Do institutional investors process and act upon information?

Evidence from mergers and acquisitions

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Abstract

We study the role played by institutional investors in the U.S. takeover market. An increase in a firm's institutional ownership raises its likelihood of receiving a takeover bid, mainly driven by stock offers. We support the causal relationship using Russell index reconstitution as the instrument. Our additional analysis shows that institutional investors help mitigate the information asymmetry between bidders and targets, allowing target firms to accept a larger fraction of stock payment. The positive relationship between a target's institutional ownership and a stock-based offer is more pronounced when the bidder- or deal-related information asymmetry is higher, suggesting that institutional investors act as an information conduit between bidders and targets. Moreover, the positive impact is stronger when the bidder's shares are correctly priced, but the scope of their actions is limited with regards to post-merger performances. Our evidence suggests that institutional investors play an important role in alleviating information asymmetry and assessing the associated values during takeover transactions.

Keywords: institutional ownership, mergers and acquisitions, payment methods, information asymmetry, valuation.

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1. Introduction

A volume of research has investigated the economic impacts of institutional ownership on corporate policies and performance. The central question in this line of research is whether institutional money managers are an effective agent in supervising firms held in their portfolios on behalf of the atomistic investors. The issue has received increasing interest from both academic scholars and market participants. Institutional investors typically hold over 50% of equity shares of all U.S. public firms (Grinstein and Michaely, 2005), implying that corporate ownership is effectively in the hands of these institutions. Moreover, with the rise of index strategies in recent years, there has been an unprecedented increase in the ownership held by indexed funds (see, e.g., Appel et al., 2016; Schmidt and Fahlenbrach, 2017). Although institutional investors are often deemed sophisticate, acting as firms' delegated monitors (Jensen, 1993), it remains questionable whether indexed institutions actively process information of thousands of firms in their portfolios.[1]

The debate in the extant literature on the effectiveness of institutional investors and, in particular, indexed institutions has persisted. Recent studies show that indexed institutions, albeit their passive strategies, have positive impacts on innovation activities (Aghion et al., 2013), voluntary information disclosure (Boone and White, 2015), dividend payouts (Crane et al., 2016), and board independence (Appel et al., 2016). On the contrary, Bebchuk et al. (2017), Schmidt and Fahlenbrach (2017), and Heath et al. (2019) document a negative association between indexed ownership and the monitoring effectiveness. For instance, Schmidt and Fahlenbrach (2017) find that an increase in indexed ownership leads to fewer independent directors and worse acquisition outcomes.[2] Such mixed evidence suggests that institutions are likely to engage in firms' policy-making processes selectively, arguably when the influence of engagement is far-reaching. To assess whether institutional investors play an effective monitoring role in the capital markets, it seems important to investigate their effectiveness in the scenario when they are incentivized to exert effort.

In this paper, we aim to offer a novel insight into this debate by studying the role played by institutional investors in mergers and acquisitions (M&A). Separated from recent studies that focus on the institutional investors of bidding firms (Chen et al.,

[1]Since the main objective of index funds is to minimize the tracking errors with respect to benchmark indices, they may not have a strong incentive for monitoring or advising firms in their portfolios. Bebchuk and Hirst (2019) argue that indexed institutions managing highly diversified portfolios tend to have limited resources to interact with their holding firms, regardless of their ability or incentive to do so. For example, the "Big Three" asset managers (i.e., Blackrock, Vanguard, and State Street) are reported to hold over 17 thousand stocks globally, while the number of their stewardship personnel ranges from 11 to 33 (Table 1, Bebchuk and Hirst, 2019).

[2]Appel et al. (2016), despite documenting a positive effect of indexed ownership on board independence, find little evidence as to indexed institutions' influence on corporate investment and cash-holding policies.

2007; Schmidt and Fahlenbrach, 2017), we investigate the importance of institutional shareholders for the acquisition targets in M&A. In particular, we ask whether an increase of a firm's institutional ownership reflects a higher probability of it receiving takeover offers (i.e. acquisition targetivesness). Does the monitoring effort exerted by institutional owners of target firms facilitate the formation of M&A transactions through alleviating the information asymmetry between bidders and targets? Our study concentrates on institutional shareholders' monitoring effectiveness and information advantage, especially for stock payment takeover offers, and the economic benefits of their monitoring effort.

It is well-documented that institutions allocate their monitoring effort based proportionally on the relative importance of a firm's stock in their portfolios (Fich et al., 2015). In the context of M&A, a takeover decision carries significant but different weights for shareholders on the opposite side of the transaction. For shareholders of the bidders, an acquisition decision is analogous to evaluating one of the foremost and consequential investment projects. In contrast, the target shareholders' decision amounts to whether or not to accept the takeover offer and tender their ownership. Thus, the wealth effect and the sensitivity for valuation are more prominent for the target side.[3] In addition, the legal setting in the U.S. similarly reflects a greater significance of M&A decisions for target shareholders.[4] Arguably, institutional shareholders of the target firms should have a stronger motivation to engage in the information processing and negotiation of the takeover deal.

Since the M&A negotiation takes place behind closed doors, target institutional shareholders' influence on takeover deals and their underlying motives are not easily observable.[5] The existence of targets' institutional owners can significantly affect the negotiation of M&A deals between bidders and targets. It is reasonable to expect that, given the large stake of ownership, institutional owners tend to know more about the quality and potential synergy of bidders' offer than average investors. This information advantage suggests that institutional owners can influence the deal negation and characteristics, including payment methods, offer premium, and deal completion (Gaspar et al., 2005; Fich et al., 2015). However, there is a lack of empirical evidence on how targets' institutional

[3]Through surveying 19 large-sample studies, Eckbo (2009) shows that bidders' announcement returns are typically small (less than 1%) but significantly negative for large bidders and all-stock payment offers. On the contrary, the offer premium is about 45-50%, which tends to be higher for public bidders and all-cash offers.

[4]In most states, the law requires that a takeover proposal be evaluated by the board and approved by shareholders. In contrast, submitting a bid is not subject to a shareholder approval unless the bidding firm chooses to issue new shares more than 20% of outstanding shares to finance its takeover transaction.

[5]The survey analysis of McCahery et al. (2016) find that there exist behind-the-scenes interventions of the long-term investors and the use of proxy advisors by most investors to improve their voting decisions. Additionally, active and passive funds are reported to have influences on corporate strategies of the holding firms based on their direct insight into the firm and connection with firm management (see "Mutual funds start to put their mouth where their money is", reported by Reuters on March 15, 2019).

investors facilitate M&A transactions and whether this effect varies across different levels of information asymmetry associated with the deal and related parties. Our study intends to fill this gap in the literature.

Using a sample of 110,983 firm-year observations of U.S. public firms in 1984–2018, we find a positive association between the probability that a firm becomes an acquisition target and the increase in the presence of institutional investors, especially for quasi-indexed institutions.[6] Importantly, we show that the higher takeover probability following a change in institutional ownership is concentrated in the bids with stock offers. For firms that have received takeover offers, we find that the increase in institutional ownership leads to a higher probability (or fraction) of stock payment offers.

Firms with high takeover probabilities may exhibit certain attributes that attract certain types of bidders and institutional investors. We address this endogeneity concern by exploiting exogenous variation in institutional ownership associated with Russell index annual reconstitutions. As Russell's index membership assignment relies only on the market capitalization of stocks, an event of Russell 1000/2000 membership switch is plausibly exogenous to firm characteristics and other confounding factors, conditional on the end-of-May market value (Russell, 2016).[7] This exogenous variation allows us to estimate the effect of institutional ownership using an instrumental variable (IV) estimation approach. Our IV results provide strong support to the causal interpretation of our main findings.

We investigate the mechanism through which institutional owners affect the targetiveness of a public firm. Prior literature on stock acquisitions has devoted a great deal of attention to the issues of information asymmetry (see, e.g., Hansen, 1987; Fishman, 1989; Eckbo et al., 1990, for theoretical analyses of payment methods under two-sided information asymmetry). In a recent study, Eckbo et al. (2018) show that targets are more likely to accept M&A deals paid with bidders' stocks when they are more informed about the bidding firm. Our work complements their study by showing that the positive relationship between a target's institutional ownership and the likelihood of stock-based offers is more pronounced when either the bidder or the M&A deal is associated with larger information asymmetry. Our evidence, in support of their rational payment hypothesis, suggests that institutional investors act as an information conduit between the two parties and help mitigate the complication caused by information asymmetry. Our results are robust to different measures of information asymmetry, including a composite proxy for bidder's information asymmetry (Karpoff et al., 2013), bidders' prior activities

[6]Our sample of M&A consists of 5,556 U.S. domestic M&A with public targets from non-regulated industries. When we zoom into various deal-level tests that require the bidder characteristics, our sample size reduces to 3,236 M&A transactions between public bidders and targets.

[7]Prior studies have employed this approach to establish the causal effect of the institutional ownership (Fich et al., 2015; Appel et al., 2016; Crane et al., 2016; Schmidt and Fahlenbrach, 2017; Cremers et al., 2019) on various corporate outcomes.

related to the use of stocks, and the proxies of information asymmetry at the transaction level (Eckbo et al., 2018), and to the inclusion of institutions' cross-holdings of both target and bidder firms.

To corroborate the notion that institutional owners process the information of targeted firms in their portfolios and enable a stock-based offer more feasible, we examine whether the institutions have the ability to identify when bidders' shares — the means of acquisition payment — are misvalued. Our evidence shows that bidder opportunism is not a factor driving the positive effect of targets' institutional ownership on the fraction of stock payment in a deal.[8] Instead it indicates that the targets are more resilient to the overpriced stock offers following the change in institutional ownership. That is, the positive relationship between the change in institutional ownership and the fraction of stock in the deal payment is stronger when the bidder's shares are relatively correctly priced. Our results are robust to alternative proxies of misvaluation of bidder's shares, including the mispricing component measures developed by Rhodes-Kropf et al. (2005) and the short-selling interest for the bidders' shares before a deal announcement (Ben-David et al., 2015). We also exploit Regulation Fair Disclosure (Reg FD) introduced in 2000 an exogenous shock to the information environment and examine how such a shock affects the role played by institutions in payment method design in takeover deals. Consistent with the rational payment design argument, the deal-consideration structure suggests that such a role played by the institutions is needed the most when the asymmetric information problem is the greatest.

To further evaluate the information role of institutional investors in evaluating bidders' values, we explore whether targets' institutional investors, whose holdings changes prior to announcement, process information ex-ante and act accordingly ex-post via their retention of shares in the merged firms.[9] Given that an essential characteristic of stock-related deals is the importance of estimation of the potential combined firms' value and synergy creation, the fact that institutions could end up with a higher number of the merged firms' shares magnifies the need for ex-ante assessment of information about bidder firms. Our findings from the tests on retention rates support the conjecture that institutional investors have incentives to acquire information and make rational ex-post holdings decisions in accordance with their expectation of the value of bidder/merged firms. Overall, our results lend strong support to the notion that institutional shareholders act upon their acquisition of information and play an advisory role when profound and influential corporate events like M&A take place.

[8]Contrary to the prediction of rational payment method, bidder opportunism holds that the choice of stock payments arises when a bidder attempts to sell overvalued shares to a target (Shleifer and Vishny, 2003; Rhodes-Kropf et al., 2005; Ang and Cheng, 2006; Dong et al., 2006).

[9]Our variables of ex-post retention of shares are post-announcement retention of holdings (pre-merged retention) and post-completion retention of holdings (post-merged retention) following Burch et al. (2012).

Our study extends the extant literature in three important ways. First, it contributes to the M&A literature on takeover probability by showing that institutional ownership has a significantly positive relation with a firm takeover probability (Palepu (1986); Ambrose and Megginson (1992); Song and Walkling (1993) among others). Second, our study complements the existing literature on the role played by institutional investors in assisting the portfolio firms (Chen et al., 2007; Fich et al., 2015). In particular, our evidence sheds new light on the motivation for institutional investors to exert their influence on the deal consideration, notably on stock-based bids when the problems of information asymmetry and the misvaluation of bidder's shares are severe (Eckbo et al., 2018). Third, our paper contributes to the line of literature on the method of payment under two-sided information asymmetry about the true value of their respective shares (Hansen, 1987; Fishman, 1989; Eckbo et al., 1990). We show that the increase in institutional holdings in a target facilitates a higher fraction of stock payment through the reduction in the information symmetry between a target and a bidder. Thus, it is an important determinant of the means of payment method in M&A.

The remainder of our paper proceeds as follows. Section 2 describes our data and sample construction. Section 3 presents our results on the effect of the change in targets' institutional ownership on the takeover likelihood, deal payment structure. This section also inspects the economic mechanism through which targets' institutional owners influence the payment design in a takeover deal and the ex-post retention rate of holdings by these institutions in stock-for-stock deals. Section 4 assesses the robustness of our findings. Section 5 concludes the paper.

2. Data and empirical methods

2.1. M&A sample formation

We first collect all U.S. domestic M&A transactions announced (both completed and withdrawn) between January 1, 1984 and December 31, 2018 from the Thomson Reuters Securities Data Corporation (SDC) database. Our sample begins in 1984 because Chen et al. (2007) find that M&A transactions tracked in the SDC is incomplete and less reliable before 1984.[10] We use all deals in which the form of deal is coded as merger or acquisitions of majority interest and more than 50% of targets' outstanding shares are acquired or sought. Transactions with deal values less than $1 million or with the relative size (deal value divided by the bidder's market value of equity) less than 1% are excluded from our sample. We apply these size restrictions to exclude M&A deals in which the potential acquisition offers are mechanically too small to matter for institutional holders of the target firm. Since we examine the takeover likelihoods of public firms in our study,

[10]This sample period cutoff has been used in other recent studies, like Fich et al. (2015) and Brooks et al. (2018).

we require targets to be public firms, whereas bidders can be public, private, or subsidiaries.[11] We further require successful (withdrawn) deals are completed (withdrawn) within 1,000 days from the announcement date. Finally, targets are required to have financial information and stock market data available from Compustat Annual Files and the Center for Research in Security Prices (CRSP), respectively.[12]

Our initial sample consists of 8,369 U.S. domestic M&A announced between 1984 and 2018 with a transaction value of no less than $1 million. To examine the influence of institutional ownership on M&A transactions, We require that targets have institutional holdings data reported in Thomson Reuters Institutional Holdings 13F database (formerly known as CDA/Spectrum).[13] We further remove financial firms (SIC codes between 6000-6999) and utilities (SIC codes between 4900-4999).[14] Since our analysis requires an unambiguous classification of payment methods, we keep only M&A deals with payment consideration clearly defined in SDC as cash only, stock only, or a combination of cash and stock. In the end, our final sample contains 5,556 M&A deals (both completed and withdrawn) between a public target and a public or private bidder. When we require both bidders and targets to be public firms, the sample size reduces to 3,236 deals. Appendix A summarizes the sample selection criteria and the number of observations.

Figure 1 shows the distribution of bidders over our sample period and across payment methods. The distribution is comparable to that of the sample used in Eckbo et al. (2018). The total number of bids decreases significantly after the merger wave in the late 1990s due to a sizeable reduction in the number of public firms in the U.S. About two-third of takeover bids is concentrated in the top 10 of Fama and French 48 Industry. These patterns are consistent with the takeover markets in the U.S between public targets and bidder firms (Boone et al., 2014; Fich et al., 2015).

[Insert Figure 1 here]

2.2. Variables and summary statistics

Our variable of interest is the *change in institutional ownership*, defined as the quarterly change of the fraction of institutional ownership (total shares owned by all institutional investors divided by the total number of outstanding shares) at the fiscal year-end. We find that the percentage of total institutional ownership for target and bidder firms

[11] For some deal-level analyses, we further restrict bidders to be public firms in order to control for bidders' characteristics. This also eliminates potential effects of bidders' public status (public vs non-public) on the deal structure and acquisition outcomes.

[12] We limit our sample to firms with positive book value of assets and total sales.

[13] The Thomson Reuters database covers institutional managers with greater than $100 million of assets under management. Security holdings reported in the 13F forms filed with the Securities and Exchange Commission (SEC) are updated quarterly.

[14] Financial firms and utilities are known to follow different financial reporting standards. Thus, including them may bias the analyses of takeover likelihoods and payment consideration.

in our M&A sample continues to increase since 1984, reaching about 70% in 2018. Figure 2 shows the time-series movement of the percentage of institutional ownership over our sample period.

[Insert Figure 2 here]

To examine the association between firms' institutional ownership and their probability of receiving a takeover offer, we first employ a large sample of 110,983 firm-year observations of U.S. public firms in 1984-2018. We identify firms that received takeover offers in a given year using our M&A sample (5,556 deals), and the number of targets accounts for 5,411 firm-year observations. Following prior studies (e.g., Palepu, 1986; Moeller et al., 2007; Brar et al., 2009; Phillips and Zhdanov, 2013), we employ the acquisition probability model and control for an array of firm characteristics that exert explanatory power for takeover likelihoods, including firm size, Tobin's Q, leverage, cash flows, sale growth, return on assets, compounded excess returns, industry acquisition, growth-resource mismatch, and R&D expenses. Panel A of 1 reports summary statistics of these variables, which are largely consistent relevant studies with a comparable sample.

For deal-level analysis, we focus on a sample of 3,236 M&A deals in which both bidders and targets are U.S public firms with valid accounting and stock information at the fiscal year-end before the announcement date. All continuous independent variables are winsorized at 1^{st} and 99^{th} percentiles. All financial variables are measured at the end of fiscal year prior to deal announcement date. Panel B presents the summary statistics of deal, bidder and target characteristics, which resemble characteristics of comparable samples in previous studies (Masulis et al., 2007; Fich et al., 2015). On average, the completion rate in our sample is 82.1% which is similar to that of 83% in Fich et al. (2015). Above 37.8% of targets and bidders operate in the same 4-digit SIC industry. The proportion of tender offer in our sample is approximately 24%. This figure would be comparable to 18% (Officer, 2003; Fich et al., 2015) if not excluding utility and financial targets. The average fraction of stock in deal consideration is 46%. Consistent with the literature, bidder firms are bigger in size based on both mean and median values. Bidders also have higher market-to-book and cash flows on average. In our sample, the mean R&D ratio of target firms is slightly higher than that of bidder firms. Consistent with previous studies, leverage ratios of targets and bidders are similar.

