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REVIEW PAPER

The rationality of M&A targets in the choice of payment methods

Michael Klitzka[1] · **Jianan He**[1] · **Dirk Schiereck**[1]

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Abstract
This study analyzes mergers and acquisitions (M&A) payment methods in large transactions of public U.S. acquirers between 2009 and 2016. While we find consistent with previous evidence that asymmetric information between acquirers and targets significantly influences the choice of M&A payment methods, we show that contrary to prevailing findings in the literature, acquirers cannot exploit their overvaluation through stock-financed M&A at targets' disadvantage. In addition, when facing larger uncertainty in the counterparty's valuation, a higher ratio of cash is applied in M&A payment. Our results document that both acquirers and targets are rational in choosing M&A payment methods.

Keywords Mergers and acquisitions (M&A) · Choice of payment methods · Rational payment design · Equity overvaluation and misvaluation · Information asymmetry

JEL Classification G14

Mathematics Subject Classification 91G50 Corporate finance (dividends, real options, etc.)

1 Introduction

Prior studies provide evidence that M&A activities are closely related to the overall stock market valuation (e.g. Shleifer and Vishny 2003; Rhodes-Kropf and Viswanathan 2004; Schlingemann 2004; Ang and Cheng 2006). Hutzschenreuter et al. (2012) review a number of studies regarding influencing factors of M&A performance and note that not only the environment but also the firms'

✉ Jianan He
jiananhe91@gmail.com

[1] Department of Business Administration, Economics, and Law, Technical University of Darmstadt, Hochschulstr. 1, 64289 Darmstadt, Germany

experience and transaction characteristics are important for M&A outcomes. The choice of payment methods, as an important decision made during the M&A process, is regarded as a medium to reflect how firms read the information about the overall market valuation and their relative strength against the counterparty. In an informational efficient environment, M&A payment methods should be irrelevant as stock markets correctly price all information to reflect firms' intrinsic value. However, many studies point out the impact of payment methods on M&A performance and interpret stock-financed M&A as a signal for overvalued acquirers' equity, which is subsequently subject to stock price corrections (e.g. Myers 1984; Hansen 1987; Eckbo et al. 1990; Fishman 1989; Berkovitch and Narayanan 1990). In the case of stock swaps by overvalued acquirers, why would targets still accept these offers? Shleifer and Vishny (2003) explain it with market information asymmetry, where targets cannot identify acquirers' intrinsic value. Besides, Rhodes-Kropf and Viswanathan (2004) observe that even rational targets would prefer stock payment when the overall stock market valuation is high. Di Giuli (2013) argues that targets' managers believe in the value creation of M&A and therefore are convinced that the merged entity's share price will develop so positively in the long term that the temporary exploitation can be accepted. However, recent literature is divided on the question of whether acquirer's overvaluation leads to stock financing in M&A. While Savor and Lu (2009), Di Giuli (2013), Ben-David et al. (2015), and Vagenas-Nanos (2020) argue in favor of the overvaluation hypothesis, Eckbo et al. (2018) and De Bodt et al. (2019) present opposite evidence. Eckbo et al. (2018) conclude that targets are not likely to "naively accept overpriced bidder shares" and elaborate the rational payment design hypothesis. This hypothesis states that both firms know their own values but only the probability distribution over the counterparty's value. Targets have different abilities to monitor acquirers' valuation and a greater skill of assessing information leads to a less diffuse distribution over possible valuation numbers. Thus, the more informed targets are about acquirers, the larger the fraction of stock financing, and as a result, deal terms are fairer to both parties (Eckbo et al. 2018).

Although recent literature has already examined the relationship between payment methods and valuation, the knowledge about "the informational implication of the medium of exchange not just on the bidder side but also on the target side" (Malmendier et al. 2016) is still limited. In this study, we follow Malmendier et al.'s (2016) call for further research and question whether acquirers can exploit their overvaluation by M&A payment methods based on targets' unawareness or short-term horizon. We assume that both acquirers and targets are fully rational, and as a consequence, deals that involve potential equity overvaluation would be paid in cash. In order to verify our assumption, we distinguish the equity overvaluation of acquirers and targets from deal information asymmetry caused by region, industry, and public status. In addition, we control common determinants of payment methods such as deal size and acquirers' financials. A major difference in our approach compared to prior studies is that we take both acquirers' and targets' valuation into consideration while existing literature has largely neglected the evaluating capacity and bargaining power of targets in M&A payment decisions. Moreover, we examine whether the general market valuation, in addition to firm-specific mispricing, has an

impact on the choice of payment methods. To the best of our knowledge, we are the first empirically examining Eckbo et al.'s (2018) rational payment design hypothesis and providing evidence not only for the relationship between valuation and M&A payment methods but also for the assumption of equal rationality between acquirers and targets.

Our results challenge prior empirical evidence that acquirers can exploit their overvaluation by paying with stocks. First, we find that acquirers' overvaluation has no significant impact on the percentage of stocks used in M&A payment. Second, we show that a higher level of total acquirers' misvaluation leads to a higher portion of cash applied to finance M&A. We explain it with the equal rationality of acquirers or targets, evidenced by our finding that the probability of hiring M&A advisors is not influenced by being acquirers or targets but rather the counterparty's action and deal features. While targets decline overvalued acquirers' stocks, acquirers do not offer stocks when they are undervalued. Moreover, we find similar effects when investigating targets' overvaluation. It implies that both acquirers and targets can identify the counterparty's equity misvaluation and therefore refuse a high proportion of stock financing if there are significant deviations from the intrinsic value.

We provide several implications for extant literature. First, we find new empirical evidence regarding the ongoing discussion of whether acquirers' overvaluation influences M&A payment methods. We find that acquirers' overvaluation has no significant impact on the percentage of stock financing. Nevertheless, acquirers' valuation can play a significant role, but not as prevailing literature suggests. By analyzing acquirers' misvaluation we show that a high level of total misvaluation, including under- and overvaluation, can lead to a large percentage of cash payment to reduce the risk associated with valuation uncertainties. Second, given the assumption that targets' managers are rational, stock swaps suggest that either acquirers' market valuation correctly reflects their intrinsic value or targets may get compensated in other ways. Third, we extend our findings to both parties involved in M&A and show that acquirers and targets follow a similar principle in choosing payment methods, i.e. a higher level of valuation uncertainty leads to a larger percentage of cash applied. We thus supplement the rational payment design hypothesis by Eckbo et al. (2018) from the counterparty's perspective.

The remainder of the paper is structured as follows. In Sect. 2, we review the two opposing hypotheses explaining M&A payment methods, namely acquirers' overvaluation and targets' rationality. In Sect. 3, we describe the dataset, overvaluation and misvaluation measures, and applied methodologies. In Sect. 4, we present our empirical findings on the determinants of payment methods and market reactions. Finally, we conclude the paper.

2 Literature review and hypotheses development

2.1 Acquirers' overvaluation and payment methods

Previous studies show evidence of highly dynamic market prices and derive different asset pricing models to identify price-driving factors (e.g. Fama and French 1993,

1996, 2015). Nevertheless, all these models cannot exactly capture price movements due to market under- and overvaluation (e.g. Shleifer and Vishny 1997; Lin et al. 2010). Following the assumption that investors are short termist, firms' investment decisions should be affected by potential market overvaluation (Panageas 2003). Farhi and Panageas (2004) argue that market overvaluation often exists and has two opposing effects. On the one hand, overvaluation distorts investment decisions because of overly optimistic expectations, which can lead to negative outcomes. On the other hand, market overvaluation alleviates underinvestment problems by relaxing financing constraints on investment selections.

Taggart (1977) postulates that increasing overall economic activities are positively related to the likelihood of using stock financing. Moreover, Choe et al. (1993) find that companies increase their equity offerings, especially in expansionary periods. Similarly, Bayless and Chaplinsky (1996) show that seasoned equity offerings cluster around the economic period of smaller announcement discounts. Graham and Harvey (2001) extend the theory by showing that the overall market climate has an impact on financing decisions. In their survey, 67% of the CFOs agree that the magnitude of equity under- or overvaluation by the market is a crucial factor for firms' financing decisions. Also, 63% of the responding CFOs agree that a higher overall stock price level can stimulate firms' equity valuation positively. This further implies that acquirers can cash out the temporary market overvaluation by offering stock-financed M&A. Shleifer and Vishny (2003) find evidence that M&A waves are associated with periods of very high stock market valuation. Based on the assumption that financial markets are inefficient, they present a theoretical model explaining M&A payment methods based on the stock market misvaluation of the combining firms. In their model, M&A is a form of arbitrage that rational acquirers take advantage of market inefficiency by using overvalued stocks to finance M&A. Rhodes-Kropf and Viswanathan (2004) show that even when acquirers and targets are both rational, overvalued acquirers tend to finance M&A with stocks. Rhodes-Kropf et al. (2005) report empirical evidence for the overvaluation hypothesis when isolating the misvaluation component of firms' value.

However, recent empirical research is divided on the overvaluation hypothesis. Confirming this hypothesis, Di Giuli (2013) shows that acquirers exploit short-term market overvaluation by paying with stocks. He investigates 1187 deals between publicly held U.S. acquirers and targets from 1990 to 2005 and uses the combined post-merger market-to-book ratio as a proxy for potential overvaluation. As a result, this ratio is positively related to the use of stock payment. Moreover, Karim et al. (2016) investigate accruals-based earnings management before stock-paid M&A and find acquirers do manage earnings to boost their valuation prior to M&A. On the contrary, they do not find such evidence when transactions are paid with cash. Most recently, Vagenas-Nanos (2020) examines 1456 stock-only and 896 cash-only acquisitions from U.S. listed acquirers between 1985 and 2016. He shows that in a quasi-experimental design when acquirers are more overvalued than their targets, acquirers can exploit overvaluation by financing M&A with stocks. He finds a positive stock price correction of up to 28% for overvalued stock acquirers in the long-run period after M&A. Similarly, Savor and Lu (2009) show that the long-term performance of acquirers who completed stock-only deals is significantly higher than

those who withdrew the deals. Ben-David et al. (2015) estimate overvaluation with short interests. They find that firms with higher short interests are more likely to engage in stock swaps. Fu et al. (2013) and Akbulut (2013) find that overvalued acquirers prefer stock financing in M&A, while their shareholders suffer negative market reactions in the short term.

In contrast, Eckbo et al. (2018) find evidence against the overvaluation hypothesis. By examining 6200 U.S. M&A transactions between 1980 and 2014, they show a lower probability of stock-only payment in M&A when acquirers are significantly overvalued. Moreover, they find that the risk-adjusted performance of stock-paid acquirers is not positive. De Bodt et al. (2019) support these findings. They argue that the overlooked change in the U.S. accounting rules is crucial for earlier interpretations of the overvaluation hypothesis. Before 2001, the "pooling of interests" method was allowed for stock swaps. Under this method, acquirers could simplify accounting procedures by fusing the accounting statements of acquirers and targets if transactions were solely paid by stocks. De Bodt et al. (2019) investigate a sample of 4080 deals between 2001 and 2017. They find that the overvaluation measure introduced by Rhodes-Kropf et al. (2005) either loses significance or even suggests that overvalued acquirers are less likely to use stock payment in M&A.

