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The Cost of Equity: Evidence from Investment Banking Valuations

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Abstract

Using manually compiled cost of equity (COE) estimates disclosed in takeover regulatory filings, we provide novel evidence on how investment bankers estimate discount rates. COE estimates are related to several risk proxies, such as beta and size. Other firm characteristics are unrelated to COE estimates or provide relations contradicting academic evidence. We also explore the role of incentives. For example, banks use significantly higher COEs in management buyouts, which potentially underestimates target value, making the bid more attractive for target shareholder approval.

I. Introduction

How is the cost of equity (COE) constructed in practice? There is an enormous academic literature that either proposes measures of COE or uses them to study asset prices or corporate decisions. Further, practitioners employ discount rates ubiquitously, including for discounted cash flow (DCF) analysis to value firms or investment projects (e.g., Kaplan and Ruback (1995)). However, despite the fundamentally important role that discount rates play in finance, our understanding of how finance professionals construct and use COE is still limited.[1] This article provides new evidence by analyzing how influential practitioners, that is, investment bankers, estimate COE.

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[1]See Graham (2022) for recent survey evidence of corporate discount rates, as well as a discussion of related research.

We do so by collecting and studying investment banks' COE estimates from mergers and acquisitions (M&A) transactions. In the United States, publicly traded targets almost always hire an investment bank to provide a valuation analysis, the details of which are disclosed in fairness opinions in merger regulatory filings. These M&A activities are among the most economically important investment decisions a firm undertakes. The investment bank's valuation analysis plays a critical role in the process, potentially influencing both deal term negotiations as well as shareholder approval. Since the COE is a crucial determinant of the bank's valuation estimates, it not only can impact deal outcomes, but also market participants' perception of the deal.

We aim to shed light on two main research questions. First, how do target investment banks construct COE estimates in their M&A valuation analyses? Specifically, what firm attributes do banks consider? Studying this question can provide evidence on what investment banks aim to measure. For example, do they include firm attributes to incorporate risk into the COE? One hypothesis is that banks incorporate firm variables established in the asset pricing literature, providing a framework for testing which firm characteristics might be related to banks' COE. Alternatively, bankers' practices might differ from the literature, as they might not be aware of the academic findings, or even if they are, they might be uncertain about robustness or whether the variables measure risk.

Our second research question asks whether target banks' incentives impact the COE estimates. This question speaks to what investment banks seek to influence with their target valuation estimates. On the one hand, investment banks might consider their reputation and estimate the COE as accurately as they can or perhaps even provide a low-end COE estimate to increase the target valuation when negotiating with the bidder's side. On the other hand, banks could estimate discount rates on the high end if they seek to provide a relatively low valuation, which could make the bidder's offer look attractive for the purposes of receiving shareholder approval. We examine the effects of bank incentives in several M&A scenarios, including the effects of contingent pay, where the bank has an incentive to facilitate deal completion, and management buyouts (MBOs), where target management can profit by offering a low price to existing shareholders.

We study a sample of target firms from 1993 to 2017. It is possible that investment bank valuations of M&A target firms are a less representative sample. We compare the sample of our target firms with the CRSP/Compustat universe and document that firm characteristics across these two groups are largely similar. Still, given our discussion of the incentives target investment banks face, as well as the unique timing that an acquisition represents in a target firm's lifecycle or the business cycle, banks' COE estimates in our data might not represent investment bank behavior more generally.

We begin our analysis by showing that bank-estimated COE values are significantly higher than those implied from the CAPM or multifactor asset pricing models (differences range from 0.75 to 3.46 percentage points), suggesting that bankers deviate from commonly used models in the academic literature.[2] Although

[2]Some of the merger filings provide banks' WACC estimates but not their COE estimates. In these cases, we convert the WACC values to COEs using a procedure described in more detail in Section III.B.

bankers employ aspects of these models, as we find that their COE estimates are positively related to beta and the inverse of firm size, in many ways, the bank-estimated COEs contradict findings from the empirical academic literature. For example, distress risk and volatility tend to be positively related to bank COE, although the literature finds evidence of a negative relation between these characteristics and expected returns (e.g., Ang, Hodrick, Xing, and Zhang (2006), Campbell, Hilscher, and Szilagyi (2008)). Past returns tend to be negatively associated with bank-estimated COE. Other common predictors of expected return, including the market-to-book ratio, profitability, and investment, are generally unrelated to banks' COE estimates. There is some evidence that stock illiquidity is positively related to COE, although the evidence is mixed.

