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Do Institutional Investors Process and Act on Information? Evidence from M&A Targets

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We document important links between targets' institutional ownership and takeover-bid outcomes. Firms' institutional ownership increases the likelihood of receiving stock-for-stock bids. The impact becomes stronger when information asymmetries are higher, whereas we find little support for alternative channels, such as bidder misvaluation or target-side adverse selection. The information channel is further buttressed in our analyses of institutions' share-retention decisions, targets' demand for top-tier advisors, collar provisions, and targets' share of expected synergies. Our findings suggest that institutions' information advantage facilitates rational payment design and targets' bargaining power gains, alleviating deadweight losses associated with stock-for-stock offers. (*JEL* G23, G32, G34)

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A volume of research has investigated the economic impacts of institutional ownership on corporate policies and performance. One of the central questions in this line of research is whether professional investment managers have enough motivation and resources to influence the firms held in their portfolios. It is a common perception that institutional investors have a superior ability to acquire and analyze information and, with their expertise, can act as a delegated monitor in the capital markets (Jensen 1993). Yet empirical

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support to this notion has been inconclusive. Although the growing importance of institutional investors in corporate ownership has spurred a renewed interest in their roles among researchers and commentators, new evidence from recent studies pursuing this inquiry is still mixed, and the long-standing debate seems to continue. Some studies show that institutional investors can exert positive effects on innovation (Aghion, Van Reenen, and Zingales 2013), voluntary disclosure (Boone and White 2015), payout (Crane, Michenaud, and Weston 2016), and board independence (Appel, Gormley, and Keim 2016). On the contrary, others argue that the increase in institutional ownership has been detrimental to corporate governance (Schmidt and Fahlenbrach 2017; Bebchuk and Hirst 2019; Heath et al. 2021).[1]

The mixed evidence, we believe, points to the need of a different lens through which to view the debate on institutional ownership. In this regard, Schmidt and Fahlenbrach (2017) and Appel, Gormley, and Keim (2016) point out the engagement cost as a crucial element, arguing that the cost must be low for institutional investors to pursue interventions that improve the value of their portfolio firms.[2] In a similar vein, if a matter in question has material and far-reaching consequences for shareholders, institutional investors may selectively make effort to analyze and leverage the information surrounding portfolio firms. The matter-of-materiality view points out that a right question to ask may be when-rather than whether-institutional investors are incentivized to exert such an effort and bear the cost. In this paper, by zooming in on one such setting, namely, mergers and acquisitions (M&As), we offer a novel insight into this debate.

Most prior studies in this stream of literature examine the role of institutional investors in firms' acquisition decision (see, e.g., Chen, Harford, and Li 2007; Schmidt and Fahlenbrach 2017). Unlike these studies, we focus our investigation on M&A targets and their institutional shareholders. The scenario in which a firm becomes a takeover target provides an ideal setting to test whether institutional investors process and capitalize on the information they have. To wit, a takeover decision carries significant yet distinct weights for shareholders on the two sides of the deal. An acquisition decision for bidder shareholders is analogous to an investment project with a relatively large scale, whereas target shareholders' decision involves an irrevocable action, namely, whether to tender their ownership permanently. In other

[1] Bebchuk and Hirst (2019) argue that highly diversified institutions have limited resources to interact with their portfolio firms, pointing out that the "Big Three" managers-Blackrock, Vanguard, and State Street-for example, hold over 17,000 stocks globally, whereas the number of their stewardship personnel ranges from 11 to 33 (table 1, Bebchuk and Hirst (2019)). Schmidt and Fahlenbrach (2017) find that an increase in indexed ownership leads to fewer independent directors and worse acquisition outcomes.

[2] For example, supporting the removal of poison pills or staggered boards can be considered low-cost engagement (Schmidt and Fahlenbrach 2017), whereas interventions aimed to change individual firm-specific policies may be too costly to execute even if such a change improves firm value. Appel, Gormley, and Keim (2016), although documenting a positive effect of indexed ownership on board independence, find little evidence as to the effect on investment and cash-holding policies.

words, the materiality of an M&A decision is more prominent for target shareholders than bidder ones. Therefore, target shareholders, especially well-informed ones, such as institutional owners, are incentivized to process information to evaluate the bid received. In fact, the legal setting in the United States is consistent with this expectation as the laws reflect a greater significance of M&A decisions for target shareholders.[3] Accordingly, when preparing takeover offers, rational bidders are likely to factor in the presence of institutional shareholders in target firms.

By capitalizing on M&A targets as a laboratory, our paper aims to examine several intertwined predictions pertaining to institutional investors' information advantage—or lack thereof—and its impacts on M&A consideration structure and other deal outcomes. Although the target-side institutional ownership has not been extensively studied—nor is it explicitly modeled—in the literature, prior research concerned with merger payment provides some insights for the theoretical development of our predictions. In particular, theory of rational payment design studied in Eckbo, Makaew, and Thorburn (2018) highlights the information channel that predicts a link between information advantage and stock payments in takeover bids.

If institutional investors are better informed about bidders and merger synergies than do average investors, they presumably have an incentive to leverage this advantage to ensure a fair price for their ownership stake. Eckbo, Makaew, and Thorburn's (2018) theory of rational payment suggests that such an information advantage should manifest itself in the design of merger considerations. They show that the more the target knows about the bidder, the higher is the fraction of stock in the merger consideration. Our hypothesis builds on the economic insight of the rational payment design: That is, when the information advantage of their institutional investors allows target firms to evaluate takeover offers and bidders more accurately, the bidders in equilibrium should be more willing to use their shares as the payment, provided that the shares are fairly priced. Additionally, we hypothesize that if it is the mitigation of information problems-as argued in the rational payment hypothesis-that underlies the positive impact of institutional ownership on the bidders' tendency to make stock-based offers, such an impact will be stronger among the bidders with a higher level of information asymmetries. Moreover, the information advantage of institutional investors should allow targets and their shareholders to garner bargaining power gains and economic benefits associated with the mergers, we expect. For example, institutions can make informed shareholding decisions concerning the shares of the to-be-combined firms to improve their own portfolio performance. Similarly, if the

[3] Laws in most states require that the board and shareholders evaluate and approve a takeover proposal. In contrast, submitting a bid is not subject to a shareholder approval unless the bidder chooses to issue new shares as much as 20% or more of total shares outstanding to finance its acquisition.

information advantage leads to an increase in bargaining power on the target side, it is likely to affect other deal outcomes in favor of targets.

Using a large sample of the U.S. firms from 1984 through 2018, we find strong empirical support to our hypotheses.[4] We first show that following an increase in firms' institutional ownership, the probability of receiving stock-for-stock offers increases. We ensure the robustness of our finding to various controlling factors widely documented in the M&A literature. In addition, we address potential endogeneity issues that some firms might have attributes that attract institutional investors, takeover bidders, or both. To support the causal interpretation of our finding, we exploit exogenous variation in institutional ownership associated with Russell index annual reconstitutions (Fich, Harford, and Tran 2015; Appel, Gormley, and Keim 2016; Crane, Michenaud, and Weston 2016; Schmidt and Fahlenbrach 2017; Cremers, Pareek, and Sautner 2020). The results of the instrumental variable (IV) estimation reassure us the positive impact of institutional ownership on stock-for-stock offers we find (Section 3.2 discusses the instruments and the IV method in more detail).

Given that investment objectives and strategies vary across different types of institutional investors, these heterogeneities warrant some discussions in light of the development of both our theoretical prediction and empirical approach. Firstly, if our analysis were to focus exclusively on investors' ability to utilize information and influence portfolio firms, institutions with monitoring incentives and active strategies would be a more appropriate choice, whereas the recent rise of indexed institutions has received growing attention. The development of our prediction, however, does not require particular types of institutions, because our theoretical motivation, as discussed earlier, emerges from a distinct scenario that triggers an incentive for institutional investors to leverage their superior information-even the ones without such an incentive in normal circumstances. Conversely, if the impact of institutional ownership described above were found to originate solely from those institutions with strong monitoring incentives or active strategies, such evidence would weaken our argument (or potentially be viewed as a foregone conclusion). Additionally, a noteworthy empirical regularity in our sample is that indexed institutions comprise the lion's share of institutional ownership. Given this salient trend, indexed institutional ownership is likely to play certain roles, presumably in a selective capacity, in capital markets. While our hypothesis development does not attempt to pin down the exact types of institutions contributing the most to the information effect, we examine potential heterogeneities across different institution types for completeness of our analysis. The results suggest that although independent blockholders (Chen, Harford, and Li 2007), institutions with a longer

[4] Our M&A sample consists of 5,706 transactions by the U.S. firms. Our sample is reduced to 3,236 transactions between public bidders and targets when we conduct various deal-level tests that require bidder characteristics.

investment horizon (Bushee 1998), and those with a greater monitoring incentive (Fich, Harford, and Tran 2015) seem to contribute more to the relationship we find, the positive impact on the stock-based offers, albeit weaker, does show up among their counterpart types, except for the investors with a short horizon (Section 3.3 provides more details).

As the next step, we examine the economic mechanism through which firms' institutional ownership affects the design of merger consideration. Prior literature on stock-based mergers has devoted a great deal of attention to the issues of information asymmetry (for theoretical analyses of the design of payment under two-sided information asymmetry, see, e.g., Hansen, 1987; Fishman, 1989; Eckbo, Giammarino, and Heinkel, 1990). In their recent study Eckbo, Makaew, and Thorburn (2018) show that a target firm is more likely to accept a bidder's shares as the merger payment when it is more informed about the bidder. In line with our hypothesis rooted in this stream of research, we find evidence of the information channel underlying stock-for-stock offers. Our analysis reveals that the positive relationship between targets' institutional ownership and the likelihood of stock-for-stock offers gets stronger when bidders or M&A deals entail high information asymmetries. The result suggests that the information advantage of institutional investors helps mitigate asymmetric information problems that otherwise would discourage the use of the bidder's shares as the payment, supporting Eckbo, Makaew, and Thorburn's (2018) theory of rational payment design. We ensure the robustness of this finding by using various measures of information asymmetry, including a composite index consisting of eight different firm characteristics of bidders (Karpoff, Lee, and Masulis 2013) and the measures that capture bidders' recent takeover and equity issue activities, geographical proximity, and interindustry complementarity, respectively (Eckbo, Makaew, and Thorburn 2018).

While these results align well with the notion that institutions' information advantage renders stock-based offers a more feasible option, we evaluate alternative mechanisms that might be at play. Perhaps one of the most notable challenges to the rational payment hypothesis stems from the bidder opportunism argument, namely, the possibility that mispricing prompts opportunistic bidders to use their overvalued shares as the merger consideration in an attempt to reap the benefit at the expense of targets' shareholders (Shleifer and Vishny 2003; Rhodes-Kropf, Robinson, and Viswanathan 2005; Ang and Cheng 2006; Dong et al. 2006). Had targets' institutional ownership been associated with stock-for-stock offers motivated by the bidder opportunism, such a link would then suggest that institutional ownership was unrelated with information advantage or even worse, was perceived as a de facto invitation for bidders' exploitative use of overpriced shares. On the contrary, the presence of well-informed institutional shareholders on the target side should drive away the bidders with overpriced shares. Using various measures of misvaluation—mispricing decomposition (Rhodes-Kropf, Robinson, and Viswanathan 2005)

and the short-selling interest (Ben-David, Drake, and Roulstone 2015)—we show that the impact of institutional ownership on stock-for-stock offers only holds for the subset of bidders whose shares are less prone to mispricing. These results thus mitigate the concern that targets' institutional shareholders wind up inviting opportunistic bidders to use their overpriced shares as the payment.

In addition, given that information problems could originate from both buyer and seller sides of transactions, takeover bidders—just like buyers in general trades—would also want to alleviate the risk of overpayment.[5] This is particularly so when they are faced with informed sellers who put assets of high information asymmetry up for sale. The described adverse selection problem attributable to the target side might then discourage bidders from making cash offers, yielding the "same" outcome as the prediction of the rational payment design hypothesis (i.e., a positive link between institutional ownership and stock-for-stock offers). However, the target-side adverse selection entails a different economic interpretation, such that bidders' action space is constrained by the adverse selection problem. To disentangle the two intertwined effects, we condition our analysis on both bidder and target-side information asymmetries. The result of this extended analysis is twofold. The positive impact of targets' institutional ownership on stock-for-stock offers appears pronounced for targets with high information asymmetries, consistent with the possibility that bidders are discouraged from using cash offers when they trade with informed sellers whose assets are difficult to value. However, when we take one step further to incorporate bidders' information asymmetries into the analysis, the impact of institutional ownership on the likelihood of stock offers disappears when low-asymmetry bidders are combined with high-asymmetry targets. In contrast, the effect remains strong for high-asymmetry bidders, whether the target is of high asymmetry or low asymmetry. These results together suggest that the information channel we find, although attributable partly to the adverse selection risk on the target side, derives primarily from the mitigation of bidders' information asymmetries.

To paint a more complete picture, we then explore a variety of different angles to provide further corroborating evidence for the information advantage of institutional investors. First of all, we hypothesize that if institutions can make an informed assessment of bidders and merger synergies, they should attempt to (and be able to) benefit directly from it. To that end, we examine whether institutions selectively hold on to the shares of the post-merger combined entities whose merger synergies are expected to be largest. Presumably investors would retain the shares of merged firms, rather than realizing immediate trading profits, only if they expect the merged firms to deliver greater values in the long run. By analyzing the share-retention patterns at the individual institution level, we show that institutions that have

[5] We thank an anonymous referee for pointing this out to us.

increased their ownership of a target firm *before* the merger announcement, tend to hold more shares of the combined firm post deal completion—say, high share retention.[6] More importantly, we show that the high share retention is concentrated in the subset of stock mergers with larger synergies, proxied for by short- and long-term performance measures. The results together suggest that institutional investors indeed leverage their information to make share-retention decisions in accordance with their assessment of the to-be-merged firms.

Additionally, we expect that the information advantage of institutions allows target firms to earn bargaining power gains, which should then affect various outcomes associated with mergers.[7] For example, the information advantage is likely to curtail the targets' demand for top-of-the-league M&A advisors, who would otherwise be hired at a premium. That is, the information advantage and bargaining power that targets have gained may substitute for the roles played by M&A advisors. Prior literature shows that top-tier advisors help their client firms attain a relatively large share of synergy gains (Kale, Kini, and Ryan 2003; Golubov, Petmezas, and Travlos 2012), resulting in a higher market reaction (Rau 2000; Bao and Edmans 2011), yet they typically cost more to hire (Rau 2000). Consistent with the described substitution effect, we find that the institutional ownership of target firms does curtail their demand for top-tier advisors, particularly when bidders' shares are less difficult to assess.

