hostile offer (1/0)	0.0937***	−0.0111	0.0945***	−0.0106
	(0.0328)	(0.0251)	(0.0328)	(0.0251)
λ	−0.3073	−0.1482	−0.3006	−0.1480
	(0.9025)	(0.5220)	(0.9019)	(0.5227)
Constant	1.0685	0.6166	1.0590	0.6187
	(1.5233)	(0.8884)	(1.5204)	(0.8894)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
F-statistic	81.40***	53.50***	84.03***	53.96***
R^2 statistic	14.94%	14.35%	14.92%	14.28%
Observations	5,150	5,150	5,150	5,150

This table presents multivariate cross-sectional ordinary least squares regression results for the relationship between takeover premium and target firms' ex-ante risk of a stock price crash. Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1 as only applies for these regressions. Variables are measured at time t unless otherwise indicated. The alternative measures of takeover premium are Premium (−84) and CAR (−84, 126) and the alternative measures of target firms' ex-ante (t − 1) risk of a stock price crash are NCSKEW and DUVOL. Variable definitions are presented in the Appendix. An inverse Mills ratio (λ) is added to each regression, computed from the multivariate pooled (firm-year) probit regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)) in columns (3) and (6) of Table 4, with NCSKEW

Table 5. (Continued)

and DUVOL as the alternative measures of target firms' ex-ante risk of a stock price crash, respectively. Included in those regressions – but excluded from the regressions here – is IDDL (1/0), in satisfaction of the exclusion condition for application of a Heckman correction for sample selection. Industry dummies use primary two-digit standard industrial classification (SIC) codes as per those for the Table 4 regressions. Robust standard errors clustered at the two-digit SIC-based industry level are shown in parentheses beneath coefficients for each of the explanatory variables.
***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

target likelihood, making any effect of NCSKEW and DUVOL on takeover premium susceptible to bias induced by omitting to correct for the unobservable factors. Following Gaspar, Massa and Matos (2005) and Fich, Harford and Tran (2015), we therefore apply a Heckman two-stage procedure to examine the effect of target firms' ex-ante crash risk on takeover premium.

The first stages are the probit regressions in columns (3) and (6) of Table 4 for NCSKEW and DUVOL, respectively. Included in these regressions, but excluded from the second stages for takeover premium in Table 5 is IDDL (1/0), in satisfaction of the exclusion condition for application of a Heckman procedure. IDDL (1/0) is defined in the Appendix as a dummy variable equal to one for a firm year after headquarters state enactment of an inevitable disclosure doctrine law, and zero otherwise. The rationale behind these laws satisfying the exclusion condition in this outcome context is that the explicit intention is to protect firms' trade secrets, by preventing departing employees from joining rival firms for an extended period. This induces labour market illiquidity (Klasa *et al.*, 2018), which makes firms headquartered in enacting states more attractive as takeover targets to circumvent the anti-poaching restrictions and acquire valuable human capital (Chen, Gao and Ma, 2020). The marginal effects for IDDL (1/0) in Table 4 are indeed positive and statistically significant (to at least the 5% level). At the same time though, the anti-poaching restrictions have no direct connection to the terms of takeover payment. Indeed, Chen, Gao and Ma (2020) find that whilst the anti-poaching restrictions increase takeover target likelihood, they do not also affect takeover premium.

We compute the inverse Mills ratios (λ) from the first stages, which proxy for aggregate unobservable factors determining takeover target likelihood. We then add λ to the second-stage estimations of Equation (6), duly correcting the standard errors. The results show that target firms' ex-ante crash risk is negatively and significantly related to both measures of takeover premium. All coefficients for NCSKEW and DUVOL are statistically significant to at least the 5% level. Given the Heckman correction for takeover target selection, our finding that, ceteris paribus and on average, target firms with higher ex-ante crash risk generate a lower premium is unlikely to be a spurious result of omitted correlation between target firms' ex-ante crash risk and unobservable factors determining takeover target likelihood. We therefore find strong support for H2.

We also examine the relationship between target firms' ex-ante risk of a stock price crash and the choice of takeover payment method. To test for a positive relationship between target firms' ex-ante crash risk and takeover payment with stock, as formally stated in H3, we similarly estimate the following multivariate cross-sectional regression:

$$Stock_i = \alpha + \beta \times Crash\,risk_{i,t-1} + \theta \times Controls_{i,t-1} + Industry_{dummies} + Year_{dummies} + \varepsilon_i \qquad (7)$$

where $Stock_i$, for target firm i, is either Stock proportion or Stock payment (1/0), our alternative measures of choice of takeover payment method, which are defined in the Appendix as the proportion of stock in the payment method and a dummy variable equal to one for payment solely with stock, and zero otherwise, respectively. We rely on a tobit regression for modelling Stock proportion and a probit regression for modelling Stock payment (1/0). In line with extant studies of the choice of takeover payment method, we drop Target termination fee (1/0) and Lockup (1/0) from the vector of controls.