We go on to examine how COE estimated by investment banks relates to COE derived from disclosures by the firms themselves (Gormsen and Huber (2023), (2024)). In univariate analysis, we find a significantly positive relation between COE estimated by the investment banks and COE derived from firm management disclosures, as regression estimates suggest that for every percentage point that management-modeled COE increases, the bank-estimated COE increases by 57 basis points. However, this relation significantly weakens once we also consider the effects of firm characteristics. In the multivariate specifications, a 1 percentage point increase in manager-derived COE suggests a 21–30 bps. increase in the COE estimated by the investment bank. Further, several firm characteristics, such as size and return volatility continue to be significantly related to bank-estimated COE, even after controlling for management-derived COE. In summary, we provide evidence suggesting that bank-estimated COE is distinct from COE modeled from firm management disclosures. However, we exercise caution is asserting that the COE differences are solely due to differences between banks and management, as different methodological choices between our study and Gormsen and Huber's works could help explain disparities.

We next examine incentive effects associated with banks' COE estimates. For example, we study deals where banks' fees are contingent on deal completion, which gives banks an incentive to estimate a high discount rate and ultimately a low valuation to make the offer price look attractive for target shareholder approval. We also investigate bank COE estimates in MBOs, which are deals where the target firm's managers have incentives to purchase the firm from shareholders at the lowest possible price. While we do not find significant evidence that contingent pay agreements lead to higher bank COE (and lower valuation) estimates, we do find that banks' COE estimates are substantially higher in MBOs compared with other M&A transactions, even after controlling for firm and deal characteristics as well as industry fixed effects. The economic significance is remarkably large: MBOs are associated with equity discount rates that are 4.1–5.6 percentage points higher, reflecting discount rates that are 27%–37% larger than the sample average. We interpret these results as consistent with the notion that managers and the banks they hire increase discount rates in valuation analyses to negotiate a lower purchase price with the target shareholders who are bought out in MBOs.

We show in Appendix Table A1 that our main findings are qualitatively similar if we restrict the sample only to deals in which the merger filings directly disclose banks' COE estimates.

We also explore bank reputation in COE estimates. Reputation is an important asset for investment banks, particularly for M&A advisory. It is costly for reputable banks to lose their standing, which can provide incentives to act in the best interest of their clients, thereby providing lower COE estimates to increase the offer price. Moreover, maintaining their reputation can help banks attract future business from other potential target firms. Consistent with this expectation, we find that the top 5 investment banks' COE estimates are significantly lower by about 1%. Although this result may suggest that top banks use lower discount rates to improve the valuation estimates of targets, it could also reflect a potential selection issue between target quality and investment bank reputation.

Finally, we explore the potential value implications of banks' COE estimates. Prior research finds a relation between investment banks' valuation analysis and M&A deal outcomes (Eaton, Guo, Liu, and Officer (2022)), and we explore whether the investment bank's choice of COE in DCF analysis is associated with target shareholder wealth effects. As part of this analysis, we also investigate how estimation precision affects the relation between the COE and premiums, as a more precise discount rate may provide a more meaningful valuation estimate and be more likely to impact deal outcomes, such as premiums. We would expect a negative relation between COE and deal premiums if, all else equal, high discount rates provide lower bank-estimated valuations that limit negotiated premiums received by target shareholders. Alternatively, we would expect no relation, in multivariate analysis, if variation in discount rates is a function of firm and deal characteristics. We find an insignificant relation between COE and takeover premiums, though there is a negative association when banks' COE estimates are more precise. Thus, we find some evidence that the value received by target shareholders is lower as the estimated COE rises. However, we suggest caution in interpreting our premium results as the results are not particularly strong, plus our analyses examine associations, not causal relations.

The remainder of the article is organized as follows: Section II reviews the related literature. Section III discusses our data. Section IV investigates how COE is related to firm characteristics. Section V examines banks' incentive effects associated with banks' COE estimates. Section VI concludes.