Similarly, we expect collar provisions-protection against adverse movements in share prices-to be designed in favor of targets if the information advantage has led to an increase in their bargaining power. Collars alleviate variability in the values of merger payments, thus making stock bids more cash-like, but as Officer (2004, 2006) shows, these agreements are priced in the merger payments; that is, they are not costless. Following Officer (2004, 2006), we examine the likelihood of two types of collar provisions, floating-ratio collar and fixed-ratio one, being included in deals. It is important to clarify different contracting features of the two collar agreements: That is, fixed-ratio collars (floating-ratio collars) protect the value of merger payment against a wide (modest) fluctuation in the share price.[8] Therefore, fixed-ratio collars can benefit targets and their shareholders, even the ones with a relatively accurate assessment of merger offer, because their payoff is hedged against abnormally large losses that are beyond expectations. In contrast,

[6] Following Burch, Nanda, and Silveri (2012), we examine both precompletion retention (between the announcement and the completion of a merger) and post-completion retention. Section 5.1 describes them in greater detail.

[7] We thank an anonymous referee for making these suggestions to us.

[8] With a fixed-ratio collar, the payoff to the target firm fluctuates between the upper and lower limits agreed on but is set to the respective limits when the price of the bidder's shares moves outside the bounds (the payoff is thus hedged against a large abnormal swing in the share price). With a floating-ratio collar, the payoff remains unchanged when the price moves between the upper and lower limits but varies with the price outside the bounds (the payoff is hedged against relatively modest changes in the share price, but not large ones).

floating-ratio collars provide no such protection against large losses, although incurring costs to target firms because collar provisions are implicitly priced (Officer 2006). Therefore, the benefit is likely marginal or outweighed by its costs. Given these distinct features, we expect fixed-ratio collars to be the rational choice for those targets with the information advantage and bargaining power gains. Consistent with this expectation, we find that the likelihood of floating-ratio collars declines with target firms' institutional ownership, whereas that of fixed-ratio collars increases.

Furthermore, if the information advantage leads to an increase in bargaining power, it is likely to help targets earn a relatively large share of expected synergies, we hypothesize. We examine the split of the dollar-value cumulative abnormal return ("dollar-CAR," Ahern, 2012) between bidders and targets. Our results suggest that the impact of institutional ownership on target firms' share of dollar-CARs, albeit weak unconditionally, is positive and strong among independent block-holders and institutions with a longer horizon. These results collectively lend further support to the information channel that underlies the rational payment hypothesis. That is, the information advantage that facilitates the rational payment design should ensure some economic benefits for targets and their shareholders and at the same time, reduce the demand for the costly features of merger agreements deemed substitutable or redundant.

Our study extends the extant literature in three important ways. First, it adds to the large literature examining whether the presence of institutional investors in firms' ownership structure is beneficial-or rather detrimental-to various outcomes of their portfolio firms (see, e.g., Chen, Harford, and Li, 2007; Fich, Harford, and Tran, 2015). By providing evidence that the presence of informed shareholders on the target side can change the bidding behaviors of acquirers, we shed new light on the motivation for institutional investors to exert effort when the issue in question is material. Second, we contribute to the stream of research concerned with the design of merger payment under two-sided information asymmetries(Hansen 1987; Fishman 1989; Eckbo, Giammarino, and Heinkel 1990). Stock-based mergers are prone to the problems of information asymmetry and misvaluation. We show that the information advantage of institutional investors helps mitigate these problems, thus encouraging the use of shares as a rational means of payment for mergers (Eckbo, Makaew, and Thorburn 2018). Third, our work extends the literature examining the role of institutional ownership in M&As (see, e.g., Gaspar, Massa, and Matos 2005; Harford, Jenter, and Li 2011). Unlike most studies analyzing the impact of institutional ownership on bidders' decisions, we focus our analysis on targets to show that institutional ownership significantly affects various deal outcomes. Our findings, collectively, support the notion that institutional investors can leverage their information advantage, culminating in value creation in capital markets.

1. Data

1.1 Sample

We collect all M&A transactions between the U.S. firms announced between 1984 and 2018 from the Thomson Reuters Securities Data Corporation (SDC) database. Our sample period begins in 1984 given the concern that the SDC M&A data may be less reliable (Chen, Harford, and Li 2007). We then keep the deals that meet the following criteria: the ones that (1) are coded as merger "M" or acquisition of majority interest "AM"; (2) have acquired or sought more than 50% of the target ownership; (3) have a deal value greater than [$]1 million and the ratio of the deal value to the bidder's market equity (relative size) greater than 1%; (4) are either completed or withdrawn within 1,000 days from the announcement; (5) involve public targets with the data available from the Compustat, CRSP, and Thomson Reuters Institutional Holdings 13F, respectively; and (6) involve firms in nonfinancial and non-utility industries (SIC codes outside the intervals of 6000-6999 and 4900-4999).[9] In addition, for our analysis of payment methods, we require the merger consideration to be clearly defined as stock only, cash only, or a combination of stock and cash. Applying these sample filters, we obtain our M&A sample that consists of 5,706 deals, although the sample size reduces to 3,236 deals when our analysis requires characteristics of bidders (i.e., public bidders). Appendix Table A1 describes our sample selection criteria in detail.

Figure 1 reports the time-series distribution of M&A deals by payment methods over our sample period. For ease of comparison with prior studies, these series are plotted based on our public-bidder sample (i.e., 3,236 deals between public bidders and targets). As is well known, the takeover market in the United States has reached a peak in the late 1990s and since then, the number of M&A deals has declined. The share of stock-only deals likewise has dropped significantly since this peak, from 120 deals in 1998 to below 25 in 2000 and thereafter on an annual basis. The trends observed in our sample are similar to those reported by other studies (Boone, Lie, and Liu 2014; Fich, Harford, and Tran 2015; Eckbo, Makaew, and Thorburn 2018).

1.2 Variables and summary statistics

This subsection discusses the variables employed in our empirical analyses. For ease of exposition, descriptions of instruments for our IV estimation (Section 3.2), premerger cross-holding (Section 3.4), institution-level share retention rates (Section 5.1), top M&A advisors (Section 5.2), collar agreements (Section 5.3), and expected synergies (Section 5.4) are provided in the

[9] While we begin our investigation with all types of bidders (public, private or subsidiaries), we require bidders to be public firms in order to control for bidders' characteristics in our deal-level analyses. The deal size filters are applied to exclude M&A offers that are too small to matter to institutional shareholders of target firms.

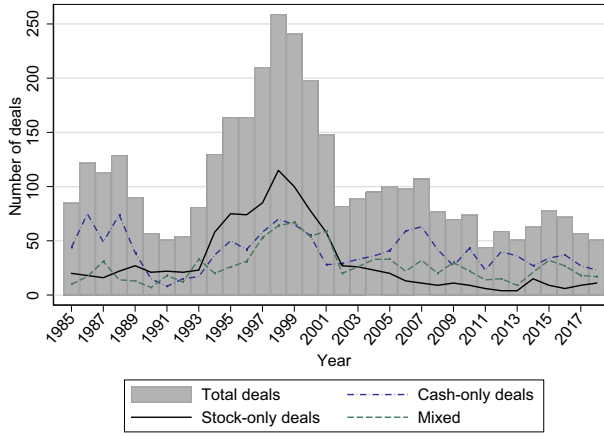

Figure 1
Time trends in M&A offers by payment methods
This figure plots time trends in M&A bids by different payment methods from 1984 to 2018. The bar graph represents the total number of bids, whereas the solid line, dash-dotted line, and dashed line, respectively, represent the numbers of bids with stock-only, cash-only, and mixed payments. The sample consists of 3,236 completed or withdrawn offers with a transaction value of no less than $1 million and target firms with institutional ownership data on Thomson Reuters 13F. Both targets and bidders are U.S. firms publicly traded on U.S. stock exchanges. Appendix Table A1 describes the sample construction procedure in detail.

corresponding sections. Appendix Table A2 provides detailed descriptions of all variables used in our study.

1.2.1 Variables for the baseline payment structure model. Our main variable of interest is the change in institutional ownership ΔIO, defined as the change in the fraction of institutional ownership in a target firm over the fiscal year prior to a deal announcement (Schmidt and Fahlenbrach 2017). Because institutional ownership may be inherently associated with certain firm characteristics (e.g., firm size), an analysis of the level of institutional ownership across firms can lead to biased inferences. Moreover, the within-firm estimation is not applicable to an M&A target sample, which is absent of the firm-year panel structure. Therefore, our choice of the differenced variable ΔIO is a relatively robust way to uncover the effect of institutional investors that we want to capture (Sias, Starks, and Titman 2006). We also check our results using different institution types, such as monitoring institutions (*Monitoring IO*, Fich, Harford, and Tran, 2015), long-term institutions (*QIX-DED IO*, Bushee, 1998), and independent blockholders (*Indep-Block IO*, Chen, Harford, and Li, 2007). Figure 2 plots the time-series change in institutional ownership over our sample period. Institutional ownership for our sample firms has continued to increase since 1984, reaching near 70% in 2018. Similar upward trends appear in different types of institutional ownership.

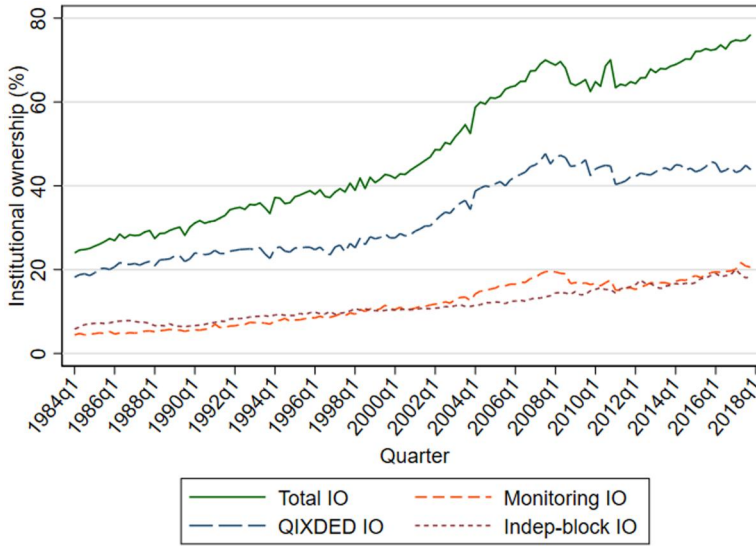

Figure 2
Time trends in institutional ownership
This figure plots time trends in institutional ownership (IO) by different types of institutional investors from 1984 and 2018. The sample consists of M&A target firms that are involved in 3,236 completed or withdrawn offers with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Both targets and bidders are U.S. firms publicly traded on U.S. stock exchanges. Appendix Table A1 describes the sample construction procedure in detail. The solid line represents total IO, whereas long-dashed, dashed, and short-dashed lines, respectively, represent QIX-DED IO, Monitoring IO, and Indep-Block IO. Appendix Table A2 defines the variables in detail.

When investigating the impact on the merger consideration structure, we focus on our "public bidder sample," namely, 3,236 M&A deals in which both bidders and targets are U.S. public firms that satisfy the sample filters described above. Our payment structure model follows Fich, Harford, and Tran (2015) to control for both deal characteristics (relative size and binary indicators, respectively, for hostile attempt, competed bid, tender offer, same four-digit SIC industry, and target termination fee) and target and bidder characteristics (firm size, leverage, cash flow, R&D, and market-to-book).

1.2.2 Proxies for information asymmetry. To examine our rational payment hypothesis that institutional ownership alleviates information asymmetry, we employ several measures of information asymmetries associated with bidders and merger transactions. First, Karpoff, Lee, and Masulis's (2013) composite index of various bidder characteristics is constructed based on the principle-component analysis of the following eight variables: firm size, tangible assets, firm age, number of analysts following, number of IPOs and SEOs, daily bid-ask spreads, daily return volatility, and abnormal accruals (for the analysis of target-side adverse selection in Section 4.3, we prepare a

"target version" of the composite index). The detailed procedure is provided in Appendix C, while the definitions of each component are in Appendix B.

Our second set of bidder-level proxies aims to capture the extent to which bidders have been active in acquisition and SEO in recent years. Eckbo, Makaew, and Thorburn (2018) point out that the information disclosed and transmitted with respect to firms' stock market activities allows outside investors to assess those firms more accurately. Therefore, the information asymmetry is likely low for firms that recently have undergone acquisitions or SEOs. We prepare a dummy variable *Recent acquisition* (*Recent SEO*) that takes a value of one if the bidder announced another takeover (issued seasoned equity) within the past 2 years.[10]

Furthermore, we follow Eckbo, Makaew, and Thorburn (2018) to construct the deal-level measures. A dummy *Local deal* captures the geographical proximity (headquarters within 30 miles), which is calculated using the spherical law of cosine following Cai, Tian, and Xia (2016).[11] A measure of interindustry relatedness *Industry complementarity* captures the extent to which the input-output flows overlap between bidders and targets at the industry level.[12] The M&A deals are expected to have a relatively low level of information asymmetry when the bidder and the target are geographically close to each other and likewise, when the two have a high complementarity.

1.2.3 Proxies for stock misvaluation. To evaluate whether the bidder opportunism associated with share mispricing might play out in facilitating stock-based offers, we employ two sets of misvaluation measures. Rhodes-Kropf, Robinson, and Viswanathan (2005) decompose market-to-book ratio *MTB* into firm-specific error and current-sector deviation from the firm long-run value. We take the median of the misvaluation component of ln[*MTB*] to partition our sample into high and low misvaluation groups. Appendix D provides the procedure and related statistics in detail.

Our second measure is the short interest ratio of bidders' stocks prior to the deal announcement. Ben-David, Drake, and Roulstone (2015) argue that stocks' short position is a superior measure of overvaluation because a mispricing measure derived in firm fundamentals is indicative of future productivity and thus may lead to confounding factors in one's analysis

[10] Our results are robust to using the 18-month window (Eckbo, Makaew, and Thorburn 2018).

[11] The latitude and longitude coordinates are from the 2000 U.S. Census Gazetteer Files. The coordinates are matched with the firm's ZIP code or the location of its city center if the former is missing. Our results hold when we use alternative cutoff values for distance (e.g., 100 km, Kedia, Panchapagesan, and Uysal (2008)).