2.2 Targets' rationality and payment methods

Why should targets accept stock offers if—in theory—predominantly overvalued acquirers make those offers? Shleifer and Vishny (2003) explain it as a consequence of information asymmetry, where targets cannot evaluate acquirers' intrinsic value. Moreover, they argue that targets may accept stock offers because of short-term M&A premiums, where managers can liquidate stock options at a higher price. Rhodes-Kropf and Viswanathan (2004) state that "the naïve explanation that overvalued bidders wish to use stock is incomplete because targets should not be eager to accept stock". Nevertheless, they suggest that even rational targets are more likely to accept the overvalued stock payment if the overall market valuation is high. They argue that in an overvalued market, targets benefit from their high valuation while cannot fully identify acquirers' overvaluation. Based on this underestimation and the expectation of further positive market development, targets tend to accept stock payment. Di Giuli (2013) argues that targets believe in the value creation of M&A and are therefore convinced that the long-run performance will exceed the temporary cost induced by overvalued acquirers' stocks.

In terms of rationality, Hansen (1987) draws up the theory of two-sided information asymmetry between acquirers and targets. He states that because both parties have proprietary information, acquirers will not offer stock payment when targets evaluate it too low. Targets, on the other side, use the information of offered price and payment methods as a signal to read acquirers' valuation. Given this, acquirers have to make offers based on targets' rationality. This theory reveals that compared to cash, stock payment pushes targets to make more efficient decisions on whether to accept M&A offers. Fishman (1989) strengthens Hansen's hypothesis and concludes that given this information asymmetry equilibrium, the

probability that targets will reject is higher for stock offers. Fu et al. (2013) investigate 1319 stock-financed and 671 cash-financed M&A between 1985 and 2006 and find that overvalued acquirers pay higher premiums and generate negative synergy effects in the short run. Their evidence implies that targets' rationality and bargaining power make acquirers less likely to take advantage of stock payment in M&A. Bi and Gregory (2011) analyze a sample of 669 M&A transactions from 1985 to 2004 and find that acquirers' overvaluation measured by price-to-value ratios increases the probability of stock payment. In addition, they find that overvalued acquirers tend to buy overvalued targets with stocks, implying the rationality of both sides. Eckbo et al. (2018) provide empirical evidence based on 6200 M&A transactions between 1980 and 2014 and find that the percentage of stock applied in financing M&A is insignificant with acquirers' overvaluation. Besides, the likelihood of stock offers increases, only if targets are well informed about acquirers, for example, when both parties are close in terms of geography and industry. Then, the risk of getting exploited by acquirers is lower and targets are "less likely to naively accept overpriced bidder shares". Eckbo et al. (2018) further elaborate the rational payment design hypothesis, where both acquirers and targets know their own intrinsic value but only the probability distribution over the counterparty's value. When targets have better access to acquirers' information, they are more certain about acquirers' valuation and thus face lower risk associated with payment methods.

To strengthen their bargaining power, targets can use different mechanisms to fend off unattractive bids or extract higher premiums according to the shareholders' interest hypothesis. For example, targets can apply takeover defenses such as poison pills or classified boards in hostile M&A (e.g. Comment and Schwert 1995; Bebchuk et al. 2002; Gordon 2002). More generally, targets can hire M&A advisors to enhance their expertise in valuation and M&A negotiation (e.g. Ismail 2010; Ertugrul 2015). Etrugrul (2015) shows that targets gain 27.6% higher returns in acquirer-initiated deals with the aid of top-tier M&A advisors. Besides, targets can improve their market position to get more bargaining power in M&A. Ahern (2012) shows that for each dollar in pre-merger combined market equity of both firms, targets gain about 3.5 cents more than acquirers, where firms with more unique assets gain a larger share of total M&A gains.

In our study, we focus on friendly M&A and assume that there is no significant difference in valuation abilities between acquirers and targets and both parties have bargaining power during M&A. We test this assumption by the probability of hiring M&A advisors for both parties. If this assumption holds, it implies that rational targets should accept stock payment only when the risk of getting exploited by the payment method is low. Here, we define two sources of risk. The main risk comes from the level of acquirers' overvaluation, where larger overvaluation suggests more risk associated with stock-financed M&A and targets would not accept overvalued stocks unless they are compensated in other ways. The second risk results from the information asymmetry between acquirers and targets. When the cost of assessing the counterparty's true value is too high, cash payment is preferred (Fishman 1989). Assuming targets are equally rational as acquirers and have bargaining power in friendly takeovers, we hypothesize:

H1: *In friendly M&A, acquirers cannot exploit rational targets by using overvalued stock payment. When the uncertainty of acquirers' valuation is high, a larger portion of cash payment is applied.*

On the other hand, rational acquirers should react to the uncertainty of targets' valuation in a similar way. If acquirers decide to buy possibly overvalued targets, they should prefer cash over stock financing. The risk of paying cash for overvalued targets is only associated with financial burdens. However, if stock-swaps are carried out, there is also corporate control risk in addition to financial burdens (Stulz 1988). Among others, Faccio and Masulis (2005) show empirical evidence on 3667 European M&A between 1997 and 2000. They find that when acquirers' voting shares are concentrated on several shareholders, they prefer cash payment in M&A to avoid the risk of losing control. Thus, we hypothesize:

H2: *In friendly M&A, rational acquirers will not prefer stock payment for overvalued targets. When the uncertainty of targets' valuation is high, a larger portion of cash payment is applied.*

If the overvaluation hypothesis holds, markets can price in the information gained with payment methods and interpret stock financing as a sign of overvalued acquirers, which further leads to negative announcement effects for their shareholders. For example, Dong et al. (2006) find for 2922 successful and 810 unsuccessful M&A from 1978 to 2000, acquirers' announcement returns are negatively related to stock payment but positively associated with cash payment. Moeller et al. (2004) present similar results on acquirers' abnormal returns upon M&A announcements. Interestingly, they find that acquirers who only use stock financing do not suffer negative returns while those who apply both cash and stock financing have the largest abnormal returns.

However, following the rationality of targets, the choice of payment methods should not be viewed as a signal of overvalued acquirers, suggesting non-negative announcement effects for acquirers who only apply stock payment. Golubov et al. (2016) show that the choice of payment methods has no explanatory power in acquirers' returns and conclude that stock swaps do not destroy shareholders' value. Martynova and Renneboog (2011) investigate 2109 European M&A between 1993 and 2001 and find that acquirers with all-cash financing get significantly positive abnormal returns (+1.03%) around announcements, whereas stock-paid acquirers receive positive but insignificant results. Alexandridis et al. (2017) report similar results for 3811 completed U.S. M&A between 2010 and 2015, where acquirers who use 100% stock payment have insignificant announcement effects. Following the equal rationality of acquirers and targets, markets should not react negatively when acquirers finance M&A solely with stocks. Thus, we hypothesize:

H3: *Acquirers' abnormal returns for all-stock financed M&A are not negative upon announcements.*

Table 1 Sample distributions by acquirers' industry and announcement year

		N	Cash	Stock	Mixed	%
Panel A: Distribution by Industry SIC Code						
01–09	Agriculture, Forestry, Fishing	1	1	0	0	0.09
10–14	Mining	72	35	12	25	6.23
15–17	Construction	8	8	0	0	0.69
20–39	Manufacturing	499	428	14	57	43.20
40–49	Transportation & Public Utilities	138	88	17	33	11.95
50–51	Wholesale Trade	40	32	1	7	3.46
52–59	Retail Trade	33	23	5	5	2.86
60–67	Finance, Insurance, Real Estate	247	137	44	66	21.39
70–89	Services	117	99	3	15	10.13
91–99	Public Administration	0	0	0	0	0.00
	Total	1155	851	96	208	100.00
Panel B: Distribution by Year						
2009		85	48	11	26	8.29
2010		142	103	12	27	12.56
2011		133	101	14	18	11.18
2012		162	128	7	27	14.75
2013		168	122	13	33	14.06
2014		200	153	20	27	16.01
2015		202	141	17	44	17.40
2016		63	55	2	6	5.76
Total		1155	851	96	208	100.00

3 Data and method

3.1 Sample selection

We collect an initial sample of 12604 completed U.S. M&A between 2009 and 2016 from the Thomson Reuters database, where all acquiring firms are publicly listed. To select the final sample, we apply the following criteria:

1. The transaction is not a hostile M&A.
2. The percentage of shares acquired after the transaction is not less than 50%.
3. The transaction volume is over 100 million USD.
4. The acquirer's stock and financial data are available for the observation period.
5. The acquirer's market-to-book ratio is positive (Faccio and Masulis 2005).

After the screening, there are 1155 transactions in the final sample, which is applied for further empirical analyses. Table 1 provides an overview of M&A payment distributions by industry and year. The manufacturing sector takes the most of our sample with 43.20% of transactions, followed by the financial sector with 21.39%. These two sectors account for approximately two-thirds of the sample. The number of transactions shows a general uptrend from 2009 to 2015 but a significant decrease in 2016, partially triggered by the regulation from the U.S. Treasury Department against tax-inversion in cross-border M&A transactions. The regulation punishes firms who reduce tax burdens by acquiring overseas subsidiaries. M&A payment methods[1] show a strong preference for cash. Of the total 1155 transactions, 73.59% are financed solely with cash, suggesting 26.41% of the sample at least partially financed with stocks. Approximately 8.31% of the transactions are stock swaps, where no cash payment is involved. This distribution is consistent with the findings of De Bodt et al. (2015). They observe that since 2001 as the Statements of Financial Accounting Standards *No. 141, Business Combinations* and *No. 142, Goodwill and Other Intangibles* were changed, where the pooling payment method for M&A was dropped, the number of solely stock-financed M&A declined significantly from around 62% in 2000 to approximately 10% in 2010.

3.2 Overvaluation and misvaluation measures

Following the existing literature, we measure equity overvaluation by applying the excess value-based approach[2] and the industry-adjusted market-to-book ratio suggested by Lin et al. (2010). Follow Berger and Ofek (1995), we calculate the first overvaluation indicator by the excess value of the firm as:

$$EXVIA_{i,t} = \ln\left(\frac{CPTL_{i,t}}{I(CPTL)_{i,t}}\right), \tag{1}$$

where *CPTL* is total capital, which is the market value of equity plus the book value of debt, *I (CPTL)* is the imputed value derived by the firm's size (market cap) multiplying the median capital to size ratio in the firm's industry. A larger *EXVIA* implies that the firm is valued at a higher level compared to the industry's median. In order to calculate the industry data, the initial sample of 12604 public U.S. acquiring firms between 2009 and 2016 is applied. We intentionally use acquiring firms but not all listed firms due to the comparability reason, which enables us to exclude the effect of firms' different possibilities to conduct M&A. We also consider the absolute term |*EXVIA*| as an indicator of misvaluation, where a higher level suggests a larger variation compared to peers.[3]

[1] The percentage of cash payment is obtained from the Thomson Reuters SDC deal synopsis when available, otherwise manually collected from the company's SEC filings (type 10-K).

[2] After being introduced by Berger and Ofek (1995), the excess value-based approach is commonly used in further studies as an indicator of overvaluation, e.g. Jiraporn et al. (2006), Dos Santos et al. (2008), Pantzalis and Park (2009), and Lin et al. (2010).

[3] As a supplement measure of misvaluation, we also apply $EXVIA^2$ to imply both tails of *EXVIA*.