We estimate the regression in Equation (7) after applying the same Heckman correction for the takeover target selection just discussed. Table 6 presents the results. These show that target firms' ex-ante crash risk is positively and

Table 6. Relationship between takeover payment method and target firms' ex-ante risk of a stock price crash

	Dependent variable			
Explanatory variables	Stock proportion (1)	Stock payment (1/0) (2)	Stock proportion (3)	Stock payment (1/0) (4)
$NCSKEW_{t-1}$	0.0252**	0.0152*		
	(0.0108)	(0.0089)		
$DUVOL_{t-1}$			0.0568**	0.0372*
			(0.0250)	(0.0213)
$ROAD_{t-1}$	−0.0279	0.0008	−0.0292	−0.0001
	(0.0546)	(0.0404)	(0.0545)	(0.0403)
$TBQD_{t-1}$	0.0011	−0.0050	0.0014	−0.0048
	(0.0104)	(0.0094)	(0.0104)	(0.0094)
LIQ_{t-1}	0.0702**	0.0487*	0.0698**	0.0485*
	(0.0337)	(0.0252)	(0.0337)	(0.0251)
LEV_{t-1}	−0.0699	−0.0698	−0.0717	−0.0708
	(0.0734)	(0.0726)	(0.0733)	(0.0725)
SGW_{t-1}	0.0483*	0.0292	0.0486*	0.0294
	(0.0250)	(0.0205)	(0.0250)	(0.0205)
$TANG_{t-1}$	−0.0367	−0.0500	−0.0361	−0.0495
	(0.0531)	(0.0510)	(0.0531)	(0.0511)
$SIZE_{t-1}$	0.0104	−0.0024	0.0105	−0.0024
	(0.0102)	(0.0083)	(0.0102)	(0.0084)
AGE_{t-1}	−0.0023*	−0.0024**	−0.0022*	−0.0023**
	(0.0012)	(0.0011)	(0.0012)	(0.0011)
HHI_{t-1}	0.3011**	0.3442***	0.3005**	0.3430***
	(0.1181)	(0.1217)	(0.1176)	(0.1215)
MSBL $(1/0)_{t-1}$	0.0336	0.0299	0.0333	0.0297
	(0.0323)	(0.0295)	(0.0323)	(0.0296)
Tender offer (1/0)	−0.2902***	−0.2787***	−0.2901***	−0.2787***
	(0.0182)	(0.0137)	(0.0182)	(0.0137)
Same industry (1/0)	0.1470***	0.0958***	0.1471***	0.0958***
	(0.0182)	(0.0132)	(0.0182)	(0.0132)
Hostile offer (1/0)	−0.1091***	−0.0839***	−0.1092***	−0.0839***
	(0.0152)	(0.0152)	(0.0152)	(0.0152)
λ	0.5685*	0.4746*	0.5600*	0.4693*
	(0.3143)	(0.2797)	(0.3136)	(0.2795)
Constant	−0.9645*	0.1126***	−0.9490*	0.1126***
	(0.5308)	(0.0056)	(0.5287)	(0.0056)
Industry dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
F-statistic	109.24***		106.97***	
χ^2 statistic		8043.75***		8048.84***
Pseudo R^2 statistic	30.55%	25.85%	30.55%	25.86%
Observations	5,150	5,058	5,150	5,058

This table presents multivariate cross-sectional tobit and probit regression results for the relationship between choice of takeover payment method and target firms' ex-ante risk of a stock price crash. Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1 as only applies for these regressions. Variables are measured at time t unless otherwise indicated. The alternative measures of choice of takeover payment method are Stock proportion and Stock payment (1/0). Tobit regression results apply to Stock proportion and probit regression results apply to Stock payment (1/0). The alternative measures of target firms' ex-ante (t − 1) risk of a stock price crash are NCSKEW and DUVOL. Variable definitions are presented in the Appendix. An inverse Mills ratio (λ) is added to each regression, computed from the multivariate pooled (firm-year) probit regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)) in columns (3) and (6) of Table 4, with NCSKEW and DUVOL as the alternative measures of target firms' ex-ante risk of a stock price crash, respectively. Included in those regressions – but excluded from the regressions here – is IDDL (1/0), in satisfaction of the exclusion condition for application of a Heckman correction for sample selection. Industry dummies use primary two-digit standard industrial classification (SIC) codes as per those for the Table 4 regressions. Observations for the Stock payment (1/0) regressions are slightly less than those for the Stock proportion regressions because of no variation in the binary-based choice of takeover payment method for certain industry clusters. Robust standard errors clustered at the two-digit SIC-based industry level are

Table 6. (Continued)

shown in parentheses beneath coefficients for each of the explanatory variables for the tobit regressions and marginal effects for one-unit changes in each of the explanatory variables for the probit regressions.
***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

significantly related to both measures of choice of takeover payment method at conventional levels of statistical significance.[4] These findings therefore provide strong support for H3 and more broadly for the argument that takeover payment with stock lowers bidders' risk of overpayment when target firms' information asymmetry – and hence uncertainty about expected synergies – is higher (see Hansen, 1987; Luypaert and Van Caneghem, 2017; Officer, Poulsen and Stegemoller, 2009).

Enrichment and robustness

Managerial quality and discretion around financial accruals

If managerial news hoarding behaviour is a likely antecedent of stock price crash risk, then the core hypothesized positive relationship between firms' ex-ante crash risk and takeover target likelihood should depend to a significant extent on inferior managerial quality and greater managerial discretion around financial accruals. This is because, according to the theory of the market for corporate control, managers are more likely to be targeted in an active takeover market should they fail to act in the best interests of shareholders (see Jensen and Ruback, 1983; Manne, 1965). Such managers are more likely to have a motive for news hoarding behaviour. In addition, extant studies extensively document that a firm's crash risk relates closely to the quality of its reported earnings (see Hutton, Marcus and Tehranian, 2009; Kim, Li and Zhang, 2011a; Zhu, 2016). Such managers are also more likely to have a motive for earnings management.