[12] The inter-industry relatedness coefficients and the concordance table to match 4-digit SIC codes with BEA industries are obtained from Joseph P.H. Fan's website https://cuhk.edu.hk/ief/josephfan/pages/relatedness_project.html (Fan and Lang 2000). For each target-bidder pair, we then calculate the average input and output correlation to construct the variable in a similar way to Eckbo, Makaew, and Thorburn (2018)

(Rhodes-Kropf, Robinson, and Viswanathan 2005; Dong et al. 2006). Moreover, short positions are costly to build and are usually held by informed investors. Ben-David, Drake, and Roulstone (2015) show that a large short position in a bidder prior to deal announcement coincides with overvaluation of its shares and is associated with a higher probability of using shares as a means of payment. The short interest ratio is calculated as short positions established as of the settlement date (the fifteenth of each month), divided by the number of shares outstanding at the end of month reported in CRSP. We then follow Ben-David, Drake, and Roulstone (2015) and Rapach, Ringgenberg, and Zhou (2016) to construct *Adjusted short interest* 6 months prior to the announcement date to account for the trend of short interest over time.[13] We use the median to split our sample.

1.2.4 Summary statistics. Table 1 reports the summary statistics for the variables introduced. Overall, the distributions of the variables are in line with those documented in prior studies (see, e.g., Cremers, Nair, and John (2008) and Fich, Harford, and Tran (2015)). The average fraction of stock in deal consideration is 46%. More than 37% of deals in our sample have both targets and bidders operating in the same four-digit SIC industry. The proportion of tender offers in our sample is approximately 24%, comparable to 18% documented in Officer (2003) and Fich, Harford, and Tran (2015) who include financial and utility firms. Consistent with the literature, bidders typically have a larger firm size and higher market-to-book and cash flows than do targets. However, bidders and targets tend to have similar leverage ratios and R&D expenditures.

2. Probability of Receiving Stock-Based Offers

2.1 Baseline results

We first assess whether there is a link between targets' institutional ownership and the merger payment structure. We first conduct an unconditional comparison between the firms that have experienced the largest increase (top quintile) in institutional ownership in the fiscal year prior to the deal announcement and the rest. Figure 3 reports the univariate results in terms of the proportion of stock-only offers and the mean fraction of stocks in the payment structure, using our whole M&A sample (panel A) and the public bidder sample (panel B), respectively. Panel A of Figure 3 shows that both the proportion of stock-only deals (26%) and mean fraction of stocks in the payment structure (33%) are higher for the targets in the top quintile, compared with others (17% and 29%, respectively). Panel B displays similar patterns for the public bidder sample (34% vs. 28% and 49% vs. 44%).

[13] The adjusted short interest takes the difference between a firm's short interest ratio and the mean ratio for all firms traded on NYSE, AMEX, and NASDAQ. Our results are robust to using the adjusted short interest 1 month prior to announcement. The short interest data come from Compustat Monthly Securities Database.

Table 1
Summary statistics

	N	Mean	p25	p50	p75	SD
Deal characteristics						
Cash-only deals [0/1]	3.236	0.396	0.000	0.000	1.000	0.489
Stock-only deals [0/1]	3.236	0.300	0.000	0.000	1.000	0.458
Hostile deal [0/1]	3.236	0.095	0.000	0.000	0.000	0.294
Termination fee [0/1]	3.236	0.592	0.000	1.000	1.000	0.492
Competed bid [0/1]	3.236	0.116	0.000	0.000	0.000	0.321
Tender offer [0/1]	3.236	0.239	0.000	0.000	0.000	0.426
Same industry [0/1]	3.236	0.378	0.000	0.000	1.000	0.485
Relative size	3.236	0.387	0.064	0.186	0.474	0.614
Target characteristics						
Size	3.236	5.379	4.082	5.218	6.571	1.794
Market-to-book	3.236	2.886	1.187	1.947	3.300	4.448
Leverage	3.236	0.191	0.004	0.134	0.314	0.206
Cash flow	3.236	0.016	0.008	0.074	0.119	0.220
R&D	3.236	0.063	0.000	0.006	0.086	0.108
Bidder characteristics						
Size	3.236	6.949	5.508	6.985	8.353	2.078
Market-to-book	3.236	3.760	1.621	2.512	4.140	4.934
Leverage	3.236	0.200	0.034	0.167	0.300	0.185
Cash flow	3.236	0.066	0.047	0.090	0.132	0.140
R&D	3.236	0.042	0.000	0.006	0.058	0.068
Information asymmetry						
Composite index (B)	3.226	−0.030	−0.684	−0.007	0.636	0.995
Recent acquirer [0/1]	3.236	0.229	0.000	0.000	0.000	0.420
Recent SEO [0/1]	3.236	0.222	0.000	0.000	0.000	0.416
Local deal [0/1]	3.236	0.190	0.000	0.000	0.000	0.392
Industry complementary	3.202	0.656	0.280	1.000	1.000	0.375
Misvaluation of bidder shares						
RRV Model I	2.985	0.309	−0.156	0.272	0.738	0.723
RRV Model II	2.985	0.247	−0.199	0.202	0.643	0.686
RRV Model III	2.985	0.247	−0.201	0.203	0.648	0.683
Short interest ratio	3.236	0.021	0.000	0.006	0.025	0.038
Other variables						
Percentage of stock	3.236	0.459	0.000	0.394	1.000	0.449
Prob(H)	3.236	0.376	0.000	0.000	1.000	0.484
Num(H)	3.236	0.422	0.000	0.000	1.000	0.587
Collar	1.921	0.117	0.000	0.000	0.000	0.321
Floating ER	1.921	0.075	0.000	0.000	0.000	0.264
Target $CAR	3.120	4.416	−0.243	3.198	8.206	9.057

This table reports summary statistics for the variables used in our analysis. The sample of M&A target firms that are involved in 3,236 completed or withdrawn offers with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Both targets and bidders are U.S. firms publicly traded on U.S. stock exchanges. The sample period spans from 1984 to 2018. Appendix Table A1 describes the sample construction procedure in detail. All continuous variables are winsorized at the 1^{st} and 99^{th} percentiles. Appendix Table A2 defines the variables.

The prima facie evidence for stock-based merger bids leads to our formal investigation. To examine the likelihood of stock-based offers, we estimate a multinomial logit model, where the dependent variable is an indicator that takes the values of zero, one, and two, respectively, if the payment design of the deal in question is cash-only (base outcome), mixed, and stock-only. We also estimate a tobit model to examine the proportion of stock as the dependent variable. Table 2 reports the results using our entire M&A sample (columns 1-3) and the public bidder sample (columns 4-6), with the Tobit results

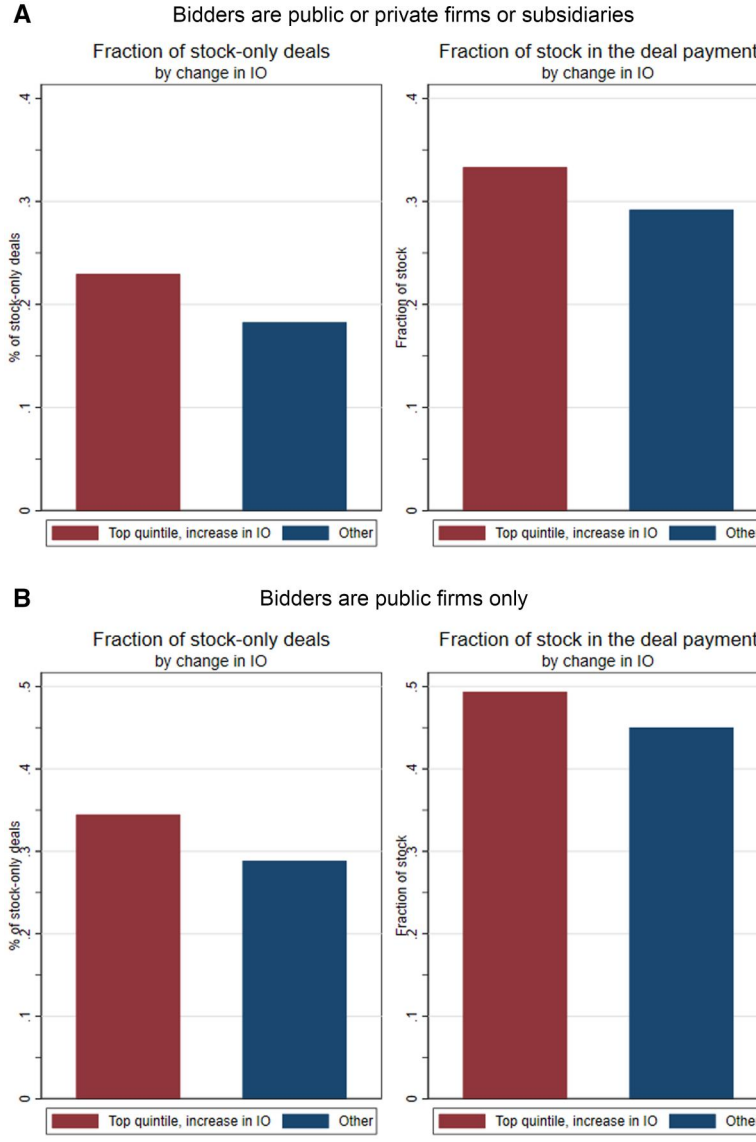

Figure 3
Institutional ownership and stock payments in M&A offers
This figure plots the fraction of stock-only offers (left) and the percentage of stock in payment structure, to compare firms in the top quintile of increase in institutional ownership with the rest. In panel A (panel B), the sample consists of 5,706 (3,236) completed or withdrawn offers in which bidders are U.S. public or private firms or subsidiaries (public firms only). Both targets and bidders are U.S. firms. Appendix Table A1 describes the sample construction procedure in detail.

Table 2
Targets' institutional ownership and the consideration structure

	Bidder ∈ [Pub,Pri,Sub]			Bidder ∈ [Public]		
	Multinomial logit		Tobit	Multinomial logit		Tobit
	Mixed (1)	Stock-only (2)	%stock (3)	Mixed (4)	Stock-only (5)	%stock (6)
ΔIO	0.114	0.896**	0.109**	−0.009	1.092**	0.146***
	(.766)	(.023)	(.016)	(.986)	(.041)	(.010)
Deal characteristics						
Hostile deal [0/1]	−0.345***	−1.164***	−0.104***	−0.773***	−1.680***	−0.179***
	(.010)	(.000)	(.000)	(.000)	(.000)	(.000)
Termination fee [0/1]	0.411***	0.359***	0.053***	0.380***	0.312**	0.038**
	(.000)	(.000)	(.000)	(.008)	(.032)	(.016)
Competed bid [0/1]	−0.108	−0.940***	−0.084***	−0.261	−0.786***	−0.073***
	(.353)	(.000)	(.000)	(.138)	(.000)	(.000)
Tender offer [0/1]	−1.576***	−3.723***	−0.327***	−2.146***	−3.945***	−0.437***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Same industry [0/1]	0.814***	0.839***	0.109***	0.228*	0.115	0.010
	(.000)	(.000)	(.000)	(.053)	(.344)	(.438)
Relative size				0.159	0.003	−0.026**
				(.186)	(.983)	(.042)
Size	0.414***	0.192***	0.025***	0.601***	0.517***	0.058***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Target characteristics						
Size	0.414***	0.192***	0.025***	0.601***	0.517***	0.058***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Market-to-book	0.031***	0.058***	0.008***	0.039***	0.064***	0.006***
	(.002)	(.000)	(.000)	(.006)	(.000)	(.000)
Leverage	0.256	−1.022***	−0.116***	0.116	−1.293***	−0.168***
	(.228)	(.000)	(.000)	(.707)	(.000)	(.000)
Cash flow	−0.831***	−0.838***	−0.122***	−0.420	−0.292	−0.025
	(.001)	(.000)	(.000)	(.252)	(.415)	(.501)
R&D	0.964	1.186**	0.187***	0.192	0.550	0.087
	(.135)	(.032)	(.005)	(.839)	(.535)	(.349)
Bidder characteristics						
Size				−0.366***	−0.440***	−0.053***
				(.000)	(.000)	(.000)
Market-to-book				0.008	0.036***	0.004***
				(.559)	(.010)	(.007)
Leverage				0.008	−0.468	−0.060
				(.980)	(.184)	(.115)
Cash flow				−2.591***	−3.164***	−0.265***
				(.000)	(.000)	(.000)
R&D				1.591	2.207	0.197
				(.274)	(.110)	(.134)
Industry & Year FE	Yes		Yes	Yes		Yes
N	5,706		5,706	3,236		3,236
Pseudo R^2	.251		.348	.310		.455

This table reports the regression results of testing the impact of targets' institutional ownership on the extent to which stock payment is used in a takeover offer. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. In columns 1-3 (columns 4-6), bidders are U.S. public or private firms or subsidiaries (public firms). Appendix Table A1 describes the sample construction procedure in detail. In columns 1, 2, 4, and 5, the multinomial logit model is estimated, where the dependent variable is set to one or two, respectively, if a firm receives a cash-stock mixed bid and a stock-only bid, each evaluated against the base case (cash-only bid). In columns 3 and 6, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

in columns 3 and 6. The multinomial logit results suggest that targets' institutional ownership indeed increases the probability of stock-only offers.[14] Similarly, the tobit results confirm that institutional ownership facilitates the bidders' use of shares as a means of merger payment. The results are qualitatively the same when our public bidder sample of 3,236 deals is used.

Given the asymmetric information problem and potential mispricing associated with bidders' shares, a target would consider a stock-based offer only if such a problem could be mitigated. The bidder likewise would only put a stock offer on the table when it expects the target to be able to evaluate its offer fairly. Does the positive association we find thus suggest the information advantage of targets' shareholders that helps mitigate the problem, or something else? In Section 4, we return to this economic mechanism and other potential channels in more detail.

2.2 IV estimation

To support the causal interpretation of the impact of institutional ownership we find, we use the instrumental variable (IV) approach. Although we focus our analysis on the change of institutional ownership in an attempt to mitigate a mechanistic correlation between the level of institutional ownership and takeover outcome, endogeneity concerns arguably remain because some unobservable factors might affect both variables. For example, cost-effective or innovative firms may attract institutional money and potential bidders at the same time. To address these concerns, we use the reconstitution of the Russell indices as a source of exogenous variation in institutional ownership (Chang, Hong, and Liskovich 2015; Appel, Gormley, and Keim 2016; Crane, Michenaud, and Weston 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 indices.[15] Since the membership assignment relies only on the end-of-May market capitalization of each stock, an event of Russell 1000/2000 membership switch is plausibly exogenous to firm characteristics and other confounding factors. That is, a firm's certain characteristics that attract stock offers are unlikely to induce a change in the firm'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

[14] We also conduct a test of the probability of becoming a target using a firm-year panel sample (Table A5). The results show that firms' institutional ownership has a positive impact on such a likelihood. However, we obtain a statistically significant estimate only for the stock-payment case, which primarily contributes to the significance for our full-sample result. Therefore, consistent with our findings reported in Table 2, the analysis of a panel sample suggests that firms with a relatively high institutional ownership are more likely to encourage bidders to make stock-based merger offers.