II. Related Literature

Our article is related to a small but growing literature that investigates COE estimates provided by other finance professionals, such as firm executives or equity analysts. Surveys of finance professionals provide insights into how practitioners think about and purport to use discount rates for valuation analyses (Graham and Harvey (2001), Mukhlynina and Nyborg (2020), and Graham (2022)). Other research studies discount rates implied from archival data such as analyst reports (Balakrishnan, Shivakumar, and Taori (2021)) or earnings calls (Gormsen and Huber (2023), (2024)). Table 1 summarizes this literature.

While Gormsen and Huber (2023) do not provide evidence on how firm attributes relate to cost of capital (COC) and discount rates, Gormsen and Huber (2024) do, and they find that their measure is positively related to beta, return volatility, and the inverse of size, consistent with our COE evidence. Other variables

TABLE 1

Related Studies that Retrieve Cost of Equity/Capital Estimates from Archival Data

Table 1 provides an overview of related studies that collect the cost of equity or capital estimates from archival data. Authors, sample period, data source, providers of the cost of equity estimates, the average cost of equity/capital estimates, and the finding regarding how firm attributes relate to the cost of equity (i.e., COE) or cost of capital (i.e., COC) estimates are taken from the original studies.

Number	Authors	Sample Period	Data Source	How is COE Estimated?	Mean COE	How do Firm Attributes Relate to COE or COC?
1	Gormsen and Huber (2023)	2002–2021	Refinitiv (Thomson One) conference calls	Firm managers' perceived costs of equity	10.1	N/A
2	Gormsen and Huber (2024)	2002–2022	Refinitiv (Thomson One) and FactSet conference calls	Firm managers' perceived costs of equity	10.3	COC estimates are related to a firm's beta (+), leverage (−), age (−), size (−), financial constraints (−), idiosyncratic volatility (+), asset to book equity (−), European firm dummy (−), net equity issuance (+), equity payout yield (−)
3	Balakrishnan, Shivakumar, and Taori (2021)	2001–2017	Thomson One analysts research reports	Analysts' COE estimates	10.1	COE estimates are related to a firm's beta (+), book-to-market ratio (+), size (−), leverage (+), and idiosyncratic volatility (+).
4	This study	1993–2017	Merger documents	Investment banks' estimates in merger valuations	15.3	COE estimates are related to a firm's beta (+), size (−), past return (−), financial distress (+), return volatility (+).

that are related to COE in at least some of our specifications, such as distress risk, past returns, and liquidity, do not load in Gormsen and Huber's analysis. Though the Gormen and Huber papers do not consider the role incentives play in providing the rates, the management conference calls represent a different setting from ours and management incentives might differ from those for investment banks. Table 1 suggests that the COEs derived from management disclosures, which Gormsen and Huber refer to as managers' perceived COC, are lower than those estimated by banks. However, Gormsen and Huber suggest that the hurdle rates managers use for investment decisions are considerably higher, which makes them closer to the rates estimated by banks in our data.

Balakrishnan et al. (2021) also examine the determinants of discount rates estimated by professionals external to the firm (analysts in their case). We find that bank estimates differ from analysts' in several ways. While we both find that some firm attributes, such as beta, volatility, and the inverse of size are positively related to COE rates, other relations such as those involving M/B and past returns differ. Further, bank-estimated COEs appear to be higher than analyst-estimated rates. Differences in the nature of the settings and the incentives faced by analysts versus investment bankers may explain why our findings differ. For example, as pointed out by Balakrishnan et al. (2021), equity analysts are not necessarily incentivized to accurately estimate discount rates, and they might adjust discount rates to justify their target prices or recommendations. Irvine (2004) argues that analysts face incentives to make stock recommendations that generate trading revenue for the brokers that employ them. He finds that analysts buy recommendations, but not holding or selling recommendations, leads to more brokerage trading revenue,

which could help explain analysts' relatively low discount rates on average. In contrast, as previously discussed, investment banks face competing incentives that on balance could lead to more accurate discount rates, or in some cases, such as MBOs, could even lead to higher-end discount rate estimates.