To examine whether the positive relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood depends on inferior managerial behaviour, we modify Equation (5) to incorporate an interaction term between our alternative measures of firms' ex-ante crash risk, Crash $\text{risk}_{\text{i,t}-1}$ (NCSKEW and DUVOL), and proxies for inferior managerial quality and greater managerial discretion around financial accruals, Inferior managerial $\text{behaviour}_{\text{i,t}-1}$:

$$\begin{aligned}\Pr\left[Target_{i,t}=1\right] = \alpha + \beta_1 \times Crash\,risk_{i,t-1} + \beta_2 \\ \times Inferior\,managerial\,behaviour_{i,t-1} \\ + \beta_3 \times Crash\,risk_{i,t-1} \\ \times Inferior\,managerial\,behaviour_{i,t-1} + \gamma \\ \times Controls_{i,t-1} + Industry_{dummies} \\ + Year_{dummies} + \varepsilon_{i,t} \qquad (8)\end{aligned}$$

Following Hermalin and Weisbach (1998), Agrawal and Jaffe (2003), Taylor (2010) and Jenter and Lewellen (2021), for our first proxy for inferior managerial quality, we rely on industry-adjusted return on assets, computed as the deviation of a firm's return on assets from its industry median for a given fiscal year. We construct a dummy variable, Negative ROAD (1/0), equal to one for negative industry-adjusted return on assets, and zero otherwise. For our second proxy for inferior managerial quality, we follow Dong and Doukas (2022) in constructing a regression-based absolute measure of corporate investment inefficiency, which captures under- or over-investment. Again, we construct a dummy variable to differentiate between inferior and superior quality managers. Here, the dummy variable, High AINVINEFF (1/0), equals one if a firm has a level of investment inefficiency higher than the median level for all firms in a given fiscal year, and zero otherwise. Our proxy for managerial discretion around financial accruals, and hence earnings management, follows Hutton, Marcus and Tehranian (2009) and Kim, Li and Zhang (2011a), in being based on a moving sum of the absolute value of discretionary financial accruals (estimated as in Dechow, Sloan and Sweeney, 1995) for a given fiscal year and the two preceding fiscal years. To differentiate between high and low earnings management, we construct another dummy variable, High ACCM (1/0), equal to one if a firm has a level of earnings management higher

[4]As an aside, we find more takeover payment with stock for US public bidders with higher TBQD, pointing to these bidders being overvalued.

than the median level for all firms in a given fiscal year, and zero otherwise. Definitions for each of these variables are also presented in the Appendix.

We estimate the regression in Equation (8) and present the results in Table 7. These show that the marginal effects for each of the interaction terms are positive and statistically significant.[5] Moreover, each source of dependency explains around half of the effect of firms' ex-ante crash risk on takeover target likelihood. The dependencies are, therefore, consistent with the above conjecture and afford richer insight into the notion that correction of managerial behaviour is a stimulus for the market for corporate control, but one that depends on the likely extent of managerial news hoarding behaviour.

Endogeneity and causality

The results from our single-stage probit regression in Equation (5) might have generated a spurious inference if the relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood is affected by endogeneity; in particular, reverse causality and bias induced by omitted variables. In the case of reverse causality, extant studies suggest that greater threat from the market for corporate control either exacerbates (Bhargava, Faircloth and Zeng, 2017) or constrains (Balachandran *et al.*, 2020) firms' crash risk. However, what matters for the core inference already drawn in our study is that these conflicting findings suggest that takeover target likelihood affects firms' crash risk. In the case of bias induced by omitted variables, unobservable or difficult-to-measure determinants of takeover target likelihood, such as the value of human capital (Chen, Gao and Ma, 2020), might also be correlated with firms' crash risk. Indeed, Liu and Ni (2021) find that human capital outflows lead to higher crash risk.

To address these endogeneity and causality concerns, we jointly exploit two established instrumental variables for stock price crash risk (defined in the Appendix), which – as we reason below – have strong theoretical exogeneity for this outcome context, within a re-estimation of Equation (5) using a two-stage least squares (2SLS) linear probability regression as follows:[6]

First stage

$$Crash\,risk_{i,t-1} = \alpha + \beta \times IV_{i,t-1} + \gamma \times Controls_{i,t-1} + Industry_{dummies} + Year_{dummies} + \varepsilon_{i,t-1} \quad (9i)$$

Second stage

$$\Pr\left[Target_{i,t} = 1\right] = \alpha + \beta \times Crash\,risk_{i,t-1} + \gamma \times Controls_{i,t-1} + Industry_{dummies} + Year_{dummies} + \varepsilon_{i,t} \quad (9ii)$$

Our first instrumental variable ($IV_{i,t-1}$) is a dummy variable, DBNL (1/0), that exploits relevance and exogeneity in headquarters state enactment of data breach notification laws. The explicit intention of these laws is to safeguard customers' personal information by requiring firms in enacting states to notify individuals whose personal information is lost or stolen in a cyber attack. After enactment (DBNL (1/0) is equal to one for a firm year after enactment, and zero otherwise), headquartered firms are required to disclose data breaches publicly and to bear associated costs. Liu and Ni (2023) infer that, as a tradeoff against the possibility of this mandatory disclosure, managers in enacting states have a greater tendency to manipulate real activities and to hoard news for managing investors' expectations. Whilst therefore likely being positively correlated with higher ex-ante crash risk (as captured by NCSKEW and DUVOL), mandatory disclosure of this kind is only intended to protect firms' customer interests and thus has no direct connection to the likelihood of firms being selected as takeover targets.