[15] On the "rank day", which is at the end of May each year, Russell assigns index membership based on the market capitalization of stocks. The largest 1,000 stocks (ranked 1 to 1,000) and next 2,000 stocks comprise Russell 1000 and Russell 2000, respectively. The annual reconstitution occurs at the end of June using index weights based on the float-adjusted market capitalization of member stocks. The purpose of the float adjustment is to "include only those shares available to the public" (FTSE Russell, 2019, pp.23–24).

1000. Therefore, a switch from Russell 1000 to Russell 2000 leads to an increase in stock holdings by institutions tracking the Russell indices, whereas a switch from Russell 2000 to Russell 1000 results in a decrease in such holdings.

Panel A of Figure 4 illustrates the discontinuity in institutional ownership in the end-of-May market-cap rank around the Russell 1000/2000 Index threshold for our sample period (left panel) and the Russell prebanding policy period.[16] In panel B, the upper-left panel plots the takeover likelihood against the end-of-May market-cap rank around the threshold, while the other three, respectively, the likelihood of different payment types. These plots suggest that firms switching to the Russell 2000 are more likely to receive a takeover bid, with the discontinuity around the threshold, and the effect is more pronounced in the cases of stock-based bids.

Following Fich, Harford, and Tran (2015) and Schmidt and Fahlenbrach (2017), we use the 2SLS framework to examine the impact of institutional ownership on the likelihood of stock-based offers. Table 3 reports the estimation results. The number of observations decreases by about 30% due to the additional data requirement that target firms are Russell index constituents. The first-stage results show that the switch from the Russel 2000 to Russell 1000 results in a decrease in institutional ownership, consistent with the intuition discussed. We also include a change in the May market-cap rank and its squared term to account for the variation of institutional ownership associated with firm size. This is because a positive relationship between the market-cap rank (inverse of the rank value) and institutional ownership is generally expected. Kleibergen-Paap F-stat 19.6 suggests the relevance condition of instruments is satisfied.

The IV second-stage results in Table 3 buttress our findings reported in Table 2.[17] That is, exogenous variation in institutional ownership of target firms leads to a positive impact on the likelihood of receiving stock-based offers. Overall, our IV results lend support to the causal interpretation of our finding that institution ownership of targets facilitates the bidders' use of their shares as the merger payment.

2.3 Types of institutional investors

This subsection examines potential heterogeneities across different types of institutional investors. As discussed in the introduction, our prediction is not contingent on specific traits of institutions as a necessary condition, because it builds on the assumption that the episode of becoming a merger target yields

[16] Since 2007, Russell initiated the banding policy for reconstitution where firms close to the cutoff threshold do not automatically switch to the new index if its market capitalization does not deviate beyond the 2.5% banding thresholds on either side of the thresholds.

[17] In untabulated results, we find similar results when we use our public bidder sample. We also find our IV results robust to using the sample prior to FTSE Russell's "banding policy" started in 2007, which may degrade the validity of the index switch as an instrument.

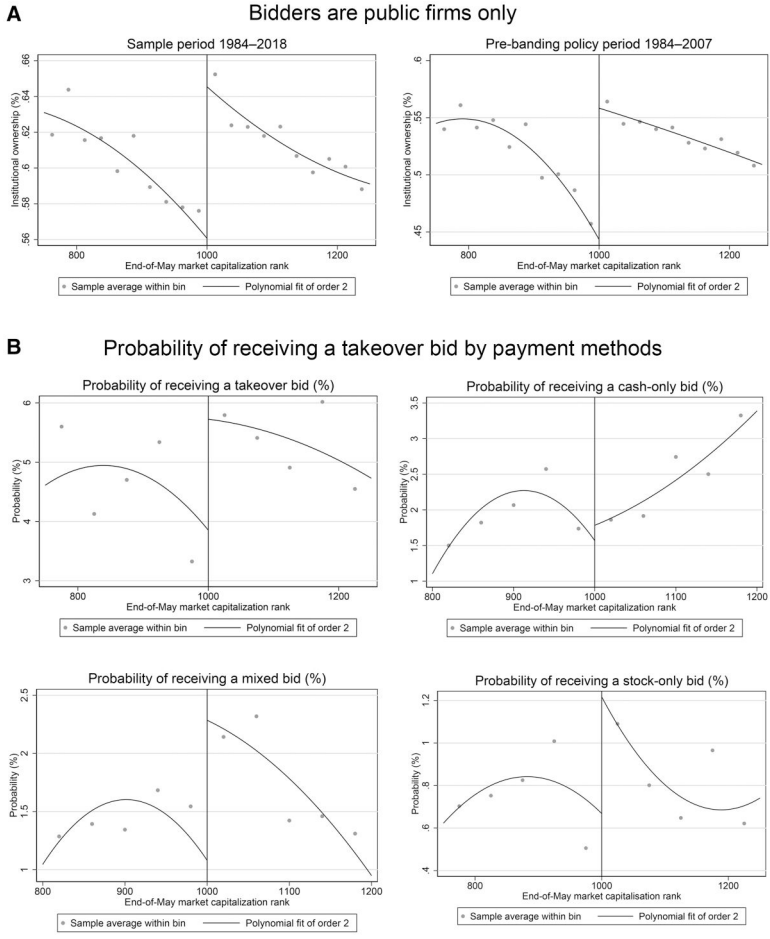

Figure 4
Discontinuities in institutional ownership and the targetiveness around the Russell 1000/2000 threshold
This figure plots institutional ownership (panel A) and the probability of receiving a takeover bid (panel B) around the Russell 1000/2000 threshold, that is, $1,000^{th}$ in the end-of-May market capitalization rank, for the stocks ranked 750^{th}-$1,250^{th}$. Panel A reports the distribution of institutional ownership against the May market-cap rank for the baseline sample period 1984-2018 and the prebanding policy period 1984-2007. Panel B presents the probability of receiving a takeover bid against the May market-cap rank, based on all payment type (upper-left panel), cash-only bids (upper-right), cash-stock mixed bids (lower-left), and stock-only bids, respectively. The sample consists of firm-year observations from 1984 to 2018 from the Compustat, and the M&A targets in the sample are the firms that are involved in completed or withdrawn offers with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public or private firms or subsidiaries. Appendix Table A1 describes the sample construction procedure in detail.

significant consequences that motivate institutions to leverage their information advantage, even the ones with no such incentive in normal circumstances. However, given prior evidence of heterogeneities across institutions in their influences on investee firms' policies and outcomes, the salience of the impact

Table 3
IV estimation using Russell index reconstitution

	Pr[Stock-only bid]		%stock
	1^{st} stage (1)	2^{nd} stage (2)	2^{nd} stage (3)
ΔIO		0.867***	0.522*
		(.009)	(.082)
$R1000_{t-1} \rightarrow R2000_t$	−0.003		
	(.839)		
$R2000_{t-1} \rightarrow R1000_t$	−0.025**		
	(.016)		
$\Delta Rank_t$	0.005***		
	(.000)		
$(\Delta Rank_t)^2$	0.000		
	(.252)		
$\ln(mktcap_{May})$	0.007**	0.032***	0.052***
	(.013)	(.001)	(.000)
Hostile deal [0/1]	0.002	−0.094***	−0.120***
	(.676)	(.000)	(.000)
Termination fee [0/1]	0.011***	0.007	0.025*
	(.009)	(.651)	(.081)
Competed bid [0/1]	−0.000	−0.055***	−0.069***
	(.943)	(.000)	(.000)
Tender offer [0/1]	−0.007*	−0.213***	−0.316***
	(.062)	(.000)	(.000)
Same industry [0/1]	0.008**	0.060***	0.110***
	(.034)	(.000)	(.000)
Relative size	−0.012***	−0.029***	−0.020*
	(.000)	(.009)	(.078)
Size	0.002***	0.002	0.003**
	(.000)	(.325)	(.048)
Market-to-book	0.010	−0.068**	−0.017
	(.336)	(.034)	(.614)
Leverage	0.055***	−0.056	−0.096**
	(.000)	(.215)	(.031)
Cash flow	−0.048	0.292***	0.256***
	(.120)	(.004)	(.007)
R&D	−0.048	0.292***	0.256***
	(.120)	(.004)	(.007)
Industry & Year FE	Yes	Yes	Yes
N	4,036	4,036	4,036
Adjusted R^2		.16	.32
Weak-instrument test: H0 = weak instrument			
Kleibergen-Paap F-stat	19.593		

This table reports the IV estimation results of testing the impact of targets' institutional ownership on the probability of receiving a stock-only offer and the extent to which stock payment is used in a takeover offer. Column 1 reports the first stage result, and columns 2 and 3, respectively, the second-stage results for the likelihood of receiving a takeover offer and that of a stock-for-stock offer. The sample consists of M&A target firms. Appendix Table A1 describes the sample construction procedure in detail although the sample size is smaller, compared with Tables 1 and 2, due to further exclusion of non-Russell index members. Appendix Table A2 defines the variables, and Appendix E describes the IV method and the instruments.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

we find may likewise vary to some extent. The related literature documents that such an incentive is stronger when the institution holds a large block ownership (*Indep-Block IO*, Chen, Harford, and Li, 2007), has a relatively long horizon (*QIX-DED IO*, Bushee, 1998), and has invested in the shares of

Table 4
Different types of institutions

	Dependent variable = Percentage of stock			
	(1)	(2)	(3)	(4)
ΔIO	0.146***			
	(.010)			
ΔMonitoring IO		0.168*		
		(.082)		
ΔNonmonitoring IO		0.123**		
		(.035)		
ΔQIX-DED IO			0.133*	
			(.066)	
ΔTRA IO			0.106	
			(.221)	
ΔIndep-block IO				0.405**
				(.037)
ΔNon-indep-block IO				0.143**
				(.011)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	3,236	3,236	3,236	3,236
Pseudo R^2	.455	.455	.455	.455

This table reports the regression results of testing the impact of different types of institutional ownership on the use of stock as the merger payment. In all cases, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

firms that constitute a significant weight of its portfolios (*Mornitoring IO*, Fich, Harford, and Tran, 2015). Table 4 reports in columns 2-4 the results of our tobit analysis using these measures, respectively, whereas its column 1 displays the coefficient reported in column 6 of Table 2 for ease of comparison.

The results show that although the institutions with the described characteristics seem to contribute more to the relationship we find, their counterpart types do generate the positive impact on the likelihood of stock-based merger offers. The only exception is the short-horizon institutions, for which the result is statistically insignificant, presumably relating to the transient nature of their investment strategies (Bushee 1998). Overall, these results support our prediction that the impact on stock-based offers does not critically hinge upon certain characteristics of institutions.

2.4 Controlling for premerger cross-holding and other considerations

To further ensure the robustness of our findings, we consider various other factors. First of all, given the focus of our study, we control for the potential impact of institutions' cross-holding of bidders and targets. In the M&A

context, cross-holding is established when an institutional investor holds the shares of both the target and the bidder of a merger prior to the merger announcement. As documented in prior literature, cross-holding institutions are presumably well informed about the merger deals in question (Matvos and Ostrovsky 2008; Harford, Jenter, and Li 2011; Brooks, Chen, and Zeng 2018). Therefore, we ensure that the impact of target firms' institutional ownership on stock-based offers we find is not an artifact of that of institutional cross-holding.

Table 5 reports our tobit estimation results that account for institutional cross-holding. Following prior studies, we employ several measures of cross-holding (Matvos and Ostrovsky 2008; Brooks, Chen, and Zeng 2018). We use the numbers of top-5, −10, and −20 cross-holding institutions (*Top-5/-10/-20*), respectively, in columns 1 through 3 and targets' institutional ownership represented by cross-holding institutions *Target Cross IO* and such ownership with at least 1% in both the target and the bidder *Target Cross IO*[1 pct], respectively, in columns 5 and 6. Across all measures, the coefficient for targets' institutional ownership remains statistically significant and its economic magnitude is similar to the one reported in Table 2.[18] These results show that the cross-holding effect does not explain away the impact of targets' institutional ownership we find.

In addition, we consider a battery of additional factors. Various deal characteristics considered include toehold, lockup provision, prior bidding, and merger of equals. Industry and market characteristics include competitive industry, high-tech industry, 1-year macroeconomic change, and target Herfindahl-Hirschman index. We also consider market-adjusted returns of targets and bidders and the inverse Mills ratio (Heckman 1979) estimated from the targetiveness model using a firm-year panel sample (i.e., a probit model of the likelihood of becoming a target). Our results (untabulated for brevity) remain qualitatively the same when these factors are accounted for.

3. Evidence of the Mitigation of Information Problems

Having uncovered a strong impact of target firms' institutional ownership on the merger payment structure, we now turn to examining the economic mechanism underlying our finding. To the extent that institutional investors have information advantages concerning M&A deals, the theory of rational payment design (Eckbo, Makaew, and Thorburn 2018) suggests that the impact of institutional ownership we find should be stronger when information asymmetries associated with bidders and merger deals are more severe. In this section, we conduct a series of analyses to test both our hypothesis and alternative possibilities.

[18] Our results also hold (unreported) when we include *Bidder cross IO* or *Bidder cross IO*[1 pct]; that is, bidders' institutional ownership represented by cross-holding institutions.