A related strand of literature finds that expected returns estimated from existing asset pricing models are poor measures of corporate discount rates (Fama and French (1997), Hommel, Landier, and Thesmar (2021)) and using inadequate models, such as the CAPM, can lead to valuation errors by corporations (Dessaint, Olivier, Otto, and Thesmar (2021)).[3] Our research contributes to this literature by showing that relatively sophisticated finance professionals, investment bankers, appear to incorporate measures of risk, such as beta and firm size, in their COE estimates, yet a large portion of the variation in their estimated equity rates are unexplained by well-known asset pricing models.

Our article also contributes to the literature on equity valuation in corporate control transactions. A growing literature investigates the informativeness of investment banks' valuations (e.g., DeAngelo (1990), Kisgen , Qian, and Song (2009), Cain and Denis (2013), Shaffer (2024), and Eaton et al. (2022)). This literature finds evidence suggesting that banks' fairness opinions valuations are informative yet biased. We extend this literature by showing that banks do consider perceived firm risks such as beta and volatility and upward adjust their COE estimates based on the risk level. However, managerial incentives and conflicts of interest appear to bias banks' COE estimates, as evidenced by significantly higher discount rates used in banks' valuation analysis in MBO transactions. Our results thus also speak to the mixed empirical evidence on managerial conflicts of interest in corporate takeovers.[4]

III. Data

In this section, we discuss the setting we exploit to collect the COE data from investment banks before describing sample selection criteria, key variables used in the analysis, and sample characteristics.

A. The Setting

Readily available COE data is scant and the few data sets that are widely available are often unreliable. For example, the Securities Data Company (SDC) mergers data set contains discount rate variables, but they are missing for the vast majority of deals and any non-missing values do not differentiate between the COE versus the overall firm COC (weighted average cost of capital (WACC)). We address this data limitation by hand-collecting the key variable for our analysis, the COE, from M&A regulatory filings that describe many aspects of the deals in detail, including how investment banks perform their valuation analyses. We focus

[3]Related research by Krüger, Landier, and Thesmar (2015) find that using a single discount rate, rather than adjusting for investment-specific risks, can lead to valuation mistakes.

[4]Perry and Williams (1994) and Hafzalla (2009) find that managers manipulate accounting accruals to reduce earnings or issue more negative news prior to MBO transactions. In contrast, DeAngelo (1986) finds no evidence of pre-buyout earnings management.

on the firms targeted for acquisition because they are almost always required to file merger documents, whereas it is typically not necessary for bidder firms to file proxy statements (Li, Liu, and Wu (2018)).

As part of the M&A process, the target firm typically hires one or more investment banks to advise on the deal. Investment banks typically use multiple methods to assess target firm value, and the discounted cash flow (DCF) approach is nearly always used (Liu (2020)). The valuation estimates are used to negotiate the offer price, and merger terms are formally delivered to the target board as part of the written valuation opinion. Once the deal terms are finalized, the merger is publicly announced, and the fairness opinions are disclosed in regulatory filings shortly thereafter. We hand-collect valuation analysis information, including discount rates used in DCF analysis, from the fairness opinions.

B. Sample Construction and Key Variables

Table 2, Panel A describes our sample selection criteria. We obtain 8,232 M&A deals from 1993 through 2017 after applying standard filters. For example, the target firms must be public and have data available on CRSP and Compustat. Next, since we source valuation analysis data from the regulatory filings, we require that relevant merger documents are available on SEC EDGAR and that the filings contain keywords related to discount rates.[5] These requirements yield 4,337 deals.[6] To make the data collection process feasible, we construct a random sample of 1,000 deals out of the 4,337 by generating a random number following a uniform distribution for each deal and sorting our sample by this random variable. We then keep the first 1,000 observations. This procedure is similar to a simple random sampling with equal probability without replacement.

After our random sampling procedure, we read the merger regulatory filings and manually collected the discount rate information. Our final sample consists of 899 deals that have sufficient information on how investment banks estimate discount rates for their target firm valuation analysis. Since target firms occasionally hire multiple investment banks, the firm's COE is calculated as the average across all banks' estimates in the deal. Our sample of 899 deals is one of the largest M&A data sets composed of hand-collected data from regulatory filings. Other studies' samples are in the 300–500 deals range (Boone and Mulherin (2007), Heitzman (2011), Gorbenko and Malenko (2014), Liu and Mulherin (2018)).