As the second overvaluation indicator, we follow Lin et al. (2010) and adjust the firm's market-to-book ratio by the industry median:

$$MBIA_{i,t} = \ln\left(\frac{MB_{i,t}}{Med(MB)_{i,t}}\right), \tag{2}$$

where *MB* is the firm's market-to-book ratio and *Med (MB)* is the industry's median market-to-book ratio. For the industry data, the same sample of 12604 U.S. acquiring firms is applied. Similar to |*EXVIA*|, we also apply the absolute term |*MBIA*| as an indicator of uncertainty in valuation, where a higher level suggests a larger variation compared to peers.

As mentioned in the literature review, several papers point out that the overall market valuation can influence firms' financing decisions (e.g. Taggart 1977; Choe et al. 1993). Rhodes-Kropf and Viswanathan (2004) observe that targets tend to accept stock payment when the overall market valuation is high. Following the momentum concept of Fama and French (1993), we proxy the market trend by:

$$MACRO_{i,t} = \ln\left(\frac{BUS(-1)}{BUS(-12)}\right), \tag{3}$$

where *BUS* refers to the market valuation, measured by the total return index of a country's leading stock index, e.g. the S&P 500 index for U.S. firms. Besides, -1 and -12 refer to 1 and 12 months before the M&A announcement, respectively. The larger the *MACRO* indicator is, the higher the market valuation compared to one year ago.

Finally, we use *MI* as an index that combines all three valuation indicators described above. *MI* is constructed as:

$$MI_{i,t} = \frac{1}{N}\frac{1}{K}\sum_{k}^{K} RANK\left(VAL_{i,t}\right), \tag{4}$$

where *RANK* is the rank function, which assigns a rank within each *VAL* indicator and a higher rank implies a larger level of overvaluation or misvaluation. *VAL* refers to the available valuation measures for the firm. In specific, we apply *EXVIA*, *MBIA*, and *MACRO* for the overvaluation index *MI – Overvaluation*. Differently, we construct *MI – Mispricing* using |*EXVIA*|, |*MBIA*|, and *MACRO*. We add *MACRO* here based on the argument that if the overall market valuation is high, investors might be less cautious on detecting firms' true valuation. However, under a market downturn, investors tend to make more careful investment decisions and firms are less likely mispriced. *MI* is calculated for each firm by the average of available ranks $\frac{1}{K}\sum_{k}^{K} RANK\left(VAL_{i,t}\right)$ divided by the total number of firms *N*. Lin et al. (2010) argue that the index combining several valuation measures can provide a more comprehensive picture by balancing out their shortcomings and aggregating the information.

In addition to the valuation issue, previous studies also show that the information asymmetry between acquirers and targets also influences the choice of payment methods (e.g. Fishman 1989; Choe et al. 1993; Eckbo et al. 2018). In specific, when the effort of evaluating the counterparty's true valuation is too high, cash payment

is preferred. To predict the risk of information asymmetry, we follow Faccio and Masulis (2005) and Eckbo et al. (2018) using deal-specific features, such as *Cross-industry*, *Cross-border*, and *Unlisted Target*. *Cross-industry* is a dummy variable equal to 1 if acquirers and targets are from different industries, measured by two-digit SIC codes (Drees et al. 2013). *Cross-border* is a dummy variable equal to 1 if acquirers and targets are from different countries. *Unlisted Target* is a dummy variable equal to 1 if targets are privately held. We consider the information asymmetry likely higher when acquirers and targets have larger regional and industrial differences and less information from public markets.

To investigate the influence of valuation on the choice of M&A payment methods, we apply the two-boundary Tobit regression model[4] on the dependent variable *Cash Payment (%)*, which is the percentage of cash applied to finance the deal. It equals 1 if the transaction is 100% paid by cash and 0 if solely financed with stocks, where the percentage of cash payment is obtained from the Thomson Reuters SDC deal synopsis when available, otherwise manually collected from the SEC filings. For regressions, a general model is of the form:

$$Cash\ Payment(\%)_i = \hat{\alpha}_{1,i} + \hat{\alpha}_{2,i} + \sum_{j=1}^{m} \hat{\beta}_{j,i} Var_{j,i} + \varepsilon_i, \tag{5}$$

where $\hat{\alpha}_{1,i}$ is the first intercept and $\hat{\alpha}_{2,i}$ is the log-standard deviation of the latent variable. As independent variables, we test the above-mentioned valuation measures under controlling the information asymmetry for the final sample of 1155 transactions. Besides, we also consider variables in terms of acquirers' financials and other deal-related features. We apply acquirers' financials at the end of the year prior to M&A announcements if not otherwise stated. We collect acquirers' *Total Assets* and *Dividend Payout* in U.S. Dollar and calculate the dividend payout ratio *Divd./Tot. Ass.* as a proxy for cash-rich firms (e.g. Jensen 1986; Denis et al. 1994; Martin 1996). *Leverage* is measured by the sum of total debt and deal value divided by the sum of total assets and deal value (Faccio and Masulis 2005). *Collateral* is calculated by the ratio of property, plant, and equipment to total assets. *Return-on-equity* presents firms' profitability and the standalone ratio of *Market-to-book* predicts firms' growth opportunities (Smith and Watts 1992; Martin 1996). *Closely Held Shares* imply how concentrated acquirers' shares are allocated. We also apply the following deal-related variables. *Relative Deal Size* is the ratio of deal size divided by the sum of deal size and acquirers' market cap (Raudszus et al. 2014). *CAR* [*–40; –1*] is a proxy of acquirers' stock run-up, measured by the market model (*MM*) and the Fama and French three-factor model (*FF*), which are explained in Sect. 3.3. We present a detailed description of all explanatory variables in the Appendix.

Table 2 summarizes the descriptive statistics of the sample. The differences between 100% cash-financed and 100% stock-financed M&A are tested for statistical significance, where we do not include the mixed payment and thus cannot

[4] Faccio and Masulis (2005) recommend this regression model for the choice of payment methods where the percentage of cash is limited to [0, 1].

Table 2 Summary of statistics

	Mean	Median	Std. Dev	Δ Mean Cash—Stock	Δ Median Cash—Stock
Panel A: All-cash Financed M&A ($N=851$)					
Acquirers' Overvaluation (N=851)					
EXVIA	−0.52	−0.60	0.41	−0.23***	−0.30***
MBIA	0.32	0.27	0.67	0.21***	0.32***
MACRO	0.09	0.11	0.14	0.01	−0.01
MI – Overvaluation	0.49	0.49	0.15	−0.05***	−0.05***
Acquirers' Misvaluation (N=851)					
|EXVIA|	0.61	0.63	0.29	0.24***	0.29***
|MBIA|	0.53	0.41	0.52	−0.04	−0.04
MI – Mispricing	0.51	0.51	0.15	0.05***	0.05***
Targets' Overvaluation (N=191)					
EXVIA	−0.84	−0.82	0.20	−0.14***	−0.12***
MBIA	0.21	0.15	1.01	−0.01	0.10
MACRO	0.08	0.09	0.15	0.00	−0.01
MI – Overvaluation	0.47	0.48	0.17	0.02***	0.01***
Targets' Misvaluation (N=191)					
|EXVIA|	0.87	0.83	0.19	0.17***	0.12***
|MBIA|	0.53	0.25	0.70	0.17*	0.11*
MI – Mispricing	0.54	0.55	0.15	0.08***	0.09***
Acquirers' Financials					
Total Assets ($mil)	30818	7645	98925	17321***	3895***
Dividend Payout ($mil)	678	116	1537	406***	62***
Leverage	0.45	0.37	0.62	−0.28***	−0.15***
Collateral	0.26	0.15	0.26	−0.06**	−0.06
Return-on-equity	0.22	0.20	0.43	0.09	0.09
Market-to-book	3.39	2.21	7.27	1.50***	0.88***
Closely Held Shares	8.00	1.52	14.02	−5.84***	−4.02***
Deal-related Features					
Relative Deal Size	0.14	0.07	0.19	−0.21***	−0.26***
Deal Value ($mil)	1030	420	1863	−1279**	−169**
CAR [−40; −1] (MM)	−0.01	−0.01	0.08	−0.01	0.00
CAR [−40; −1] (3F)	−0.01	−0.01	0.08	−0.01	0.00
Asymmetric Information (Binary)					
Cross-industry	0.59			0.25***	
Cross-border	0.23			0.14***	
Unlisted Target	0.80			0.50***	
Panel B: All-stock Financed M&A ($N=96$)					
Acquirers' Overvaluation (N=96)					
EXVIA	−0.28	−0.30	0.34		
MBIA	0.11	−0.04	0.70		
MACRO	0.09	0.11	0.19		

Table 2 (continued)

	Mean	Median	Std. Dev	Δ Mean Cash—Stock	Δ Median Cash—Stock
MI – Overvaluation	0.54	0.54	0.16		
Acquirers' Misvaluation (N = 96)					
|EXVIA|	0.37	0.34	0.24		
|MBIA|	0.57	0.45	0.43		
MI – Mispricing	0.46	0.46	0.14		
Targets' Overvaluation (N = 64)					
EXVIA	− 0.71	− 0.71	0.21		
MBIA	0.22	0.05	0.61		
MACRO	0.08	0.11	0.18		
MI – Overvaluation	0.45	0.47	0.19		
Targets' Misvaluation (N = 64)					
|EXVIA|	0.70	0.71	0.22		
|MBIA|	0.36	0.14	0.42		
MI – Mispricing	0.46	0.46	0.15		
Acquirers' Financials					
Total Assets ($mil)	13498	3749	28749		
Dividend Payout ($mil)	272	54	856		
Leverage	0.74	0.51	0.80		
Collateral	0.33	0.22	0.33		
Return-on-equity	0.13	0.11	0.17		
Market-to-book	1.88	1.33	1.53		
Closely Held Shares	13.83	5.54	18.92		
Deal-related Features					
Relative Deal Size	0.36	0.34	0.22		
Deal Value ($mil)	2309	590	5481		
CAR [− 40; − 1] (MM)	− 0.01	0.00	0.09		
CAR [− 40; − 1] (3F)	− 0.01	0.00	0.09		
Asymmetric Information (Binary)					
Cross− industry	0.34				
Cross-border	0.10				
Unlisted Target	0.29				
Panel C: Mixed Financed M&A (*N* = 208)					
Acquirers' Overvaluation (N = 208)					
EXVIA	− 0.40	− 0.46	0.39		
MBIA	0.35	0.21	0.84		
MACRO	0.06	0.10	0.19		
MI – Overvaluation	0.52	0.50	0.15		
Acquirers' Misvaluation (N = 208)					
|EXVIA|	0.49	0.48	0.29		
|MBIA|	0.62	0.43	0.66		
MI – Mispricing	0.47	0.47	0.15		

Table 2 (continued)

	Mean	Median	Std. Dev	Δ Mean Cash—Stock	Δ Median Cash—Stock
Targets' Overvaluation (N = 87)					
EXVIA	−0.76	−0.72	0.22		
MBIA	0.22	0.15	0.57		
MACRO	0.04	0.09	0.23		
MI – Overvaluation	0.51	0.51	0.15		
Targets' Misvaluation (N = 87)					
|EXVIA|	0.75	0.72	0.23		
|MBIA|	0.34	0.15	0.38		
MI – Mispricing	0.44	0.42	0.18		
Acquirers' Financials					
Total Assets ($mil)	19078	5343	37553		
Dividend Payout ($mil)	437	83	1130		
Leverage	0.78	0.58	1.14		
Collateral	0.34	0.22	0.32		
Return-on-equity	0.21	0.17	0.22		
Market-to-book	3.70	1.87	9.01		
Closely Held Shares	12.97	6.71	16.99		
Deal-related Features					
Relative Deal Size	0.30	0.24	0.23		
Deal Value ($mil)	3043	900	6569		
CAR [−40; −1] (MM)	−0.01	−0.02	0.09		
CAR [−40; −1] (3F)	0.00	−0.01	0.09		
Asymmetric Information (Binary)					
Cross-industry	0.53				
Cross-border	0.12				
Unlisted Target	0.59				