Table 5
Institutions' cross-holdings of bidders and targets

	Dependent variable = Percentage of stock				
	(1)	(2)	(3)	(4)	(5)
ΔIO	0.147**	0.152***	0.142**	0.130**	0.135**
	(.010)	(.008)	(.013)	(.024)	(.019)
Cross top-5 count	0.013*				
	(.059)				
Cross top-10 count		0.011**			
		(.012)			
Cross top-20 count			0.011***		
			(.000)		
Target cross IO				0.104**	
				(.017)	
Target cross IO [1 pct]					0.198***
					(.007)
Deal characteristics					
Hostile deal [0/1]	−0.177***	−0.176***	−0.176***	−0.180***	−0.179***
	(.000)	(.000)	(.000)	(.000)	(.000)
Termination fee [0/1]	0.040**	0.041**	0.039**	0.038**	0.038**
	(.013)	(.012)	(.014)	(.019)	(.017)
Competed bid [0/1]	−0.073***	−0.074***	−0.075***	−0.074***	−0.073***
	(.000)	(.000)	(.000)	(.000)	(.000)
Tender offer [0/1]	−0.431***	−0.431***	−0.430***	−0.432***	−0.431***
	(.000)	(.000)	(.000)	(.000)	(.000)
Same industry [0/1]	0.006	0.004	0.002	0.005	0.004
	(.678)	(.740)	(.864)	(.731)	(.761)
Relative size	−0.021	−0.020	−0.019	−0.019	−0.019
	(.125)	(.141)	(.155)	(.147)	(.157)
Target characteristics					
Size	0.057***	0.055***	0.049***	0.053***	0.054***
	(.000)	(.000)	(.000)	(.000)	(.000)
Market-to-book	0.007***	0.007***	0.006***	0.007***	0.007***
	(.000)	(.000)	(.000)	(.000)	(.000)
Leverage	−0.156***	−0.154***	−0.142***	−0.153***	−0.155***
	(.000)	(.000)	(.000)	(.000)	(.000)
Cash flow	0.002	0.003	0.005	−0.005	−0.005
	(.958)	(.930)	(.890)	(.904)	(.902)
R&D	0.107	0.101	0.091	0.106	0.103
	(.266)	(.293)	(.340)	(.267)	(.283)
Bidder characteristics					
Size	−0.055***	−0.055***	−0.055***	−0.058***	−0.055***
	(.000)	(.000)	(.000)	(.000)	(.000)
Market-to-book	0.003**	0.003**	0.003**	0.003*	0.003**
	(.049)	(.045)	(.047)	(.060)	(.046)
Leverage	−0.071*	−0.069*	−0.062	−0.065	−0.070*
	(.071)	(.080)	(.113)	(.100)	(.076)
Cash flow	−0.332***	−0.331***	−0.323***	−0.340***	−0.337***
	(.000)	(.000)	(.000)	(.000)	(.000)
R&D	0.167	0.156	0.147	0.144	0.159
	(.225)	(.256)	(.283)	(.296)	(.248)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
N	3,088	3,088	3,088	3,088	3,088
Pseudo R^2	.462	.463	.466	.463	.463

This table reports the regression results of testing whether the relationship between targets' institutional ownership and the use of stock as the merger payment is assumed away by institutions' cross-holding of both bidder and target. Institutional cross-holding is measured by either the fraction of ownership held by a target's institutional shareholders that own—that is, cross-hold—shares of the bidder or the number of top-5/-10/-20 institutional shareholders that cross-hold both target and bidder. In all cases, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

3.1 Stock-based offers with high information asymmetry

To evaluate the key premise of our hypothesis, we first examine takeover payment structure in the presence of asymmetric information. In a typical scenario of a merger offer, information friction makes it difficult for the shareholders of a target firm to assess the offer made with the bidder's shares as the merger payment. The information problem would then discourage the target from considering stock-based merger offers and likewise rational bidders from offering their shares as the payment. A rational bidder would make a stock-based offer only if the target's shareholders are correctly informed about the value of the bidder shares (Eckbo, Makaew, and Thorburn 2018).[19] Therefore, if the link between the target institutional ownership and stock-based offers we find reflects a mitigation of information asymmetries as predicted by the rational payment argument, the mitigation effect should be derived primarily from those M&A deals with a high level of asymmetries, we hypothesize.

We employ various empirical proxies, as introduced in Section 2, to capture information asymmetries associated with bidders and merger deals. Table 6 reports our results based on these measures, respectively, Karpoff, Lee, and Masulis's (2013) composite index (panel A), recent acquisition and recent SEO dummies (panel B), and local deal dummy and industry complementarity (panel C). Consistent with our prediction, the results show that the impact of targets' institutional ownership on stock payment is more pronounced when bidders and deals are characterized as having a relatively high level of information asymmetries. Panel A, for example, shows that a 1% increase in institutional ownership leads to a 29.2% increase in the fraction of stocks in the payment when the bidder is more opaque. In contrast, we find that for the bidders and deals with low information asymmetries, the effect of targets' institutional ownership becomes economically and statistically insignificant. We find similar contrasts in panels B and C, based on other proxies. The effect is concentrated in those merger offers initiated by the bidders that have no record of acquisition or SEO in 2 years prior to the deal announcement, that are located far from the target, or that operate in industries that are less complementary to that of the target.

These results together support the notion of rational payment design, which predicts that well-informed shareholders on the target side alleviate the asymmetric information problem that would otherwise discourage bidders from making stock-based merger offers. Consistent with the prediction, such a mitigation effect is strongest when the asymmetric information problem is most severe.

[19] As discussed, the subsequent subsections evaluate alternative possibilities, most notably the bidder opportunism hypothesis, which predicts that bidders take advantage of information asymmetries to use their overvalued shares as the merger payment.

Table 6
Information asymmetry and the stock-based payment

A. Composite proxy for bidder information asymmetry

	Low information asymmetry (1)	High information asymmetry (2)
ΔIO	0.025	0.292***
	(.751)	(.000)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1,630	1,599
Pseudo R^2	.475	.481

B. Other proxies for bidder information asymmetry

	Recent acquisitions [0/1]		Recent SEO [0/1]	
	Recent (1)	Nonrecent (2)	Recent (3)	Nonrecent (4)
ΔIO	0.058	0.178***	0.090	0.156**
	(.604)	(.006)	(.423)	(.016)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	740	2,496	720	2,516
Pseudo R^2	.635	.460	.592	.461

C. Proxies for deal-level information asymmetry

	Local deal [0/1]		Industry complementarity	
	Local (1)	Nonlocal (2)	High (3)	Low (4)
ΔIO	0.037	0.182***	0.094	0.197**
	(.766)	(.004)	(.201)	(.027)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	615	2,621	1,725	1,511
Pseudo R^2	.632	.459	.514	.454

This table reports the regression results of testing the role of information asymmetry in the relationship between targets' institutional ownership and the use of stock as the merger payment. As indicated in the panel headers, different measures of information asymmetries associated with M&A bidders and deals are used to classify firms into high and low information asymmetry subgroups. The medians of each measure are used. In all cases, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables, and Appendix C describes the composite index in detail.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

3.2 Does misvaluation prompt bidders with asymmetric information to offer their shares?

In this subsection and the next, we evaluate alternative economic mechanisms that might explain our finding. We begin by examining the bidder

opportunism hypothesis, presumably one of the most notable such possibilities. Contrary to the rational payment design, the bidder opportunism hypothesis assumes that bidders can take advantage of information asymmetries to sell their overvalued shares to targets and reap the benefit at the expense of the targets' shareholders (Shleifer and Vishny 2003; Rhodes-Kropf, Robinson, and Viswanathan 2005). If the bidder opportunism indeed played a role in our prior analyses, our results could be seen as suggesting that institutional ownership on the target side invited more stock-based offers, including the ones with overpriced shares.

To evaluate whether bidder opportunism is a mechanism at play in our results, we employ well-established empirical proxies of share mispricing. We examine whether the impact of targets' institutional ownership is omnipresent or only shows up when the bidders' shares are fairly priced. Table 7 reports our results based on Rhodes-Kropf, Robinson, and Viswanathan's (2005) market-to-book decomposition methods (panel A) and Ben-David, Drake, and Roulstone's (2015) short interest ratio (panel B). To the extent that institutional investors have an information advantage to detect overpriced shares, we expect the positive impact of targets' institutional ownership on stock-based offers to be concentrated in the low mispricing subgroup. Consistent with this expectation, we find that the coefficient on institutional ownership is indifferent from zero for the high mispricing group, whereas it is positive and significant both economically and statistically when the bidders' shares are relatively fairly priced. In column 6 of panel A, for instance, we see that a 1% increase in a target's institutional ownership leads to a 28% increase in the fraction of stock in the bidder's payment, which translates to an increase from the sample mean by 13%. The results are consistent across different sample stratification methods (three market to book decomposition models and the short interest ratio).[20]

These results therefore address the potential concern that the bidder opportunism might explain the positive relationship between targets' institutional ownership and stock-based merger offers. Our findings instead suggest that the bidders with overpriced shares tend to—presumably rationally—avoid using their shares as the merger payment when the target has a strong presence of institutional ownership.

3.3 Does target-side adverse selection discourage bidders from making cash offers?

As the next step, we explore the possibility that the asymmetric information problem originating from target firms may account for our finding. As discussed in the introduction, takeover bidders may be discouraged from using

[20] We perform further robustness checks, such as excluding 2008 to account for the effect of staggered introduction of short-selling ban and excluding the hot market period 1995-2000 to differentiate the short-position proxy from the marketwide overvaluation (Boehmer, Jones, and Zhang 2013). Our results (unreported) are robust to these changes.

Table 7
Stock mispricing

A. Rhodes-Kropf, Robinson, and Viswanathan (2005) market-to-book decomposition

RRV-Misvaluation	Model I		Model II		Model III	
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
ΔIO	0.099 (.195)	0.222** (.015)	0.067 (.383)	0.267*** (.003)	0.081 (.294)	0.277*** (.002)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	1,491	1,473	1,494	1,472	1,493	1,471
Pseudo R^2	.585	.418	.569	.431	.573	.424

B. Bidder short-selling intensity

	High (1)	Low (2)
ΔIO	− 0.009 (.911)	0.336*** (.000)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1,635	1,601
Pseudo R^2	.452	.505

This table reports the regression results of testing whether the relationship between targets' institutional ownership and the use of stock as the merger payment is driven by bidders with overpriced shares. As indicated in the panel headers, different measures of stock mispricing associated with M&A bidders are used to classify firms into high and low mispricing subgroups. The annual median of sum of firm-specific error and time-series sector error and that of adjusted short interest ratio, respectively, are used in panels A and B. In all cases, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables, and Appendix D describes the market-to-book decomposition procedure in detail.
$^{*}p < .1$; $^{**}p < .05$; $^{***}p < .01$ (based on standard errors robust to clustering at the firm level).

cash as a means of payment because they, just like buyers of trades, may be uneasy about the overvaluation of a target firm's assets that are up for sale. The bidders' concern over the target-side adverse selection risk is likely to intensify when the target's shareholders-the seller-are correctly informed about the value of the target, whereas it is difficult for bidders to assess. Interestingly, the target-side adverse selection can yield the "same" prediction—the positive relationship reported in Section 3—as that of the rational payment hypothesis. Yet, the two hypotheses are grounded in different bases: The target-side adverse selection hypothesis predicts that the information advantage of target shareholders imposes a constraint on bidders' option to use cash as a means of payment, whereas the rational payment hypothesis argues that it eases the constraint on their option to use stocks. Given the dual nature of the information problem immanent in merger transactions, one's attempt to isolate one effect from the other in an empirical test may be

unwarranted. Although our result is not exempt from the same caveat, our analysis conditioned on both bidder and target-side information asymmetries helps disentangle the two intertwined effects.

Our analysis proceeds in two steps. We first investigate the impact of target firms' institutional ownership on stock offers in conjunction with target firms' asymmetric information, using the "target version" of the composite index for information asymmetries (see Section 2.2 for the construct details). The results reported in panel A of Table 8 show that the positive impact of targets' institutional ownership on stock-based offers is pronounced for those with high information asymmetries, consistent with the possibility that adverse selection discourages bidders from making cash offers when they trade with informed sellers whose assets are difficult to value. However, the full picture of this story is obtained from our results based on double conditioning, reported in panel B. To elaborate, in panel B, the deal observations are sorted into four groups, namely, low-asymmetry bidders with low and high-asymmetry targets (columns 1 and 2) and high-asymmetry bidders with low and high-asymmetry targets (columns 3 and 4). The result in column 2 indicates that the impact of institutional ownership on stock-based offers is no longer present when low-asymmetry bidders are paired with high-asymmetry targets, whereas columns 3 and 4 show that the effect remains strong for high-asymmetry bidders, regardless of targets' information asymmetries.

Collectively, these results suggest that although it may be attributable in part to the target-side adverse selection, the information effect we find stems primarily from those merger deals offered by high-asymmetry bidders. Our findings therefore support the notion that the information advantage of targets' institutional investors facilitates the rational payment design, thereby creating the space for high-asymmetry bidders-who would otherwise have used more cash-to use more stock offers.

4. Further Evidence of the Information Advantage of Institutional Investors

This section provides corroborating evidence for the information advantage of institutional shareholders. Our follow-up analysis explores a variety of different angles aimed at the benefits that naturally arise from such a merit. We begin by examining whether it enables institutions themselves to derive enhanced portfolio returns directly from merger events (Section 5.1). Additionally, we examine whether target firms-with their information advantage and bargaining power gains-can earn some economic benefits associated with mergers (Sections 5.2-5.4).

4.1 Institutions' share-retention decision around mergers

If institutional investors can make an informed assessment of mergers and the pairs of firms to be combined, they are likely to leverage it to benefit directly

Table 8
Information asymmetry and target-side adverse selection risk

A. Composite proxy for target information asymmetry

	Low information asymmetry (1)	High information asymmetry (2)
ΔIO	0.068	0.233***
	(.394)	(.005)
Deal/Target/Bidder controls	Yes	Yes
Industry & Year FE	Yes	Yes
N	1,568	1,551
Pseudo R^2	.520	.465

B. Two-sided information asymmetry

	$Low^B + Low^T$ (1)	$Low^B + High^T$ (2)	$High^B + Low^T$ (3)	$High^B + High^T$ (4)
ΔIO	−0.016	0.173	0.280*	0.309***
	(.861)	(.282)	(.056)	(.001)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	1,148	419	417	1,128
Pseudo R^2	.555	.547	.731	.479

This table reports the regression results of testing the effect of target-side adverse selection risk under information asymmetry in the relationship between targets' institutional ownership and the use of stock as the merger payment. As indicated in the panel headers, the composite proxy for information asymmetries associated with M&A targets (panel A), and targets and bidders (panel B) are used to classify firms into high and low information asymmetry subgroups. The medians of each measure are used. In all cases, the tobit model is estimated, where the dependent variable is the fraction of stock in the consideration structure. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables, and Appendix C describes the composite index in detail.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

from shareholding decisions around the mergers. We use the investor-level data to examine this prediction. The potential merger synergy is arguably one of the most crucial elements for the targets' shareholders to consider when deciding whether to hold on to the shares of the to-be-combined firms. Anticipating such a scenario, institutional shareholders have an incentive to carefully assess the merger synergies. The institutions with this information are then expected to retain the shares selectively, only if the mergers are value-creating for the to-be-combined firms. An analysis of the institutions' share retention decision around mergers thus allows us to assess whether they ex ante process the information concerning merger synergies and act accordingly.