[Insert Table 1 here]

2.3. Proxies of information asymmetry

We employ several measures to capture the level of information asymmetry related to bidder firms and the M&A deals. The first proxy is a composite index of various *bidder characteristics*, which is constructed based on the principle-component analysis following

Karpoff et al. (2013). In particular, we use eight primitive measures of bidder characteristics, including firm size, tangible assets, firm age, number of analysts followings, number of issued stocks, daily bid-ask spread, daily return volatility and bidders' abnormal accruals. These component variables are defined in Appendix B. We also explain the construction of the information asymmetry proxy in Appendix C.

We further construct a second set of proxies based on the bidder's prior activities, including recent acquisitions and seasoned equity offerings. The degree of information asymmetry about a bidder firm is considerably lower when other public activities are associated with its use of stocks. Eckbo et al. (2018) point out that information a bidder disclosed in its prior use of stock has allowed outside investors to assess its value. *Recent acquisition [0,1]* is a dummy variable that equals one if the bidder has announced another takeover deal within the past two years. This variable indicates whether the bidder has previously revealed information to outsiders or attracted market attention, hence making it less opaque. *Recent SEO [0,1]* is a dummy variable that equals one if the bidder has issued common equity within the past two years.[15]

Next, we follow Eckbo et al. (2018) and construct proxies measuring the deal-level information asymmetry: the geographic proximity between the bidder and the target and the degree of industry complementarity. *Local deal* is a dummy variable that equals one if the bidder and target are located within 30 miles of each other. The physical distance between M&A firms is calculated using the spherical law of cosine following Cai et al. (2016), where the latitude and longitude coordinates of the bidder and target are obtained from the 2000 US Census Gazetteer Files.[16] The M&A deals between bidder and target firms that are closer to each other are expected to have a lower level of information asymmetry. *Industry complementarity* measures the overlap of the input-output industries between the bidder and target.[17] The higher the value of industry complementarity, the less information asymmetry the bidder is to the target firm.

2.4. Proxies of stock misvaluation

We construct two variables to measure bidder firms' potential stock misvaluation. First, Rhodes-Kropf et al. (2005) (RRV) propose the decomposition of market-to-book

[15]For both proxies, we have used the 18-month windows as in Eckbo et al. (2018) for robustness check. Our results remain the same.

[16]The coordinates are looked up using the firm's zip code or the location of its city centre if the former is missing. We test alternative cut-off values of bidder-target distance, like the 100 km used in Kedia et al. (2008). Our results are robust to using these alternative distance cut-offs.

[17]Following Fan and Lang (2000), for each BEA industry i, we compute the percentage $b_{ik}(v_{ik})$ of output (or input) supplied to (or purchased from) each intermediate BEA industry k. For each pair of industries, we then calculate the correlation coefficient between b_{ik} and b_{jk} across all k except i and j. We then map the BEA industries with the 4-digit SIC codes of the target and bidder firms, and for each target-bidder pair, we calculate the average input and output correlation and our measure of complementarity.

(MTB) ratios, which is the sum of firm-specific error component and current-sector deviation from the firm long-run value component. We use this measure to investigate the effect of bidders' stock overvaluation on the relationship between the change in targets' institutional ownership and the fraction of stock payment. Detailed description of the decomposition of bidders' market-to-book ratio and the summary statistics are reported in Appendix D. We split our sample using the median of the misvaluation component of $log(MTB)$. We expect that bidder shares are relatively less mispriced in the *low misvaluation* group prior to the announcement date.

Our second measure of bidder misvaluation is constructed based on the short-selling ratio of bidder stocks prior to the deal announcement. Ben-David et al. (2015) point out that stocks' short position is a reasonable indication of overvaluation for two reasons. First, an estimate of mispricing derived from firm fundamentals could be a confounding factor as it relies on the future productivity of the firm (Rhodes-Kropf et al., 2005; Dong et al., 2006). Second, short positions are costly and often executed by informed investors. High short-selling position in the bidder firm prior to deal announcement coincides with overvaluation of bidder shares and a greater probability of becoming stock bidder (Ben-David et al., 2015). Therefore, we expect that high short positions in a bidder firm before a deal announcement indicate relative overvaluation of its shares. The short interest ratio is defined as the short positions on the settlement date of 15th each month divided by the number of shares outstanding at the month-end as reported on CRSP. Following Ben-David et al. (2015); Rapach et al. (2016), we construct our second proxy for bidder overvaluation based on the adjusted short interest 6-month prior to the announcement date to account for the trend of short interest over time.[18] The *high misvaluation* group consists of bidders with above-median adjusted short ratios.

3. Empirical results

3.1. Takeover likelihoods and target institutional ownership

We begin by examining the unconditional probability of a firm becoming a takeover target. The dependent variable equals one if a firm receives one or more acquisition offers in a given year and zero otherwise. In addition to the explanatory variables explained in Section 2.2, we also include industry and year fixed effects to account for the variations in merger activities over time and across industries. Panel A of Table 2 presents regression results based on the logistic probability model that examines firms' likelihood of becoming a target. The estimated signs of our control variables suggest that firms' takeover

[18] Our short interest data comes from Compustat Monthly Securities Database. The difference between a firm's Short Interest Ratio and the mean Short Interest Ratio for all firms traded on NYSE, AMEX and NASDAQ. We also test the adjusted short-interest rate 1-month prior to the announcement date, and the result is robust in this valuation test.

probability decrease with firm size, cash flow, and market-to-book ratio, but decrease with prior stock returns and R&D expenditures. These results are largely comparable to those documented in prior studies.

Our results show that change in a firm's institutional ownership is positively associated with the likelihood of it receiving takeover offers. The average marginal effect is around 1.3% shown in Table 2. The overall fitness measured by the Pseudo R^2, albeit relatively low at 3% with fixed effect controls, is similar to previous studies on takeover probability (Ambrose and Megginson, 1992; Cremers et al., 2008).[19] Our findings indicate that firms are significantly more likely to become an acquisition target following the increase in institutional ownership. We also find that the most prominent effect on takeover probability comes from the change in quasi-indexer institutional ownership in the year prior to the bid announcement.

Interestingly, our findings are different from Ambrose and Megginson (1992), who find that the change target's institutional ownership is negatively correlated to the takeover probability. This difference arises because of several reasons, of which the most obvious one is the difference in sample construction. While Ambrose and Megginson (1992) sample spans from Jan 1^{st} 1981 to December 1986, our study covers much longer time period where takeover bids are announced between 1984 and 2018. There are significant differences in the level and the growth of institutional ownership between 1984 and 2018, as well as significant changes of takeover activities in the U.S.

[20]

Panel B of Table 2 reports estimates from multinomial logit regressions of probability of each payment method type on the change in targets' institutional ownership. The dependent variable takes value of zero if firm did not receive takeover bid in a given (baseline), one if receiving cash-only bid, two if received mixed bid and three if receive stock bid. Our findings suggest that the positive association of targets' institutional ownership and its takeover likelihood is concentrated in the stock deal sample, with the average marginal effect of 0.7% higher probability of a firm receiving a stock-only bid. Taken together, the results presented in table 2 provides a ground to support our hypothesis 1 that institutional owners have an effect on the target firm that allows for stock-related offers.

[Insert Table 2 here]

[19]In a different setting, Ambrose and Megginson (1992) show that change in target's institutional ownership is negatively correlated to the takeover probability. This difference arises mainly because our study covers a much longer period (1984-2018), during which the average quarterly institutional holdings grow from about 20% to approximately 52%, and the speed of the growth surged especially after 2000.

[20]The mean of the quarterly institutional holdings grows from about 20% to approximately 52% during this period, and the speed of the growth over the year surges especially after 2000.

3.2. Stock payment probability and and target institutional ownership

To understand the association between payment methods and target institutional ownership, We first compare the probability of stock-payment deals following changes in the percentage of institutional ownership (or the fraction of stock in the deal payment). Figure 3 provides descriptive analysis of the effect of the change in targets' institutional ownership prior to the bid announcement on stock-related deals.

Figure 3(a) shows the distribution of stock-only deals for the sample where bidders are U.S public, private firms or subsidiary firms. The fraction of stock-only deals and the percentage of stock payments are higher for the targets that experienced largest change in its institutional ownership in the fiscal year prior to the deal announcement. Figure 3(b) illustrates descriptive statistics for the sample of public bidders only. We find that on average the fraction of stock-only deals rises from 26% to 33% when public targets experience the largest increase in its institutional ownership in the prior year to the deal announcement. The distribution of fraction of stock payments also shows consistent pattern. We find that the fraction of stocks in the deal consideration is 6% higher on average when targets are in the fifth quintile (highest increase) of the change in its institutional ownership.

[Insert Figure 3 here]

Next, we perform deal-level multivariate analysis to investigate the effect of institutional owners in target firms. We control for five firm's characteristics including firm size, market-to-book, leverage, cash flow and R&D ratio. We also control for six deal characteristics including dummy variables for hostile deal, target termination fee, multiple competing bids, tender offer, same 4-digit SIC industry and a control variable for the relative size of deal value to market capitalisation of the bidder firm pre-announcement (Harford et al., 2009). We also restrict to a deal sample of 3,236 deals where the bidder firms are U.S publicly listed firms (*deal sample* for analysis at later stage) that have accounting and stock market information available. This allows us to control for bidder characteristics that are identified as determinants of medium of exchange in mergers and acquisitions. We control for the target characteristics, as well as the bidder and deal characteristics that are directly related to the percentage of stock payment.

The first 4 result columns of table 3 reports the coefficient estimates from the multinomial logit regressions for the choice of payment method. The signs of estimates of control variables are intuitive. On the target side, targets of the stock-only deals are relative bigger in size relatively to targets in cash-only sample. On the bidder side in the sample where bidders are public firms, bidders of stock-only deals are smaller in size and have lower cash flows. Both targets and bidders have high significant positive market-to-book values when stocks are the medium of exchange. Our findings suggest a higher probability of stock-only payments following the change in targets' institutional

ownership prior to the bid announcement. The results are fairly consistent across both samples where bidders are pubic, private and subsidiary (Column 2-5) and where bidders are public firms only (Column 6-9).

The last two columns of table 3 presents estimates from Tobit regressions for the fraction of stock in the takeover bids based on the deal-level sample. We control for characteristics of deal, bidder and target firms that are directly related to both stock payment probability (and stock percentage) and the change in institutional investors prior to the deal announcement. The signs of these control variables are consistent with previous research findings. Our results suggest that there is a positive relationship between the presence of target's institutional ownership and the fraction of stock payment in deal consideration. The results shown in Panel B of Table 3 for the sample of public bidders are robust to adding a full battery of control variables. These include additional control variables for deal characteristics (toehold, lockup of target or bidder shares, prior bidding, merger of equals), market characteristics (competitive industry, high-tech industry, one-year macroeconomic change, target Herfindahl-Hirschman index), alternative measures of firm-specific characteristics (Tobin's Q, liquidity measures) or additional control variables for firm-specific characteristics (prior-year market-adjusted returns of the target and bidder) as employed in Masulis et al. (2007); Fich et al. (2015). Our results are also robust to including an inverse Mill's ratio estimated from the model with industry and year-fixed effects in Panel A in Table 2, to address a concern related to self-selection of firms becoming acquisition targets (Heckman, 1979).[21] These findings augment our previous results that targets' institutional investors is one of the determinants of the choice of medium of exchange under information asymmetry in mergers and acquisitions.

[Insert Table 3 here]

In summary, we show that the change in targets' institutional ownership has a statistically significant and economically meaningful effect on the deal payment structure. Targets are more likely to receive all-stock offer or receive deals with relatively higher percentage of stock payments following the change in its institutional ownership pre-announcement.

3.3. Instrumental variable estimation using Russell index reconstitution

In this subsection, we use an instrumental variable (IV) approach to support the causal interpretation of our findings. As our baseline estimation examines the effect of a change in institutional ownership, a mechanistic correlation between the level of

[21]We also relax one sample restriction that the public target firms exclude those in the financial and utility industries to be comparable with other deal samples employed in prior M&A studies (Chen et al., 2007; Moeller et al., 2007; Fich et al., 2015). The positive association between targets' institutional ownership and fraction of stock payment remains significant at 5% significance level.

institutional ownership and a takeover outcome is mitigated to some extent. However, endogeneity concerns arguably remain, because some unobservable factors might affect both firms' institutional ownership and the likelihood that they become a takeover target. For example, cost effective firms or innovative firms might attract institutional money more, while bidders are more likely to target such a firm. Similarly, some institutions might actively chasing firms that are likely to be a takeover target.

To address these concerns, we use Russell index reconstitutions as a source of exogenous variation in institutional ownership. Like in the growing literature employing this approach (Appel et al., 2016; Chang et al., 2015; Crane et al., 2016; Schmidt and Fahlenbrach, 2017), our identification strategy exploits shocks to institutional ownership associated with index membership switches between the Russell 1000 and Russell 2000 indexes. To elaborate, on the "rank day", which is at the end of May each year, Russell assigns index membership based on the market capitalization of stocks (Russell, 2016). The larget 1,000 stocks (ranked from first to 1,000th) and the next 2,000 stocks (from 1,001th to 3,000th), respectively, compose Russell 1000 and Russell 2000. The annual reconstitution takes place at the end of June using index weights that are based on the float-adjusted market capitalization of the member stocks.[22] Since the membership assignment relies only on stocks' market capitalization, an event of Russell 1000/2000 membership switch is plausibly exogenous to firm characteristics and other confounding factors, conditional on the end-of-May market value. That is, certain attributes linked with the likelihood of becoming a takeover target are unlikely to induce a change in a stock's index membership status. Moreover, as index weights are determined within each index, the top-tier members of Russell 2000 get larger weights than the bottom tiers of Russell 1000. Therefore, a change of a stock's membership from Russell 1000 to Russell 2000 leads to increases in holdings of the stock by institutional tracking Russell indexes, whereas a switch from Russell 2000 to Russell 1000 results in decreases in such holdings.

Panel A of Figure 4 illustrates the discontinuity in total institutional ownership in the end-of-May market capitalisation rank for firms around the Russell 1000/2000 Index threshold, in both the Russell pre-banding policy period and our whole sample period.[23] Panel B of Figure 4 displays the function form and a fitted regression curve of the takeover likelihood and probability of each payment method for firms around the threshold, without control variable for deal, target and/or bidder characteristics. It provides suggestive evidence that firms switching to the Russell 2000 in a certain year have a higher prob-

[22]The purpose of Russell's float adjustment is to "include only those shares available to the public" (FTSE Russell, 2015, pp.23-24). Each constituent's shares outstanding at the end of June is adjusted based on Russell's proprietary criteria.

[23]Since 2007, Russell initiated the banding policy for reconstitution where firms close to the cut-off threshold do not automatically switch to the new index if its market capitalisation does not deviate beyond the 2.5% banding thresholds on either side of the cut-off threshold. As the robustness check for the alternative sample choice, we perform analysis for the period before 2007 only (pre-banding policy sample).

ability of receiving a bid in the following year. Specifically, the effect is concentrated in stock-only bids and/or mixed-payment bids whereas there is no meaningful discontinuity for cash-only bids around the Russell 1000/2000 threshold.

[Insert Figure 4 here]

Following Fich et al. (2015) and Schmidt and Fahlenbrach (2017), among others, we estimate our takeover likelihood equations in the 2SLS framework. In Panel A of Table 4, we provide our IV estimation results using the whole sample (including firm-years without a takeover deal). The first-stage results reported in Columns (1) and (3) show that the index membership switches generate the effects consistent with the predictions discussed above: a switch from Russell 1000 to Russell 2000 (from Russell 2000 to Russell 1000) results in an increase (decrease) in institutional ownership. As Russell began the banding policy in 2007, we perform a robustness check using the pre-banding policy period (Column 3). In addition to membership switches, we include change in the May market-cap rank and its squared term to capture variation in institutional ownership associated with market capitalization. That is, a positive relationship between the market-cap rank (inverse of the rank value) and institutional ownership is generally expected. Furthermore, we also show evidence supporting the validity of instruments in our setting. Test for overidentifying restrictions show Hansen-J p-value of 0.643 in column (1) & 0.466 in column (3) implying no rejection of the null hypothesis of valid overidentifying restrictions condition. Test for relevance condition show Kleibergen-Paap F-stat of 275.197 in column (1) for the whole sample and 268.971 in column (3) for the pre-banding policy sample, suggesting that instruments are collectively not weak in predicting the change in targets' institutional ownership. Our second-stage results reported in Columns (2) and (4) are consistent with our baseline results presented in Table 2, suggesting the exogenous increase in institutional ownership in the target leads to higher takeover likelihood, particularly in form of stock deals.

[Insert Table 4 here]

Similarly, the results in Panel B of Table 5 confirm that an exogenous increase in a firm's institutional ownership has a positive impact on the likelihood that the firm receives a stock offer. Table 5 reports the results using our deal sample in which the bidders are public, private and subsidiary as reported in Panel A of Table 3. Although the results still hold if using the sample in which the bidders are public firms only, the weaker power of IV estimation tests using this small sample does not necessarily lead to reliable estimates. Overall, our IV results lend strong support to the causal interpretation of our main findings that an increase in institutional ownership leads to an increase in the likelihood of an all-stock offer and the fraction of stock in a deal payment.

[Insert Table 5 here]

3.4. Inspecting the mechanism

In this section, we investigate economic mechanism through which targets' institutional investors influence the payment design in a takeover deal.

3.4.1. Information asymmetries associated with bidders and deals

We begin our analysis by checking our basic premise, that is, institutional investors acquire and process information when they are motivated to do so. Institutional investors could utilise their valuable information to value the offer made by bidder firms. The increase in institutional ownership is associated with higher fraction of stock in the deal payment, suggesting that the institutional investors of the target firms are collectively willing to accept stock deals based on their assessment of the proprietary information about the bidder that is not revealed to the market.