This table presents the summary statistics of 1155 M&A from 2009 to 2016 for all-cash (N = 851), all-stock (N = 96), and mixed (N = 208) financed M&A. The t-test (mean) and Wilcoxon rank-sum test (median) are applied to the differences between all-cash and all-stock M&A. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

gather the full information of payment methods. From the preliminary tests, we find that acquirers' and targets' overvaluation and misvaluation measures show significant differences between all-cash and all-stock deals. Nevertheless, different measures tend to capture various information. In particular, *EXVIA* and *MI-Overvaluation* are lower for cash acquirers while *MBIA* shows the opposite. |*EXVIA*| and *MI-Mispricing* are larger for cash acquirers while |*MBIA*| is insignificant. Here, we argue that *EXVIA* and |*EXVIA*| contain the information of both equity and debt relative to industry peers while *MBIA* and |*MBIA*| only reveal the market price of equity, which can lead to different results. Notably, through these preliminary tests, we identify significant differences between how overvaluation

and misvaluation influence the choice of payment, which are further investigated with regression analyses. Moreover, all-cash acquirers are larger by total assets and pay more dividends. The financial leverage is significantly higher for all-stock acquirers as well as the amount of closely held shares. As for deal size, all-cash deals are smaller than all-stock deals in absolute and relative terms. The proxies of asymmetric information all indicate that the level of information asymmetry is higher in all-cash deals.

3.3 Event study

In order to investigate whether acquirers' stock financing is viewed as a signal for overvaluation by investors, the event study following MacKinlay (1997) is applied. The expected return of firm i on day t is calculated by the market model as:

$$E\left(R_{i,t}\right) = \hat{\alpha}_i + \hat{\beta}_i * R_{m,t} + \varepsilon_i, \tag{6}$$

where R_m refers to the return of the S&P500 index for U.S. acquirers. The period to estimate $\hat{\alpha}_i$ and $\hat{\beta}_i$ is $[-257, -6]$, meaning the corresponding days prior to the M&A announcement. To test the robustness, the Fama and French (1993) three-factor model is applied:

$$E\left(R_{i,t}\right) - r_f = \hat{\alpha}_i + \hat{b_i} * \left(r_{m,t} - r_f\right) + \hat{b}_{s,i} * SMB_t + \hat{b}_{v,i} * HML_t + \varepsilon_i. \tag{7}$$

In this model, r_f is the risk-free rate and r_m is the return of the market portfolio. *SMB* and *HML* measure the excess returns of small over big caps and of value over growth stocks, respectively. Data for the U.S. Fama and French three factors are directly obtained from their website. Abnormal return is calculated by the difference of actual return and expected return:

$$AR_{i,t} = R_{i,t} - E\left(R_{i,t}\right). \tag{8}$$

The cumulative abnormal return of stock i during the event window $\left[\tau_1;\tau_2\right]$ is calculated as:

$$CAR_{i,[\tau_1;\tau_2]} = \sum_{t=\tau_1}^{\tau_2} AR_{i,t}. \tag{9}$$

Finally, for a sample of N observations, the average cumulative abnormal return is derived by:

$$CAAR_{[\tau_1;\tau_2]} = \frac{1}{N} \sum_{i=1}^{N} CAR_{i,[\tau_1;\tau_2]}. \tag{10}$$

To identify the determinants of stock market reactions to M&A announcements, the ordered logit regression is applied. Harrington and Shrider (2007) argue that it is a better way to analyze abnormal returns compared to the ordinary

least squares regression due to significantly increased deviations around the event. Here, we first divide acquirers' CARs into quantiles and assign them discrete scores (S) as follows: 1 if the CAR is lower than the first quantile; 2 if it is between the first and the second quantile; 3 if it is between the second and the third quantile; and 4 if it is higher than the third quantile. Then, we run regressions on the scores of CARs with the independent variables explained in Sect. 3.2:

$$\mathrm{S}(CAR_{i,[\tau_1;\tau_2]}) = \hat{\alpha}_i + \sum_{j=1}^{m} \hat{\beta}_{j,i} Var_{j,i} + \varepsilon_i. \tag{11}$$

4 Empirical results on payment methods

4.1 Targets' rationality and M&A payment methods

To test the first hypothesis that rational targets cannot be exploited by overvalued acquirers in the choice of payment methods, we first verify the rationality of targets in terms of hiring transaction advisors. Following Etrugrul (2015), who finds that top-tier advisors can help targets get a better bargaining position in M&A negotiations, we investigate whether there are differences between acquirers and targets when hiring top-tier advisors. We divide M&A advisors into top-tier and others by their market shares and identify the biggest five investment banks as top-tier advisors (Golubov et al. 2012; Etrugrul 2015). According to Bloomberg (2017), Goldman Sachs, Morgan Stanley, Bank of America Merrill Lynch, JP Morgan, and Citigroup are identified as top-tier M&A advisors. In line with Golubov et al. (2012), we classify deals, in which at least one advisor belongs to the five banks, as consulted by a top-tier advisor. For the final sample of 1155 transactions, we collect the information of advisors from the Thomson Reuters SDC deal synopsis when available, otherwise manually collected from the SEC filings. According to the available data, 930 targets have M&A advisors, out of which 361 are top-tier advisors; 736 acquirers are advised, out of which 358 are from top-tier M&A advisors. The high percentage of top-tier advisors can be attributed to our sample selection, where we only include the deal size of over 100 million USD.

Table 3 shows the results of logit regressions on the binary variable *Top-Tier Advisor*, which equals 1 if the firm has a top-tier M&A advisor and 0 otherwise. Each transaction has two observations of advisors, respectively from the acquirer and the target, making 2310 total observations. The binary variable *Acquirer* equals 1 if the observation refers to the acquirer's side. *Opp. Advisor* is a binary variable that equals 1 if the opposite party hires an advisor regardless if it is a top-tier advisor or not. The results show that hiring a top-tier advisor does not depend on being acquirer or target, supported by the insignificant coefficients of *Acquirer* for all models. Nevertheless, if the counterparty is advised, it is more likely for the observed firm to hire a top-tier advisor. In addition, our results show

Table 3 Rationality on hiring top-tier M&A advisors

	Model (1)	Model (2)	Model (3)	Model (4)
Acquirer/Target Status				
Acquirer	−0.164	−0.165	−0.157	−0.156
	(−1.610)	(−1.619)	(−1.562)	(−1.562)
Opposite Party Advisor				
Opp. Advisor	1.115***	1.116***	1.113***	1.109***
	(7.900)	(7.935)	(7.979)	(7.982)
Asymmetric Information				
Cross-industry	−0.286***	−0.279***	−0.168*	−0.163*
	(2.785)	(2.736)	(1.691)	(1.650)
Cross-border	−0.101	−0.106	−0.071	−0.078
	(−0.782)	(−0.834)	(−0.565)	(−0.627)
Deal-related Information				
(ln) Deal Value	1.525***	1.529***	1.460***	1.468***
	(13.671)	(13.867)	(13.522)	(13.744)
Year Fixed	Yes	No	Yes	No
Industry Fixed	Yes	Yes	No	No
Constant	−5.847***	−5.905***	−5.723***	−5.840***
	(−14.615)	(−16.942)	(−15.306)	(−18.382)
Observations	2310	2310	2310	2310
Pseudo R^2	0.152	0.153	0.133	0.134

This table presents the results of logit regressions on the top-tier advisor (1), otherwise 0. Robust z-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

negative coefficients for cross-industry deals, particularly under the industry-fixed effect. It implies that when acquirers and targets are from different industries, both parties are less likely to hire top-tier advisors. However, when the industrial information is homogeneous, the involved parties tend to explore their bargaining power with the aid of top-tier investment banks. We also find that for larger deals, firms tend to hire top-tier advisors, partially attributed to the self-selection issue, where the leading banks actively pitch for big deals. Based on these results, we conclude that targets are as rational as acquirers in terms of hiring M&A advisors and should not be at disadvantage in professional knowledge to identify valuation deviations with the help of their advisors.

After verifying the assumption, we investigate the relationship between acquirers' overvaluation and the percentage of cash payment that targets accept in M&A. Table 4 shows the results of Tobit regressions where the dependent variable *Cash Payment (%)* ranges from 0 to 1. The results show that acquirers' overvaluation measures are insignificant in all models, indicating that acquirers' overvaluation is not related to M&A payment methods. We argue that when acquirers are overvalued and this overvaluation can be identified with accessible information, they have little opportunity to cash out through the choice of payment

Table 4 Payment methods and acquirers' overvaluation

	Model (1)	Model (2)	Model (3)	Model (4)
Acquirers' Overvaluation				
EXVIA	−0.006			
	(−0.044)			
MBIA		0.043		
		(0.474)		
MACRO			0.141	
			(0.411)	
MI—Overvaluation				−0.193
				(−0.561)
Asymmetric Information				
Cross-industry	0.241***	0.241***	0.239***	0.243***
	(2.861)	(2.866)	(2.832)	(2.886)
Cross-border	0.186	0.181	0.187	0.188
	(1.577)	(1.530)	(1.580)	(1.589)
Unlisted Target	0.723***	0.724***	0.722***	0.722***
	(7.571)	(7.617)	(7.610)	(7.612)
Acquirers' Financials				
(ln) Tot. Ass	0.345***	0.353***	0.343***	0.349***
	(2.947)	(3.303)	(3.290)	(3.323)
Divd./Tot. Ass	0.514	0.486	0.514	0.532
	(1.085)	(1.030)	(1.092)	(1.125)
Leverage	0.098	0.097	0.098	0.100
	(1.098)	(1.092)	(1.105)	(1.120)
Collateral	0.194	0.190	0.190	0.213
	(1.178)	(1.192)	(1.189)	(1.301)
Return-on-equity	−0.053	−0.063	−0.054	−0.046
	(−0.496)	(−0.577)	(−0.502)	(−0.427)
Market-to-book	0.007	0.005	0.007	0.008
	(0.960)	(0.494)	(0.959)	(1.042)
Closely Held Shares	−0.007***	−0.007***	−0.007***	−0.007***
	(−2.738)	(−2.744)	(−2.729)	(−2.764)
Deal-related Features				
Relative Deal Value	−1.111***	−1.061***	−1.119***	−1.116***
	(−3.699)	(−3.659)	(−4.221)	(−4.217)
(ln) Deal Value	−0.504***	−0.515***	−0.502***	−0.505***
	(−3.952)	(−4.161)	(−4.167)	(−4.181)
CAR [−40; −1] (MM)	−0.695	−0.718	−0.700	−0.677
	(−1.517)	(−1.559)	(−1.530)	(−1.474)
Year Fixed	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes
Constant	−0.779	−0.860	−0.721	−0.731
	(−0.768)	(−0.950)	(−0.818)	(−0.831)

Table 4 (continued)

	Model (1)	Model (2)	Model (3)	Model (4)
Sigma	0.945***	0.945***	0.945***	0.945***
	(16.629)	(16.628)	(16.629)	(16.629)
Observations	1150	1150	1150	1150
Pseudo R^2	0.255	0.255	0.255	0.255

This table presents the results of Tobit regressions on the percentage of cash applied to finance M&A. Robust t-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

methods. We support Eckbo et al. (2018) and De Bodt et al. (2019) that targets do not naively accept overvalued stock payment and further explain targets' rationality as follows: if targets are aware of acquirers' overvaluation, they would either not accept the offer or be compensated in other ways, e.g., through M&A premiums, leading that the percentage of cash payment is not related to acquirers' overvaluation.