Our second instrumental variable, AMFFLOW, is an absolute measure of hypothetical sales pressure on a firm's stock during a given fiscal year, as mimicked by investor outflows from mutual funds

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[5]Andreou, Lambertides and Magidou (2023) document findings that imply these dependencies are likely to be less significant following enforcement of the Sarbanes–Oxley (SOX) Act, around halfway through our sample period. We find no statistically significant differences, however, between the marginal effects for each of the interaction terms after running separate regressions before and after SOX.

[6]We rely on a 2SLS linear probability regression to utilize all diagnostics relating to our use of instrumental variables. Our results are nevertheless robust to alternatively relying on a two-stage probit regression, specifically suited to a limited dependent variable, and thereby maintaining consistency with how we initially estimated Equation (5).

Table 7. Relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood: dependence on ex-ante inferior managerial quality and on ex-ante greater managerial discretion around financial accruals

	Dependent variable = Target (1/0)					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
$NCSKEW_{t-1}$	0.0034***	0.0036***	0.0035***			
	(0.0009)	(0.0009)	(0.0009)			
$DUVOL_{t-1}$				0.0079***	0.0081***	0.0080***
				(0.0018)	(0.0018)	(0.0018)
Negative ROAD $(1/0)_{t-1}$	−0.0043***			−0.0043***		
	(0.0016)			(0.0016)		
$NCSKEW_{t-1}$ × Negative ROAD $(1/0)_{t-1}$	0.0033*					
	(0.0017)					
$DUVOL_{t-1}$ × Negative ROAD $(1/0)_{t-1}$				0.0073**		
				(0.0036)		
High AINVINEFF $(1/0)_{t-1}$		−0.0017			−0.0017	
		(0.0015)			(0.0015)	
$NCSKEW_{t-1}$ × High AINVINEFF $(1/0)_{t-1}$		0.0033*				
		(0.0017)				
$DUVOL_{t-1}$ × High AINVINEFF $(1/0)_{t-1}$					0.0072*	
					(0.0036)	
High ACCM $(1/0)_{t-1}$			−0.0025*			−0.0025*
			(0.0015)			(0.0015)
$NCSKEW_{t-1}$ × High ACCM $(1/0)_{t-1}$			0.0039**			
			(0.0017)			
$DUVOL_{t-1}$ × High ACCM $(1/0)_{t-1}$						0.0080**
						(0.0036)
$TBQD_{t-1}$	−0.0040***	−0.0039***	−0.0039***	−0.0040***	−0.0039***	−0.0039***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
LIQ_{t-1}	0.0036	0.0013	0.0009	0.0037	0.0013	0.0009
	(0.0045)	(0.0044)	(0.0044)	(0.0045)	(0.0044)	(0.0044)
LEV_{t-1}	0.0264***	0.0240***	0.0240***	0.0263***	0.0240***	0.0240***
	(0.0041)	(0.0040)	(0.0040)	(0.0041)	(0.0040)	(0.0040)
SGW_{t-1}	−0.0013	−0.0008	−0.0009	−0.0013	−0.0008	−0.0009
	(0.0022)	(0.0021)	(0.0021)	(0.0022)	(0.0021)	(0.0021)
$TANG_{t-1}$	−0.0187***	−0.0171***	−0.0178***	−0.0187***	−0.0171***	−0.0179***
	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)	(0.0049)
$SIZE_{t-1}$	−0.0035***	−0.0033***	−0.0034***	−0.0035***	−0.0033***	−0.0034***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
AGE_{t-1}	−0.0003***	−0.0003***	−0.0003***	−0.0003***	−0.0003***	−0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
HHI_{t-1}	0.0075	0.0070	0.0077	0.0074	0.0069	0.0076
	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0164)	(0.0164)
MSBL $(1/0)_{t-1}$	0.0076**	0.0074**	0.0074**	0.0076**	0.0074**	0.0074**
	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)	(0.0030)
Constant	0.0516***	0.0516***	0.0516***	0.0516***	0.0516***	0.0516***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
χ^2 statistic	1258.58***	1265.85***	1266.05***	1260.51***	1266.94***	1266.48***
Pseudo R^2 statistic	4.03%	4.01%	4.02%	4.03%	4.02%	4.02%
Observations	100,354	100,354	100,354	100,354	100,354	100,354

This table presents multivariate pooled (firm-year) probit regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)). Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1. Variables are measured at time t unless otherwise indicated. The alternative measures of firms' ex-ante (t − 1) risk of a stock price crash are NCSKEW and DUVOL, the alternative measures of ex-ante inferior managerial quality are Negative ROAD (1/0) and High AINVINEFF (1/0), and the measure of ex-ante greater managerial discretion around financial accruals is High ACCM (1/0). The interaction terms capture dependence of the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target on ex-ante inferior managerial quality and on ex-ante greater managerial

Table 7. (Continued)

discretion around financial accruals. Variable definitions are presented in the Appendix. Industry dummies use primary two-digit standard industrial classification codes. Robust standard errors clustered at the firm level are shown in parentheses beneath marginal effects for one-unit changes in each of the explanatory variables.
***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

that hold its stock (estimated as in Edmans, Goldstein and Jiang, 2012). This instrumental variable is, therefore, also likely to be positively correlated with NCSKEW and DUVOL. Indeed, Kim, Lee and Zhu (2022) document that AMFFLOW is positively and significantly related to the likelihood that an individual firm held by funds experiences a stock price crash. At the same time, and as argued by Edmans, Goldstein and Jiang (2012), investors' decisions to divest funds' shares are unlikely to be directly correlated with the takeover prospects of an individual firm held by the funds, since investors who wish to speculate on takeover target likelihood for an individual firm will trade the firm's stock and not that of the funds. This argument becomes even more plausible given that AMFFLOW is constructed based on projected and mechanized, not actual, investor outflows from funds.