[Insert Table 6 here]

In Panel A of Table 6, we partition our deal sample into the high and low information asymmetry based on the composite proxy for bidder information asymmetry. The result shows that the change in targets' institutional ownership has pronounced effect on the fraction of stock in the deal payment when the bidder firms are more opaque. A 1% change in total institutional ownership prior to deal announcement is associated with a statistically and economically significant increase of 27.4% in fraction of stock in the deal payment when bidder firm is more informational asymmetric. Targets' institutional investors has a positive effect but insignificant effect on fraction of stock payments when bidders appear to be more transparent. In untabulated tests, we find that the increase in institutional ownership is associated with average marginal effect of 18% higher probability of target receiving stock-only deals. Our findings support the hypothesis that the importance of institutional investors are more prevalent when the level of information asymmetry between the bidder and the target firm is high. Our results indicates that the role of institution investors diminishes with the degree of information about the bidder being revealed to the market. Panel B of Table 6 reports reasonably consistent results of the positive association between institutional ownership and fraction of stock payments for sub-sample of high information asymmetric bidders, where alternative proxies for information asymmetry are used. We find the positive association is pronounced when bidders are not recent acquirers and when bidders have not recently issued season equity offerings within the 2-year period prior to deal announcement. These findings suggest that the role played by targets' institutional investors in determining medium of exchange in a takeover deal is more prevalent when there is a higher degree of uncertainty about the bidder value.

We supplement our analysis with additional tests using proxies for deal-level information asymmetry between a target and a bidder. Results from Panel C of Table 6 reinforce

our conjecture that the institutional investors in the target firm can act as an intermediary to bridge the gap of the information asymmetry that would otherwise discourage stock payment. We document that the impact of targets' institutional investors in reducing information asymmetry and allowing for higher fraction of stock payments is greatest when the information asymmetry problem is greatest. Overall, our results provide support for the argument that information provided by targets' institutional investors compensates for asymmetric information problem hindering the use of stock payments.

3.4.2. Misvaluation of the bidder shares

Next, we examine whether institutional investors are able to assess the value of bidder shares correctly. We partition our sample into low and high misvaluation groups to investigate the effect of targets' institutional investors on fraction of stock payments in relation to bidder valuation.

[Insert Table 7 here]

Estimated coefficients from Panel A of Table 7 suggest that institutional holdings in the target firm associates with higher fraction of stock offers when the bidder's shares are less mispriced. Our results are robust across models used to decompose the market-to-book value of the bidder's shares. Our results show that when the bidder's shares are less mispriced, the association between the change in institutional ownership in the year prior to deal announcement and fraction of stock is statistically significant at 1% significance level. It is also economically meaningful as the change of fraction of stock is about 13 percentage point from the subsample mean of fraction of stock (estimated coefficients are about 30%) given 1% change in institutional ownership of the target firm. As a robustness check, we also partition our sample into the low and high misvaluation groups by the median of bidder's firm-specific misvaluation component. On average, the estimated coefficient of the change in IO on fraction of stock across the 3 models is approximate 25 %. These results are quantitatively similar to the results reported in Table 7. Our findings support the hypothesis that targets' institutional investors play an important role in assessing the offer value and potentially influence target management to avoid detrimental decisions to its shareholders.

The results shown in Panel B of Table 7 reveal fraction of stock payments positively relates to the change in targets' institutional ownership when bidder shares are overpriced, indicated by the relative high short ratio. The results support our findings above that the effect of institutional investors is significant when the bidder shares are relatively less overpriced. To account for possible bias inherent in using short-positions as a proxy for misvaluation, we conduct robust tests across different subsample including: excluding 2008 to account for effect of staggered introduction of short-selling ban and overall market condition that might have caused biases in estimation of misvaluation,

excluding the hot market period 1995-2000 to differentiate short-position proxy from the market-wide overvaluation.[24] Our results are robust to the exclusion of these periods. Overall, these findings are consistent with the notion that institutional investors perform their monitoring role in evaluating the stock-offer in deal payment.

By examining the information asymmetries associated with bidders and misvaluation of bidder shares, our findings suggest that a reduction in degree of information asymmetry following the change in targets' institutional ownership allows for significantly higher fraction of stock payments. Our findings conditioned on the increasing presence of targets' institutional owners yield support for rational payment method. Overall, these results provide support the notion that institutional investors play an important role in reducing information asymmetry problem associated with evaluation of takeover offers, thus their presence is a determinant of the payment design.

3.4.3. A shock to information environment

To further corroborate our findings on the effect of institutional owners through the information channel, we exploit an exogenous shock to information environment and examine how such a shock affects the role played by institutions in payment method design in takeover deals. An ideal natural experiment would be an event that affects the information available to the target firms' managers and shareholders only, but such an event is not readily available. To our knowledge, Regulation Fair Disclosure (Reg FD) is the only regulatory shock that directly affect the information disclosure and have material effect in mergers and acquisitions context, as stated in the SEC document of Reg FD.[25] Since becoming effective on October 23, 2000, Reg FD prohibited public companies from making selective disclosure of material non-public information to securities professionals and institutional investors. A number of studies find the effectiveness of Reg FD on curtailing information asymmetry problem through an increase in public disclosure (Heflin et al., 2003), improvement in analyst forecast (Irani and Karamanou, 2003), a reduction in price of information disseminated by analysts (Gintschel and Markov, 2004) and levelling the playing field for all market participants rather than selective parties such as analysts and institutional investors (Koch et al., 2013; Leuz and Wysocki, 2016). Thus, we expect that the influence of targets' institutional investors on deal payment structure becomes weaker following the introduction of Reg FD due to the availability of information for other investors of target firms and potential feedback from the public to the deal announcement.

However, an experiment relying on Reg FD has its own problem. Prior literature doc-

[24]Boehmer et al. (2013) find that the short-selling ban's effects are concentrated in large-cap stocks in the period from August 2008 and October 2008.

[25]SEC Final Rule: Selective Disclosure and Insider Trading (`https://www.sec.gov/rules/final/33-7881.htm`)

uments that the intended effect is unwarranted due to the "chilling effect" on information disclosure (Koch et al., 2013). The chilling effect refers to an adverse effect of Reg FD on firm disclosure such as reduction of management forecasts or increase cost of capital, particularly for smaller and high-technology firms (Sidhu et al., 2008; Duarte et al., 2008). The intended goals of Reg FD also might be restricted to large firms (Sidhu et al., 2008; Duarte et al., 2008). Another problem with using this event as a shock to information environment is the existence of other significant contemporaneous events including the crash of the dot-com bubbles followed by the U.S economic recession, the abandon of pooling accounting for business combination directly affecting mergers and acquisitions activity in the US.

In our setting, we expect a stronger effect of Reg FD on reduction of information asymmetry for the low bidder information asymmetry group rather than the high bidder information asymmetry group. The composite proxy for information asymmetry of the bidder provides a way to compensate for this possible effect. Conditioning on the composite proxy of bidder information asymmetry plausibly identifies the treatment and control groups for our test.

[Insert Table 8 here]

Table 8 contains the estimated coefficients from the regressions of fraction of stock payments on the change in target's institutional ownership for the high versus low bidder information asymmetry group in the pre-Reg FD period and post-reg FD. Our results show that the effect of institutional ownership on the fraction of stock is stronger when the information environment between target and bidder are more opaque. The effect of the change in targets' institutional ownership 5-year period before and after the event (1996-2005) is positively significant

To address a concern of the effect of other regulations around the introduction of Reg FD, we also perform a robustness test using the alternative Reg M-A cut-off date. The Reg M-A introduced on January 27, 2000 before the introduction of Reg FD.[26] Results from this robustness check are consistent with the results reported in Table 8. We find that the effect is more pronounced before the enforcement of Reg M-A or Reg FD and especially for the group of high information asymmetric bidders.

Overall, our findings indicate that there is a positive effect of Reg FD on the information environment though its effect is concentrated in the sample of firms that experience relatively lower information asymmetry problem. The test ensures that the effect of institutional owners on fraction of stock remains significant regardless of the change in information environment. Together with the findings in the prior subsections, the findings here support our conjecture of the important role played by targets' institutional

[26]Weil, Gotshal & Manges LLP memorandum on M&A Transactions in a Post-Sarbanes-Oxley Environment (`https://www.weil.com/~/media/files/pdfs/WeilAlert_10-1-04_MA-PostSOXA.pdf`)

investors in assessing information related to bidder firms pre-announcement that allows for larger fraction of stock payments.

3.5. Institutions' post-merger retention of holdings

Our findings so far suggest that targets' institutional investors can greatly influence the probability of stock offers and fraction of stock payments due to their information advantage about the deals. Given that an essential characteristic of stock-related deals is the importance of estimation of the potential combined firms' value and synergy creation, the fact that institutions could end up with a higher number of the merged firms' shares magnifies the need for ex-ante assessment of information about bidder firms. We expect that if the source of information advantage was value-enhancing, institutional owners would act accordingly on their information. If targets' institutional investors utilise their information advantage to influence the higher stock payment structure instead of merely for arbitrage purposes, we would expect those institutions whose holdings in the target firms increased prior to deal announcement should have higher shares retention in the bidder/merged firm ex-post. The first reason is that, in M&As, target shares on average experience the largest abnormal returns at the deal announcement. If target's institution owners did not have an influence on payment design during consideration period given that a large positive pay-off is realised at announcement, we should expect a non-positive relationship between the change in ownership pre-announcement and fraction of stock payments, as well as a non-positive relationship between the change of ownership pre-announcement and ex-post share retention rate. Second, higher fraction of stock payments expose target's institution investors to a higher ex-post valuation risk of bidder/merged firms. The higher retention rates would mean that institutions might assess bidder information ex-ante in order for them to take additional risk.

In this subsection, we examine whether targets' institutional investors process information ex-ante and act accordingly ex-post. For this test, we limit our sample to stock-for-stock deals only and require that institutions own at least 1% of target ownership and do not own bidder shares prior to the deal announcement following Burch et al. (2012). This allows us to investigate the actions taken by targets' institution investors who have relatively strong incentives to carefully evaluate the deal terms.

We then define the post-merger retention rate as the number of bidder shares the institution owns two-quarter after the deal completion date divided by the expected number of shares the institutions would own, based on their ownership of target shares at the latest quarter before announcement and deal exchange ratio (SDC).[27] To account

[27]The "exchange ratio" variable on SDC is the number of new shares per legacy target shares quoted from deal consideration. When there is missing exchange ratio, we extract information from M&A tear sheets as follows: For deals with collar agreements, exchange ratio is determined based on the number of shares issued eventually (Dasgupta et al., 2019). For deals with two-tier stock swap or exchange of

for the possible trading strategies employed by institutions around announcement that affects the retention rates, we also use the pre-merger retention rate for completeness. It is defined as the number of target shares owned at the latest quarter before the date of deal completion divided by the number of target shares owned at the latest quarter before the deal announcement. Burch et al. (2012) discuss that selling activity could already under way before the merger is completed. Pre-merger retention rate is used as a robust measure for the retention rate. One reason is that institutions that do not want to retain shares in the acquirer firm might choose to sell their target shares after announcement but before the effective date because the largest returns on target shares could have been realised at the deal announcement and there is a possibility is that the acquirer's shares might be poorly evaluated after deal completion. The post-merger retention rate cannot capture this effect. We winsorize both retention rate variables at 1^{st} and 99^{th} percentiles.[28]

We define the change in targets' institutional ownership at institution-level as 4-quarter change in institution holdings in a target firm before the date of deal announcement, label as *Change in IO (inst)*. We employ this new variable that is different from the previous measure of the change in firm-level targets' institutional ownership since it allows us to examine those institutions that directly relates to ex-post retention rates.

[Insert Table 9 here]

Results in Table 9 indicate that institutions retain more shares in a bidder/merged firm in stock-for-stock deals after increase their holdings in target firms pre-announcement. Our results suggest that institutions whose holdings increased before announcement and retain more shares ex-post would have a favourable view of the proposed stock deals. Combining with the findings that those institutions also have influence on the higher fraction of stock payments, we provide supportive evidence for the argument that the observed high retention rate association is related to information assessment of target's institutional investors about bidder shares.[29]

To further understand whether the retention decision by institutional owners is based on educative knowledge of the stock-related deals, we examine a relationship between ex-post retention rates and the before-announcement change in target institutions with regards to deal synergies. We expect that if institutions are informative about the

multiple class shares, the exchange ratio remains as missing. Our results are robust to dropping all stock-for-stock deals with missing exchange ratio.

[28]The mean, median and standard deviation are 54% and 0% for post-merger retention rate variable, versus 55% and 54% for pre-merger retention rate respectively in our stock-for-stock deal sample. The summary statistics for retention rates, pre-announcement institutional holdings and institution size are comparable with the results reported in Burch et al. (2012).

[29]In untabulated tests for robustness of our results, we also run regression of the likelihood of ex-post retention on the change in target's institutional ownership (inst) using probit regressions following Burch et al. (2012). The results are consistent with those reported in Table 9.

takeover deal, there would be a positive association between share retentions and pre-announcement holdings in deals with higher synergies. Specifically, we first study the interested relationship in subsamples partitioned by median of three-day announcement combined CARs (cCAR [-1,+1]) (Harford et al., 2011; Brooks et al., 2018). However, one main concern with using cCAR[-1,+1] for testing the impact of institutional investors in our setting is that institutions might merely take an action after observing public info available at t=0, thus it does not require their ability to produce and analyse information during the negotiation process. To address this concern, we also employ long-run operating performance of the merged firms (3-year average change in post-merger returns on assets (ΔROA), 3-year average change in post-merger sales growth (ΔSLG) and 3-year average change in cost of goods sold ratio (ΔCOGS), which is defined as the sum of cost of good sold divided by sales at the beginning of the year (Ghosh, 2001)) as proxies for deal synergies. This allows us to interpret the role of institutional investors in taking such an action in anticipation of the synergy to be created in the following years as it requires institutional investors' ability to do so.

Our findings reveal that shares retention by institutions appears to be informative, that is the positive relationship between the high retention rate and the change in holding ex-ante is significant in the subsample of deals with higher deal synergy, be it a short-term or long-term values. Panel B of Table 9 show that the high share retention rate by institutions in stock-for-stock deals is pronounced in the subsample of deals with better synergy, as proxied by the combined CAR[-1,+1].[30] However, the post-merger retention rate and post-merger performance might to be measured in roughly the same time window. If so, the positive correlation between the two variables seems mechanistic i.e., institutions would buy more shares of a firm at t+1 if its performance is good at t+1. In contrast, the pre-merger retention suffers less from this issue. However, we argue that post-merger retention rate measure is still suitable in our tests based on deal synergy measure. This is because those institutions that had been holding the target firm before the announcement could have sold their shares immediately after the announcement where the largest returns would have been realised, instead of retaining holdings until post-completion. We find that using either of the measures of ex-post retention rates, pre-merger and post-merger retention rates, gives consistent results that when deals are perceived to create synergy by the market, the retention rate by institutions who made the holdings decision ex-ante is higher.

Panel C shows consistent results from regressions of subsample partitioned by the

[30]CAR[-1,+1] are estimated based on the market model. The market model parameters are estimated within the window [-291,-41] prior to the date of the deal announcement. We require that the minimum number of returns observations is 100 in the estimation period (Eckbo et al., 2018). Consistent with prior literature, we observe that on average, the market reacts negatively to stock-deal announced by a public bidder to acquire public target firm (Bouwman et al., 2009), reacts more positively to target shares and negatively to bidder shares at announcement.

long-term post-merger performance of the bidder firms. Our results show that the high retention rate by targets' institutional investors is pronounced in the subsample of firms with high relative increase in the long-run sales growth and returns on assets, thus suggesting that target's institutional investors act on their information about valuation of long-run 'synergy creation' via their ex-post holdings decision. The weak evidence from tests based on the operating expenses show that the high retention rate is pronounced in the subsample of firms with low change in cost of goods sold, which is consistent with our interpretation above. Overall, the ex-post retention rate results show that these institutions do have relevant skills in assessing the value of bidder/merged firm, be it a short-term valuation or a longer-term value measures. These findings further support our conjecture that these target's institutional investors are informed about bidder firms during the consideration process and have influence on fraction of stock payments through their ex-ante information of bidder firms. Moreover, the results on post-merged retention rate are indicative of the possibility of ex-post action taken by the target shareholders had the bidders offered overpriced shares as suggested for future research by Eckbo et al. (2018). In equilibrium, the rational payment method justifies the payment structure when the target is more informed about the bidders through their 'sophisticated' shareholders and when target shareholders are more likely to retained shares in the merged firm.

4. Robustness and further tests

4.1. Does pre-merger cross-holding explain away the effect of institutions on stock payment

Prior literature documents the role played by institutional cross-holding in M&As. Cross-holding in the M&A context occurs when an institutional investor holds the equity ownership of both the target and the bidder firms. Presumably, such cross-holding institutions are likely to have information advantages with regard to a M&A deal in question (Matvos and Ostrovsky, 2008; Harford et al., 2011; Brooks et al., 2018). Therefore, we ensure that the positive effect of target firms' institutional ownership on the fraction of stock payment we find is not an artifact of the effect of institutional cross-holding. If the incremental effect of institutional ownership in the target firm remains significant and robust in estimated magnitude, we can infer that the incremental effect is not subsumed by the effect of institutional cross ownership. To check whether our results stand up to the effect of institutional cross-holding, we employ several measures following prior studies (Matvos and Ostrovsky, 2008; Brooks et al., 2018). Table 10 reports the results of our tobit estimation that accounts for institutional cross-holding. Columns (2)-(4) include the number of top5/10/20 institutional cross owners in both the target and bidder firms. Columns (5) and (6) include measures for target institutional ownership who own bidder shares (ta_cross_IO) and with 1% threshold in holdings on both side of the

deal (ta_cross_IO_1pct). In all cases, we find that the results are similar to our baseline results on stock payment as reported in Panel B of Table 3 for the public bidders sample. Even after controlling for the potential information advantage associated with institutions' cross-holding of both the target and the bidder, the target firms' institutional ownership has a positive and statistically significant effect on the fraction of stock payment in a takeover deal.