To this end, we follow Burch, Nanda, and Silveri (2012) to examine both the post-completion retention rate and precompletion retention rate.[21] The

[21] Both measures are winsorized at the 1% level in both tails. The mean and median post-completion (precompletion) retention rates are 54% and 0% (55% and 54%) in our stock-for-stock deal sample, similar to Burch, Nanda, and Silveri (2012).

post-completion retention rate is the number of bidder shares owned by an institution two quarters after the deal completion, divided by the number of bidder shares owned by the institution as the result of the stock-based merger.[22] Similarly, the precompletion retention rate (between the announcement and the completion of a merger) is defined as the number of target shares owned at the latest quarter before the deal completion date, divided by the number of target shares owned at the latest quarter before the deal announcement. The precompletion retention rate is used to account for possible trading strategies by institutional investors around an announcement that may affect the post-completion retention rate. To wit, investors' selling activities could already be under way before the merger is completed (Burch, Nanda, and Silveri 2012), and the investors with no intention to hold-as the result of the stock merger-shares of the bidder would choose to sell their shares of the target firm before the stock swap takes place. Some investors might prefer this strategy because the target firms' share price gains are usually large at the deal announcement and the combined firms' stocks may perform poorly after the deal completion. Such a strategy could then bias the post-completion retention rate. In contrast, the precompletion retention rate suffers little from this issue.

Table 9 reports our results for the whole sample (panel A) and the subsamples based on deal synergies (panels B and C). We restrict our attention to the institutions that own at least 1% of a target firm-and no bidder shares-prior to the announcement of a stock-for-stock deal (Burch, Nanda, and Silveri 2012). Such a sample allows us to investigate the actions taken by those institutions that have incentives to carefully evaluate the merger offers in question. The change in the institution-level ownership of a target firm $\Delta IO[inst]$ is measured as a four-quarter change before the date of deal announcement. From our whole sample results in panel A of Table 9, we see that the institutions that have increased their holdings in a target firm before the announcement, retain more shares of the merged firm (post-completion retention) and the target firm (precompletion retention) in stock-for-stock deal.[23] The institutions whose ownership of a target firm has increased before the announcement and also retained more shares ex post, seem to have formed a more favorable view on the potential merger synergies.

[22] The number of bidder shares that a target's institutional shareholder would own, as the result of a stock merger, is estimated based on its share ownership of the target at the quarter before the announcement and the deal exchange ratio from SDC. The deal exchange ratio is the number of new shares per legacy target shares quoted from the deal consideration. When this is missing, we extract the information from M&A tear sheets as follows: for deals with collar agreements, it is based on the number of shares issued eventually (Dasgupta, Harford, and Ma 2023). We keep the exchange ratio missing if a deal involves two-tier stock swap or multiple class shares. Our results are robust to dropping all deals with missing exchange ratio.

[23] We find the qualitatively the same results (unreported) when we examine the likelihood of retention, using the retention dummy as the dependent variable in the probit model following Burch, Nanda, and Silveri (2012).

Table 9
Institution-level ex post share retention rates

A. Institutional-level baseline results

	Postcompletion retention	Precompletion retention
ΔIO[inst]	0.016*	0.012***
	(.099)	(.000)
Deal characteristics		
Hostile deal [0/1]	0.039	−0.064
	(.843)	(.271)
Termination fee [0/1]	−0.032	−0.012
	(.576)	(.544)
Competed bid [0/1]	−0.120	0.062*
	(.278)	(.086)
Tender offer [0/1]	−0.194*	−0.126***
	(.069)	(.000)
Same industry [0/1]	0.019	−0.014
	(.666)	(.379)
Relative size	−0.079	−0.033*
	(.112)	(.055)
Bidder CAR[-1;+1]	0.405*	−0.095
	(.098)	(.256)
Target CAR[-1;+1]	−0.017	−0.189***
	(.874)	(.000)
Completion days	0.000	−0.001***
	(.727)	(.000)
Percent of portfolio	0.783*	0.791***
	(.055)	(.000)
Institution size	0.128***	0.034***
	(.000)	(.000)
Target characteristics		
Size	0.027	0.005
	(.306)	(.589)
Market-to-book	0.000	−0.003
	(.998)	(.160)
Leverage	−0.050	−0.028
	(.712)	(.525)
R&D	0.081	−0.297**
	(.819)	(.014)
Cash flow	0.225	−0.148***
	(.148)	(.003)
Bidder characteristics		
Size	−0.037*	−0.046***
	(.098)	(.000)
Leverage	−0.114	0.144***
	(.380)	(.001)
R&D	0.081	0.130
	(.852)	(.399)
Market-to-book	−0.001	−0.000
	(.717)	(.798)
Cash flow	0.379*	0.105
	(.052)	(.144)
Industry & Year FE	Yes	Yes
N	4,972	5,597
Adjusted R^2	.044	.078

B. Partitioning by combined CARs

	Postcompletion retention		Precompletion retention	
CAR[−1, +1]	High (1)	Low (2)	High (3)	Low (4)
ΔIO[inst]	0.023*	0.007	0.014***	0.010*
	(.073)	(.668)	(.001)	(.081)

(continued)

Table 9
Continued

B. Partitioning by combined CARs

	Postcompletion retention		Precompletion retention	
CAR[−1, +1]	High (1)	Low (2)	High (3)	Low (4)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	2,913	2,057	3,420	2,174
Adjusted R^2	.040	.069	.075	.116

C. Partitioning by postmerger long-term performance

	Postcompletion retention		Precompletion retention	
3-year avg ΔROA	High (1)	Low (2)	High (3)	Low (4)
ΔIO[inst]	0.034**	0.005	0.019***	0.011**
	(.046)	(.759)	(.000)	(.037)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	2,027	2,120	2,347	2,289
Adjusted R^2	.054	.047	.085	.091
3-year avg ΔSLG	High (1)	Low (2)	High (3)	Low (4)
ΔIO[inst]	0.024*	0.011	0.018***	0.010**
	(.089)	(.406)	(.001)	(.020)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	2,251	2,721	2,481	3,116
Adjusted R^2	.070	.034	.099	.079
3-year avg ΔCOGS	High (1)	Low (2)	High (3)	Low (4)
ΔIO[inst]	0.011	0.028*	0.013***	0.019***
	(.444)	(.079)	(.010)	(.000)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	2,183	2,118	2,441	2,438
Adjusted R^2	.048	.050	.089	.083

This table reports the regression results of testing the institutions' decision to retain shares of postmerger combined firms. The dependent variable is either the postcompletion retention rate (column 1) or the precompletion retention rate (column 2). Panel A reports the results for the whole sample, and panels B and C, respectively, report the results for the subsamples formed based on combined CARs and postmerger long-term performance, as indicated in the panel headers. The sample consists of institutional investors holding M&A target firms involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

More importantly, we then employ several proxies for short-term and long-term synergies to examine whether the institutions' share retention decision is motivated by their analysis of merger synergies to be realized. In

panels B and C of Table 9, our sample stratification is based on the following measures: 3-day combined cumulative abnormal returns around the announcement $CAR[-1,+1]$ and post-merger 3-year changes in, respectively, return on assets ΔROA, sales growth ΔSLG, and costs of goods sold to sales $\Delta CoGS$ (Ghosh 2001; Harford, Jenter, and Li 2011; Brooks, Chen, and Zeng 2018).[24] Our results show that the positive relationship between the ex ante target ownership and ex post share retention is stronger when bigger merger synergies are expected. The results are consistent across both retention measures and across all short-term and long-term measures of deal synergies. We find that the share retention rates increase when the announcement returns are high. Similarly, the share retention rates are higher when the merged firms experience a relatively large increase in their ROA and sales and a relatively large decrease in their costs. These results thus suggest that the institutions' share-retention decisions are informed and value-driven, motivated by potential deal synergies.

Our analysis of share-retention decisions provides further support to the notion that institutional investors are incentivized to capitalize upon their information advantage in the merger process. It allows the institutions to form a more accurate assessment of bidders and merger synergies, leading to informed share-retention decisions-whether to retain or dispose of the shares-linked to the prospect of the to-be-merged firms.

4.2 Target firms' decision to mandate M&A advisors

Prior literature suggests that top-tier investment banks perform a superior service in mitigating information problems inherent in M&A transactions, whereas this benefit surely comes at the cost of a relatively high advisor fee (Rau 2000; Kale, Kini, and Ryan 2003; Bao and Edmans 2011; Golubov, Petmezas, and Travlos 2012). Given such a benefit-cost trade-off, the information advantage available to target firms and their institutional shareholders is likely to affect their choice to appoint M&A advisors. Specifically, to the extent that it allows them to evaluate the offers more accurately, a substitution effect is expected such that the institutional ownership of targets curtails their demand for top-tier advisors. Furthermore, we expect the substitution effect to be more salient when the information problem is relatively mild, that is, when the expensive service provided by top-tier advisors has little to contribute.

Following Golubov, Petmezas, and Travlos (2012), we define top-tier advisors as the top-eight M&A advisors. We further control for the deal value (logarithm of) and the proportion of stock because these variables are known to correlate strongly with the probability and number of advisors appointed

[24] CAR is estimated from the market model, where the parameters are estimated in $[-291, -41]$ prior to the announcement, with the minimum of 100 valid return observations in the estimation period (Eckbo, Makaew, and Thorburn 2018).

Table 10
Targets' demand for top-tier M&A advisors

	Whole sample		High information asymmetry		Low information asymmetry	
	Prob(H) (1)	Num(H) (2)	Prob(H) (3)	Num(H) (4)	Prob(H) (5)	Num(H) (6)
ΔIO	−0.255	−0.105	0.890	0.064	−1.212**	−0.286**
	(.566)	(.226)	(.199)	(.553)	(.035)	(.025)
[Average marginal effect]	[−5.6%]		[11.4%]		[−30.1%]	
Deal characteristics						
Deal value(log)	0.575***	0.102***	0.602***	0.078***	0.660***	0.126***
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
Stock percentage	0.194	0.042*	−0.139	0.003	0.382**	0.074*
	(.167)	(.084)	(.569)	(.912)	(.040)	(.072)
Hostile deal [0;1]	0.704***	0.135***	0.712***	0.125***	0.467*	0.120**
	(.000)	(.000)	(.010)	(.003)	(.059)	(.031)
Target termination fee [0;1]	0.434***	0.047**	0.541***	0.057**	0.337**	0.047
	(.000)	(.032)	(.008)	(.037)	(.044)	(.211)
Competed bid [0;1]	−0.018	0.011	0.320	0.051	−0.216	−0.022
	(.921)	(.766)	(.240)	(.243)	(.322)	(.679)
Tender offer [0;1]	0.213*	0.026	0.167	0.008	0.266*	0.043
	(.098)	(.261)	(.478)	(.803)	(.090)	(.197)
Same industry [0;1]	−0.113	−0.006	−0.070	0.006	−0.152	−0.020
	(.269)	(.744)	(.658)	(.788)	(.284)	(.545)
Relative size	−0.092	−0.020	−0.173	−0.013	−0.190	0.007
	(.402)	(.290)	(.293)	(.533)	(.421)	(.914)
Target characteristics						
Size	0.318***	0.088***	0.524***	0.081***	0.214**	0.079***
	(.000)	(.000)	(.000)	(.000)	(.032)	(.000)
Market-to-book	−0.007	−0.001	0.003	0.001	−0.019	−0.004
	(.564)	(.623)	(.892)	(.614)	(.190)	(.243)
Leverage	0.155	0.023	0.027	0.013	0.065	0.017
	(.586)	(.677)	(.956)	(.854)	(.865)	(.838)
Cash flow	−0.355	−0.087*	−0.528	−0.101*	−0.334	−0.051
	(.232)	(.053)	(.228)	(.058)	(.469)	(.550)
R&D	1.419**	0.201*	0.776	0.022	2.227**	0.454**
	(.048)	(.079)	(.455)	(.866)	(.039)	(.036)
Bidder characteristics						
Size	0.027	−0.001	0.008	0.004	−0.010	−0.000
	(.581)	(.859)	(.947)	(.763)	(.894)	(.990)
Market-to-book	0.009	0.004*	0.009	0.002	0.006	0.006
	(.410)	(.065)	(.573)	(.284)	(.678)	(.183)
Leverage	−0.474	−0.092*	−0.484	−0.058	−0.370	−0.035
	(.102)	(.085)	(.289)	(.370)	(.399)	(.725)
Cash flow	0.075	0.005	0.011	0.012	0.780	0.245
	(.862)	(.936)	(.984)	(.855)	(.356)	(.278)
R&D	−0.239	−0.017	2.104	0.242	−3.886**	−0.555
	(.815)	(.921)	(.112)	(.175)	(.034)	(.166)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	3,228	3,235	1,563	1,596	1,620	1,629
Pseudo R^2 / Adjusted R^2	.28	.33	.30	.26	.24	.29

This table reports the regression results of testing the role of information asymmetry in the relationship between targets' institutional ownership and hiring of top-tier M&A advisors. Prob(H) and Num(H) indicates the probability of hiring and the number of the top-8 advisors, respectively. The average marginal effects from logit regression estimates are reported in columns 1, 3, and 5. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

(Golubov, Petmezas, and Travlos 2012; Allen et al. 2004). Table 10 reports the results of this analysis. Our whole sample results (columns 1 and 2) show that targets' institutional ownership appears to have a negative impact on their decision to appoint top-tier advisors, but the impact is statistically insignificant. However, we find a strong substitution effect when we examine high-asymmetry bidders (columns 3 and 4) and low-asymmetry ones (columns 5 and 6) separately. Consistent with our prediction, the negative impact of their institutional ownership on target firms' demand for top-tier advisors is strong and statistically significant among those deals involving low-asymmetry bidders, in which the information advantage and bargaining power that targets have garnered can substitute for the role played by M&A advisors to some extent. In untabulated results, we find our results also robust to using top and mid-tier advisors (Allen et al. 2004).

4.3 Design of collar agreements in stock deals

One of the important features of stock-based mergers is collar agreements that safeguard against a decline in the valuation of the bidder's shares that the shareholders of the target may suffer ex post. As described in footnote 8, these agreements typically provide one of two distinct forms of protection. Floating-ratio collars are designed to render the value of the merger payment unchanged when the price of the bidder's shares moves between the upper and lower limits agreed on and to let it vary with the price when the price moves outside the bounds. The design of fixed-ratio collars is the opposite: the value of the payment changes with the price when the price moves between the upper and lower limits and is set to the respective limits when the price moves outside the bounds.

As a means of protecting the targets' payoff against wide fluctuations in the bidders' share price, fixed-ratio collars can benefit targets and their shareholders, even the ones with a relatively accurate assessment of merger offer, because their payoff is hedged against abnormally large losses that are beyond expectations. In contrast, floating-ratio collars provide no such protection against large losses and only work for small changes in the bidder's share price. Therefore, if floating-ratio collars were to be negotiated, they would cause additional costs-again, as Officer (2006) shows, collar provisions are implicitly priced in the merger payment-with a relatively small benefit to target firms. Moreover, given that a stock-for-stock offer combined with a floating-ratio collar is analogous to a cash offer *and* becomes identical to a cash offer in the protected range (Officer 2006), a positive relationship between the targets' institutional ownership and floating-ratio collars, if found, would be in contradiction with the rational payment argument.