Table 8 presents the results from estimating the regression in Equations (9i) and (9ii) for both measures of firms' ex-ante crash risk. All diagnostics relating to our use of these instrumental variables suggest that they also have strong empirical relevance and validity. Firstly, the first-stage coefficients for DBNL (1/0) and AMFFLOW are positive and statistically significant to at least the 1% level. More importantly, the F-statistics for the joint effects partially outside these significances significantly exceed the recommended 10% critical value. Secondly, the reduced-form (OLS-based) coefficients also reveal an indirect trace via the instrumental variables of a positive and significant relationship between firms' ex-ante crash risk and takeover target likelihood. Thirdly, the insignificant χ^2 statistics for tests of no over-identification from DBNL (1/0) and AMFFLOW in the second stage suggests that at least one of the instrumental variables is likely to be exogenous with respect to takeover target likelihood.[7]

The second-stage results continue to show that NCSKEW and DUVOL are positively and statistically significantly related to takeover target likelihood. In addition, the χ^2 statistics for tests of exogeneity of NCSKEW and DUVOL suggest that non-instrumented, these measures of firms' ex-ante crash risk are insufficiently exogenous to not require being instrumented when evaluating the effect on takeover target likelihood, as when initially estimating Equation (5). Importantly, the suggestion is that the effect is otherwise downward biased. We therefore conclude that in all likelihood, firms' ex-ante risk of a stock price crash has a positive causal effect on takeover target likelihood.

Actual stock price crashes

Our core hypothesized positive relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood does not necessitate that firms have experienced a stock price crash. However, based on conventional measures for capturing actual stock price crashes, both of our alternative measures of firms' ex-ante crash risk, NCSKEW and DUVOL, envelop firms that have experienced a stock price crash during the fiscal year preceding the year for evaluating takeover target likelihood. We therefore lastly differentiate between firms that have and have not experienced a stock price crash.

We follow Kim, Li and Zhang (2011b) and Li and Zeng (2019) in constructing two alternative measures for capturing firms' ex-ante incidence of an actual stock price crash (defined in the Appendix): (1) COUNT, which measures, during a given fiscal year, the number of incidences when

[7]The simple correlation between DBNL (1/0) and AMFFLOW is −0.27, which suggests that the instrumental variables are likely to be isolating different exogenous components of firms' ex-ante crash risk. In addition, we get similar all-round results when alternatively, singularly using DBNL (1/0) and AMFFLOW in the just-identified regressions.

Table 8. Relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood: instrumenting for firms' ex-ante risk of a stock price crash

	Dependent variable				
Explanatory variables	First stage $NCSKEW_{t-1}$ (1)	Second stage Target (1/0) (2)	First stage $DUVOL_{t-1}$ (3)	Second stage Target (1/0) (4)	Reduced form Target (1/0) (5)
$NCSKEW_{t-1}$		0.3509***			
		(0.0481)			
$DUVOL_{t-1}$				0.7459***	
				(0.1028)	
DBNL $(1/0)_{t-1}$	0.0736***		0.0315***		0.0292***
	(0.0102)		(0.0047)		(0.0023)
$AMFFLOW_{t-1}$	0.0308***		0.0173***		0.0055**
	(0.0088)		(0.0041)		(0.0023)
$ROAD_{t-1}$	0.0775***	−0.0126	0.0349***	−0.0118	0.0155***
	(0.0186)	(0.0088)	(0.0085)	(0.0087)	(0.0048)
$TBQD_{t-1}$	−0.0097***	−0.0004	−0.0045***	−0.0004	−0.0038***
	(0.0012)	(0.0007)	(0.0006)	(0.0007)	(0.0003)
LIQ_{t-1}	0.0472**	−0.0104	0.0178**	−0.0068	0.0054
	(0.0184)	(0.0081)	(0.0084)	(0.0079)	(0.0048)
LEV_{t-1}	−0.0710***	0.0529***	−0.0290***	0.0500***	0.0270***
	(0.0161)	(0.0079)	(0.0074)	(0.0076)	(0.0042)
SGW_{t-1}	0.0111	−0.0061	0.0017	−0.0034	−0.0022
	(0.0088)	(0.0038)	(0.0041)	(0.0037)	(0.0021)
$TANG_{t-1}$	−0.0365**	−0.0020	−0.0113	−0.0064	−0.0148***
	(0.0180)	(0.0079)	(0.0084)	(0.0078)	(0.0046)
$SIZE_{t-1}$	0.0611***	−0.0245***	0.0285***	−0.0244***	−0.0028***
	(0.0018)	(0.0030)	(0.0008)	(0.0030)	(0.0004)
AGE_{t-1}	−0.0034***	0.0008***	−0.0015***	0.0007***	−0.0004***
	(0.0003)	(0.0002)	(0.0001)	(0.0002)	(0.0001)
HHI_{t-1}	0.0231	0.0006	0.0260	−0.0106	0.0087
	(0.0607)	(0.0274)	(0.0281)	(0.0271)	(0.0160)
MSBL $(1/0)_{t-1}$	0.0014	0.0069	−0.0006	0.0078	0.0076**
	(0.0128)	(0.0056)	(0.0058)	(0.0055)	(0.0036)
Constant	−0.6373***	0.3209***	−0.3307***	0.3440***	0.0971***
	(0.0704)	(0.0424)	(0.0332)	(0.0446)	(0.0163)
Industry dummies	Yes		Yes		Yes
Year dummies	Yes		Yes		Yes
F-statistic for joint effect of DBNL (1/0) and AMFFLOW in first stages	44.68		42.81		
10% critical value for F-statistic for joint effect of DBNL (1/0) and AMFFLOW in first stages	19.93		19.93		
R^2 statistic for joint variation in DBNL (1/0) and AMFFLOW in first stages	3.68%		4.08%		
χ^2 statistic for test of no over-identification from DBNL (1/0) and AMFFLOW in second stages	2.43		2.22		
χ^2 statistic for test of exogeneity of NCSKEW and DUVOL in second stages	182.13***		169.85***		
χ^2 statistic for second stages	631.73***		624.46***		
F-statistic for reduced form					24.31***
Observations	100,354		100,354		100,354