[Insert Table 10 here]

4.2. Deal completion, deal synergies and post-merger performances

Our results so far establish a positive relationship between targets' institutional ownership and fraction of stock payment when the information asymmetry is more severe, suggesting that targets' institutional investors play an important role in information production and assessment of bidder firms. To better understand their potential influence on other aspects of the takeover deals, we examine the relationship between targets' institutional ownership and deal completion, deal synergies, as well as post-merger long-term performance in this subsection.

First, we examine the association of targets' institutional ownership and probability of deal completion similar to Officer (2003). We further focus on the sample of stock-for-stock deals where the valuation of bidders' shares is important in order to investigate whether institutional investors have effect on completion probability through their assessment of bidders' shares. For this test, we partition our stock-for-stock deal sample by the median of misvaluation of bidder shares as in Section *4.3.2* to examine the relationship between targets' institutional ownership and completion probability.

[Insert Table 11 here]

Results in Table 11 suggest that institutional investors take action that is beneficial to the target firm, albeit limited scope of the action. We find no significant effect of targets' institutional ownership and deal completion consistent with previous studies (Chen et al., 2007; Fich et al., 2015). Interestingly, our results presented in column (2)-(5) of Table 11 from stock-for-stock deal sample tests show a weak evidence on the negative relationship between change in targets' institutional ownership and deal completion likelihood when the bidders' shares are more relatively misvalued, whereas it is insignificant when the bidders' shares are less misvalued. Thus, our findings suggest that although institutional owners do not actively increase the completion likelihood, their ability to weed out the unfavourable deals is still value-enhancing for the target firm.

Next, we examine the relationship between the change in target's institutional ownership and deal synergies, estimated by the cumulative abnormal returns CARs[-1,+1] of the target, bidder and combined CARs.

[Insert Table 12 here]

Panel A of Table 12 shows that there is no significant relationship between the market reaction to target shares around announcement and the change in targets' institutional ownership for the whole sample or subsample partitioned by payment method. Panel B of Table 12 shows no significant relationship between the market reaction to bidder shares around announcement and the change in targets' institutional ownership. The test on bidder returns gives suggestive evidence against the bidder opportunism. As discussed in Eckbo et al. (2018), if there is evidence for bidder opportunism hypothesis and market-to-book is an appropriate proxy for bidder valuation (Rhodes-Kropf et al., 2005), we should observe its significant negative effect on bidder CAR[-1,+1]. We however do not observe such a significant effect of bidder market-to-book to bidder returns as predicted by bidder opportunism hypothesis of payment method.

We also investigate if targets' institutional owners can create value by influencing deal premium. Acquisition premium is defined as the offer price divided by the target stock price 4-week prior to the announcement date, and limited to 0% and 200% following Officer (2003). Results in panel C of Table 12 shows no significant effect of the target's institutional ownership and deal synergy, which is proxied by the combined CAR[-1,+1] and calculated as the firm market value weighted average of acquirer and target three-day announcement CARs (Harford et al., 2011). Results in Panel D show a consistent results with previous literature that there is no significant effect of the general target's institutional ownership on deal premium.

In untabulated tests, we examine whether targets' institutional owners have the ability to choose deals that perform relatively well in a longer horizon, measured by long-run stock performance and long-run operating performance. If institutional owners had influence on payment structure resulting to a higher fraction of stock offered, we should expect that holding bidder shares is not value-decreasing action. However, we do not observe any significant effect of the change in targets' institutional ownership and post-merger long-run financial performance, measured by 24-month buy-hold bidder returns following Lyon et al. (1999). We also do not find any association between long-run operating performances of bidder firms, measured by the change in returns on assets 24-month post-completion following Healy et al. (1992); Loughran and Ritter (1997), and the change in targets' institutional ownership in the year prior to deal announcement.

Overall, we do not observe any statistically or economically association between targets' institutional ownership and returns and post-merger long-run performances. By inspecting the mechanism through which targets' institutional owners affect the deal structure as in Section *4* and examining the their relationship with other aspects of takeover deals, we find suggestive evidence of the limited scope of action taken by these investors. These findings are consistent with general consensus about the effect and the

extent to which general institutional investors affect portfolio firms.[31]

4.3. Types of targets' institutional owners that exert influence on deal payment structure

Institutional owners are not homogenous and thus their influence on the portfolio firms can vary greatly. Prior studies have documented evidence that the monitoring behaviour is most pronounced for institutions with largest holdings, low turn-over rate (Chen et al., 2007; Gaspar et al., 2005), institutions whose holdings in the target firm account for a significant proportion of institution portfolio value (Fich et al., 2015). In our setting, we expect that institutions with largest motivation to monitor the target would show strongest effect on the fraction of stock payments through the informational channel. That is, institutions with important stake in the target firm should have the highest incentive to value the offer made by the bidder. To investigate this heterogeneous effect of institutional investors, we classify institutional ownership into several types. Our measure for *Monitoring institutional ownership* is defined as the ownership by institutions whose holdings in the target firm is in the top 10% of their portfolio Fich et al. (2015). We also examine the interested effect each of institutional type of institutional owners following (Bushee, 1998). *Quasi-indexer institutions* are long horizon, low portfolio turnover, and highly diversified investors; *Dedicated institutions* are characterized as having concentrated portfolio holdings and low turnover; and *Transient institutions* are those holding diversified portfolios and with high turnover ratios.[32]. We also examine the effect of institutional ownership of the largest (*top1 IO*), five-largest institutional investors (*top5 IO*), independent institutions and blockholder institutions following Chen et al. (2007).

[Insert Table 13 here]

Results in Table 13 show that institutions with highest incentive to monitor enhance the target's ability to value bidder shares the most, thus positively affect fraction of stock payment. In addition to that, they need not to be the most concentrated group in the target firms.[33] We find the monitoring institutions, top5 and independent institutions are among the type of institutions who have influence on the design of payment structure. Interestingly, we also find that passive institutional investors, as measured by quasi-indexer ownership also influence the payment structure through their information advantage in

[31]Fich et al. (2015) find the limited value-enhancing effect of general institutional investors or blockholders in the target firms on the merger performances. Our results align with the finding that trading of all institutions does not associated with positive abnormal returns (Bennett et al., 2003)

[32]We thank Brian Bushee for providing institutional investor classification data on his website. See `http://acct.wharton.upenn.edu/faculty/bushee/IIclass.html`

[33]Monitoring institutions as defined in (Fich et al., 2015) measure the fraction of institution's portfolio represented by a target firm, instead of the conventional measure of institutional ownership by fraction of the firm held by institutions. Thus, these institutions do not necessarily have concentrated holdings from the target firm point of view.

influential events like M&A, suggesting that these institutions might be motivated enough to get involved with corporate decisions when it is needed the most (Appel et al., 2016; Crane et al., 2016; Boone and White, 2015). One concern is that the relationship between targets' institutional ownership, particularly passive ownership and fraction of stock payment might be merely driven by high target ownership dispersion. In untabulated tests which control for ownership dispersion, we find that even though institutional ownership dispersion is significantly associated with fraction of stock payment at 10% significance level, the positive effect of targets' institutional ownership on fraction of stock payment remain significant and similar in magnitude of estimates.[34]

4.4. Effect of hedge fund activism

One concern with our findings of the effect of the change in target's institutional investors on takeover likelihood and stock payments is that the observed effect could be a by-product of activist campaigns. Many studies on hedge fund activism find that activists pursue certain firms because they anticipate that those firms will be soon acquired (Greenwood and Schor, 2009; Brav et al., 2008; Boyson et al., 2017). Hedge fund activists hold concentrated ownership in the target firms in order to influence boards of directors, managers and consequently corporate policies. Hedge fund activism generates significantly positive abnormal returns for target firms around deal announcement (Brav et al., 2008; Greenwood and Schor, 2009; Boyson et al., 2017).[35] However, our findings on the effect of the change in targets' ownership on stock takeover likelihood (and fraction of stock payments) is mostly consistent with that of the quasi-index ownership rather than dedicated or transient ownership (who are much more likely be activist investors).[36] We do not observe the significant effect of the change in total institutional ownership on announcement returns or long-run post-merger returns as shown in section *6.3*.

In addition to that, hedge fund activism has a positive effect on deal completion (Boyson et al., 2017) or generates positive returns when they are able to effect in deal completion (Greenwood and Schor, 2009). Instead of a positive effect of the increase in institution owners on deal completion, we observe that the increase in ownership has a more 'passively' positive effect on the target firms i.e. a reduction in completion of deals where bidder are overvalued as shown in Table 10. Our collective evidence assuages the

[34]Institutional ownership dispersion is calculated as institutional ownership concentration multiplied by (-1). The IO concentration is proxied by Herfindahl-Hirschman index of institutional ownership following Luis Palacios, Rabih Moussawi, and Denys Glushkov (2009)

[35]Brav et al. (2008) find that activism in targets firm leads to an average target CAR[-20,+20] of 7% - 8% for the period 2000-2006. Boyson et al. (2017) reports an average target CAR[]-25,+5] ranges between 17.1% - 43.4 % for the sample from 2000 to 2012. Greenwood and Schor (2009) shows an average CARs of at least 15% across various activism type

[36]Brav et al. (2008) find that hedge fund activists hold target firms for about 12-20 months and with initial concentrated ownership at a median of more than 6%. These are not characteristics of quasi-indexer institutions as classified by Bushee (1998)

concern that hedge fund activism drives our observed findings.

5. Conclusion

This study investigates the role played by institutional investors in mergers and acquisition setting. We find that firms have higher likelihood of receiving stock-related takeover bids following the change in institutional ownership. We find the increase in targets' institutional ownership is associated with higher fraction of stock payments and this effect is pronounced where the information asymmetry problem between a target and a bidder is more severe. We support the causal relationship from IV estimation using Russell index reconstitutions and the change in ranking based on the end-of-May market capitalisation as instruments.

To understand the economic mechanisms through which institutional owners influence the payment design, we perform the cross-section analyses associated with asymmetric information about the bidders and valuation of bidder shares prior to the deal announcement. Our results show that the positive relationship between a target's institutional ownership and a stock-based offer is pronounced when the information asymmetry problem is more severe. Additional analysis finds that the positive association between institutional ownership and fraction of stock is stronger when the bidder's shares–the currency of the transaction–are correctly priced. Our findings on ex-post retention rates by targets' institutional owners in relation to deal synergy reveals that those investors have the capacity and motivation to acquire and process information about bidder's values. The results further support our conjecture that the increase in presence of these institutional investors enhance a target's ability to more accurately value a bidder and lessen the information asymmetry problem inherent in a takeover deal, thus allow for higher fraction of stock payment. Thus, our study complements the line of literature on stock acquisitions by providing evidence to support the rational payment hypothesis, as well as identify that the targets' institutional ownership an important determinant of optimal payment structure design.

We also find that this incremental effect of targets' institutional ownership on payment design is not subsumed by cross institutional ownership between target and bidder firms. However, their influence appears to be limited on many other aspects of takeover deals such as deal premium or completion, possibly explained by the cost-benefit framework that institutional investors adhere to. Consistent with prior literature on the heterogeneous effect of institutional ownership, we indeed find that institutions with the relatively high incentive to engage in information production and assessment in takeover deals do so. Taken together, our evidence lends support for the notion that institutional investors play an important role when needed, particularly in alleviating information asymmetry in takeover transactions and assessing the associated values.

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Figure 1 – The activity and payment methods of M&A deals over years
The number of bids and distribution across payment methods for the sample of 3,236 takeover bids for U.S public targets by U.S bidders for the period 1984-2017. Both targets and bidders are non-financial and non-utility firms and the target firms have institutional ownership reported on 13F.

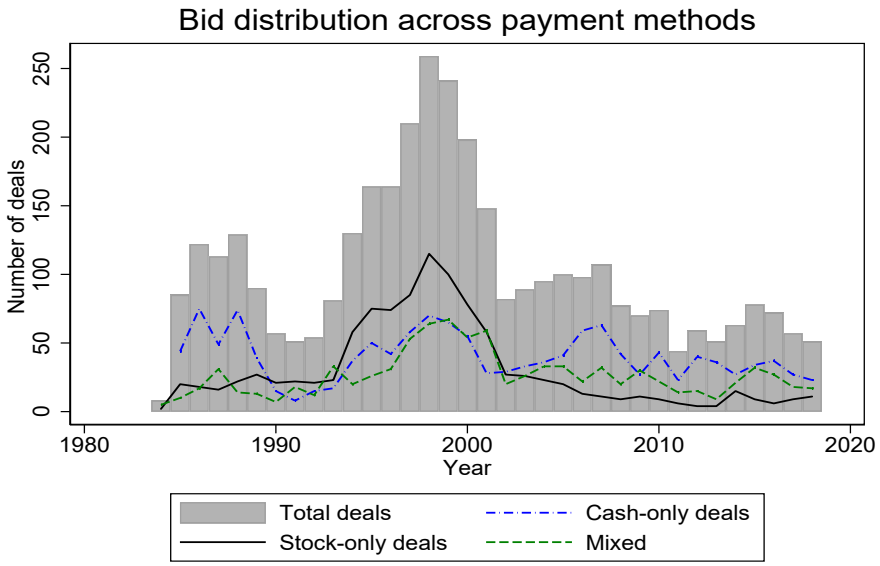


Figure 2 – Times-series variations of institutional ownership
The times-series of total institutional ownership and by type for the sample of 3,236 takeover bids for U.S public targets by U.S bidders for the period 1984-2017. Both targets and bidders are non-financial and non-utility firms and the target firms have institutional ownership reported on 13F.

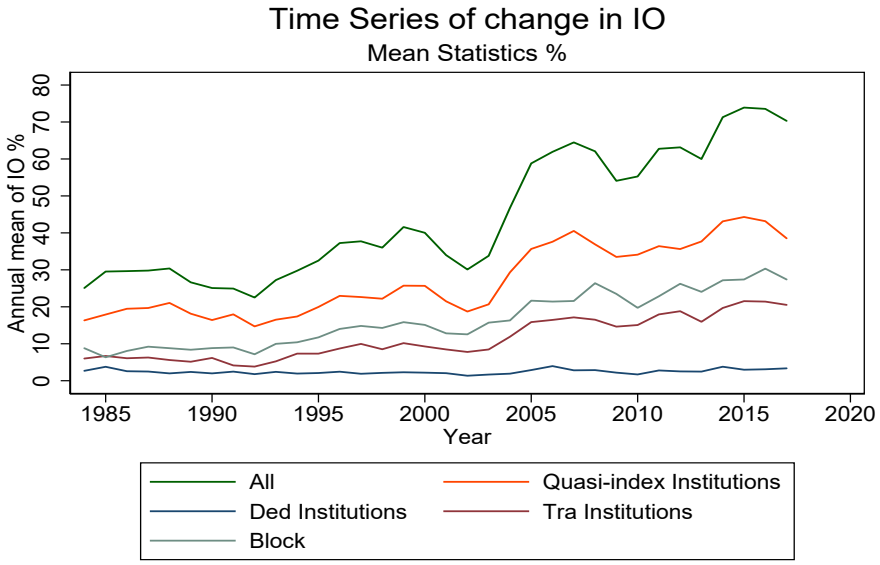
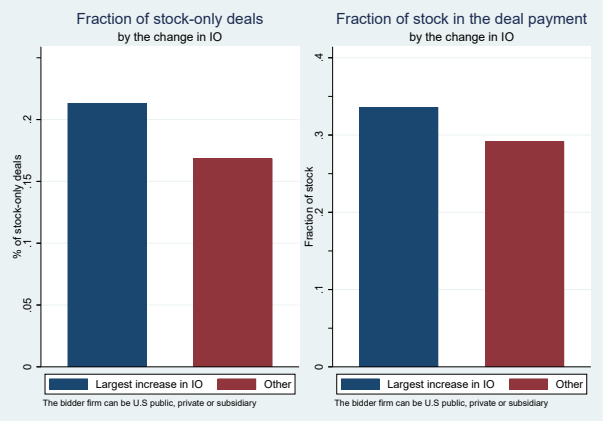
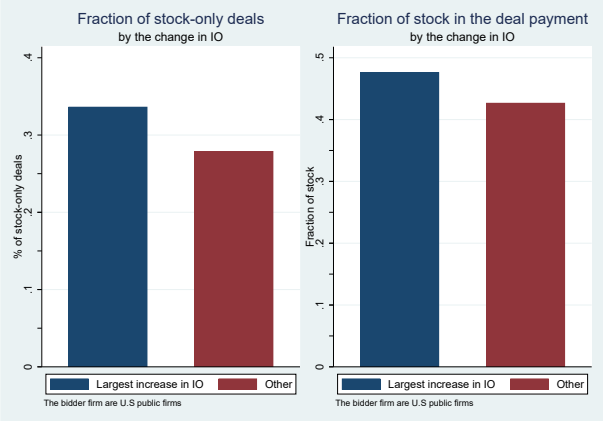


Figure 3 – Distribution of stock deals and stock payment

The figure shows the fraction of stock-only deals and the fraction of stock in deal payment when comparing the fifth quintile versus other quintiles of the change in institutional ownership. Figure 3(a) presents the sample where the bidder can be U.S public, private or subsidiary. Figure 3(b) presents the distribution for the sample where the bidder is U.S public firm only.