In terms of deal-related information asymmetry, we find that *Cross-industry* and *Unlisted Target* are significantly positively related to *Cash Payment (%)*. It implies that if acquirers and targets are from different industries, a larger portion of cash payment is applied to reduce the risk caused by industrial information asymmetry. As for targets who are not publicly listed, there is a possibility that targets' managers want to cash out from M&A transactions, and acquirers can reduce the risk of losing control by paying with cash. According to our results, acquirers' total assets are positively related to *Cash Payment (%)*, while shares held by block-holders (*Closely Held Shares*) show significant negative coefficients. We explain that for larger firms, whose shares are distributed more decentralized, cash financing is preferred in M&A. It can be attributed to the high complexity of stock payment in terms of operating costs and regulatory requirements. The negative signs of deal value imply that in larger deals, both absolutely and relatively, a lower percentage of cash payment is applied. We argue that the risk increases with larger transactions. Therefore, acquirers are exploring risk reduction and risk sharing possibilities with a higher portion of stock financing. Our findings support Hansen's (1987) risk-sharing theory and are in line with Faccio and Masulis' (2005) finding that partial stock payment is often used in large deals.

Generally, we find that overvalued acquirers cannot take advantage of payment methods based on targets' rationality. Although targets can leverage their information to evaluate acquirers' equity and make reasonable decisions during M&A, the information asymmetry still influences how certain they are about the valuation. In this content, larger variations in acquirers' *EXVIA* and *MBIA* can imply a higher risk level associated with information asymmetry. Therefore, we apply the absolute terms of *EXVIA* and *MBIA* to measure acquirers' misvaluation. Besides, *MI – Mispricing* that combines |*EXVIA*|, |*MBIA*|, and *MACRO* is applied as a misvaluation

Table 5 Payment methods and acquirers' misvaluation

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Acquirers' Mispricing					
|EXVIA|	0.834***				
	(4.664)				
$EXVIA^2$		0.785***			
		(4.608)			
|MBIA|			−0.213		
			(−1.443)		
MACRO				0.146	
				(0.420)	
MI – Mispricing					0.482**
					(2.205)
Asymmetric Information					
Cross-industry	0.251***	0.281***	0.259***	0.266***	0.268***
	(−3.134)	(3.372)	(3.062)	(3.120)	(3.155)
Cross-border	0.151	0.177	0.216*	0.208*	0.199*
	(1.266)	(1.516)	(1.811)	(1.742)	(1.666)
Unlisted Target	0.711***	0.650***	0.661***	0.660***	0.665***
	(7.713)	(7.054)	(7.060)	(7.026)	(7.080)
Acquirers' Financials					
(ln) Tot. Ass	0.392***	0.379***	0.328***	0.347***	0.373***
	(3.750)	(3.555)	(3.093)	(3.284)	(3.468)
Divd./Tot. Ass	0.746**	−0.098	0.650	0.468	0.472
	(2.354)	(−0.933)	(1.317)	(0.980)	(0.995)
Leverage	0.097	0.669	0.092	0.082	0.076
	(1.179)	(1.430)	(1.014)	(0.922)	(0.851)
Collateral	0.380**	0.075	0.212	0.191	0.209
	(2.382)	(0.862)	(1.310)	(1.178)	(1.293)
Return-on-equity	−0.103	0.354**	−0.036	−0.049	−0.066
	(−1.080)	(2.196)	(−0.333)	(−0.455)	(−0.608)
Market-to-book	0.010	0.009	0.020*	0.007	0.006
	(1.550)	(1.140)	(1.910)	(0.941)	(0.739)
Closely Held Shares	−0.008***	−0.009***	−0.008***	−0.008***	−0.008***
	(−3.166)	(−3.335)	(−2.760)	(−2.744)	(−2.853)
Deal Information					
Relative Deal Value	−1.053***	−1.096***	−1.159***	−1.116***	−1.044***
	(−4.247)	(−4.083)	(−4.308)	(−4.167)	(−3.851)
(ln) Deal Value	−0.524***	−0.552***	−0.526***	−0.542***	−0.563***
	(−4.724)	(−4.583)	(−4.307)	(−4.434)	(−4.565)
CAR [−40; −1] (MM)	−0.835*	−0.782*	−0.692	−0.698	−0.739
	(−1.813)	(−1.731)	(−1.494)	(−1.507)	(−1.595)
Year Fixed	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes

Table 5 (continued)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Constant	−1.397	−1.252	−0.427	−0.660	−1.103
	(−1.540)	(−1.379)	(−0.475)	(−0.740)	(−1.184)
Sigma	0.923***	0.929***	0.954***	0.956***	0.955***
	(16.321)	(16.660)	(16.618)	(16.613)	(16.618)
Observations	1150	1150	1150	1150	1150
Pseudo R^2	0.268	0.266	0.251	0.249	0.260

This table presents the results of Tobit regressions on the percentage of cash applied to finance M&A. Robust t-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

index explained in Sect. 3.2. We also apply $EXVIA^2$ as a supplement indicator to test if both tails of *EXVIA* can influence payment decisions.

Table 5 shows the results of payment methods related to the uncertainty in acquirers' valuation. We find that the mispricing measures |*EXVIA*|, $EXVIA^2$, and *MI-Mispricing* are highly significant and their positive signs indicate that a higher level of acquirers' misvaluation leads to a larger portion of cash financing. |*EXVIA*| contains the information of acquirers' equity and debt relative to industry peers and therefore can reveal a more comprehensive view compared to |*MBIA*|, which only reflects the market price of equity. |*MBIA*| and *MACRO* show no significant influence on payment methods, suggesting that acquirers' price multiples and the historical market development are insignificant factors for targets' decisions. The deal-relate asymmetric information proxies *Cross-industry* and *Unlisted Targets* are robust and positively related to *Cash Payment (%)*. Other controlling factors such as acquirers' total assets, closely held shares, and deal size show consistency.

Our results support Rhodes-Kropf and Viswanathan's (2004) statement that "the naïve explanation that overvalued bidders wish to use stock is incomplete because targets should not be eager to accept stock". Based on our findings of acquirers' overvaluation and misvaluation, we support Eckbo et al.'s (2018) evidence that although overvaluation should not be related to the choice of payment methods, the uncertainty about acquirers' valuation makes targets prefer cash payment to stock payment. We explain it by the two-sided information theory according to Hansen (1987) and Fishman (1989) that when the uncertainty in valuation is high, cash payment allows both sides to reduce the risk associated with the non-public information and avoids the excess cost of finding out the counterparty's true value. Moreover, based on the assumption that both parties are rational, while targets decline overvalued acquirers' stocks, undervalued acquirers would not offer stock payment in M&A.

4.2 Acquirers' rationality and M&A payment methods

Following the two-sided information theory, acquirers should react to targets' overvaluation and misvaluation in a similar way when choosing payment methods. Under

Table 6 Payment methods and targets' overvaluation

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Targets' Overvaluation						
EXVIA	−0.420					
	(−0.907)					
MBIA		0.041				
		(1.171)				
MACRO			0.153			
			(0.317)			
MI—Overvaluation				−0.000		
				(−0.000)		
Asymmetric Information						
Rel. EXVIA					−0.384	
					(−1.672)	
Rel. MBIA						−0.044
						(−1.227)
Cross-industry	0.215	0.247*	0.219	0.183	0.212	0.245*
	(1.571)	(1.793)	(1.589)	(1.353)	(1.544)	(1.782)
Cross-border	0.582**	0.565**	0.577**	0.540**	0.533**	0.570**
	(2.533)	(2.482)	(2.478)	(2.396)	(2.323)	(2.502)
Acquirers' Financials						
(ln) Tot. Ass	0.562***	0.573***	0.565***	0.603***	0.749***	0.562***
	(2.724)	(2.754)	(2.716)	(2.918)	(3.067)	(2.713)
Divd./Tot. Ass	3.108	2.739	3.042	2.861	3.173	2.599
	(1.156)	(1.026)	(1.123)	(1.074)	(1.179)	(0.970)
Leverage	0.313**	0.309**	0.329**	0.327**	0.368**	0.309**
	(2.045)	(2.020)	(2.152)	(2.191)	(2.380)	(2.020)
Collateral	−0.174	−0.212	−0.233	−0.242	−0.127	−0.216
	(−0.565)	(−0.701)	(−0.765)	(−0.798)	(−0.410)	(−0.713)
Return-on-equity	0.263	0.272	0.263	0.269	0.240	0.284
	(1.495)	(1.542)	(1.487)	(1.557)	(1.360)	(1.604)
Market-to-book	−0.007	−0.008	−0.007	−0.008	−0.004	−0.005
	(−0.674)	(−0.712)	(−0.653)	(−0.726)	(−0.397)	(−0.487)
Closely Held Shares	−0.002	−0.003	−0.002	−0.001	−0.001	−0.003
	(−0.435)	(−0.597)	(−0.348)	(−0.185)	(−0.243)	(−0.605)
Deal Information						
Relative Deal Value	−1.865***	−1.812***	−1.911***	−1.708***	−1.498**	−1.865***
	(−3.463)	(−3.353)	(−3.547)	(−3.187)	(−2.559)	(−3.483)
(ln) Deal Value	−0.614***	−0.641***	−0.607***	−0.671***	−0.760***	−0.630***
	(−2.902)	(−2.982)	(−2.860)	(−3.155)	(−3.193)	(−2.959)
CAR [−40; −1]	−0.402	−0.482	−0.419	−0.386	−0.460	−0.458
	(−0.557)	(−0.667)	(−0.578)	(−0.545)	(−0.635)	(−0.635)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes

Table 6 (continued)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
Constant	−2.910*	−2.728	−2.632	−2.871*	−4.085**	−2.620
	(−1.702)	(−1.612)	(−1.555)	(−1.683)	(−2.097)	(−1.553)
Sigma	0.867***	0.866***	0.870***	0.851***	0.867***	0.866***
	(10.538)	(10.544)	(10.539)	(10.566)	(10.545)	(10.545)
Observations	341	341	341	341	341	341
Pseudo R^2	0.334	0.336	0.333	0.336	0.338	0.336

This table presents the results of Tobit regressions on the percentage of cash applied to finance M&A. Robust t-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

this assumption, we build a subsample of transactions that include publicly listed targets to address the call of Malmendier et al. (2016) for further research on targets' valuation. As shown in Table 2, there are 342 transactions included in the subsample. We apply the same measures for targets' overvaluation by *EXVIA*, *MBIA*, *MACRO*, and *MI – Overvaluation* and misvaluation by |*EXVIA*|, |*MBIA*|, *MACRO*, and *MI – Mispricing*. We also test the supplement information contained in $EXVIA^2$ if both tails of *EXVIA* are associated with the choice of payment methods. Besides, we add relative overvaluation measures *Rel. EXVIA* and *Rel. MBIA*, calculated by the difference between the respective acquirers' and targets' overvaluation measures, where a larger number indicates that acquirers are more overpriced than targets. We also calculate *Rel.* |*EXVIA*| and *Rel.* |*MBIA*| as the sum of the respective acquirers' and targets' mispricing measures, based on the consideration that larger variations in acquirers' and targets' mispricing together would increase the risk but not be compensated.