This table presents multivariate pooled (firm-year) two-stage least squares linear probability regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)). Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1. Variables are measured at time t unless otherwise indicated. The alternative measures of firms' ex-ante (t − 1) risk of a stock price crash are NCSKEW and DUVOL and the joint instrumental variables for these measures are DBNL (1/0) and AMFFLOW. The reduced-form results are ordinary least squares based. Variable definitions

Table 8. (Continued)

are presented in the Appendix. Industry dummies use primary two-digit standard industrial classification codes. Robust standard errors clustered at the firm level are shown in parentheses beneath coefficients for one-unit changes in each of the explanatory variables. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

a firm's residual weekly returns (estimated using Equation (1)) exceed 3.2 standard deviations below its mean residual weekly return minus the number of incidences when its residual weekly returns exceed 3.2 standard deviations above its mean residual weekly return; and (2) CRASH (1/0), which is a dummy variable equal to one if below incidences of COUNT exceed 0, and zero otherwise. The descriptive statistics in Table 2 show that CRASH (1/0) averages 17.3% for the 100,354 firm-year observations in Panel A and that this overall rate of ex-ante incidence of an actual crash is only slightly lower than the rate of 18.7% for the 5,150 observations restricted to takeover targets in Panel B.

We first re-estimate Equation (5) after replacing NCSKEW and DUVOL with COUNT and CRASH (1/0). Columns (1) and (2) of Table 9 present the results for COUNT and CRASH (1/0), respectively. These show that firms' ex-ante incidence of an actual crash is positively and statistically significantly related to takeover target likelihood. We then re-estimate the same equation with NCSKEW and DUVOL intact, but after dropping observations for which CRASH (1/0) equals 1. Columns (3) and (4) present these results for NCSKEW and DUVOL, respectively. They do indeed continue to provide support for our core hypothesis, and with remarkably similar effect and statistical significance as when initially estimating Equation (5).

The results in columns (3) and (4) though might be more about the effect of information asymmetry and less about the effect of crash risk per se. We therefore again re-estimate Equation (5) with NCSKEW and DUVOL intact after dropping observations for which CRASH (1/0) equals 1, but after adding another well-documented proxy for information asymmetry (e.g. by Jennings and Mazzeo, 1993; Luypaert and Van Caneghem, 2017): the number of unique financial analysts providing earnings forecasts for a firm during a given fiscal year over which we also measure NCSKEW and DUVOL. We orthogonalize this proxy (ANAFOL, defined in the Appendix) by scaling it by the book value of assets in millions of dollars (as already embedded in SIZE). Columns (5) and (6) present these results for NCSKEW and DUVOL, respectively. They continue to provide support for our core hypothesis, and with similar effect and statistical significance as when not adding ANAFOL.

Conclusion

In this study, we are the first to examine the effects of firms' ex-ante risk of a stock price crash, a likely antecedent of which is managers' concealment of news on aspects of the market for corporate control. For a large and expansive sample of US publicly listed firms, and controlling for a raft of salient variables, we specifically examine whether firms' ex-ante crash risk affects their likelihood of being selected as a takeover target, as well as whether the crash risk of firms that are actually selected as targets affects takeover premium and payment method.

We find that firms with higher ex-ante crash risk are more likely to be selected as takeover targets and that this effect depends significantly on inferior managerial quality and greater managerial discretion around financial accruals. The overall effect, which in all likelihood is a causal effect, affords richer insight into the notion that correction of managerial behaviour is a stimulus for the market for corporate control, but one that depends on the likely extent of managers' concealment of news. We also find that target firms with higher crash risk generate a significantly lower takeover premium and receive significantly more payment with stock. The latter effects are after duly correcting for unobservable factors in takeover target selection. Collectively, our findings strongly suggest that decision-making in the market for corporate control is at least partially explained by incentives linked to opportunistic prices and takeovers of lemons.