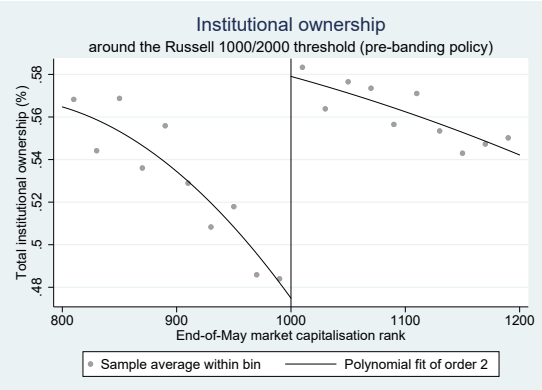
(a) Bidders are public, private & subsidiaries



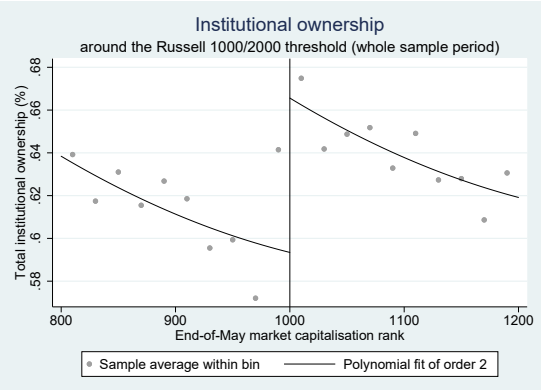
(b) Bidders are public firms

Figure 4 – Russell 1000/2000 Reconstitutions as instruments for IV estimation

Panel A of this figure shows the total institutional ownership around the Russell 1000/2000 threshold. Stocks to the left of the threshold line are members of the Russell 1000 and stocks to the right are of the threshold line members of Russell 2000. The graphs display the function form and a fitted regression curve of institutional ownership for the firms around the threshold. Figure 4A (a) and (b) present the distribution of institutional ownership for firms around the Russell 1000/2000 threshold in the pre-banding policy period (1984-2007) and the whole sample period (1984-2018), respectively.



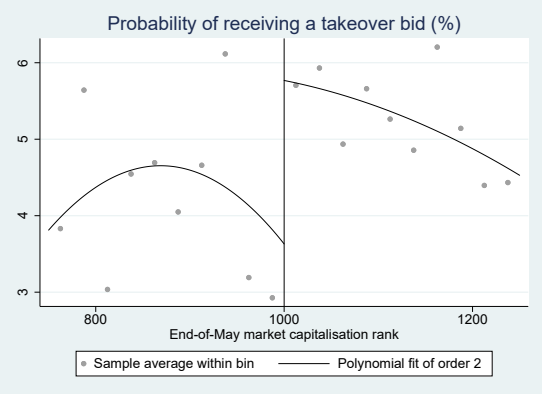
(a) Pre-banding policy sample



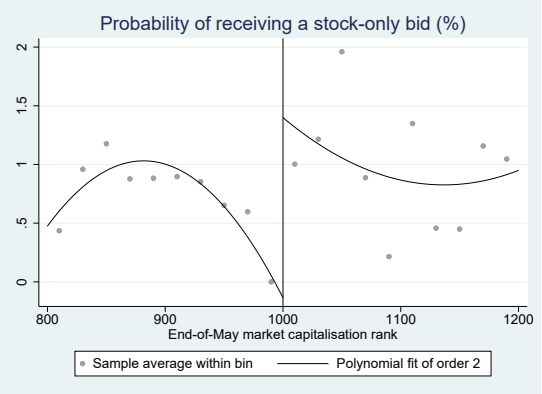
(b) Whole sample

Figure 4 – Russell 1000/2000 Reconstitutions as instruments for IV estimation (continue)

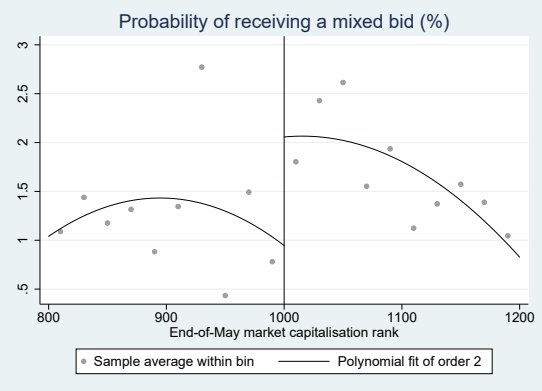
Panel B of this figure shows the probability that a firm receives a takeover bid and a specific type of payment method bid in the following year after the Russell 1000/2000 reconstitutions. Stocks to the left of the threshold line are members of the Russell 1000 and stocks to the right are of the threshold line members of Russell 2000. The graphs display the function form and a fitted regression curve of the takeover likelihood and type of payment likelihood for the firms around the threshold, without control variable for deal, target and/or bidder characteristics. Figure 4B (a), (b), (c) and (d) presents the probability of receiving a takeover bid, probability of receiving a stock-only bid, probability of receiving a mixed-payment bid and the probability of receiving a cash-only bid, respectively, for the whole sample period (1984-2018).



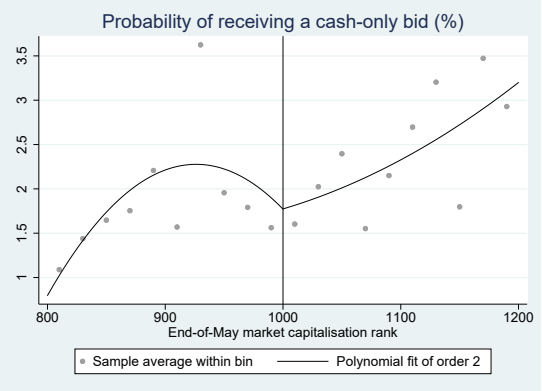
(a) Takeover bid



(b) Stock-only bid



(c) Mixed-payment bid



(d) Cash bid

Table 1 – Summary statistics

This table presents the summary statistics of the variables used in our analysis. Panel A shows the variables used in the takeover probability models for the panel sample of 110,983 firm-year observations of U.S. public firms. Panel B shows various deal, target, or bidder characteristics for the sample of 3,236 M&A bids in which the deal value is no less than $1 million and both targets and bidders are U.S. public firms. All variables are defined in Appendix B.

Panel A: Panel sample

	N	Mean	p25	Median	p75	S.D.
Change in total IO	110983	0.016	−0.023	0.005	0.051	0.096
Size	110983	5.256	3.715	5.125	6.684	2.108
Tobin's Q	110983	1.983	1.087	1.450	2.193	1.601
Leverage	110983	0.179	0.004	0.124	0.288	0.195
Cash flow	110983	0.001	−0.004	0.071	0.119	0.250
R&D	110983	0.054	0.000	0.002	0.063	0.104
Sale growth	110983	0.188	−0.028	0.082	0.237	0.574
Return on assets	110983	0.053	0.027	0.107	0.167	0.226
Compounded excess return	110983	0.121	0.016	0.148	0.238	0.161
Industry acquisition [0;1]	110983	0.039	0.000	0.000	0.000	0.195
Growth-resource mismatch [0;1]	110983	0.330	0.000	0.000	1.000	0.470

Panel B: M&A sample

	N	Mean	p25	Median	p75	S.D.
Deal characteristics						
Cash-only deals [0;1]	3236	0.396	0.000	0.000	1.000	0.489
Stock-only deals [0;1]	3236	0.300	0.000	0.000	1.000	0.458
Hostile deal [0;1]	3236	0.095	0.000	0.000	0.000	0.294
Target termination fee [0;1]	3236	0.592	0.000	1.000	1.000	0.492
Competed Bid [0;1]	3236	0.116	0.000	0.000	0.000	0.321
Tender offer [0;1]	3236	0.239	0.000	0.000	0.000	0.426
Same industry [0;1]	3236	0.378	0.000	0.000	1.000	0.485
Relative size	3236	0.387	0.064	0.186	0.474	0.614
% of stock	3236	0.459	0.000	0.395	1.000	0.449
Completion [0;1]	3236	0.821	1.000	1.000	1.000	0.384
Target characteristics						
Size	3236	5.379	4.082	5.218	6.571	1.794
Market-to-book	3236	2.886	1.187	1.947	3.300	4.448
Leverage	3236	0.191	0.004	0.134	0.314	0.206
Cash flow	3236	0.016	0.008	0.074	0.119	0.220
R&D	3236	0.063	0.000	0.006	0.086	0.108
Bidder characteristics						
Size	3236	6.949	5.508	6.985	8.353	2.078
Market-to-book	3236	3.760	1.621	2.512	4.140	4.934
Leverage	3236	0.200	0.034	0.167	0.300	0.185
Cash flow	3236	0.066	0.047	0.090	0.132	0.140
R&D	3236	0.042	0.000	0.006	0.058	0.068

Table 2 – Target firms' institutional ownership and the takeover likelihood

Panel A presents estimates from logistic regressions that examine the likelihood of becoming a target for a sample of US public target firms by US public, private or subsidiary bidder firms (5556 deals announced in the period 1984-2017). The dependent variable equals zero if the firm did not receive takeover bid in a given year, one if is a target, once or multiple times in a given year. Panel B presents estimates from multinomial logistic regressions that examine the likelihood of cash-only, mixed and stock-only deals for a sample of US public target firms by US public, private or subsidiary bidder firms. This was based on a sample of 3,301 cash-only deals, 1,088 mixed deals and 1,167 stock-only deals for the period 1984-2017. The dependent variable in Panel B takes a value of zero if the firm did not receive takeover bid in a given year, one if received cash-only deals, two if received mixed deals and three if received stock-only deals. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. Standard errors are clustered at the firm level. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Likelihood of receiving a takeover bid

	(1)	(2)	(3)
Change in total IO	0.300*	0.298*	0.266*
	(0.066)	(0.065)	(0.093)
Size	−0.007	−0.006	0.002
	(0.339)	(0.526)	(0.858)
Tobin's Q	−0.169***	−0.192***	−0.187***
	(0.000)	(0.000)	(0.000)
Leverage	0.406***	0.222***	0.250***
	(0.000)	(0.007)	(0.002)
Cash flow	−0.613***	−0.526***	0.250***
	(0.000)	(0.000)	(0.003)
R&D	1.473***	1.806***	1.514***
	(0.000)	(0.000)	(0.000)
Sale growth	−0.022	−0.072**	
	(0.405)	(0.011)	
Return on assets	1.184***	1.128***	
	(0.000)	(0.000)	
Compounded excess return	0.501***	0.218	
	(0.000)	(0.224)	
Industry acquisition [0;1]	0.305***	0.097**	
	(0.000)	(0.015)	
Growth-resource mismatch [0;1]	0.069**	0.035	
	(0.021)	(0.252)	
Average marginal effect			
Change in total IO	0.014*	0.013*	0.012*
	(0.066)	(0.065)	(0.093)
Industry & Year FE	No	Yes	Yes
Number of deals	5556	5556	5556
Number of firm-year	110983	110983	110983
Pseudo R^2	0.01	0.03	0.03

Table 2 – Target institutional ownership and takeover likelihood (continue)

Panel B: Takeover likelihood by payment methods

	All-cash		**Mixed**		**All-stock**	
Change in total IO	0.373	0.324	0.115	0.080	0.641*	0.666**
	(0.103)	(0.157)	(0.750)	(0.825)	(0.074)	(0.046)
Size	−0.023**	−0.056***	0.165***	0.192***	−0.063***	0.011
	(0.014)	(0.000)	(0.000)	(0.000)	(0.000)	(0.544)
Tobin's Q	−0.344***	−0.400***	−0.181***	−0.181***	−0.008	−0.036*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.696)	(0.075)
Leverage	0.197*	0.247**	1.306***	0.857***	−0.240	−0.472**
	(0.078)	(0.030)	(0.000)	(0.000)	(0.178)	(0.012)
Cash flow	−0.578***	−0.509***	−0.900***	−0.815***	−0.585**	−0.311
	(0.001)	(0.003)	(0.002)	(0.003)	(0.032)	(0.248)
R&D	2.015***	2.472***	0.203	1.363**	2.176***	1.934***
	(0.000)	(0.000)	(0.717)	(0.020)	(0.000)	(0.000)
Sale growth	−0.249***	−0.266***	0.083	−0.044	0.201***	0.105**
	(0.000)	(0.000)	(0.137)	(0.472)	(0.000)	(0.011)
Return on assets	1.837***	1.982***	0.941**	0.966***	1.137***	0.644**
	(0.000)	(0.000)	(0.016)	(0.009)	(0.000)	(0.035)
Compounded excess return	0.404***	0.319	0.676***	0.332	1.009***	0.283
	(0.001)	(0.183)	(0.001)	(0.454)	(0.000)	(0.459)
Industry acquisition [0;1]	0.340***	0.134	0.046	−0.121	0.340***	−0.010
	(0.000)	(0.138)	(0.778)	(0.466)	(0.008)	(0.940)
Growth-resource mismatch [0;1]	0.105***	0.083**	0.199***	0.132**	−0.048	−0.112*
	(0.009)	(0.040)	(0.003)	(0.047)	(0.466)	(0.091)
Average marginal effect (robust SE)						
Change in total IO	0.010	0.009	0.001	0.001	0.006*	0.007**
	(0.110)	(0.166)	(0.787)	(0.865)	(0.080)	(0.049)
Industry & Year FE	No	Yes	No	Yes	No	Yes
Number of deals	3301	3301	1088	1088	1167	1167
Number of firm-year	110983	110983	110983	110983	110983	110983
Likelihood ratio	15297.02	15297.78	15348.66	15343.73	15297.02	15297.78

Table 3 – Target institutional ownership and the payment structure

This table presents estimates from the multinomial logit regressions for the payment method for two samples: bidders are public, private firms or subsidiaries and a sample in which bidders are public firms only, and estimates from Tobit regressions for the fraction of stock offered. For the multinomial logit regressions, the dependent variables takes value of zero if bids are cash-only (baseline), equal to one if mixed deals and two if stock deals. The last two columns of this table present estimates from Tobit regressions of the change in target's institutional ownership on the fraction of stock in the deal consideration for the sample of public, private or subsidiary bidders (Bidder=[Pub,Pri,Sub]), and the sample of public-only bidders (Bidder =[Public]). All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	Multinomial logit regression				Tobit regression	
	Bidder= [Pub,Pri,Sub]		Bidder= [Public]		Bidder= [Pub,Pri,Sub]	Bidder= [Public]
	Mixed	Stock-only	Mixed	Stock-only		
Institutional ownership						
Change in total IO	0.114	0.896**	−0.009	1.092**	0.109**	0.146***
	(0.766)	(0.023)	(0.986)	(0.041)	(0.016)	(0.010)
Deal characteristics						
Hostile deal [0;1]	-0.345***	-1.164***	−0.773***	−1.680***	−0.104***	−0.179***
	(0.010)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Target termination fee [0;1]	0.411***	0.359***	0.380***	0.312**	0.053***	0.038**
	(0.000)	(0.000)	(0.008)	(0.032)	(0.000)	(0.016)
Competed Bid [0;1]	-0.108	-0.940***	−0.261	−0.786***	−0.084***	−0.073***
	(0.353)	(0.000)	(0.138)	(0.000)	(0.000)	(0.000)
Tender offer [0;1]	-1.576***	-3.723***	−2.146***	−3.945***	−0.327***	−0.437***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Same industry [0;1]	0.814***	0.839***	0.228*	0.115	0.109***	0.010
	(0.000)	(0.000)	(0.053)	(0.344)	(0.000)	(0.438)
Relative size			0.159	0.003		−0.026**
			(0.186)	(0.983)		(0.042)
Target characteristics						
Size	0.414***	0.192***	0.601***	0.517***	0.025***	0.058***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book	0.031***	0.058***	0.039***	0.064***	0.008***	0.006***
	(0.002)	(0.000)	(0.006)	(0.000)	(0.000)	(0.000)
Leverage	0.256	-1.022***	0.116	−1.293***	−0.116***	−0.168***
	(0.228)	(0.000)	(0.707)	(0.000)	(0.000)	(0.000)
Cash flow	-0.831***	-0.838***	−0.420	−0.292	−0.122***	−0.025
	(0.001)	(0.000)	(0.252)	(0.415)	(0.000)	(0.501)
R&D	0.964	1.186**	0.192	0.550	0.187***	0.087
	(0.135)	(0.032)	(0.839)	(0.535)	(0.005)	(0.349)
Bidder characteristics						
Size			−0.366***	−0.440***		−0.053***
			(0.000)	(0.000)		(0.000)
Market-to-book			0.008	0.036***		0.004***
			(0.559)	(0.010)		(0.007)
Leverage			0.008	−0.468		−0.060
			(0.980)	(0.184)		(0.115)
Cash flow			−2.591***	−3.164***		−0.265***
			(0.000)	(0.000)		(0.000)
R&D			1.591	2.207		0.197
			(0.274)	(0.110)		(0.134)
Industry & Year FE		Yes		Yes	Yes	Yes
N		5706		3236	5706	3236
Pseudo R^2		0.251		0.310	0.348	0.455

Table 4 – IV estimation using Russell index reconstitution

Panel A of this table presents the instrumental variable (IV) regression results of the takeover probability on the change in fraction of firms' institutional ownership. Panel B of this table presents the instrumental variable (IV) regression results of the stock-bid probability on the change in fraction of firms' institutional ownership. The instrumental variables employed are dummy variables indicating the switch between the Russell 1000 and Russell 2000 indices from year *(t-1)* to *t*, first and second polynomial order of the change in ranking based on end-of-May market capitalisation from year *(t-1)* to *t*. We also control for the end-of-May market capitalisation (*ln(end-of-May market capitalisation)*). The definitions of explanatory variables are reported in the Appendix A. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Likelihood of receiving a takeover bid