Following Officer (2004, 2006), we collect data on the inclusion and the type of collar agreements from deal synopsis and SEC filings (S-4 form). We construct an indicator variable Collar that takes the value of 1 if the deal includes any types of collar agreements. More importantly, we create two

Table 11
Design of collar agreement in stock deals

	Logit			Multinomial logit	
	Collar (1)	Floating ratio (2)	Fixed ratio (3)	Floating ratio (4)	Fixed ratio (5)
ΔIO	0.564	−2.125**	4.413***	−1.914**	4.209***
	(.419)	(.016)	(.000)	(.031)	(.001)
[Average marginal effect]	[5.0%]	[-14.3%]	[14.2%]	[-13.3%]	[12.2%]
Deal characteristics					
Hostile deal [0/1]	−0.750	−0.739	0.000	−0.828	−16.244
	(.122)	(.266)	(.)	(.213)	(.991)
Target termination fee [0/1]	0.457**	0.712***	0.204	0.724***	0.286
	(.025)	(.006)	(.577)	(.006)	(.435)
Competed bid [0/1]	0.666**	0.758**	0.282	0.784**	0.385
	(.023)	(.028)	(.617)	(.024)	(.498)
Tender offer [0/1]	−0.336	−0.393	−0.587	−0.432	−0.636
	(.397)	(.394)	(.478)	(.352)	(.445)
Same industry [0/1]	−0.460***	−0.410**	−0.374	−0.430**	−0.430
	(.007)	(.046)	(.242)	(.037)	(.180)
Relative size	−0.351	−0.762**	0.133	−0.759**	0.112
	(.139)	(.032)	(.685)	(.034)	(.738)
Target characteristics					
Size	−0.196**	−0.110	−0.234	−0.128	−0.263*
	(.017)	(.276)	(.114)	(.207)	(.077)
Market-to-book	−0.037**	−0.012	−0.087**	−0.017	−0.091**
	(.040)	(.568)	(.021)	(.410)	(.016)
Leverage	−0.078	−0.419	0.316	−0.388	0.265
	(.861)	(.451)	(.701)	(.486)	(.748)
Cash flow	1.260**	1.045*	2.112**	1.155*	2.232**
	(.013)	(.089)	(.030)	(.062)	(.022)
R&D	0.740	0.253	3.320	0.459	3.375
	(.511)	(.849)	(.105)	(.732)	(.100)
Bidder characteristics					
Size	0.166**	0.089	0.277**	0.110	0.305**
	(.025)	(.330)	(.031)	(.230)	(.019)
Market-to-book	0.031**	0.025	0.037	0.029*	0.042
	(.031)	(.118)	(.150)	(.076)	(.110)
Leverage	0.203	0.571	−0.628	0.550	−0.554
	(.664)	(.310)	(.467)	(.330)	(.524)
Cash flow	−0.152	0.166	−0.721	0.114	−0.726
	(.809)	(.828)	(.536)	(.882)	(.535)
R&D	−2.071	−0.307	−6.008*	−0.586	−6.171*
	(.193)	(.870)	(.074)	(.756)	(.068)
Industry & Year FE	Yes	Yes	Yes	Yes	Yes
N	1,627	1,378	1,118	1,921	
Pseudo R^2	.128	.122	.153	.233	

This table reports the regression results of testing the role of information asymmetry in the relationship between targets' institutional ownership and the design of collar agreement in stock deals. In columns 1, 2, and 3, the logit model is estimated. In columns 4 and 5, the multinomial logit is estimated, where the dependent variable is set to one or two, respectively, if a collar agreement in a stock-related deal includes floating exchange ratio, and a fixed exchange ratio, each evaluated against the base case (no collar agreement). We restrict the sample to M&A target firms that are involved in completed or withdrawn stock-related offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F (1,919 deals). Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

additional indicator variables *Floating ratio collar* and *Fixed ratio collar* to further classify the deals with collars into two types as discussed. Table 11 reports the results for each variable. When both types of collars are lumped together (column 1 of Table 11), target firms' institutional ownership appears to have no impact on the likelihood of including them, presumably because of the offsetting effects of the two types of provisions. However, its influence on the likelihood of floating-ratio collars is negative and statistically significant (column 2), whereas its impact on fixed-ratio collars is positive (column 3). Columns 4 and 5 provide the multinomial logit results that are qualitatively the same. These results confirm our prediction that when target firms gain information advantage and bargaining power, their rational choice is likely to be the cost-effective type of collar provision over the other one, that is, fixed-ratio collar that protects the targets' payoff against abnormally large losses.

4.4 Targets' share of expected synergy gains

In this subsection, we examine whether the institutional ownership of target firms is positively associated with their share of expected synergy gains. Intuitively, if the information advantage of their institutional shareholders leads to greater bargaining power on the target side in merger negotiations, target firms are likely to take a relatively large share of expected synergy gains. To investigate how expected gains are shared between targets and bidders, we follow Ahern (2012) to measure targets' share of dollar CARs *Target $CAR*. We then analyze how it is affected by target firms' institutional ownership.

Our findings reported in Table 12 show that the impact of institutional ownership on targets' share of dollar CAR is overall positive. Although the impact appears nonexistent for the total institutional ownership (column 1 of Table 12), it becomes positive and statistically significant for independent block-holders *Indep-block* (column 3) and long-term institutions *QIX-DED* (column 4). These results are consistent with prior literature that suggests that these types of institutions exert a relatively strong impact on announcement returns (Chen, Harford, and Li 2007; Fich, Harford, and Tran 2015). However, our results still require some caution in making inferences because announcement returns, as Ben-David, Bhattacharya, and Jacobsen (2021) show, may not fully capture expected merger synergies. Despite this caution, the results seem to provide some suggestive evidence for bargaining power gains attributable to the institutional ownership of target firms.

Table 12
Targets' share of synergy gains

	Dependent variable = Target $CAR			
	(1)	(2)	(3)	(4)
ΔIO	− 0.003			
	(.785)			
ΔMonitoring IO		0.002		
		(.918)		
ΔNonmonitoring IO		− 0.008		
		(.510)		
ΔQIX-DED IO			0.026*	
			(.051)	
ΔTRA IO			− 0.025	
			(.226)	
ΔIndep-block IO				0.123**
				(.024)
ΔNon-indep-block IO				− 0.005
				(.633)
Deal/Target/Bidder controls	Yes	Yes	Yes	Yes
Industry & Year FE	Yes	Yes	Yes	Yes
N	3,119	3,119	3,119	3,119
Adjusted R^2	.089	.088	.089	.091

This table reports the regression results of testing the impact of different types of institutional ownership on the target's share of synergy gains. In all cases, the ordinary least squares (OLS) model is estimated, where the dependent variable, Target$CAR[-1,+1], is the relative dollar gains between target and bidder for the 3 days around the deal announcement date. The sample consists of M&A target firms that are involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

5. Conclusion

In this paper, we have investigated how the institutional ownership of target firms plays out in M&A deals. A large volume of research examines a long-standing question whether institutional investors can influence corporate outcomes and policies of their portfolio firms. Despite a common perception that institutional investors have the information and skills to make positive impacts, empirical support is still inconclusive. Particularly, any such positive impacts discovered might be subject to critiques on the grounds of the sheer size of assets under management and the resource constraints that institutional investors are faced with. Our study departs from prior ones by shifting the focus of question toward when-rather than whether-institutional investors' information advantage comes into play. We then use M&A target firms as a laboratory to address this question.

We first show that the institutional ownership of targets is associated with an increase in both the likelihood of receiving stock-based offers and the fraction of stocks in the merger payment. More importantly, we provide evidence for the information advantage of institutional investors, consistent with the prediction rooted in the theory of rational payment design (e.g., Eckbo, Makaew, and Thorburn, 2018). The impact we find is accounted for

primarily by those deals in which the information problem (particularly, that of bidder side) is severe. Similarly, we ensure that our results are not driven by the bidders' attempt to take advantage of their overpriced shares. Our findings therefore support the prediction that the information advantage of institutional investors helps mitigate the deadweight losses associated with stock deals. Moreover, in our additional analysis that exploits a range of different aspects, we uncover that the information advantage and bargaining power gains enable target firms and their shareholders to earn economic benefits associated with mergers. All in all, we believe that our evidence goes a long way toward analyzing the motivation and engagement of institutional investors and the determinants of M&A consideration structure.

Code Availability

The replication code and data are available in the Harvard Dataverse at https://doi.org/10.7910/DVN/OKB6FJ.

Appendices

Table A1
Formation of M&A samples This table describes the formation of our M&A sample

Sample criteria	No.
Initial M&A sample	
Deals are announced between January 1, 1984, and December 31, 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 capitalization 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 1,000 days	12,491
CRSP/Compustat/13F	
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)
Exclude observations with missing control variables for takeover probability tests and those in financial (SIC 6000-6999) and utility (4900-4999) industries	6,015 (3,505)
Information on deal payment is available and the fraction of stock payment is not missing, to enable classification into either stock-only, cash-only, or mixed	5,706 (3,236)

After applying the sample selection criteria outlined below, the resultant sample consists of 5,706 completed or withdrawn M&A offers between 1984 and 2018 in which the takeover target is U.S. public firms that have data available from CRSP, Compustat, and Thomson Reuters 13F. The respective number of offers in which both targets and bidders are U.S. public firms are shown in the parentheses.

Table A2
Variable definitions

Variables	Definitions (data sources)
Deal characteristics	
Stock-only deals	Equals one if consideration is share-only (SDC M&A)
Cash-only deals	Equals one if consideration is cash-only (SDC M&A)
Mixed deals	Equals one if consideration is a mix of shares and cash payment (SDC M&A)
Hostile deals	Equals one if deal attitude is hostile or unsolicited (SDC M&A)
Termination fee	Equals one if target has termination fee provision in the merger agreement (SDC M&A)
Competed bids	Equals one if there are more than one bidder for the deal (SDC M&A)
Tender offer	Equals one if tender merger flag is labelled "YES" (SDC M&A)
Same industry	Equals one if target and bidder are in the same four-digit SIC industry (Compustat)
Relative size	Deal value divided by market capitalisation of bidder (SDC M&A)
Local deals	Equals one if bidder and target are located within 30 miles. The spherical law of cosines formula: 3963 miles × acos[sin(lat_b) × sin(lat_t) + cos(lat_b) × cos(lat_t) × cos($long_b$-$long_t$)], where (lat_b,$long_b$) and (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	Equals one if bidder announced another merger bid within 2 years prior to the sample bid (SDC M&A)
Recent SEO	Equals one 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)
Collar agreement	Equals one if stock deals included a collar agreement (SDC M&A)
Flexible exchange	Equals one if collar agreement includes terms that are identified as fixed payment (FP) (Officer 2004) (SEC Edgars Form S-4)
Institutional ownership	
ΔIO	Change in the fraction of total institutional ownership at the fiscal year-end (Thomson Reuters 13F)
ΔIO[inst]	Change in the fraction of total ownership in target firms at the institution-level at the fiscal year-end.
Target Cross IO	Ownership represented by a target's institutional shareholders that own-i.e., cross-hold-shares of the bidder (Target Cross IO[1 pct] is such ownership greater than 1% in both firms)
Cross top-five count	Number of top-five institutional shareholders that cross-hold both target and bidder firms (Cross top-10 count and Cross top-20 count are defined in the same way)
ΔMonitoring IO	Change in monitoring institutional ownership at the fiscal year-end, where Monitoring IO (Fich, Harford, and Tran 2015) is defined as the ownership represented by institutions whose holdings in the target firm account for top 10% of their portfolios
ΔQIX-DED IO	Change in ownership represented by quasi-indexer and dedicated institutions (Bushee 1998) at the fiscal year-end
ΔIndep-Block IO	Change in independent blockholder ownership (Chen, Harford, and Li 2007) at the fiscal year-end.
Firm characteristics	
Firm size	Natural logarithm of book assets (Compustat)
Leverage	Long-term debt divided by book assets (Compustat)
Cash flow	Income before extraordinary items and depreciation divided by book assets (Compustat)
Return on asset	Earnings before interests divided by book 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 assets (Compustat)
Compounded excess returns	Compounded monthly excess returns at the fiscal year-end (CRSP)
Sales growth	$sale_t/sale_{t-1} - 1$ (Compustat)
Growth-resource mismatch	Equals one if there is a combination of low sale growth, high liquidity and low leverage or high sale growth, low liquidity and high leverage, and zero otherwise (Compustat)

(continued)

Table A2
Continued

Variables	Definitions (data sources)
Industry acquisition	Equals one 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 zero otherwise (SDC, Compustat)
Tangible assets	Tangible assets divided by book assets (Compustat)
Firm age	Age of a firm at the announcement date since its appearance in the CRSP database
Analysts following	Number of analysts forecasting a firm's EPS in the fiscal year before the announcement (I/B/E/S)
Return volatility	Standard deviation of daily stock returns for a period of $[-90, -11]$ trading days prior to the announcement date (CRSP)
Bid-ask spread	Mean bid-ask spreads of a firm's daily stock price divided by its price for a period of $[-90, -11]$ trading days prior to the announcement date (CRSP)
No. of IPO & SEOs	Number of IPO and SEOs prior to the announcement date (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, year, and ROA_{it-1}). The firm-specific abnormal accruals is the residuals obtained from the modified Jones model: $\frac{Accr_{it}}{at_{it-1}} = \alpha_0 + \alpha_1 \times \frac{1}{at_{it-1}} + \alpha_2 \times \frac{\Delta sale_{it}}{at_{it-1}} + \alpha_3 \times \frac{ppe_{it}}{at_{it-1}}$, where $Accr_{it}$ is the total accruals for firm i in year t, defined as the difference between earnings before extraordinary items and discontinued operations ibc_{it}, and operating cash flow from continuing operations $oancf_{it} - xidoc_{it}$, following Karpoff, Lee, and Masulis (2013) (Compustat)
Composite proxy for information asymmetry	Composite index of bidder (target) information asymmetry based on the factor analysis using eight bidder (target) firm characteristics (Karpoff, Lee, and Masulis 2013). Detail of the index construction is provided in Appendix C
Misvaluation	Sum of firm-specific error and time-series sector error. Firm-specific error: $m_{it} - v(\theta_{it}; \alpha_{jt})$, where α_{kjt} is the annual, sector-average multiples. 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. The detailed procedure is provided in Appendix D (Compustat)
Adjusted short interest	The difference between a stock's short interest ratio and the mean ratio of all common stocks (shrcd 10, 11) traded on NYSE, AMEX and NASDAQ in the same month, where short interest ratio is the short position on the 15^{th} of each month (settlement date), divided by shares outstanding of the same month (Compustat, CRSP)
Post-completion retention rate	The number of a bidder's shares owned by an institution two quarters after the deal completion, divided by the expected number of shares the institution would own, based on its ownership of the target's shares at the latest quarter before the announcement and deal exchange ratio (Thomson Reuters 13F, SDC M&A)
Precompletion retention rate	The number of a target's shares owned at the latest quarter before the deal completion, divided by the number of the target's shares owned at the latest quarter before the deal announcement (Thomson Reuters 13F, SDC M&A)
CAR[-1,+1]	Three-day CARs, bidder and target combined (CRSP)
3-year avg ΔROA	Difference between the 3-year-average post-announcement ROA and the preannouncement ROA of bidder firm (Compustat)
3-year avg ΔSLG	Difference between the 3-year-average post-announcement sales growth and the preannouncement sales growth (Compustat)
3-year avg $\Delta CoGS$	Difference between the 3-year-average post-announcement cost of goods sold (CoGS) and the preannouncement CoGS of bidder firm (Compustat)
Prob(H)/Num(H)	Probability of hiring/the number of the top-8 advisors. Top-8 advisors are used as a proxy for top-tier advisors, and those include Goldman Sachs, Merrill Lynch, Morgan Stanley, JP Morgan, Citi (Salomon Smith), Credit Suisse First Boston, Barclays (Lehman Brothers), Lazard, following (Golubov, Petmezas, and Travlos 2012) (SDC M&A)