In addition to highlighting an important overlooked factor to an understanding of

Table 9. Relationship between firms' ex-ante risk of a stock price crash and takeover target likelihood: effect of ex-ante incidence of an actual stock price crash

	Dependent variable = Target (1/0)					
Explanatory variables	(1)	(2)	(3)	(4)	(5)	(6)
$COUNT_{t-1}$	0.0029***					
	(0.0011)					
CRASH $(1/0)_{t-1}$		0.0050***				
		(0.0018)				
$NCSKEW_{t-1}$			0.0036***		0.0044***	
			(0.0013)		(0.0013)	
$DUVOL_{t-1}$				0.0082***		0.0095***
				(0.0024)		(0.0024)
$ROAD_{t-1}$	0.0169***	0.0170***	0.0178***	0.0178***	0.0171***	0.0172***
	(0.0048)	(0.0048)	(0.0052)	(0.0052)	(0.0053)	(0.0053)
$TBQD_{t-1}$	−0.0040***	−0.0040***	−0.0037***	−0.0037***	−0.0030***	−0.0030***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
LIQ_{t-1}	0.0062	0.0062	0.0085*	0.0085*	0.0135***	0.0135***
	(0.0046)	(0.0046)	(0.0050)	(0.0050)	(0.0051)	(0.0051)
LEV_{t-1}	0.0260***	0.0257***	0.0256***	0.0255***	0.0192***	0.0191***
	(0.0040)	(0.0040)	(0.0044)	(0.0044)	(0.0044)	(0.0044)
SGW_{t-1}	−0.0015	−0.0015	−0.0032	−0.0032	−0.0016	−0.0016
	(0.0022)	(0.0022)	(0.0024)	(0.0024)	(0.0024)	(0.0024)
$TANG_{t-1}$	−0.0179***	−0.0178***	−0.0125**	−0.0126**	−0.0106**	−0.0106***
	(0.0049)	(0.0049)	(0.0052)	(0.0052)	(0.0052)	(0.0052)
$SIZE_{t-1}$	−0.0036***	−0.0035***	−0.0039***	−0.0039***	−0.0044***	−0.0044***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
AGE_{t-1}	−0.0003***	−0.0003***	−0.0002***	−0.0002***	−0.0003***	−0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
HHI_{t-1}	0.0076	0.0076	0.0034	0.0034	0.0062	0.0061
	(0.0164)	(0.0164)	(0.0178)	(0.0178)	(0.0177)	(0.0177)
MSBL $(1/0)_{t-1}$	0.0076**	0.0076**	0.0072**	0.0073**	0.0083**	0.0083**
	(0.0030)	(0.0030)	(0.0033)	(0.0033)	(0.0034)	(0.0034)
$ANAFOL_{t-1}$					−0.3500***	−0.3494***
					(0.0314)	(0.0313)
Constant	0.0516***	0.0516***	0.0507***	0.0507***	0.0507***	0.0507***
	(0.0007)	(0.0007)	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
χ^2 statistic	1259.55***	1255.68***	1066.49***	1068.43***	1197.43***	1199.46***
Pseudo R^2 statistic	4.01%	3.99%	4.08%	4.08%	4.61%	4.62%
Observations	100,354	100,354	82,963	82,963	82,963	82,963

This table presents multivariate pooled (firm-year) probit regression results for the relationship between firms' ex-ante risk of a stock price crash and incidence/no incidence of selection as a takeover target (Target (1/0)). Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1. Variables are measured at time t unless otherwise indicated. The alternative measures of firms' ex-ante (t − 1) incidence of an actual stock price crash are COUNT and CRASH (1/0) and the alternative measures of firms' ex-ante risk of a stock price crash are NCSKEW and DUVOL but after dropping observations with CRASH (1/0) = 1. Variable definitions are presented in the Appendix. Industry dummies use primary two-digit standard industrial classification codes. Robust standard errors clustered at the firm level are shown in parentheses beneath marginal effects for one-unit changes in each of the explanatory variables.
***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

decision-making in the market for corporate control, our study makes significant contributions to a growing body of literature on stock price crash risk. We provide the first evidence to suggest that higher ex-ante risk of a stock price crash causes greater takeover target likelihood, whereas extant studies are inconclusive about whether greater exposure to the market for corporate control causes greater crash risk. We leave for further study consideration of what kinds of bidders seek to acquire firms with higher crash risk and how those bidders fair after acquiring such firms.

Appendix

Variable definitions

This Appendix presents a full set of variable definitions. Variable definitions are ordered according to when the variables are referred to in the paper.