	Full sample		**Pre-Banding policy**	
	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage
Change in total IO		0.113**		0.105*
		(0.042)		(0.073)
$Russell1000_{t-1} \rightarrow Russell2000_t$	0.021***		0.019***	
	(0.000)		(0.000)	
$Russell2000_{t-1} \rightarrow Russell1000_t$	−0.033***		−0.031***	
	(0.000)		(0.000)	
$\Delta_{(Rank_{t-1} \rightarrow Rank_t)}$	0.004***		0.004***	
	(0.000)		(0.000)	
$\Delta^2_{(Rank_{t-1} \rightarrow Rank_t)}$	0.000***		0.000***	
	(0.000)		(0.000)	
$\ln(mktcap_{end-of-May,t})$)	−0.004***	−0.005***	−0.008***	−0.008***
	(0.000)	(0.000)	(0.000)	(0.000)
D.Size	0.043***	−0.016***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)	(0.008)
Tobin's Q	0.008***	−0.006***	0.011***	−0.006***
	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	−0.002	0.014***	−0.003	0.005
	(0.339)	(0.002)	(0.316)	(0.420)
Cash flow	0.055***	−0.015	0.081***	−0.031**
	(0.000)	(0.120)	(0.000)	(0.011)
R&D	0.003	0.045***	−0.016**	0.044***
	(0.652)	(0.001)	(0.039)	(0.008)
Sale growth	0.002**	0.000	0.012***	−0.004**
	(0.012)	(0.916)	(0.000)	(0.047)
Return on assets	−0.012**	0.029***	−0.012*	0.039***
	(0.010)	(0.005)	(0.054)	(0.001)
Compounded excess return	0.012**	0.015	−0.008	0.006
	(0.011)	(0.170)	(0.178)	(0.656)
Industry acquisition [0;1]	0.002	0.003	−0.003**	0.009***
	(0.358)	(0.482)	(0.025)	(0.004)
Growth-resource mismatch [0;1]	−0.003***	0.003*	−0.001	0.004*
	(0.000)	(0.069)	(0.118)	(0.051)
Industry & Year FE	Yes	Yes	Yes	Yes
N	73712	73712	53547	53547
Adjusted R^2		0.01		0.01
Weak-instrument test: H0 = weak instrument				
Kleibergen-Paap F-stat		275.197		268.971
Overidentifying restrictions test: H0 = overidentifying restriction is valid				
Hansen-J p-value		0.643		0.466
Endogenity test: H0 = variables are exogenous				
Wu-Hausman F-stat		3.128		3.333
		(p=0.077)		(p=0.068)

Table 4 – IV estimation using Russell index reconstitution (continue)

Panel B: Likelihood of receiving a stock takeover bid

	Full sample		**Pre-Banding policy**	
	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage
Change in total IO		0.062*		0.085**
		(0.055)		(0.050)
$Russell1000_{t-1} \rightarrow Russell2000_t$	0.021***		0.021***	
	(0.000)		(0.000)	
$Russell2000_{t-1} \rightarrow Russell1000_t$	−0.033***		−0.031***	
	(0.000)		(0.000)	
$\Delta_{(Rank_{t-1} \rightarrow Rank_t)}$	0.004***		0.003***	
	(0.000)		(0.000)	
$\Delta^2_{(Rank_{t-1} \rightarrow Rank_t)}$	0.000***		0.000***	
	(0.000)		(0.008)	
$\ln(mktcap_{end-of-May,t})$	−0.004***	−0.001**	−0.004***	−0.001**
	(0.000)	(0.016)	(0.000)	(0.033)
D.Size	0.043***	−0.003	0.042***	−0.003
	(0.000)	(0.251)	(0.000)	(0.464)
Tobin's Q	0.008***	−0.001	0.009***	−0.001
	(0.000)	(0.185)	(0.000)	(0.152)
Leverage	−0.002	−0.004**	0.000	−0.008***
	(0.382)	(0.026)	(0.996)	(0.003)
Cash flow	0.055***	−0.005	0.052***	−0.006
	(0.000)	(0.389)	(0.000)	(0.388)
R&D	0.003	0.020***	−0.008	0.035***
	(0.682)	(0.008)	(0.296)	(0.002)
Sale growth	0.002**	0.003**	0.003***	0.002
	(0.039)	(0.021)	(0.008)	(0.176)
Return on assets	−0.012**	0.003	0.001	0.005
	(0.026)	(0.537)	(0.887)	(0.471)
Compounded excess return	0.012***	0.004	−0.012**	0.006
	(0.008)	(0.310)	(0.038)	(0.299)
Industry acquisition [0;1]	0.002	−0.001	0.002	−0.002
	(0.410)	(0.706)	(0.472)	(0.554)
Growth-resource mismatch [0;1]	−0.003***	−0.002***	−0.003***	−0.003***
	(0.000)	(0.003)	(0.002)	(0.004)
Industry & Year FE	Yes	Yes	Yes	Yes
N	73712	73712	51254	51254
Adjusted R^2		0.01		0.01
Weak-instrument test: H0 = weak instrument				
Kleibergen-Paap F-stat		275.197		268.971
Overidentifying restrictions test: H0 = overidentifying restriction is valid				
Hansen-J p-value		0.114		0.109
Endogenity test: H0 = variables are exogenous				
Wu-Hausman F-stat		3.447		3.689
		(p=0.0634)		(p=0.0548)

Table 5 – IV estimation using Russell index reconstitution for stock payment probability

Panel A of this table presents the instrumental variable regression results of the stock-deal probability on the change in fraction of firms' institutional ownership. Panel B presents the instrumental variable regression results of fraction of stock in the deal payment on the change in fraction of firms' institutional ownership. The instrumental variables employed are dummy variables indicating the switch between the Russell 1000 and Russell 2000 indices from year *(t-1)* to *t*, first and second polynomial order of the change in ranking based on end-of-May market capitalisation from year *(t-1)* to *t* and a control variable for the market capitalisation (*ln(end-of-May market capitalisation)*). All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Stock takeover likelihood

	Full sample		**Pre-Banding policy**	
	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage
Change in total IO		0.867***		1.132***
		(0.009)		(0.004)
$Russell1000_{t-1} \rightarrow Russell2000_t$	0.005		0.008	
	(0.705)		(0.540)	
$Russell2000_{t-1} \rightarrow Russell1000_t$	−0.022**		−0.026**	
	(0.032)		(0.019)	
$\Delta_{(Rank_{t-1} \rightarrow Rank_t)}$	0.005***		0.004***	
	(0.000)		(0.000)	
$\Delta^2_{(Rank_{t-1} \rightarrow Rank_t)}$	0.000		0.000	
	(0.258)		(0.464)	
$\ln(mktcap_{end-of-May,t})$	0.007**	0.032***	0.010***	0.035***
	(0.014)	(0.001)	(0.003)	(0.007)
Deal Characteristics				
Hostile deal [0;1]	−0.001	−0.094***	0.002	−0.094***
	(0.784)	(0.000)	(0.731)	(0.000)
Target termination fee [0;1]	0.012***	0.007	0.011**	0.021
	(0.006)	(0.651)	(0.019)	(0.215)
Competed Bid [0;1]	0.000	−0.055***	0.000	−0.051***
	(0.933)	(0.000)	(0.969)	(0.001)
Tender offer [0;1]	−0.006	−0.213***	−0.009**	−0.236***
	(0.130)	(0.000)	(0.038)	(0.000)
Same industry [0;1]	0.008**	0.060***	0.003	0.057***
	(0.036)	(0.000)	(0.455)	(0.000)
Target Characteristics				
Size	−0.011***	−0.029***	−0.016***	−0.026*
	(0.000)	(0.009)	(0.000)	(0.077)
Market-to-book	0.002***	0.002	0.002***	0.003
	(0.000)	(0.325)	(0.002)	(0.141)
Leverage	0.007	−0.068**	0.013	−0.113***
	(0.461)	(0.034)	(0.300)	(0.009)
Cash flow	0.056***	−0.056	0.060***	−0.037
	(0.000)	(0.215)	(0.000)	(0.517)
R&D	−0.041	0.292***	−0.129***	0.637***
	(0.170)	(0.004)	(0.000)	(0.000)
Industry & Year FE	Yes	Yes	Yes	Yes
N	4304	4304	3236	3236
Adjusted R^2		0.161		0.182
Weak-instrument test: H0 = weak instrument				
Kleibergen-Paap F-stat		19.593		14.948
Endogenity test: H0 = variables are exogenous				
Wu-Hausman F-stat		8.199		6.503
		(p=0.004)		(p=0.011)

Table 5 – IV estimation using Russell index reconstitution for stock payment (continue)

Panel B: Likelihood of receiving a stock takeover bid

	Full sample		**Pre-Banding policy**	
	1^{st} stage	2^{nd} stage	1^{st} stage	2^{nd} stage
Change in total IO		0.522*		0.712**
		(0.082)		(0.042)
$Russell1000_{t-1} \rightarrow Russell2000_t$	−0.003		0.002	
	(0.839)		(0.884)	
$Russell2000_{t-1} \rightarrow Russell1000_t$	−0.025**		−0.025**	
	(0.016)		(0.029)	
$\Delta_{(Rank_{t-1} \rightarrow Rank_t)}$	0.005***		0.004***	
	(0.000)		(0.000)	
$\Delta^2_{(Rank_{t-1} \rightarrow Rank_t)}$	0.000		0.000	
	(0.252)		(0.394)	
$\ln(mktcap_{end-of-May,t})$	0.007**	0.052***	0.010***	0.061***
	(0.013)	(0.000)	(0.003)	(0.000)
Deal Characteristics				
Hostile deal [0;1]	0.002	−0.120***	0.005	−0.120***
	(0.676)	(0.000)	(0.355)	(0.000)
Target termination fee [0;1]	0.011***	0.025*	0.011**	0.047***
	(0.009)	(0.081)	(0.022)	(0.005)
Competed Bid [0;1]	0.000	−0.069***	0.000	−0.058***
	(0.943)	(0.000)	(0.969)	(0.000)
Tender offer [0;1]	−0.007*	−0.316***	−0.011**	−0.357***
	(0.062)	(0.000)	(0.017)	(0.000)
Same industry [0;1]	0.008**	0.110***	0.004	0.116***
	(0.034)	(0.000)	(0.412)	(0.000)
Target Characteristics				
Size	−0.012***	−0.020*	−0.017***	−0.025*
	(0.000)	(0.078)	(0.000)	(0.089)
Market-to-book	0.002***	0.003**	0.002***	0.006***
	(0.000)	(0.048)	(0.009)	(0.006)
Leverage	0.010	−0.017	0.015	−0.042
	(0.336)	(0.614)	(0.255)	(0.342)
Cash flow	0.055***	−0.096**	0.063***	−0.079
	(0.000)	(0.031)	(0.000)	(0.140)
R&D	−0.048	0.256***	−0.135***	0.481***
	(0.120)	(0.007)	(0.000)	(0.000)
Industry & Year FE	Yes	Yes	Yes	Yes
N	4036	4036	3010	3010
Adjusted R^2		0.320		0.354
Weak-instrument test: H0 = weak instrument				
Kleibergen-Paap F-stat		19.001		13.721
Endogenity test: H0 = variables are exogenous				
Wu-Hausman F-stat		2.428		2.865
		(p=0.119)		(p=0.091)

Table 6 – Informational asymmetry of bidders and between bidders and targets
This table presents results of subsample analyses using on the proxies of information asymmetry for bidders and between target and bidder firms. The dependent variable is the fraction of stock payment in the deal consideration. Panel A presents the results from the subsample estimation partitioned by the median of the composite proxy of bidder information asymmetry. Panel B and Panel C of this table present the results from cross-section tests based on alternative proxies of information asymmetry following Eckbo et al. (2018). Panel B presents results from the subsample estimation partitioned by other proxies of bidder information asymmetry. Panel C presents results from the subsample estimation partitioned by deal level information asymmetry. All regressions include control variables for deal, bidder, target characteristics as in Table 3 and include industry and year fixed-effects. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Composite proxy for bidder information asymmetry

	Low info.asym	**High info.asym**
Institutional ownership		
Change in total IO	0.050	0.283***
	(0.529)	(0.000)
Deal characteristics		
Hostile deal [0;1]	−0.162***	−0.185***
	(0.000)	(0.000)
Target termination fee [0;1]	−0.004	0.077***
	(0.847)	(0.000)
Competed Bid [0;1]	−0.072***	−0.082***
	(0.008)	(0.005)
Tender offer [0;1]	−0.361***	−0.535***
	(0.000)	(0.000)
Same industry [0;1]	−0.007	0.029
	(0.718)	(0.118)
Relative size	−0.013	−0.019
	(0.613)	(0.200)
Target characteristics		
Size	0.067***	0.040***
	(0.000)	(0.000)
Market-to-book	0.006***	0.005**
	(0.001)	(0.012)
Leverage	−0.143***	−0.211***
	(0.003)	(0.000)
Cash flow	−0.094	0.036
	(0.129)	(0.438)
R&D	−0.029	0.149
	(0.842)	(0.207)
Bidder characteristics		
Size	−0.060***	−0.036***
	(0.000)	(0.000)
Market-to-book	0.005**	0.004**
	(0.019)	(0.045)
Leverage	−0.055	−0.048
	(0.348)	(0.351)
Cash flow	−0.503***	−0.210***
	(0.000)	(0.000)
R&D	0.149	0.130
	(0.533)	(0.409)
Industry & Year FE	Yes	Yes
N	1659	1577
Pseudo R^2	0.470	0.487
Chow-test p-value	IO	0.001***

Table 6 – Deals involving high informational asymmetries (continue)

Panel B: Other proxies for bidder information asymmetry

Recent acquisitions [*0,1*]	**Recent**	**Non-recent**
Change in total IO	0.044	0.174***
	(0.691)	(0.007)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	740	2496
Pseudo R^2	0.635	0.460
Recent SEO [*0,1*]	**Recent**	**Non-recent**
Change in total IO	0.076	0.154**
	(0.498)	(0.017)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	720	2516
Pseudo R^2	0.592	0.461

Panel C: Proxies of deal-level information asymmetry

Bidder-target distance	**Local**	**Non-local**
Change in total IO	0.055	0.170***
	(0.653)	(0.007)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	615	2621
Pseudo R^2	0.632	0.459
Industry complementarity	**High**	**Low**
Change in total IO	0.089	0.187**
	(0.222)	(0.035)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1725	1511
Pseudo R^2	0.514	0.454

Table 7 – Misvaluation of bidder shares

This table presents the results from cross-section test of bidder market-to-book valuation. The dependent variable is the fraction of stock payment in the deal consideration. In Panel A, the subsamples are split by the year-median of the misvaluation component of the ln(M/V) ratio (sum of RRV firm-specific error and time-series sector error). Panel B presents estimations from the subsample partitioned by the bidder short-interest ratio 6-month prior to the date of deal announcement. All regressions include control variables for deal, bidder, target characteristics as in Table 3 and include industry and year fixed-effects. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Rhodes-Kropf et al. (2005) MTB decomposition

Misvaluation *Model I*	**High**	**Low**
Change in total IO	0.052	0.267***
	(0.451)	(0.005)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1817	1419
Pseudo R^2	0.549	0.420
Misvaluation *Model II*	**High**	**Low**
Change in total IO	−0.006	0.354***
	(0.932)	(0.000)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1826	1410
Pseudo R^2	0.538	0.440
Misvaluation *Model III*	**High**	**Low**
Change in total IO	0.031	0.307***
	(0.657)	(0.001)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1825	1411
Pseudo R^2	0.540	0.437

Panel B: Bidder short-selling intensity

Short-selling ratio	**High**	**Low**
Change in total IO	−0.010	0.329***
	(0.896)	(0.000)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1635	1601
Pseudo R^2	0.463	0.509

Table 8 – Reg-FD as a shock to information environment

This table presents estimates of the effect of change in targets' institutional ownership on the fraction of stock in the event of Regulation Fair disclosure, which became effective on October 23, 2000. The test applies to the subsample of 10-year window around the event, from 1996 to 2006. The dependent variable is the fraction of stock payment in the deal consideration. All regressions include control variables for deal, bidder, target characteristics as in Table 3 and include industry and year fixed-effects. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	Low info.asym		**High info.asym**	
	Pre-Reg FD	Post Reg-FD	Pre-Reg FD	Post Reg-FD
Change in total IO	0.233*	0.035	0.419***	0.292*
	(0.089)	(0.846)	(0.000)	(0.093)
Deal characteristics				
Hostile deal [0;1]	−0.208***	−0.141	−0.112*	−0.052
	(0.002)	(0.167)	(0.060)	(0.503)
Target termination fee [0;1]	−0.010	0.079	0.089***	0.153***
	(0.792)	(0.259)	(0.003)	(0.002)
Competed Bid [0;1]	−0.041	0.041	−0.144***	0.046
	(0.471)	(0.538)	(0.007)	(0.488)
Tender offer [0;1]	−0.606***	−0.169***	−0.645***	−0.439***
	(0.000)	(0.002)	(0.000)	(0.000)
Same industry [0;1]	0.038	−0.070	−0.010	−0.014
	(0.298)	(0.101)	(0.716)	(0.725)
Relative size	0.036	−0.003	0.011	0.076
	(0.421)	(0.973)	(0.632)	(0.128)
	(0.632)	(0.651)	(0.128)	(0.087)
Target characteristics				
Size	0.025*	0.137***	0.023	0.089***
	(0.097)	(0.000)	(0.134)	(0.000)
Market-to-book	0.003	0.012**	0.004	0.009*
	(0.344)	(0.019)	(0.219)	(0.088)
Leverage	−0.237***	−0.187	−0.216***	−0.376***
	(0.005)	(0.102)	(0.007)	(0.005)
Cash flow	0.059	−0.238*	0.015	0.077
	(0.606)	(0.087)	(0.832)	(0.299)
R&D	−0.057	0.005	0.248	0.315
	(0.828)	(0.987)	(0.167)	(0.140)
Bidder characteristics				
Size	−0.018	−0.097***	0.000	−0.108***
	(0.278)	(0.000)	(0.983)	(0.000)
Market-to-book	0.005	−0.002	0.004	0.003
	(0.189)	(0.726)	(0.122)	(0.616)
Leverage	−0.125	−0.073	−0.039	−0.015
	(0.353)	(0.615)	(0.601)	(0.906)
Cash flow	−0.183	−0.811***	−0.168*	−0.270***
	(0.460)	(0.001)	(0.078)	(0.007)
R&D	0.130	−0.265	0.158	−0.097
	(0.796)	(0.634)	(0.469)	(0.761)
Industry & Year FE	Yes	Yes	Yes	Yes
N	402	295	561	304
Pseudo R^2	0.725	0.620	0.663	0.673