Table 6 shows the results of Tobit regressions on *Cash Payment (%)* and targets' overvaluation. We get similar results as in Table 4. Combining the results of these two tables, we conclude that neither acquirers nor targets can take advantage of payment methods based on the insignificant relationship between their overvaluation measures and the percentage of cash used to finance M&A. These findings offer a new perspective to the two-sided information theory (Hansen 1987; Fishman 1989) that both parties in M&A are rational based on the information they obtain about the counterparty. We also supplement the latest findings of Eckbo et al. (2018) and De Bodt et al. (2019) where they focus more on targets' rationality and prove the insignificant relationship between payment methods and acquirers' overvaluation. Based on the fact that M&A decisions are made through a multi-stage negotiation process and both parties can leverage the information they acquire during the process (Officer 2007), the decision of M&A payment methods should not lead to a significant advantage for one party at the other's cost. In this context, the relative measures of overvaluation, which suggest whether acquirers are more overpriced than targets, are also insignificant related to payment methods. We prove the robustness that cross-border transactions and acquirers' total assets are positively related to the percentage of cash payment while larger deals are associated with a higher portion

Table 7 Payment methods and targets' misvaluation

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
Targets' Mispricing							
|EXVIA|	0.772*						
	(1.957)						
$EXVIA^2$		0.488*					
		(1.736)					
|MBIA|			0.169				
			(1.208)				
MACRO				0.153			
				(0.317)			
MI – Mispricing					0.716		
					(1.629)		
Asymmetric Information							
Rel. |EXVIA|						1.185***	
						(4.541)	
Rel. |MBIA|							0.086
							(0.877)
Cross-industry	0.176	0.220	0.228*	0.219	0.176	0.229*	0.235*
	(−1.351)	(1.617)	(1.669)	(1.589)	(1.369)	(1.773)	(1.714)
Cross-border	0.576**	0.596**	0.574**	0.577**	0.603***	0.541**	0.570**
	(2.444)	(2.589)	(2.508)	(2.478)	(2.730)	(2.464)	(2.494)
.Acquirers' Financials							
(ln) Tot. Ass	0.576***	0.560***	0.567***	0.565***	0.599***	0.700***	0.557***
	(2.691)	(2.726)	(2.734)	(2.716)	(3.028)	(3.387)	(2.685)
Divd./Tot. Ass	2.909	3.166	3.038	3.042	2.721	3.087	3.125
	(1.377)	(1.186)	(1.134)	(1.123)	(1.065)	(1.246)	(1.155)
Leverage	0.284*	0.297*	0.321**	0.329**	0.303**	0.227	0.319**
	(1.830)	(1.950)	(2.112)	(2.152)	(2.109)	(1.573)	(2.093)
Collateral	−0.143	−0.146	−0.242	−0.233	−0.244	0.182	−0.246
	(−0.418)	(−0.478)	(−0.800)	(−0.765)	(−0.846)	(0.612)	(−0.810)
Return-on-equity	0.256*	0.266	0.266	0.263	0.243	0.258	0.254
	(1.791)	(1.519)	(1.516)	(1.487)	(1.463)	(1.544)	(1.443)
Market-to-book	−0.007	−0.007	−0.007	−0.007	−0.007	−0.001	−0.010
	(−0.729)	(−0.680)	(−0.677)	(−0.653)	(−0.702)	(−0.114)	(−0.899)
Closely Held Shares	−0.001	−0.002	−0.001	−0.002	0.000	−0.005	−0.002
	(−0.229)	(−0.426)	(−0.297)	(−0.348)	(0.037)	(−1.179)	(−0.402)
Deal Information							
Relative Deal Value	−1.589**	−1.827***	−1.822***	−1.911***	−1.577***	−1.353**	−1.878***
	(−2.483)	(−3.409)	(−3.373)	(−3.547)	(−3.082)	(−2.583)	(−3.489)
(ln) Deal Value	−0.658***	−0.619***	−0.615***	−0.607***	−0.657***	−0.708***	−0.611***
	(−2.994)	(−2.937)	(−2.901)	(−2.860)	(−3.242)	(−3.407)	(−2.877)

Table 7 (continued)

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
CAR [− 40; − 1]	− 0.279	− 0.333	− 0.455	− 0.419	− 0.339	− 0.363	− 0.411
	(− 0.394)	(− 0.461)	(− 0.630)	(− 0.578)	(− 0.497)	(− 0.520)	(− 0.570)
Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	− 3.125*	− 2.821*	− 2.803*	− 2.632	− 3.259**	− 5.167***	− 2.724
	(− 1.806)	(− 1.679)	(− 1.650)	(− 1.555)	(− 2.008)	(− 2.926)	(− 1.608)
Sigma	0.823***	0.863***	0.867***	0.870***	0.825***	0.814***	0.868***
	(10.979)	(10.544)	(10.543)	(10.539)	(10.858)	(10.607)	(10.541)
Observations	341	341	341	341	341	341	341
Pseudo R^2	0.337	0.337	0.336	0.333	0.337	0.368	0.334

This table presents the results of Tobit regressions on the percentage of cash applied to finance M&A. Robust t-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

of stock payment. In addition, acquirers' leverage is significantly positively related to cash payment when we replace acquirers' overvaluation with targets' overvaluation. We explain this finding by the implied interaction effect, i.e., acquirers' leverage is interactive with their overall valuation and thus show no significant effect in Table 4. When combining with targets' overvaluation in Table 6, positive signs indicate that acquirers with higher leverage may have a better access to the debt market. They may prefer to issue new debt to finance M&A by cash to get further benefits of leverage and avoid diluting their shares with targets' shareholders.

In Table 7, we further investigate targets' misvaluation measures and find that targets' |*EXVIA*|, $EXVIA^2$, and *Rel.* |*EXVIA*| are significantly positively related to the percentage of cash payment. We address the similar conclusion as for Table 5, i.e., larger misvaluation of targets can also lead to a larger portion of cash payment in M&A. Our results indicate that both parties are rational and reduce the risk associated with the counterparty's valuation by using a larger portion of cash to finance M&A. In addition, we find that the relationship between *Cash Payment (%)* and *Rel.* |*EXVIA*| is positive with high significance. As mentioned, *Rel.* |*EXVIA*| is the sum of the acquirers' and targets' |*EXVIA*| to present the combined mispricing level. The positive sign indicates that transactions with higher combined mispricing are financed with a larger portion of cash, adding more evidence to the two-sided information theory in M&A. We do not find significant results on |*MBIA*| and *MACRO* for targets either while prove the robustness of other influencing factors, such as cross-border, acquirers' size and leverage, and deal size.

Table 8 Market reactions to M&A payment methods

Event Window	Cash (N = 851)		Stock (N = 96)		Mixed (N = 208)		All Transactions (N = 1155)	
	Mean *p* value	Median *p* value	Mean *p* value	Median *p* value	Mean *p* value	Median *p* value	Mean *p* value	Median *p* value
Market Model								
[−5; +5]	1.219 0.000***	0.696 0.000***	1.000 0.228	−0.137 0.719	2.550 0.001***	1.590 0.001***	1.441 0.000***	0.763 0.000***
[−1; +1]	1.198 0.000***	0.454 0.000***	0.436 0.546	−0.628 0.412	1.664 0.002***	0.944 0.004***	1.218 0.000***	0.480 0.000***
[−1; 0]	0.637 0.000***	0.167 0.000***	−0.044 0.942	−0.811 0.137	0.406 0.349	−0.006 0.616	0.539 0.000***	0.119 0.003***
Fama–French Three-Factor Model								
[−5; +5]	1.139 0.000***	1.139 0.000***	1.030 0.189	−0.181 0.623	2.530 0.001***	1.228 0.002***	1.380 0.000***	0.529 0.000***
[−1; +1]	1.168 0.000***	0.376 0.000***	0.384 0.582	−0.402 0.425	1.677 0.002***	0.781 0.003***	1.195 0.000***	0.380 0.000***
[−1; 0]	0.609 0.000***	0.115 0.000***	−0.107 0.857	−0.589 0.145	0.394 0.349	0.182 0.513	0.511 0.000***	0.068 0.005***

This table shows the mean and median of acquirers' CARs (%). The t-test (mean) and Wilcoxon rank-sum test (median) are applied. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

4.3 Signal of payment methods for investors

Following the rationality of acquirers and targets, we investigate how investors read the information of payment methods through acquirers' abnormal returns. In Table 8, we observe significant positive abnormal returns for cash-financed M&A but insignificant results for stock swaps. The differences between cash-only and stock-only groups are not statistically significant either. Based on these results, we cannot derive a clear signal that stock payment is an indicator of overvalued acquirers on the market. These findings are in line with Martynova and Renneboog (2011) and Alexandridis et al. (2017) that acquirers who pay solely with stocks get insignificant announcement effects. In our sample, for the event window [−5; +5], acquirers with mixed payment receive the highest abnormal returns of 2.55% according to the market model. Followed by acquirers with all-cash payment get approximately 1.22% abnormal returns during the same event window. The results of the Fama and French three-factor model are consistent with the market model. Our findings agree with Betton and Eckbo (2000) that the mixed payment of cash and stock generates the highest announcement returns for acquirers' shareholders. We argue that investors read the choice of payment methods as an indicator of acquirers' financial strength combined with risk-sharing considerations. With cash payment, acquirers show that they have sufficient free cash flow, while a portion of stock financing enables acquirers to share the risk of future performance with targets and create the same incentive to improve their business.

Table 9 Determinants of market reactions

	CAR [− 1; 0]			CAR [− 1; + 1]			CAR [− 5; + 5]		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
Cash Payment (%)	0.668***	0.672***	0.551**	0.513**	0.502**	0.495**	0.513**	0.502**	0.495**
	(3.083)	(3.054)	(2.388)	(2.527)	(2.423)	(2.216)	(2.527)	(2.423)	(2.216)
Asymmetric Information									
Cross-industry	− 0.019	− 0.035	− 0.012	0.078	0.072	0.027	0.078	0.072	0.027
	(0.168)	(0.313)	(0.105)	(− 0.709)	(− 0.644)	(− 0.234)	(− 0.709)	(− 0.644)	(− 0.234)
Cross-border	− 0.250*	− 0.234*	− 0.264**	− 0.060	− 0.041	− 0.071	− 0.060	− 0.041	− 0.071
	(− 1.903)	(− 1.772)	(− 1.979)	(− 0.483)	(− 0.325)	(− 0.557)	(− 0.483)	(− 0.325)	(− 0.557)
Unlisted Target	0.430***	0.423***	0.442***	0.494***	0.493***	0.472***	0.494***	0.493***	0.472***
	(3.106)	(2.995)	(3.151)	(3.606)	(3.540)	(3.403)	(3.606)	(3.540)	(3.403)
Acquirers' Financials									
(ln) Tot. Ass	− 0.177	− 0.147	− 0.117	− 0.490***	− 0.474***	− 0.473***	− 0.490***	− 0.474***	− 0.473***
	(− 1.547)	(− 1.276)	(− 0.963)	(− 4.196)	(− 4.038)	(− 3.890)	(− 4.196)	(− 4.038)	(− 3.890)
Divd./Tot. Ass	0.795	0.831	0.807	− 0.254	− 0.210	− 0.188	− 0.254	− 0.210	− 0.188
	(1.384)	(1.491)	(1.380)	(− 0.285)	(− 0.242)	(− 0.212)	(− 0.285)	(− 0.242)	(− 0.212)
Leverage	− 0.173	− 0.143	− 0.186	− 0.237	− 0.225	− 0.212	− 0.237	− 0.225	− 0.212
	(− 1.204)	(− 1.058)	(− 1.210)	(− 1.585)	(− 1.544)	(− 1.433)	(− 1.585)	(− 1.544)	(− 1.433)
Collateral	− 0.060	− 0.025	0.039	− 0.054	− 0.032	0.096	− 0.054	− 0.032	0.096
	(− 0.275)	(− 0.112)	(0.152)	(− 0.242)	(− 0.139)	(0.374)	(− 0.242)	(− 0.139)	(0.374)
Return-on-equity	− 0.180	− 0.149	− 0.213	− 0.027	− 0.000	− 0.013	− 0.027	− 0.000	− 0.013
	(− 0.799)	(− 0.682)	(− 0.955)	(− 0.100)	(− 0.000)	(− 0.049)	(− 0.100)	(− 0.000)	(− 0.049)
Market-to-book	0.020	0.018	0.021*	0.013	0.011	0.013	0.013	0.011	0.013
	(1.644)	(1.441)	(1.713)	(0.866)	(0.792)	(0.916)	(0.866)	(0.792)	(0.916)
Closely Held Shares	0.002	0.003	0.002	0.003	0.004	0.004	0.003	0.004	0.004
	(0.433)	(0.784)	(0.370)	(0.682)	(1.033)	(0.931)	(0.682)	(1.033)	(0.931)