The most common DCF approaches employed by investment banks are to use i) the WACC to discount the free cash flows to the firm or ii) the COE to discount cash flows to equity holders. Appendix B provides two examples illustrating investment banks' COE estimates. In Example 1, the target firm's advisor, Goldman

[5]The relevant target firm filings include either a DEFM 14A for cash offers, a SC 14D9 (and its amendment) for tender offers, or a joint filing S-4 (and its amendment) for stock offers. Keywords related to discount rates include cost of equity, discount rate, and cost of capital.

[6]The loss of 3,895 observations is mainly due to three reasons: i) withdrawn deals that do not reach a merger agreement and therefore do not file merger documents, ii) early years (1993–1996) in which only a small portion of firms provide electronic filings on EDGAR, and iii) tender offers in which no mandatory disclosure on investment bank valuation is required. Analysis discussed in Section III.C suggests that our sample is largely comparable to the CRSP/Compustat universe.

TABLE 2

Sample Selection, Distribution, and Summary Statistics

Table 2 describes the sample. We draw deals from 1993 through 2017. Panel A describes the formation of our sample from SDC. Panel B presents summary statistics for firm and deal characteristics. Panel C presents a temporal distribution of the random sample. In Panel C, *Year* is the year a deal is announced. *% of Deals* is the number of deals in the year divided by the total number of deals over the sample period. *% Public Bidders* is the number of deals involving public (non-public) acquirers in the year divided by the total number of deals in that year. Definitions of all variables are in Appendix A.

Panel A. Sample Selection

Steps	Sample Filters	# of Deals
1	Mergers and acquisitions announced from 1993 to 2017	46,429
2	Target Status: Public	12,367
3	Deal value >$1 million and % shares acquirer seeks to purchase ≥50%	11,529
4	Deal status: Completed or withdrawn	11,215
5	Number of target advisors ≥1	9,099
6	Return data on CRSP and basic accounting data on Compustat	8,232
7	Merger documents with keywords (COE, discount rate, or COC) on EDGAR	4,337
8	Randomly select 1,000 deals	1,000
9	Manually collect information on COE or WACC	899

Panel B. Deal and Target Firm Characteristics

Variable	Mean	SD	P10	P25	Median	P75	P90
Deal Characteristics							
DEAL VALUE	2371.44	6582.09	39.77	117.49	405.76	1504.73	5708.05
PREMIUM	42.54%	47.84%	2.04%	18.22%	36.38%	56.25%	87.00%
SAME INDUSTRY	0.49	0.50	0.00	0.00	0.00	1.00	1.00
TENDER	0.12	0.33	0.00	0.00	0.00	0.00	1.00
TOEHOLD	0.05	0.21	0.00	0.00	0.00	0.00	0.00
STOCK DEAL	0.27	0.44	0.00	0.00	0.00	1.00	1.00
CASH DEAL	0.43	0.50	0.00	0.00	0.00	1.00	1.00
PUBLIC BIDDER	0.73	0.44	0.00	0.00	1.00	1.00	1.00
MBO	0.02	0.15	0.00	0.00	0.00	0.00	0.00
Firm Characteristics							
MARKET CAP	1641.32	4673.00	28.86	82.31	274.63	1006.69	3600.97
M/B	4.90	63.19	0.78	1.11	1.76	2.97	5.10
BETA	1.03	0.83	0.18	0.46	0.91	1.45	1.99
PAST RETURN	4.95%	47.04%	−43.11%	−17.48%	1.01%	23.61%	53.81%
PROFITABILITY	0.28	0.31	0.03	0.05	0.22	0.42	0.65
INVESTMENT	0.05	0.24	−0.03	0.00	0.01	0.06	0.15
FINANCIAL DISTRESS	−7.30	1.00	−8.43	−7.97	−7.41	−6.77	−6.19
RETURN VOLATILITY	3.11%	1.94%	1.41%	1.85%	2.65%	3.82%	5.41%
BID–ASK SPREAD	1.82%	2.80%	0.08%	0.19%	0.90%	2.27%	4.81%
Other Liquidity Measures							
AMIHUD	3.04	19.60	0.00	0.00	0.03	0.35	3.28
ZEROS	8.23%	9.43%	0.79%	1.59%	4.62%	11.29%	21.83%