(continued)

Table A2
Continued

Variables	Definitions (data sources)
Target $CAR	Difference in dollar gains between the target and bidder, divided by the sum of the target's and bidder's market value of equity 50 trading days prior to deal announcement date, following (Ahern 2012) (CRSP)
Collar	Equals one if deal synopsis indicates that a deal includes collar agreement, and zero otherwise (SDC M&A)
Floating Ratio	Equals one if a collar agreement is defined as a floating ratio agreement, or fixed payment following (Officer 2004) (SEC filings Form S-4/A)
Fixed Ratio	Equals one if a collar agreement is defined as fixed exchange ratio agreement following (Officer 2004) (SEC filings Form S-4/A)

Appendix C. Composite Index as a Proxy for Bidder (Target) Information Asymmetry

This section describes our composite index of bidder (target) information asymmetry based on the factor analysis using eight firm characteristics (Karpoff, Lee, and Masulis 2013). The five indicators for the price informativeness are firm size, tangible assets, firm age, number of analysts followings, and number of prior IPO and SEOs (Barth, Kasznik, and McNichols 2001; Hong, Lim, and Stein 2000). The three components positively correlated with information asymmetry include bid-ask spreads, return volatility (the risk-bearing of uninformed investors, e.g., Corwin, 2003), and abnormal accruals (the quality of accounting information, see, e.g., Kothari, Leone, and Wasley, 2005; Lee and Masulis, 2009).

Panel A of Table A3 reports the results for two factors (Factor 1 and Factor 2) with eigenvalue greater than one, implying that the two factors capture sufficient variation in the eight measures. Factor 1 is considered a more appropriate proxy for the following reasons: (1) its eigenvalue of 2.49 suggests that it summarizes a significant amount of variation in the eight factor loadings; (2) each factor loading of Factor 1-as an individual proxy for information symmetry-has an opposite sign to the predicted sign of information asymmetry; and (3) 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 0.71. We therefore choose Factor 1 as the adequate measure of information symmetry of the bidders in our sample. Our final measure of bidder information asymmetry is then obtained by multiplying Factor 1 by -1.

The composite index of target information asymmetry is also constructed based eight firm characteristics (Karpoff, Lee, and Masulis 2013) described above for the target firm. Panel B of Table A3 also shows that Factor 1 is the most appropriate proxy and thus our final measure of target information asymmetry is obtained by multiplying Factor 1 by -1.

Appendix D. Bidder Misvaluation: Market-to-Book Decomposition

This section describes the procedure for the market-to-book decomposition used in our analysis. Following Rhodes-Kropf, Robinson, and Viswanathan (2005), we use three models to estimate the MTB decomposition:

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

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

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

Table A3
Factor analysis results for the composite index of information asymmetry

A. Composite index of bidder information asymmetry

Proxies	Variables	Predicted correlation with info asymmetry	Factor1	Factor2	KMO Measure of sampling adequacy
1	Firm size	—	0.8704	−0.0357	0.6585
2	Tangible assets	—	0.4430	0.7300	0.6827
3	Firm age	—	0.6844	0.2792	0.7536
4	Analyst followings	—	0.6865	−0.1186	0.7110
5	No. of IPO & SEOs	—	0.3146	−0.0250	0.7192
6	Bid-ask spreads	+	−0.4073	0.5764	0.7509
7	Return volatility	+	−0.6840	0.0419	0.7710
8	Abnormal accruals	+	−0.0377	−0.3988	0.4866
	KMO overall				0.7108
	Eigenvalue		2.5541	1.1523	

B. Composite index of target information asymmetry

Proxies	Variables	Predicted correlation with info asymmetry	Factor1	Factor2	KMO Measure of sampling adequacy
1	Firm size	—	0.8388	0.2187	0.6057
2	Tangible assets	—	0.1613	−0.0878	0.5986
3	Firm age	—	0.5247	0.0539	0.7173
4	Analyst followings	—	0.3134	−0.2501	0.5986
5	No. of IPO & SEOs	—	0.5515	−0.2004	0.7202
6	Bid-ask spreads	+	−0.3507	0.4744	0.6348
7	Return volatility	+	−0.6256	0.4196	0.7086
8	Abnormal accruals	+	−0.3553	0.5408	0.6779
	KMO overall				0.6406
	Eigenvalue		2.2606	1.1544	

This table reports the factor analysis results with the eight firm characteristics associated with information asymmetry (Karpoff, Lee, and Masulis 2013). Panel A reports statistics for the composite index of bidder information symmetry while Panel B reports statistics for the composite index of target information symmetry. Kaiser-Meyer-Olkin (KMO) statistics measure the sampling adequacy for the composite factor. Our final measure of the information asymmetry is obtained by multiplying most suitable factor (Factor 1) by -1. The sample consists of M&A bidder and target firms involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and targets with institutional ownership data on Thomson Reuters 13F. Both bidders and targets are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables, and Appendix C describes the composite index in detail.

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 logarithm of market to book $m_{it} - b_{it}$ is then decomposed into three 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 $v(\theta_{it}, \alpha_{jt})$ is obtained by applying the annual, sector-average regression multiples to firm-level accounting variables: $v(\theta_{it}, \alpha_{jt}) = \widehat{\alpha}_{0jt} + \widehat{\alpha}_{1jt} b_{it}$. Similarly, $v(\theta_{it}; \bar{\alpha}_j)$ 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 $\bar{\alpha}_j = 1/T \sum \widehat{\alpha}_{jt}$. In Model II, $ln(NI)^+_{it}$ is the logarithm of absolute value of net income and $I_{(<0)}$ is a binary indicator for negative net income. Model III adds leverage ratio, defined as the long-term debt plus debt in short-term liabilities divided by book assets.

Table A4 reports the summary statistics for the three models by different payment methods (columns 1-3). We use the sample construction criteria similar to those used in Golubov and Konstantinidi (2019): market-to-book between 0 and 100, return on equity between −1 and 1,

Table A4
Market-to-book decomposition summary statistics by payment methods

	Cash-only	Mixed	Stock-only
	Mean	Mean	Mean
$m_{it} - b_{it}$ (log of market-to-book)	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

This table reports summary statistics for the three components (firm-specific error, time-series sector error, and long-run value to book) of the market-to-book decomposition, based on three decomposition models (Rhodes-Kropf, Robinson, and Viswanathan 2005). Columns 1-3 report results for different payment methods. The sample consists of M&A bidder firms involved in completed or withdrawn offers from 1984 to 2018 with a transaction value of no less than $1 million and targets with institutional ownership data on Thomson Reuters 13F. Both bidders and targets are U.S. public firms. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables, and Appendix D describes the market-to-book decomposition procedure in detail.

book leverage between 0 and 1, and nonmissing values for all components used in Model III. These restrictions help eliminate the effect of outliers on the long-run value estimation. The Fama-French 12 industry classification is used to define sectors.

Appendix E. Russell Index Switches and Russell Rank Proxy

This section discusses the Russell index reconstitution as the instrument for change in institutional ownership used in our IV estimation. Stocks that are close to either side of the Russell 1000/2000 index threshold have similar market capitalization at the end of May ("rank date"). The assignment to Russell indices is exogenous to firms' actions, conditional on their market capitalization, because the index reconstitution solely relies on the end-of-May market capitalization. In addition, Russell uses its proprietary method in calculating market capitalization to account for float shares-those available to the public-and the index assignment depends on the float-adjusted market capitalization at the end of May, over which firms have no direct control (Crane, Michenaud, and Weston 2016). Given that the Russell 1000 and 2000 indices are value-weighted within each index, the annual index reconstitution has significant implications for institutions' holdings of stocks that switch their index membership status. To wit, the stock ranked 1,000th in Russell 1000 gets a significantly lower portfolio weight than does the one ranked first in Russell 2000 although the two stocks have almost the same market capitalization (Chang, Hong, and Liskovich 2015; Appel, Gormley, and Keim 2016; Crane, Michenaud, and Weston 2016; Schmidt and Fahlenbrach 2017). Therefore, stocks switching from Russell 2000 to Russell 1000 are likely to experience an increase in institutional ownership, whereas the opposite holds for those switching from Russell 1000 to Russell 2000.

The Russell Index data are from the FTSE Russell U.S. Monthly Index Holdings. Since Russell's proprietary ranking data used to determine the index membership is unavailable, we construct a proxy for the end-of-May market-cap ranking. Using the ranking based on Russell's June index weights is not appropriate, because most of portfolio rebalancing is completed within

Table A5
Panel sample test of institutional ownership and the targetiveness

	Logit		Multinomial logit		
	Target [0/1]		Cash-only	Mixed	Stock-only
ΔIO	0.289*	0.295*	0.297	0.314	0.697**
	(.078)	(.067)	(.154)	(.350)	(.022)
Size	−0.010	−0.005	−0.069***	0.177***	0.006
	(.211)	(.553)	(.000)	(.000)	(.765)
Tobin's Q	−0.168***	−0.192***	−0.373***	−0.164***	−0.034*
	(.000)	(.000)	(.000)	(.000)	(.079)
Leverage	0.383***	0.221***	0.251**	0.979***	−0.463**
	(.000)	(.008)	(.021)	(.000)	(.011)
Cash flow	−0.641***	−0.531***	−0.488***	−0.682**	−0.272
	(.000)	(.000)	(.007)	(.025)	(.300)
R&D	1.475***	1.777***	2.326***	1.506***	1.950***
	(.000)	(.000)	(.000)	(.007)	(.000)
Sale growth	−0.017	−0.071**	−0.251***	−0.039	0.107**
	(.510)	(.011)	(.000)	(.549)	(.013)
Return on assets	1.202***	1.125***	1.960***	0.870**	0.608**
	(.000)	(.000)	(.000)	(.021)	(.046)
Compounded excess return	0.521***	0.217	0.346	0.223	0.282
	(.000)	(.228)	(.136)	(.631)	(.522)
Industry acquisition [0/1]	0.371***	0.170***	0.260***	0.129	0.125
	(.000)	(.008)	(.002)	(.398)	(.351)
Growth-resource mismatch [0/1]	0.071**	0.034	0.085**	0.151**	−0.116*
	(.018)	(.254)	(.033)	(.026)	(.087)
Industry & Year FE	No	Yes		Yes	
N	110,983	110,983		110,983	
Pseudo R^2	.008	.027		.054	

This table reports the regression results of testing the impact of targets' institutional ownership on the likelihood of receiving a takeover offer. In columns 1 and 2, the logit model is estimated, where the dependent variable is a dummy that equals one if a firm receives a takeover bid in a given year and zero otherwise. In columns 3-5, the multinomial logit is estimated, where the dependent variable is set to one, two, or three, respectively, if a firm receives a cash-only bid, a cash-stock mixed bid, and a stock-only bid, each evaluated against the base case (firm-years without a bid). The sample consists of firm-year observations from 1984 to 2018 from the Compustat. The M&A targets in the sample are the firms that are involved in completed or withdrawn offers with a transaction value of no less than $1 million and have institutional ownership data on Thomson Reuters 13F. Bidders are U.S. public or private firms or subsidiaries. Appendix Table A1 describes the sample construction procedure in detail. Appendix Table A2 defines the variables.
*p <.1; **p <.05; ***p <.01 (based on standard errors robust to clustering at the firm level).

a few days after the reconstitution at the beginning of June (Schmidt and Fahlenbrach 2017; Appel, Gormley, and Keim 2019; Wei and Young 2019). To mitigate biases, we employ a method to approximate the Russel's end-of-May market-cap ranks based on both the Compustat quarterly data and CRSP (Ben-David, Franzoni, and Moussawi 2019).[25] Specifically, when the CRSP-based market capitalization aggregated at the firm level is equal to or larger than the Compustat-based one, the CRSP record is taken as the approximate; otherwise the Compustat record is used.

Using the approximate end-of-May market capitalization and the market-cap ranks facilitates the implementation of the Russell 1000/2000 setting in wider bandwidths. While there is a trade-off between noise and bias in employing the fuzzy regression discontinuity design (RDD) and IV estimation, in our case, the latter is the only viable option given the nature of our M&A sample

[25] The codes for generating the approximation of Russell ranks is provided in appendix B of Ben-David, Franzoni, and Moussawi (2019).

(i.e., the RDD approach leaves us only a handful of observations for analysis). We estimate the following equations in 2SLS:

$$\begin{aligned}\Delta IO_{it} = \alpha_j + \sigma_t + \beta_1(R1000_{t-1} \rightarrow R2000_t) + \beta_2(R2000_{t-1} \rightarrow R1000_t) \\ +\gamma_1 \Delta Rank_t + \gamma_2(\Delta Rank_t)^2 + \delta ln(mktcap)_t + \theta X_{it} + \epsilon_{it},\end{aligned} \tag{1}$$

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

where α_j is industry-fixed effects, σ_t is time-fixed effects, $ln(mktcap)_{it}$ is natural logarithm of the end-of-May market capitalization, and X_{it} is a set of time-varying covariates. The instruments for institutional ownership ΔIO_{it} used in the first stage (Equation (1)) are a dummy indicator for the switch from Russell 1000 to Russell 2000, a dummy indicator for the switch from Russell 2000 to Russell 1000, change in the May market-cap rank and its squared term. In the second stage, $\widehat{\Delta IO_{it}}$ is the fitted value from Equation (1), and $y_{i,t+1}$ indicates whether a firm receives a takeover offer (or a stock-for-stock offer) in the year following the change in institutional ownership.

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