Table 9 (continued)

	CAR [− 1; 0]			CAR [− 1; + 1]			CAR [− 5; + 5]		
	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)
Deal Information									
Relative Deal Value	0.872**	0.887**	1.077**	0.477	0.440	0.418	0.477	0.440	0.418
	(2.063)	(2.084)	(2.439)	(1.067)	(0.970)	(0.916)	(1.067)	(0.970)	(0.916)
(ln) Deal Value	− 0.087	− 0.109	− 0.181	0.209	0.211	0.189	0.209	0.211	0.189
	(− 0.560)	(− 0.687)	(− 1.113)	(1.292)	(1.291)	(1.136)	(1.292)	(1.291)	(1.136)
Constant Cut 1	− 2.243**	− 2.101*	− 1.858	− 4.671***	− 4.573***	− 17.859***	− 4.671***	− 4.573***	− 17.859***
	(− 2.073)	(− 1.888)	(− 1.637)	(− 4.370)	(− 4.153)	(− 12.110)	(− 4.370)	(− 4.153)	(− 12.110)
Constant Cut 2	− 1.099	− 0.948	− 0.705	− 3.532***	− 3.427***	− 16.712***	− 3.532***	− 3.427***	− 16.712***
	(− 1.017)	(− 0.852)	(− 0.621)	(− 3.319)	(− 3.126)	(− 11.346)	(− 3.319)	(− 3.126)	(− 11.346)
Constant Cut 3	0.045	0.206	0.450	− 2.368**	− 2.254**	− 15.535***	− 2.368**	− 2.254**	− 15.535***
	(0.042)	(0.185)	(0.396)	(− 2.232)	(− 2.062)	(− 10.588)	(− 2.232)	(− 2.062)	(− 10.588)
Year Fixed	No	Yes	No	No	Yes	No	No	Yes	No
Industry Fixed	No	No	Yes	No	No	Yes	No	No	Yes
Observations	1150	1150	1150	1150	1150	1150	1150	1150	1150
Adjusted R^2	0.017	0.021	0.021	0.022	0.026	0.027	0.022	0.026	0.027

This table presents the results of ordered logit regressions on acquirers' CARs of the market model. Robust t-statistics are given in parentheses. Statistical significance at the 1%, 5%, and 10% levels are indicated by ***, **, and *, respectively

Table 9 shows the results of ordered logit regressions on acquirers' CARs. We observe that a higher percentage of cash payment is significantly associated with a higher quantile of acquirers' abnormal returns, especially for the shortest event window $[-1; 0]$. It supports the event study's results that all-cash acquirers get positive CARs while do not disagree that stock payment triggers non-negative effects. Huang et al. (2016) find that cash deals are more likely to be successful, which further explains the more positive market reactions. Our results of payment methods on acquirers' CARs are consistent with Moeller et al. (2005), Martynova and Renneboog (2011), and Danbolt and Maciver (2012). Furthermore, acquiring unlisted targets leads to higher abnormal returns for acquirers. This finding is in line with Faccio et al. (2006) and Officer (2007), based on the fact that unlisted targets suffer an average acquisition discount of 15% to 30% to comparable publicly traded targets due to the illiquidity issue (Officer 2007). We also find that acquirers' total assets are negatively related to their CARs for the event windows $[-1;+1]$ and $[-5;+5]$, which can be interpreted that investors see fewer synergy effects for big firms through M&A and thus react less positively. Homberg et al. (2009) report similar results by showing that the absolute size of acquirers is negatively related to the short-term M&A performance. In addition, cross-border transactions show significant negative coefficients over the $[-1; 0]$ event window. Despite that cross-border deals have steadily gained relevance for many big companies (Mentz and Schiereck 2008), our results imply investors' concerns regarding higher geopolitical and regulatory risks associated with these transactions, which can cause negative market reactions upon M&A announcements.

5 Conclusion

We present new evidence regarding the relationship between the choice of M&A payment methods and acquirers' overvaluation. The extant literature is divided on this issue, with some studies suggesting that acquirers' overvaluation increases the percentage of stock financing in M&A (e.g. Shleifer and Vishny 2003; Rhodes-Kropf and Viswanathan 2004; Rhodes-Kropf et al. 2005), while others, especially most recent studies such as Eckbo et al. (2018) and De Bodt et al. (2019), find that overvalued acquirers have a lower likelihood of paying solely with stocks. This debate is particularly important because the assumption that stock-swaps suggesting acquirers' overvaluation would lead to immediate and long-run price corrections (Vagenas-Nanos 2020).

Based on our sample, which includes 1155 completed M&A transactions from public U.S. acquirers between 2009 and 2016, we show that acquirers and targets are both rational in hiring M&A advisors. Under the assumption of rationality, we further examine the determinants of payment methods with the focus of acquirers' and targets' valuation. While acquirers' overvaluation shows no significant impact, the misvaluation measures and proxies of information asymmetry are positively related to the percentage of cash applied in financing M&A. Our findings are consistent with Eckbo et al.'s (2018) rational payment design hypothesis that acquirers' overvaluation has no effect on payment methods but the uncertainty about the true

value is crucial. Moreover, we extend our study to targets' valuation and find that for both parties, the larger the misvaluation, the higher percentage of cash is applied to reduce the risk of valuation uncertainty. Furthermore, we provide evidence that stock payment is not a signal of overvalued acquirers for market participates by applying the event study approach.

Our results are in line with Eckbo et al. (2018) and De Bodt et al. (2019) that stock financing in M&A is not related to acquirers' overvaluation, on the contrary, misvaluation significantly lowers the likelihood of stock payment. Moreover, we show similar evidence for targets' misvaluation, implying that neither acquirers nor targets can take advantage of their valuation deviations through M&A payment methods. Based on our results, there are several practical implications for the involved parties and investors. First, due to the rationality of acquirers and targets, firms can consider stock financing as a valid option in M&A and should not concern about negative market reactions. Second, a reduction of information asymmetry between acquirers and targets increases the likelihood of stock payment. It further implies that acquirers who intend to use their stocks to finance M&A should actively create transparency. Third, highly qualified transaction advisors can be valuable for both parties in M&A valuation and negotiations. Finally, investors cannot easily regard stock-financed M&A as a signal of overvalued acquirers. In practice, acquirers' overvaluation can be offset by acquisition premiums where targets are not at a disadvantage.

Following the existing literature, we provide new insights into the discussion regarding payment methods and overvaluation and raise the following questions for further research. For example, to what extent can transaction advisors help in M&A negotiations to avoid overvalued acquirers or targets? And if acquisition premiums are higher when overvalued acquirers choose stock payment?

Appendix

A1. Summary of variables

Firms' financial data are at the end of the year prior to M&A announcements if not otherwise stated.

Variable	Definition
Acquirer	It refers to a binary variable that equals 1 if the firm is an acquirer and 0 if it's a target
CAR [−40; −1] (MM)	It refers to cumulative abnormal returns for the event window [−40; −1] calculated by the market model
CAR [−40; −1] (3F)	It refers to cumulative abnormal returns for the event window [−40; −1] calculated by the Fama and French 3-factor model
Cash Payment (%)	It refers to the percentage of cash applied to finance M&A Source: SDC database and SEC filings (type 10-K)

Variable	Definition
Closely Held Shares	It refers to the number of closely held shares divided by common shares outstanding Source: Worldscope database
Collateral	It refers to the ratio of PPE (see below) to total assets (see below) Source: Faccio and Masulis (2005)
Cross-border	It refers to a binary variable that equals 1 if the acquirer and target are from different countries and 0 otherwise Source: Faccio and Masulis (2005)
Cross-industry	It refers to a binary variable that equals 1 if the acquirer and target are from different industries and 0 otherwise Source: Faccio and Masulis (2005)
Deal Value	It refers to deal value in million USD Source: SDC database
Debt	It refers to total debt outstanding Source: Worldscope database
Dividends	It refers to total common and preferred dividends paid to shareholders Source: Worldscope database
EXVIA	$\mathrm{EXVIA}_{i,t} = \ln\left(\frac{\mathrm{CPTL}_{i,t}}{\mathrm{I(CPTL)}_{i,t}}\right)$, where CPTL is total capital, which is the market value of equity plus the book value of debt, I (CPTL) is the imputed value derived by the firm's size (market cap) multiplying the median capital to size ratio in the firm's industry Source: Berger and Ofek (1995)
|EXVIA|	It refers to the absolute term of EXVIA
EXVIA^2	It refers to the squared term of EXVIA
Leverage	It refers to the sum of total debt and deal value divided by the sum of total assets and deal value Source: Faccio and Masulis (2005)
MACRO	$\mathrm{MACRO}_{i,t} = \ln\left(\frac{\mathrm{BUS}(-1)}{\mathrm{BUS}(-12)}\right)$, where BUS refers to the market valuation, measured by the total return index of a country's leading stock index, e.g. the S&P 500 index for U.S. firms. Besides, − 1 and − 12 refer to 1 and 12 months before the M&A announcement, respectively
Market-to-book	It refers to the market-to-book ratio Source: Worldscope database
MBIA	$MBIA_{i,t} = \ln\left(\frac{MB_{i,t}}{Med(MB)_{i,t}}\right)$, where MB is the firm's market-to-book ratio and Med (MB) is the industry's median market-to-book ratio Source: Lin et al. (2010)
|MBIA|	It refers to the absolute term of MBIA
MI – Mispricing	$\mathrm{MI}_{i,t} = \frac{1}{N}\frac{1}{K}\sum_{k}^{K}\mathrm{RANK}\left(\mathrm{VAL}_{i,t}\right)$, where RANK is the rank function. VAL refers to the available valuation measures of EXVIA, MBIA, and MACRO
MI—Overvaluation	$\mathrm{MI}_{i,t} = \frac{1}{N}\frac{1}{K}\sum_{k}^{K}\mathrm{RANK}\left(\mathrm{VAL}_{i,t}\right)$, where RANK is the rank function. VAL refers to the available valuation measures of |EXVIA|, |MBIA|, and MACRO