Panel C. Sample Distribution by Year

Year	# of Deals	% of Deals	% Public Bidders
1993	1	0.11	100.00%
1994	5	0.56	60.00%
1995	20	2.22	95.00%
1996	41	4.56	95.12%
1997	35	3.89	94.29%
1998	65	7.23	89.23%
1999	64	7.12	89.06%
2000	45	5.01	86.67%
2001	30	3.34	80.00%
2002	30	3.34	73.33%
2003	29	3.23	75.86%
2004	43	4.78	65.12%
2005	40	4.45	57.50%
2006	51	5.67	58.82%
2007	55	6.12	61.82%
2008	41	4.56	63.41%
2009	26	2.89	61.54%
2010	48	5.34	66.67%
2011	40	4.45	55.00%
2012	36	4.00	63.89%
2013	25	2.78	72.00%
2014	33	3.67	66.67%
2015	40	4.45	67.50%
2016	30	3.34	73.33%
2017	26	2.89	61.54%
Total	899	100%	

Sachs, discloses that it used "*a discount rate of 8.6%, reflecting an estimate of the Company's cost of equity.*" In Example 2, KBW discloses "*discount rates ranging from 10.0% to 16.0% to estimate a range of the present values of after-tax cash flows that Central could provide to equity holders through 2017 on a stand-alone basis."* In cases in which the advisor uses a range instead of a precise point estimate, we use the mid-point as the discount rate. Both advisors explicitly state that they derive COE by initially applying the CAPM and then adjusting it based on certain firm-specific metrics (without disclosing the details of these specific adjustments).

Banks often only disclose their estimates of WACC without explicitly specifying COE estimates (see Example 3 in Appendix B). In these cases, we back out the COE by following the approach of Frank and Shen (2016) to compute the weights, cost of debt, and tax rate from Compustat data.[7] To alleviate concerns about the effects of deriving COE from the observed WACC values, we conduct a robustness analysis in Appendix Table A1 that only includes observations in which the COE values are directly disclosed in the merger filings. We observe COE directly for 359 sample deals, although the number of observations for the regression analyses in Appendix Table A1 is slightly lower because of missing explanatory variables in a few cases. This robustness analysis provides results qualitatively similar to our main findings.

C. Sample Distribution and Summary Statistics

In addition to COE, we construct additional variables including firm characteristics such as operating and stock performance, firm financial conditions, and commonly used alternative liquidity measures. These variables are described in more detail in Appendix A. Panel B of Table 2 presents summary statistics of these variables.

To alleviate concerns that our sample of M&A target firms are unrepresentative, we compare it to the CRSP/Compustat universe in Panel B of Appendix Table A2. The last 2 columns report the comparison of firm characteristics between our final sample and the CRSP/Compustat firms. The main difference is that our sample contains smaller firms compared with the average CRSP/Compustat firm, though the median comparison is not drastically different ($236 million vs. $275 million MARKET CAP). The only other statistically significant difference is volatility (0.031 vs. 0.033). Thus, our sample of target firms appears to be largely comparable to a broad sample of firms that are widely used in the literature.

We present the time-series distribution of our sample deals in Panel C of Table 2. The uptick in mergers in the late 1990s and 2000 is consistent with the merger wave documented in prior studies (Andrade, Mitchell, and Stafford (2001), Harford (2005)). We also observe a relatively large number of deals in the mid-2000s, which coincides with a leveraged buyout boom (Kaplan and Stromberg (2009)). In Appendix Figure A1, we further compare the time-series distribution of our random sample with a larger SDC sample constructed before requiring EDGAR