Table 9 – Ex-post retention rates of holdings

Panel A of this table presents the OLS regression results of ex-post retention rates on the 4-calendar quarter change in institutional ownership (measured at institution-level) immediately prior to date of deal announcement. Post-merger retention rate is defined as the number of bidder shares the institution owns two-quarter after the deal completion date divided by the expected number of shares the institutions would own. Pre-merger retention rate is defined as the number of target shares owned at the latest quarter before the date of deal completion divided by the number of target shares owned at the latest quarter before the deal announcement. Panel B of this table presents results from the subsample estimation partitioned by the median of deal synergy measure, as proxied by combined CAR[-1,+1] (cCAR[-1,+1], which is calculated as the market-capitalisation weighted average of bidder and target three-day CARs around announcement date). Panel C presents results from the subsample estimations partitioned by the respective median of long-term operating performances of the bidder firms, proxied by change in 3-year-average post-announcement bidder return on assets (ΔROA), change in 3-year-average post-announcement bidder sales growth (ΔSLG) and change in 3-year-average post-announcement bidder cost of goods sold (ΔCOGS). Dependent variables are post-merger retention rate in the first 4 result columns and pre-merger retention rate in the last 4 result columns. All regressions include control variables for deal, bidder, target characteristics as in Table 3 and control variables for institution characteristics. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Institutional-level baseline tests

	Post-merger retention		Pre-merger retention	
Change in IO (*inst*)	0.016*	0.016*	0.011***	0.012***
	(0.096)	(0.099)	(0.001)	(0.000)
Deal characteristics				
Hostile deal [0;1]	0.115	0.039	−0.160***	−0.064
	(0.520)	(0.843)	(0.003)	(0.271)
Target termination fee [0;1]	−0.110**	−0.032	−0.045***	−0.012
	(0.024)	(0.576)	(0.006)	(0.544)
Competed Bid [0;1]	−0.118	−0.120	0.030	0.062*
	(0.261)	(0.278)	(0.381)	(0.086)
Tender offer [0;1]	−0.237**	−0.194*	−0.123***	−0.126***
	(0.017)	(0.069)	(0.000)	(0.000)
Same industry [0;1]	−0.020	0.019	−0.010	−0.014
	(0.622)	(0.666)	(0.491)	(0.379)
Relative size	−0.091*	−0.079	−0.035**	−0.033*
	(0.051)	(0.112)	(0.032)	(0.055)
Bidder CAR[-1;+1]	0.304	0.405*	−0.141*	−0.095
	(0.184)	(0.098)	(0.074)	(0.256)
Target CAR[-1;+1]	−0.008	−0.017	−0.173***	−0.189***
	(0.942)	(0.874)	(0.000)	(0.000)
Completion days	0.000	0.000	−0.001***	−0.001***
	(0.732)	(0.727)	(0.000)	(0.000)
Percent of portfolio	0.687*	0.783*	0.784***	0.791***
	(0.089)	(0.055)	(0.000)	(0.000)
Institution size	0.127***	0.128***	0.033***	0.034***
	(0.000)	(0.000)	(0.000)	(0.000)
Target characteristics				
Size	−0.006	0.027	0.001	0.005
	(0.797)	(0.306)	(0.872)	(0.589)
Market-to-book	0.000	0.000	−0.003	−0.003
	(0.941)	(0.998)	(0.105)	(0.160)
Leverage	0.034	−0.050	−0.018	−0.028
	(0.781)	(0.712)	(0.661)	(0.525)
R&D	0.252	0.081	−0.179	−0.297**
	(0.432)	(0.819)	(0.103)	(0.014)
Cash flow	0.312**	0.225	−0.118**	−0.148***
	(0.033)	(0.148)	(0.014)	(0.003)
Bidder characteristics				
Size	−0.030	−0.037*	−0.045***	−0.046***
	(0.140)	(0.098)	(0.000)	(0.000)
Leverage	−0.168	−0.114	0.115***	0.144***
	(0.161)	(0.380)	(0.005)	(0.001)
R&D	0.223	0.081	0.008	0.130
	(0.580)	(0.852)	(0.955)	(0.399)
Market-to-book	−0.001	−0.001	0.000	0.000
	(0.881)	(0.717)	(0.898)	(0.798)
Cash flow	0.555***	0.379*	0.082	0.105
	(0.003)	(0.052)	(0.227)	(0.144)
Industry & Year FE	No	Yes	No	Yes
N	4972	4972	5597	5597
Adjusted R^2	0.030	0.044	0.057	0.078

Table 9 – Ex-post retention rates of holdings (continue)

Panel B: Deal synergy

	Post-merger retention				**Pre-merger retention**			
cCAR[-1,+1]	**High**		**Low**		**High**		**Low**	
Change in IO (*inst*)	0.022*	0.023*	0.010	0.007	0.015***	0.014***	0.006	0.010*
	(0.082)	(0.073)	(0.527)	(0.668)	(0.001)	(0.001)	(0.251)	(0.081)
Industry & Year FE	No	Yes	No	Yes	No	Yes	No	Yes
N	2914	2914	2058	2058	3421	3421	2176	2176
Adjusted R^2	0.03	0.040	0.030	0.069	0.058	0.075	0.078	0.116

Panel C: Long-term post-announcement operating performances of bidder firms

	Post-merger retention				**Pre-merger retention**			
3-year-aver ΔROA	**High**		**Low**		**High**		**Low**	
Change in IO (*inst*)	0.030*	0.034**	0.006	0.005	0.019***	0.019***	0.010*	0.011**
	(0.074)	(0.046)	(0.706)	(0.759)	(0.000)	(0.000)	(0.050)	(0.037)
Industry & Year FE	No	Yes	No	Yes	No	Yes	No	Yes
N	2028	2028	2121	2121	2332	2332	2312	2312
Adjusted R^2	0.044	0.054	0.019	0.047	0.041	0.085	0.068	0.091
	Post-merger retention				**Pre-merger retention**			
3-year-aver ΔSLG	**High**		**Low**		**High**		**Low**	
Change in IO (*inst*)	0.016	0.024*	0.017	0.011	0.016***	0.017***	0.009**	0.010**
	(0.258)	(0.089)	(0.216)	(0.406)	(0.002)	(0.001)	(0.034)	(0.020)
Industry & Year FE	No	Yes	No	Yes	No	Yes	No	Yes
N	2140	2140	2182	2182	2447	2447	3150	3150
Adjusted R^2	0.043	0.057	0.025	0.046	0.074	0.099	0.055	0.078
	Post-merger retention				**Pre-merger retention**			
3-year-aver ΔCOGS	**High**		**Low**		**High**		**Low**	
Change in IO (*inst*)	0.006	0.011	0.031*	0.028*	0.012**	0.013***	0.019***	0.019***
	(0.666)	(0.444)	(0.050)	(0.079)	(0.020)	(0.010)	(0.000)	(0.000)
Industry & Year FE	No	Yes	No	Yes	No	Yes	No	Yes
N	2184	2184	2118	2118	2403	2403	2455	2455
Adjusted R^2	0.023	0.048	0.039	0.050	0.069	0.087	0.062	0.083

Table 10 – Institutions' cross-holdings of bidders and targets

This table presents estimates from Tobit regressions of the fraction of stock payment on the change in institutional ownership and cross-ownership proxies. Cross-ownership proxies are *top5/10/20count* presenting the number of top 5/10/20 institutional cross-owners, *ta_ crossIO* presenting ownership by target institutions that own bidder shares, *ta_ crossIO* presenting ownership by target institutions that own bidder shares with 1% threshold restriction on bidder and target institutional ownership as in Brooks et al. (2018). All regressions include control variables for deal, bidder, target characteristics as in Table 3 and include industry and year fixed-effects. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

	Dependent variable = Fraction of stock					
Change in total IO	0.146***	0.147**	0.152***	0.142**	0.130**	0.135**
	(0.010)	(0.010)	(0.008)	(0.013)	(0.024)	(0.019)
top5count		0.013*				
		(0.056)				
top10count			0.011**			
			(0.012)			
top20count				0.011***		
				(0.000)		
ta_crossIO					0.104**	
					(0.017)	
ta_crossIO_1pct						0.199***
						(0.007)
Deal characteristics						
Hostile deal [0;1]	−0.179***	−0.177***	−0.176***	−0.176***	−0.180***	−0.179***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Target termination fee [0;1]	0.038**	0.040**	0.041**	0.039**	0.038**	0.038**
	(0.016)	(0.013)	(0.012)	(0.014)	(0.019)	(0.017)
Competed Bid [0;1]	−0.073***	−0.073***	−0.074***	−0.075***	−0.074***	−0.073***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tender offer [0;1]	−0.437***	−0.431***	−0.431***	−0.430***	−0.432***	−0.431***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Same industry [0;1]	0.010	0.006	0.004	0.002	0.005	0.004
	(0.438)	(0.678)	(0.740)	(0.864)	(0.731)	(0.761)
Relative size	−0.026**	−0.021	−0.020	−0.019	−0.019	−0.019
	(0.042)	(0.125)	(0.141)	(0.155)	(0.147)	(0.157)
Target characteristics						
Size	0.058***	0.057***	0.055***	0.049***	0.053***	0.054***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book	0.006***	0.007***	0.007***	0.006***	0.007***	0.007***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	−0.168***	−0.156***	−0.154***	−0.142***	−0.153***	−0.155***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cash flow	−0.025	0.002	0.003	0.005	−0.005	−0.005
	(0.501)	(0.958)	(0.930)	(0.890)	(0.904)	(0.902)
R&D	0.087	0.107	0.101	0.091	0.106	0.103
	(0.349)	(0.266)	(0.293)	(0.340)	(0.267)	(0.283)
Bidder characteristics						
Size	−0.053***	−0.055***	−0.055***	−0.055***	−0.058***	−0.055***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Market-to-book	0.004***	0.003**	0.003**	0.003**	0.003*	0.003**
	(0.007)	(0.049)	(0.045)	(0.047)	(0.060)	(0.046)
Leverage	−0.060	−0.071*	−0.069*	−0.062	−0.065	−0.070*
	(0.115)	(0.071)	(0.080)	(0.113)	(0.100)	(0.076)
Cash flow	−0.265***	−0.332***	−0.331***	−0.323***	−0.340***	−0.337***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R&D	0.197	0.167	0.156	0.147	0.144	0.159
	(0.134)	(0.225)	(0.256)	(0.283)	(0.296)	(0.248)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3236	3088	3088	3088	3088	3088
Pseudo R^2	0.455	0.462	0.463	0.466	0.463	0.463

Table 11 – Deal completion

This table presents estimates from the logit regressions that examine the likelihood of deal completion. The dependent variable is a dummy variable which equals to one if the announced bid is completed and zero otherwise. The main explanatory variable is a dummy variable which equals to 1 if the increase in institutional ownership in the target firm if economically significant, meaning greater than 1%. All regressions have control variables for deal, bidder, target characteristics and including industry and year fixed-effects. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

		Misvaluation of bidder shares			
		RRV Model III		**Short-ratio**	
		High	**Low**	**High**	**Low**
Change in total IO	−0.373	−1.493*	−0.612	0.002	−1.130
	(0.516)	(0.080)	(0.634)	(0.999)	(0.199)
Deal characteristics					
Hostile deal [0;1]	−3.119***	−3.577***	−3.672***	−3.505***	−3.961***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Target termination fee [0;1]	1.817***	1.735***	1.871***	1.919***	1.853***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Competed Bid [0;1]	−2.218***	−2.219***	−3.081***	−2.613***	−2.451***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tender offer [0;1]	1.917***	2.748***	1.889**	0.969	2.732***
	(0.000)	(0.001)	(0.040)	(0.155)	(0.002)
Same industry [0;1]	0.238*	0.054	0.704***	0.224	0.458**
	(0.080)	(0.787)	(0.010)	(0.444)	(0.026)
Relative size	−0.089	−0.097	0.193	−0.219	−0.013
	(0.406)	(0.613)	(0.251)	(0.477)	(0.934)
Target characteristics					
Size	−0.197***	−0.225**	−0.356***	−0.364**	−0.180*
	(0.001)	(0.029)	(0.008)	(0.017)	(0.071)
Market-to-book	−0.015	−0.046*	0.001	−0.075**	−0.011
	(0.306)	(0.073)	(0.979)	(0.041)	(0.679)
Leverage	0.648*	2.255***	0.392	1.842**	0.945
	(0.078)	(0.002)	(0.596)	(0.034)	(0.108)
Cash flow	0.164	0.799	−0.353	1.605*	0.149
	(0.662)	(0.274)	(0.587)	(0.094)	(0.794)
R&D	0.815	2.716	1.290	4.515	2.750
	(0.430)	(0.170)	(0.620)	(0.151)	(0.139)
Bidder characteristics					
Size	0.257***	0.274***	0.612***	0.465***	0.258***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.003)
Market-to-book	−0.001	−0.020	−0.004	−0.001	0.001
	(0.955)	(0.217)	(0.979)	(0.966)	(0.951)
Leverage	−0.265	−0.649	−1.850**	−1.053	−0.806
	(0.479)	(0.284)	(0.027)	(0.243)	(0.161)
Cash flow	0.147	−0.311	0.551	1.973*	−0.409
	(0.765)	(0.705)	(0.579)	(0.097)	(0.553)
R&D	1.098	1.644	2.602	−0.756	1.342
	(0.414)	(0.385)	(0.350)	(0.819)	(0.440)
Stock-only [0;1]	−0.294*				
	(0.066)				
Cash-only [0;1]	−0.205				
	(0.248)				
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
N	3225	1097	845	852	1106
Pseudo R^2	0.396	0.340	0.438	0.432	0.344

Table 12 – Deal synergies

This table presents the estimates from OLS regressions of each proxy for deal synergy on the change in institutional ownership. Columns (1), (2), (3) present results estimated from the whole deal sample, stock-related sample and cash-only sample. Panel A of this table presents the estimates from OLS regressions of three-day announcement target CAR[-1,+1] on the change in targets' institutional ownership. Panel B presents the estimates from OLS regressions of three-day announcement bidder CAR[-1,+1]. Panel C presents the estimates from OLS regressions of three-day announcement combined CAR[-1,+1]. Panel D presents the estimates from OLS regressions of acquisition premium (Officer, 2003). All regressions include control variables for deal, bidder, target characteristics as in Table 3. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Target CAR[-1+1]

	All	**Stock-for-stock**	**Cash-only**
Change in total IO	-0.066	-0.074	-0.004
	(0.120)	(0.150)	(0.953)
Industry & Year FE	Yes	Yes	Yes
N	3121	1894	1227
Adjusted R^2	0.106	0.055	0.111

Panel B: Bidder CAR[-1,+1]

	All	**Stock-for-stock**	**Cash-only**
Change in total IO	-0.008	-0.011	0.005
	(0.620)	(0.625)	(0.771)
Industry & Year FE	Yes	Yes	Yes
N	3120	1897	1223
Adjusted R^2	0.058	0.051	0.074

Panel C: Combined CAR[-1,+1]

	All	**Stock-for-stock**	**Cash-only**
Change in total IO	-0.004	-0.008	0.024
	(0.805)	(0.728)	(0.245)
Industry & Year FE	Yes	Yes	Yes
N	3047	1846	1201
Adjusted R^2	0.082	0.041	0.199

Panel D: Deal premium

	All	**Stock-for-stock**	**Cash-only**
Change in total IO	-0.035	-0.101	0.062
	(0.625)	(0.284)	(0.595)
Industry & Year FE	Yes	Yes	Yes
N	2979	1794	1185
Adjusted R^2	0.086	0.090	0.069

Table 13 – Different types of institutional owners

This table presents estimates from Tobit regressions of each measure of deal performance on the change in institutional ownership. Panel A of this table presents the subsample results based on information asymmetry of the bidder. Panel B presents the the subsample results based on misvaluation of bidder shares (RRV Model III). All regressions include control variables for deal, target, bidder characteristics as in Table 3 and industry and year fixed-effects. Intercept is included in all regressions but not reported. All continuous independent variables are measured at the end of previous fiscal year and winsorized at 1^{st} and 99^{th} percentiles. Intercept is included in regressions but not reported. p-values are in parentheses. *, **, *** denote statistical significance at 10%, 5% and 1%, respectively.

Panel A: Info.sym	**High info.asym**							**Low info.asym**						
Total IO	0.283***							0.050						
	(0.000)							(0.529)						
QIX IO		0.397***							0.036					
		(0.001)							(0.721)					
Monitoring IO			0.450***							-0.003				
			(0.003)							(0.981)				
Top1 IO				0.207							-0.074			
				(0.400)							(0.751)			
Top5 IO					0.263**							-0.027		
					(0.033)							(0.823)		
Independent IO						0.265***							0.005	
						(0.006)							(0.956)	
Blockholder IO							0.153							-0.054
							(0.125)							(0.527)
N	1577	1577	1558	1563	1563	1563	1563	1659	1659	1650	1652	1652	1652	1652
Pseudo R^2	0.487	0.487	0.490	0.484	0.486	0.487	0.485	0.470	0.469	0.470	0.470	0.470	0.470	0.470

Panel B: Misval	**Low Misvaluation**							**High Misvaluation**						
Total IO	0.310***							0.033						
	(0.001)							(0.640)						
QIX IO		0.271**							0.086					
		(0.030)							(0.371)					
Monitoring IO			0.222							0.074				
			(0.142)							(0.522)				
Top1 IO				0.383							-0.396*			
				(0.131)							(0.080)			
Top5 IO					0.333**							-0.128		
					(0.012)							(0.255)		
Independent IO						0.227**							-0.004	
						(0.032)							(0.964)	
Blockholder IO							0.192*							-0.113
							(0.065)							(0.177)
N	1431	1431	1419	1423	1423	1423	1423	1805	1805	1789	1792	1792	1792	1792
Pseudo R_2	0.441	0.437	0.439	0.438	0.441	0.440	0.439	0.525	0.525	0.527	0.527	0.526	0.526	0.527

Appendices

Appendix A. The formation of M&A samples

This table reports the sample selection criteria and the number of observations. The M&A sample consists of 5,556 completed or withdrawn deals between 1984 and 2018 in which the takeover target is a U.S. public firm and has financial accounting, stock market, and institutional ownership data from CRSP, Compustat, and Thomson Reuters 13F, respective. The respective number of M&A deals in which both targets and bidders are U.S. public firms and have data available from CRSP and Compustat are shown in the brackets.