Variable	Definition
Opp. Advisor	It refers to a binary variable that equals 1 if the counterparty in M&A hires an advisor and 0 otherwise
PPE	It refers to property, plant, and equipment Source: Worldscope database
Relative Deal Value	It refers to the ratio of deal value divided by the sum of deal value and acquirer's pre-offer market cap Source: Faccio and Masulis (2005)
Rel. EXVIA	It refers to the difference between the respective acquirers' and targets' EXVIA
Rel. |EXVIA|	It refers to the sum of the respective acquirers' and targets' |EXVIA|
Rel. MBIA	It refers to the difference between the respective acquirers' and targets' MBIA
Rel. |MBIA|	It refers to the sum of the respective acquirers' and targets' |MBIA|
Return-on-equity	It refers to the return-on-equity ratio Source: Worldscope database
Top-Tier Advisor	It refers to a binary variable that equals 1 if the firm hires a top-tier advisor and 0 otherwise
Total Assets	It refers to total assets Source: Worldscope database
Unlisted Target	It refers to a binary variable that equals 1 if the target is not publicly listed and 0 otherwise Source: Faccio and Masulis (2005)

A2. Robustness

Robustness tests are applied when (1) replacing the Tobit regression model with the logit regression model on all-cash payment; (2) excluding the financial sector from the overall sample; (3) investigating the financial constraints hypothesis according to Kaplan and Zingles (1997) by using acquirers' free cash flows in the previous year divided by PPE in the transaction year as a proxy; (4) investigating the idiosyncratic risk of both parties following Aabo et al. (2017) as a proxy for difficulties to identify the counterparty's true value. Our findings stay robust and we offer all tests in the Online-Appendix.

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References

Aabo T, Pantzalis C, Park JC (2017) Idiosyncratic volatility: An indicator of noise trading? J Bank Finance 75:136–151

Ahern KR (2012) Bargaining power and industry dependence in mergers. J Financ Econ 103:530–550

Akbulut ME (2013) Do overvaluation-driven stock acquisitions really benefit acquirer stockholders. J Financ Quant Anal 48:1025–1055

Alexandridis G, Antypas N, Travlos N (2017) Value creation from M&As: New evidence. J Corp Finance 45:632–650

Ang JS, Cheng Y (2006) Direct evidence on the market-driven acquisition theory. J Financ Res 29:199–216

Bayless M, Chaplinsky S (1996) Is there a window of opportunity for seasoned equity issuance? J Finance 51:253–278

Bebchuk LA, Coates JC IV, Subramanian G (2002) The powerful antitakeover force of staggered boards: theory, evidence and policy. Stanf Law Rev 54:887–951

Ben-David I, Drake MS, Roulstone DT (2015) Acquirer valuation and acquisition decisions: Identifying mispricing using short interest. J Financ Quant Anal 50:1–32

Berger PG, Ofek E (1995) Diversification's effect on firm value. J Financ Econ 37:39–65

Berkovitch E, Narayanan MP (1990) Competition and the medium of exchange in takeovers. Rev Financ Stud 3:153–174

Betton S, Eckbo BE (2000) Toeholds, bid Jumps, and expected payoffs in takeovers. Rev Financ Stud 13:841–882

Bi XG, Gregory A (2011) Stock market driven acquisitions versus the Q theory of takeovers: the UK evidence. J Bus Finance Acc 38:628–656

Bloomberg (2017) Bloomberg global M&A financial rankings. https://data.bloomberglp.com/professional/sites/4/Bloomberg-Global-MA-Financial-Rankings-FY-2016.pdf

Choe H, Masulis RW, Nanda VK (1993) Common stock offering across the business cycle: theory and evidence. J Empir Finance 1:3–31

Comment R, Schwert GW (1995) Poison or placebo? Evidence on the deterrence and wealth effects of modern antitakeover measures. J Financ Econ 39:3–43

Danbolt J, Maciver G (2012) Cross-border versus domestic acquisitions and the impact on shareholder wealth. J Bus Finance Acc 39:1028–1067

De Bodt E, Cousin J-G, Roll R (2015) The full stock payment marginalization in M&A transactions. SSRN Journal 2689844

De Bodt E, Cousin J-G, Officer MS (2019) Acquirer overvaluation and stock payment in M&A transactions: What explains the spurious correlation? SSRN Journal 3392956

Denis DJ, Denis DK, Sarin A (1994) The information content of dividend changes: cash flow signaling, overinvestment, and dividend clienteles. J Financ Quant Anal 29:567–587

Di Giuli A (2013) The effect of stock misvaluation and investment opportunities on the method of payment in mergers. J Corp Finance 21:196–215

Dong M, Hirshleifer D, Richardson S, Teoh SH (2006) Does investor misvaluation drive the takeover market? J Finance 61:725–762

Dos Santos MB, Errunza VR, Miller DP (2008) Does corporate international diversification destroy value? Evidence from cross-border mergers and acquisitions. J Bank Finance 32:2716–2724

Drees F, Mietzner M, Schiereck D (2013) Effects of corporate equity ownership on firm value. RMS 7:277–308

Eckbo BE, Giammarino RM, Heinkel RL (1990) Asymmetric information and the medium of exchange in takeovers: theory and tests. Rev Financ Stud 3:651–675

Eckbo BE, Makaew T, Thorburn KS (2018) Are stock-financed takeovers opportunistic? J Financ Econ 128:443–465

Ertugrul M (2015) Bargaining power of targets: takeover defenses and top-tier target advisors. J Econ Bus 78:48–78

Faccio M, Masulis RW (2005) The choice of payment method in European mergers and acquisitions. J Finance 60:1345–1388
Faccio M, McConnell JJ, Stolin D (2006) Returns to acquirers of listed and unlisted targets. J Financ Quant Anal 41:197
Fama EF, French KR (1993) Common risk factors in the returns on stocks and bonds. J Financ Econ 33:3–56
Fama EF, French KR (1996) Multifactor explanations of asset pricing anomalies. J Finance 51:55–84
Fama EF, French KR (2015) A five-factor asset pricing model. J Financ Econ 116:1–22
Farhi E, Panageas S (2004) The real effects of stock market mispricing at the aggregate: Theory and empirical evidence. SSRN Journal 720462
Fishman MJ (1989) Preemptive bidding and the role of the medium of exchange in acquisitions. J Finance 44:41–57
Fu F, Lin L, Officer MS (2013) Acquisitions driven by stock overvaluation: are they good deals? J Financ Econ 109:24–39
Golubov A, Petmezas D, Travlos NG (2012) When it pays to pay your investment banker: new evidence on the role of financial advisors in M&As. J Finance 67:271–311
Golubov A, Petmezas D, Travlos NG (2016) Do stock-financed acquisitions destroy value? New methods and evidence. Rev Finance 20:161–200
Gordon M (2002) Takeover defenses work. Is that such a bad thing? Stanf Law Rev 55:819–837
Graham JR, Harvey CR (2001) The theory and practice of corporate finance: evidence from the field. J Financ Econ 60:187–243
Hansen RG (1987) A theory for the choice of exchange medium in mergers and acquisitions. J Bus 60:77–95
Harrington SE, Shrider DG (2007) All events induce variance: analyzing abnormal returns when effects vary across firms. J Financ Quant Anal 42:229–256
Homberg F, Rost K, Osterloh M (2009) Do synergies exist in related acquisitions? a meta-analysis of acquisition studies. RMS 3:75–116
Huang P, Officer MS, Powell R (2016) Method of payment and risk mitigation in cross-border mergers and acquisitions. J Corp Finance 40:216–234
Hutzschenreuter T, Kleindienst I, Schmitt M (2012) Path-related empirical research on M&A outcome: review and research agenda. RMS 6:375–405
Ismail A (2010) Are good financial advisors really good? The performance of investment banks in the M&A market. Rev Quant Finance Acc 35:411–429
Jensen MC (1986) Agency costs of free cash flow, corporate finance, and takeovers. Am Econ Rev 76:323–329
Jiraporn P, Kim YS, Davidson WN, Singh M (2006) Corporate governance, shareholder rights and firm diversification: an empirical analysis. J Bank Finance 30:947–963
Kaplan SN, Zingales L (1997) Do investment-cash flow sensitivities provide useful measures of financing constraints? Quart J Econ 112:169–215
Karim MA, Sarkar S, Zhang S (2016) Earnings management surrounding M&A: role of economic development and investor protection. Adv Acc 35:207–215
Lin JB, Pantzalis C, Park JC (2010) Corporate hedging policy and equity mispricing. Financ Rev 45:803–824
MacKinlay AC (1997) Event studies in economics and finance. J Econ Lit 35:13–39
Malmendier U, Opp MM, Saidi F (2016) Target revaluation after failed takeover attempts: cash versus stock. J Financ Econ 119:92–106
Martin KJ (1996) The method of payment in corporate acquisitions, investment opportunities, and management ownership. J Financ 51:1227–1246
Martynova M, Renneboog L (2011) The performance of the European market for corporate control: evidence from the fifth takeover wave. Eur Financ Manag 17:208–259
Mentz M, Schiereck D (2008) Cross-border mergers and the cross-border effect: the case of the automotive supply industry. RMS 2:199–218
Moeller SB, Schlingemann FP, Stulz, RM (2004) Do shareholders of acquiring firms gain from acquisitions? J Financ Econ 73:201–228
Moeller SB, Schlingemann FP, Stulz RM (2005) Wealth destruction on a massive scale? a study of acquiring-firm returns in the recent merger wave. J Finance 55:757–781
Myers SC (1984) The capital structure puzzle. J Finance 39:574–592

Officer MS (2007) The price of corporate liquidity: acquisition discounts for unlisted targets. J Financ Econ 83:571–598
Panageas S (2003) Speculation, overpricing, and investment: theory and empirical evidence. MIT working paper
Pantzalis C, Park JC (2009) Equity market valuation of human capital and stock returns. J Bank Finance 33:1610–1623
Raudszus M, Schiereck D, Trillig J (2014) Does vertical diversification create superior value? evidence from the construction industry. RMS 8:293–325
Rhodes-Kropf M, Viswanathan S (2004) Market valuation and merger waves. J Finance 59:2685–2718
Rhodes-Kropf M, Robinson DT, Viswanathan S (2005) Valuation waves and merger activity: the empirical evidence. J Financ Econ 77:561–603
Savor PG, Lu Q (2009) Do stock mergers create value for acquirers? J Finance 64:1061–1097
Schlingemann FP (2004) Financing decisions and bidder gains. J Corp Finane 10:683–701
Shleifer A, Vishny RW (1997) The limits of arbitrage. J Finance 52:35–55
Shleifer A, Vishny RW (2003) Stock market driven acquisitions. J Financ Econ 70:295–311
Smith CW, Watts RL (1992) The investment opportunity set and corporate financing, dividend, and compensation policies. J Financ Econ 32:263–292
Stulz RM (1988) Managerial control of voting rights: financing policies and the market for corporate control. J Financ Econ 20:25–54
Taggart RA (1977) A model of corporate financing decisions. J Financ 32:1467–1484
Vagenas-Nanos E (2020) The benefits of overvaluation: evidence from mergers and acquisitions. Financ Manag 49:91–133

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