Variable	Definition
Target (1/0)	Dummy variable equal to one if a firm is selected as a takeover target during a given year, and zero otherwise. Table 1 lists the criteria for selecting the takeover deals for Target (1/0) = 1.
NCSKEW	Alternative measure of a firm's risk of a stock price crash computed as the negative conditional skewness of its residual weekly returns during a given fiscal year (estimated as in Chen, Hong and Stein, 2001). Winsorized at the 1% and 99% levels. Source: Center for Research in Security Prices.
DUVOL	Alternative measure of a firm's risk of a stock price crash computed as the ratio of the standard deviations of its down-week to up-week residual returns during a given fiscal year (estimated as in Chen, Hong and Stein, 2001). Winsorized at the 1% and 99% levels before being natural logarithmically transformed. Source: Center for Research in Security Prices.
COUNT	Alternative measure of a firm's incidence of an actual stock price crash computed as the number of incidences during a given fiscal year that its residual weekly returns exceed 3.2 standard deviations below its mean residual weekly return minus the number of incidences its residual weekly returns exceed 3.2 standard deviations above its mean residual weekly return (estimated as in Kim, Li and Zhang, 2011b). Source: Center for Research in Security Prices.
CRASH (1/0)	Alternative measure of a firm's incidence of an actual stock price crash constructed as a dummy variable equal to one for below incidences of COUNT > 0, and zero otherwise.
ROAD	Industry-adjusted return on assets computed as the deviation of a firm's return on assets (operating income before depreciation divided by book value of assets) from its two-digit standard industrial classification code based industry median for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
TBQD	Industry-adjusted Tobin's Q computed as the deviation of a firm's Tobin's Q (book value of assets minus book value of equity plus market value of equity divided by book value of assets) from its two-digit standard industrial classification code based industry mean for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
LIQ	Balance sheet liquidity computed as a firm's cash and short-term investments divided by its book value of assets for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
LEV	Total leverage computed as a firm's long-term debt plus debt in current liabilities divided by the same plus its market value of equity for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
SGW	Sales growth computed as a firm's growth rate in sales for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
TANG	Balance sheet tangibility computed as a firm's tangible assets divided by its book value of assets for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
SIZE	Firm size computed as the natural logarithm of a its book value of assets in millions of dollars for a given fiscal year. Source: Compustat.
AGE	Firm age computed as the number of years since its listing. Source: Center for Research in Security Prices.
HHI	Industry concentration computed as the sum of the squared sales based market shares for the four-digit standard industrial classification code based industry of the focus firm for a given fiscal year. Winsorized at the 1% and 99% levels. Source: Compustat.
MSBL (1/0)	Mandatory staggered board law constructed as a dummy variable equal to one for a firm year after a firm's state of incorporation enacts a mandatory staggered board law, and zero otherwise. Source for state of incorporation: Compustat.
IDDL (1/0)	Exclusive for explaining Target (1/0). Inevitable disclosure doctrine law constructed as a dummy variable equal to one for a firm year after a firm's headquarters state enacts an inevitable disclosure doctrine law, and zero otherwise. Source for headquarters state: Bill McDonald's website, https://sraf.nd.edu/.

Variable	Definition
Premium (-84)	Only applies for Target (1/0) = 1. Alternative measure of the takeover premium computed as the final offer price divided by the target firm's comparable price 84 trading days before takeover announcement minus one. Winsorized at the 1% and 99% levels. Sources: Refinitiv SDC and Center for Research in Security Prices.
CAR (-84,126)	Only applies for Target (1/0) = 1. Alternative measure of the takeover premium computed as the target firm's cumulative abnormal return from 84 trading days before to 126 trading days after takeover announcement based on the market-adjusted model and a value-weighted index for measuring market return. Winsorized at the 1% and 99% levels. Source: Center for Research in Security Prices.
Stock proportion	Only applies for Target (1/0) = 1. Alternative measure of the choice of takeover payment method computed as the proportion of stock in the takeover payment method. Source: Refinitiv SDC.
Stock payment (1/0)	Only applies for Target (1/0) = 1. Alternative measure of the choice of takeover payment method constructed as a dummy variable equal to one if Stock proportion = 1, and zero otherwise. Source: Refinitiv SDC.
Cash payment (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if the choice of takeover payment method is in the form of cash only, and zero otherwise. Source: Refinitiv SDC.
Tender offer (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if a takeover deal is structured as a tender offer, and zero otherwise. Source: Refinitiv SDC.
Target termination fee (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if a takeover deal involves a termination fee initiated by the target firm, and zero otherwise. Source: Refinitiv SDC.
Same industry (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if a takeover deal involves both firms primarily operating in the same two-digit standard industrial classification code based industry, and zero otherwise. Source: Refinitiv SDC.
Lockup (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if a takeover deal involves a lockup of either firms' assets or shares, and zero otherwise. Source: Refinitiv SDC.
Hostile offer (1/0)	Only applies for Target (1/0) = 1. Dummy variable equal to one if a takeover deal is hostile or unsolicited, and zero otherwise. Source: Refinitiv SDC.
Negative ROAD (1/0)	Alternative proxy for inferior managerial quality constructed as a dummy variable equal to one for negative ROAD, and zero otherwise.
High AINVINEFF (1/0)	Alternative proxy for inferior managerial quality constructed as a dummy variable equal to one if a firm has a level of investment inefficiency (absolute value of residual investment activities estimated as in Dong and Doukas, 2022) higher than the median level for all firms in a given fiscal year, and zero otherwise. Source: Compustat.
High ACCM (1/0)	Proxy for greater managerial discretion around financial accruals constructed as a dummy variable equal to one for a firm with a level of discretionary financial accruals (moving sum of the absolute value of discretionary financial accruals for a given fiscal year and the two preceding fiscal years estimated as in DeChow, Sloan and Sweeney, 1995) higher than the median level for all firms in a given fiscal year, and zero otherwise. Source: Compustat.
DBNL (1/0)	Joint instrumental variable for a firm's risk of a stock price crash constructed as a dummy variable equal to one for a firm year after a firm's headquarters state enacts a data breach notification law, and zero otherwise. Source for headquarters state: Bill McDonald's website, https://sraf.nd.edu/.
AMFFLOW	Joint instrumental variable for a firm's risk of a stock price crash computed as the absolute value of hypothetical sales pressure on its stock during a given fiscal year based on mutual funds that hold its stock and experience projected and mechanized investor outflows from their funds of at least 5% of total assets (estimated as in Edmans, Goldstein and Jiang, 2012). Winsorized at the 1% and 99% levels.
ANAFOL	Number of unique financial analysts providing earnings forecasts for a firm during a given fiscal year scaled by its book value of assets in millions of dollars for that fiscal year. Winsorized at the 99% level after replacing missing observations with zero. Source: Institutional Brokers' Estimate System.

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