Sample Criteria	N.
Initial M&A sample	
Deals are announced between 01/01/1984 and 31/12/2018 and both bidders and targets are U.S firms	288,707
Targets are public firms	56,458
Bidders are public, subsidiary or private firms	55,679
Deal value is at least $1 million and account for at least 1% of the bidder's market capitalisation reported at the fiscal year-end date prior to the bid announcement date	45,079
Deal is either completed or withdrawn	24,891
Deal is classified as 'merger' or 'acquisition of majority interest'	12,639
More than 50% of outstanding shares of the target are acquired in a completed deal (or sought in a withdrawn deal)	12,514
Time to completion or withdrawn is less than 1000 days	12,491
CRSP-Compustat-S34	
Deals where targets (both targets and bidders) have stock market and accounting data available from CRSP and Compustat	8,369 (5,689)
Deals where targets have ownership information available from Thomson Reuters Institutional Holdings 13F database	8,099 (5,269)
Non-missing control variables for takeover probability tests and exclude financial (SIC 6000-6999) and utility firms (4900-4999)	6,015 (3,505)
Payment consideration can be classified into 3 categories and the fraction of stock payment is not missing	5,556 (3,236)

Appendix B. Variable definitions

	Variables	Definitions	Data sources
Institutional ownership	Change in total IO	Change in the fraction of total institutional ownership at the fiscal year-end	Thomson Reuters 13F
	Cross-ownership $top5/10/20count$	Number of institutional cross-owners in both target and bidder firms	
	ta_cross_IO (ta_cross_IO_1%)	Institutional owners of a target firm that also own shares of the bidder (with a threshold of at least 1% holdings in both target and bidder firms)	
Firm characteristics	Firm size	Natural log of total book value of assets	Compustat
	Leverage	Long-term debt divided by book value of assets	Compustat
	Cash flow	Income before extraordinary items and depreciation divided by book value of assets	Compustat
	Return on asset	Earnings before interests divided by book value of assets	Compustat
	Market-to-book	Market value of equity divided by book value of equity	Compustat
	R&D	Research and development expense divided by book value of assets	Compustat
	Compounded excess returns	Compounded monthly returns at the fiscal year-end	CRSP
	Sale growth	$(Sales_t$ - $Sale_{t-1})/Sale_{t-1}$	Compustat
	Growth-resource mismatch	1 if there is a combination of low sale growth, high liquidity and low leverage or high sale growth, low liquidity and high leverage, and 0 otherwise	Compustat
	Industry acquisition	1 if there is at least one acquisition in the firm's 4-digit SIC industry in the year prior to the year of bid announcement, and 0 otherwise	Compustat
Deal characteristics	Stock-only deals	1 if consideration is Share-only	SDC M&A
	Cash-only deals	1 if consideration is Cash-only	SDC M&A
	Mixed deals	1 if consideration is mixed between shares and cash payment	SDC M&A
	Hostile deals	1 if deal attitude is hostile or unsolicited	SDC M&A
	Toehold	1 if bidder owns a fraction of target shares	SDC M&A
	Termination fee	1 if the target has termination fee provision in the merged contract	SDC M&A
	Local deals	1 if bidder and target are located within 30 miles. The spherical law of cosines formula: 3963 miles $\times$ acos[sin(lat_a) $\times$ sin(lat_t) + cos(lat_a) $\times$ cos(lat_t) $\times$ cos($long_a$-$long_t$)], where (lat_a,$long_a$), (lat_t,$long_t$) are (latitude,longitude) measured in radians, of the bidder and target location, respectively.	US Census Gazetteer 2000 & city coordinates.
	Recent acquirer	1 if bidder announced another merger bid within 2 years prior to the sample bid	SDC M&A
	Recent equity offerings	1 if bidder issued common stocks within 2 years prior to the sample bid	SDC Equity
	Industry complementarity	The degree to which the target and bidder input and output industries overlap	US BEA, Joseph Fan's website
	Same industry	1 if target and acquirer are in the same 4-digit SIC industry	Compustat
	Tender offer	1 if the tender merger flag is labelled "YES"	SDC M&A
	Competed bids	1 if there are more than 1 bidder for the deal	SDC M&A
	Relative size	Deal value divided by market capitalisation of acquirer	SDC M&A
	Completion	1 if the announced deal is completed	SDC M&A

Appendix B. Variable Definitions (continue)

	Variables	Definitions	Data sources
Information asymmetry proxies	Tangible assets	Tangible asesets divided by total book value of assets	Compustat
	No of analysts following	Number of analysts forcasting firms EPS in the fiscal year before the annoucement date.	I/B/E/S
	Firm age	Age of firm since first listed on CRSP to the annoucement date	CRSP
	Return volatility	The standard deviation of daily stock return during the trading period (-90,-11) prior to the deal annoucement date	CRSP
	Bid-ask spread	The bid-ask spread of daily stock price scaled by its price for the trading period (-90,-11) prior to the deal annoucement date	CRSP
	Number of prior stock offers	Number of IPO and SEOs by the bidder prior the deal annoucement	SDC Equity
	Abnormal accruals	Absolute value of firm-specific abnormal accruals minus the median abnormal accruals for its respective industry-performance-matched portfolio (2 digit-SIC and ROA_{it-1}) following Kothari et al. (2005). The firm-specific abnormal accruals is the residuals obtained from the modified Jones model: $TA_{it}/Assets_{it-1} = \alpha_0 + \alpha_1/Assets_{it-1} + \alpha_2 \times \Delta Sale_{it}/Assets_{it-1} + \alpha_3 \times PPE_{it}/Assets_{it-1}$.	Compustat
Misvaluation proxies	• *ln(M/V) decomposition*	$m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} ln(NI)^{+}_{it} + \alpha_{3jt} I_{<0} ln(NI)^{+}_{it} + \alpha_{4jt} LEV_{it} + \epsilon_{it}$, where m_{it} = ln(prccf*csho), b_{it}=ln(ceq), NI=Net Income, LEV=leverage, and I is an indicator variable for positive NI.	
	Misvaluation	Misvaluation of the bidder market-to-book that is specific to firm (firm-specific error, $m_{it} - v(\theta_{it}; \alpha_{jt})$ where α_{kjt} is the annual, sector-average multiples) & misvaluation within the firm's sector (time-series sector error, $v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \bar{\alpha}_j)$ where α_{kj} is the long-run sector average multiples)	Compustat
	Long run value-to-book	Long-run value-to-book reflects firm's true value, $v(\theta_{it}; \bar{\alpha}_j) - b_{it}$	
	• *Adjusted short interest*	The difference between Short interest ratio, which is the short position at the settlement date of the 15th of each month, divided by shares outstanding of the same month, and the mean of short interest ratio of all firms (shrcd 10,11 and traded on NYSE, AMEX and NASDAG) in the same month.	Compustat, CRSP
	• *Analyst earnings forecast dispersion*	Standard deviation of earnings forecast for the bidder firms for the fiscal year-end prior to the bid announcement calculated from the monthly forecasts, divided by the annual average forecast for the firm.	I/B/E/S

Appendix C. Factors of information asymmetry

This table presents the factor loadings from a factor analysis for the two factors with an eigenvalue greater than 1. We construct a single information asymmetry proxy using eight measures of the bidder firm characteristics following Karpoff et al. (2013). Previous studies have documented the association between these component variables and firms' information asymmetry. Indicators of informative prices consist of firm size, tangible assets, firm age, number of analysts followings, and number of issued stocks (Barth et al., 2001; Hong et al., 2000).[37] We expect these measures to be negatively correlated with firms' information asymmetry. The other three components that are positively correlated with information asymmetry include bid-ask spreads, return volatility (reflecting the risk-bearing of external uninformed investors, see, e.g. Corwin, 2003), and abnormal accruals (measuring the quality of accounting information, see, e.g. Kothari et al., 2005; Lee and Masulis, 2009). The final measure of the bidder information asymmetry proxy is constructed by multiplying Factor 1 by (-1). The Kaiser-Meyer-Olkin(KMO) measure of sampling adequacy statistics for each factor loading and the resulting factors are presented in the last column. Factor 1 is used as the main proxy of information symmetry for the following reasons: (1) its eigenvalue of 2.55 suggests that it summarizes a significant amount of variation in the eight factor loadings; (2) each factor loading has an opposite sign to the predicted sign of information asymmetry, thus the composite proxy for bidder information asymmetry (multiply Factor 1 by minus one) has an intuitive meaning; (3) the Kaiser-Meyer-Olkin (KMO) statistics measuring the sampling adequacy are sufficiently high for each factor loading and for the composite factor with the overall value of 0.72, all suggesting that Factor 1 is the adequate measure of information symmetry of the bidder in our sample.

N.proxy	**Variable**	**Predicted correlation with info asymmetry**	**Factor1**	**Factor2**	**KMO measure of sampling adequacy**
1	Firm size	—	0.8657	−0.0936	0.6683
2	Tangible assets	—	0.2543	0.6807	0.6836
3	Firm age	—	0.6862	0.1816	0.7662
4	Analyst followings	—	0.6645	−0.2501	0.7064
5	Issued stocks	—	0.3139	−0.2004	0.7311
6	Bid-ask spreads	+	−0.3896	0.5200	0.7761
7	Return volatility	+	−0.6920	−0.0759	0.7813
8	Abnormal accruals	+	−0.3138	−0.5180	0.7035
	KMO overall				0.7195
	Eigenvalue		2.5541	1.1523	

Appendix D. Summary statistics of market-to-book decomposition

The table reports the summary statistics for the market-to-book (MTB) decomposition across the three models following Rhodes-Kropf et al. (2005). We use the set of sample construction criteria similar to those used in Golubov and Konstantinidi (2019). Further, we keep only firms that meet the following criteria: market-to-book between 0 and 100, return on equity between -1 and 1, book leverage between 0 and 1, and non-missing values for all components used in Model III. These restrictions help eliminate the effect of the outliers on the long-run value estimation. The Fama-French 12-industry classification is used to defined sectors. Model I corresponds to $m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \epsilon_{it}$, where m_{it} is the natural logarithm of firm's market value of equity, b_{it} is the natural logarithm of the firm's book value of equity, and α_{0jt} and α_{1jt} are estimated from the annual, cross-sectional regressions for each sector. The log of market to book $(m_{it} - b_{it})$ is decomposed into 3 components: firm-specific error $(m_{it} - v(\theta_{it}, \alpha_{jt}))$, time-series sector error $(v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \bar{\alpha}_j))$ and long-run value-to-book $(v(\theta_{it}; \bar{\alpha}_j) - b_{it})$. The fundamental value of firm $v(\theta_{it}, \alpha_{jt})$ is obtained by applying the annual, sector-average regression multiples to firm-level accounting variables: $v(\theta_{it}, \alpha_{jt}) = \hat{\alpha}_{0jt} + \hat{\alpha}_{1jt} b_{it}$, whereas $v(\theta_{it}; \bar{\alpha}_j)$ is obtained by applying the long-run sector-average regression multiples to firm-level accounting variables: $v(\theta_{it}, \alpha_j) = \bar{\alpha}_{0j} + \bar{\alpha}_{1j} b_{it}$ where $\bar{\alpha}_j = 1/T \sum \hat{\alpha}_{jt}$.

Model I: $m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \epsilon_{it}$

Model II adds log of Net Income, where $ln(NI)^+_{it}$ is natural logarithm if the absolute value of firm's net income and $I_{(<0)}$ is an indicator variable for negative net income.

Model II: $m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} ln(NI)^+_{it} + \alpha_{3jt} I_{(<0)} ln(NI)^+_{it} + \epsilon_{it}$

Model III further adds firm's leverage ratio, which is defined as the long-term debt plus debt in short-term liabilities divided by the total book value of assets.

Model III: $m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} ln(NI)^+_{it} + \alpha_{3jt} I_{(<0)} ln(NI)^+_{it} + \alpha_{4jt} LEV_{it} + \epsilon_{it}$

	Cash-only	**Mixed**	**Stock-only**
	Mean	Mean	Mean
$m_{it} - b_{it}$	0.735	0.647	0.918
Model I			
Firm-specific error	0.136	0.119	0.309
Time-series sector error	0.062	0.070	0.097
Long-run value to book	0.537	0.456	0.512
Model II			
Firm-specific error	0.056	0.093	0.252
Time-series sector error	0.078	0.099	0.098
Long-run value to book	0.474	0.564	0.568
Model III			
Firm-specific error	0.063	0.091	0.248
Time-series sector error	0.051	0.078	0.098
Long-run value to book	0.622	0.475	0.572

Appendix E. Russell Index switches and Russell rank proxy

To address the endogeneity concern about the institutional holdings, we rely on the Russell 1000/2000 Index Reconstitution for our identification strategy. The Russell 1000/2000 Index data between 1984-2018 is obtained from the FTSE Russell- U.S. Monthly Index Holdings. Firms that are closed to either side of the Russell 1000/2000 threshold have similar market capitalisation at the Russell 'rank date' in May. The assignment of stocks to Russell indices is as close as random. This is because first, Russell use their proprietary calculation of total market capitalisation reflecting only shares that are available to the public and second, index assignment depends solely total market capitalisation at the end of May and last, firms cannot directly control for the float-adjusted market capitalisation used for Russell index assignment (Crane et al., 2016).

Since Russell Index are value-weighted, the random assignment of stocks into the Russell 1000/2000 Index has a great implication on the institutional shareholdings of firms with stocks that switch from their existing Russell Index inclusion. Institutions that benchmark against the Russell indices adjust their portfolio weights so that the smallest stocks in the Russell 1000 Index have significantly lower portfolio weights in comparison to the largest stocks in the Russell 2000 Index (Appel et al., 2016; Chang et al., 2015; Crane et al., 2016; Schmidt and Fahlenbrach, 2017). It therefore implies that firms that switch from Russell 2000 Index to Russell 1000 Index would experience a significant increase in institutional ownership and firms that switch from Russell 1000 to Russell 2000 would see a reduction in institutional ownership.

Since Russell does not provide the ranking data used to determine the index membership inclusion, we construct a ranking variable proxying for its float-adjusted end-of-May total market capitalisation of firms. The use of rankings based on Russell's June index weights is not appropriate because they are not the assignment variable that determines Russell 1000/2000 Index membership, thus resulting in selection bias. An approximation for end-of-May total market capitalisation rankings to determine Russell 1000/2000 Index assignment would compensate for selection bias to certain extent. (Wei and Young, 2019; Appel et al., 2019; Schmidt and Fahlenbrach, 2017). Therefore, we construct the approximation based on the CRSP-based and Compustat-based total market capitalisation at the firm level each year following Ben-David et al. (2019).[38] Specifically, the final approximation for end-of-May total market capitalisation used by Russell equals to CRSP-based total market capitalisation aggregated at the firm level but it equals to the Compustat-based total market capitalisation aggregated at the firm level where the CRSP-based proxy is smaller than the Compustat-based proxy.

The use of the 'composite' end-of-May market capitalisation and resulting change in

[38]We thank Rabih Moussawi for kindly providing us the Russell 3000 constituent data between 2000 and 2006 for our initial analysis. We also thank the authors for providing code for generating the Russell Rank proxy in the Appendix B of Ben-David et al. (2019).

ranking variables support our implementation of the Russell 1000/2000 setting in wider bandwidths. There is noise-versus-bias trade-off between the use of fuzzy RDD and IV estimation. In our case, IV estimation is the only appropriate approach that leaves us with a meaningfully large sample for regression analyses in M&A context. We also provide identification tests and postestimation statistic for discussion of validity of instrument in our setting.

Our IV estimation employ the Russell Index 1000/2000 switch, change in end-of-May market capitalisation rank and its 2^{nd} order polynomial as instruments. The first stage is a regression of change in institutional ownership on a set of instruments, firm-specific characteristics, industry and time fixed effects.

$$\begin{aligned}\Delta IO_{it} = \alpha_j + \sigma_t + \beta_1(R1000_{t-1} \rightarrow R2000_t) + \beta_2(R2000_{t-1} \rightarrow R1000_t) \\ + \gamma_0 \Delta_{(Rank_t \rightarrow Rank_{t-1})} + \gamma_1 \Delta^2_{(Rank_t \rightarrow Rank_{t-1})} + \delta ln(mktcap)_t + \theta X_{it} + \epsilon_{it}\end{aligned} \tag{1}$$

where α_j is industry-fixed effects, σ_t is time-fixed effects, X_{it} are time-varying firm-specific characteristics, $ln(mktcap)_t$ is natural log of the end-of-May market capitalisation. $R1000_{t-1} \rightarrow R2000_t$ is a dummy variable which equals to one if the target switch from the Russell 1000 Index to Russell 2000. $R2000_{t-1} \rightarrow R1000_t$ is a dummy variable which equals to one if the target switch from the Russell 2000 Index to Russell 1000. $\Delta_{(Rank_t \rightarrow Rank_{t-1})}$, $\Delta^2_{(Rank_t \rightarrow Rank_{t-1})}$ are the change in the target's ranking from (t-1) to t based on end-of May market capitalisation and its 2^{nd} order polynomial.

The second stage is a regression of the takeover likelihood on the predicted change in institutional ownership, firm-specific characteristics, industry and time fixed effects.

$$y_{i,t+1} = \omega_j + \eta_t + \lambda \widehat{\Delta IO_{it}} + \kappa ln(mktcap)_t + \phi X_{it} + \mu_{it} \tag{2}$$

where $y_{i,t+1}$ indicates whether a firm receives at least one takeover offer (or a stock-bid offer) in the year following the change in institutional ownership in a firm's fiscal year.