[7]We use the standard model of WACC to derive the cost of equity: $r_{WACC} = \frac{E}{V} r_E + \frac{D}{V} r_D (1 - t_c)$, where r_{WACC} is the WACC estimate disclosed by the bank. We follow Frank and Shen (2016) to measure parameters in the equation. Specifically, the corporate tax rate, t_c is calculated as [Item TXT/Item PI]. t_c is set to 35% if it is missing, above 1, or below 0 (Bradshaw and Sloan (2002), So (2013)). The cost of debt, r_D, is the calculated as [Item XINT/(Item DLTT + Item DLC)]. The weight of debt is calculated as value of the debt divided by value of the firm ((Item DLTT + Item DLC)/[Item AT + (Item PRCC * Item CSHO) − Item SEQ − Item TXDB]). The weight of equity is 1 minus the weight of debt.

filings with discount rate keywords. We find almost identical patterns of merger activity over time for the full SDC sample, the randomly generated 1,000 deals, and our final sample of 899 deals.

In addition to the time-series distribution, we also assess whether there are significant differences in main deal characteristics between our random sample and the larger SDC sample. Panel A of Appendix Table A2 reports the comparison. Not surprisingly, none of the main deal characteristics such as deal size, bidder type, and method of payment show significant statistical differences between the full sample and the random samples.

IV. Investment Banks' COE Estimates

How do investment banks construct COE estimates? One hypothesis is that banks incorporate firm variables that the academic literature finds relate to future stock returns. This hypothesis predicts that industry practices align with academic research and banks apply insights developed in academia in practical settings. However, even if banks are aware of the academic literature, there is far from unanimous agreement in academia about which firm attributes are most important for expected returns. Scrutiny is ongoing on the most basic risk measure, beta (e.g., Novy-Marx and Velikov (2022)), not to mention other firm attributes. For example, the literature documents that firm distress risk and volatility are negatively related to expected returns (e.g., Ang et al. (2006), Campbell et al. (2008)). Some consider these findings anomalous and difficult to reconcile with risk-based explanations, while others argue that these puzzles can be explained by a rational model (e.g., George and Hwang (2010)). In this section, we analyze how investment banks estimate the COE. We explore potential determinants and compare them to models or variables from the asset pricing literature.

A. Descriptive Statistics and Univariate Evidence

We begin by presenting descriptive statistics in Table 3. Panel A shows that the COE estimated by investment banks is 15.25% on average, with a median of 13.50%. The 10th percentile is 10.24% and the 90th is 22.50%, indicating a fair amount of variation in banks' estimated COE.

Panel B reports costs of equity estimated by prominent asset pricing models, such as the CAPM or the Fama and French (1993) 3-factor model.[8,9] We estimate

[8]We do not consider more recent asset pricing models, such as those proposed in Fama and French (2015) or Hou, Xue, and Zhang (2015). Our sample is from 1993 through 2017, meaning that the vast majority of investment bank cost of equity estimates in our data set were computed before those papers were published. In later analyses, however, we explore whether banks' COE estimates relate to a broad set of firm characteristics including investment and profitability, as in Stambaugh, Yu, and Yuan (2012).

[9]Implied cost of capital models, in which discount rates are backed out from valuation equations, such as the dividend discount model, could also serve as benchmark models (see Dick-Nielsen, Gyntelberg, and Thimsen (2022) for a recent example). However, that approach assumes that the observed market price accurately reflects fundamental firm value, which is inappropriate in the M&A setting because the substantial premiums above market price indicates the wide divergence between the observed market stock prices and equity values (DeAngelo (1990)). In M&As, investment banks are hired to estimate firm value using techniques typically without relying on the firm's open-market stock prices (e.g., DCF).

TABLE 3

Bank-Estimated COE Versus Expected Returns from Asset Pricing Models

Table 3 presents descriptive statistics of COE estimated by investment banks and expected returns implied from asset pricing model estimates. Panel A reports summary statistics for banks' COE estimates. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Panel B reports COE estimated using CAPM or the Fama and French (1993) 3-factor model. We estimate the factor beta using monthly returns during the 5-year period before the acquisition announcement. The risk-free rate is the 10-year T-bond return. We estimate factor premiums over the 50-year period before the acquisition announcement year. We report descriptive statistics for COE based on monthly estimates. Panel C reports the differences between banks' choice of COE and estimates using asset pricing models. Panel D reports correlations between banks' choice of COE and estimates from asset pricing models. The sample period is from 1993 to 2017. Definitions of all variables are in Appendix A. **, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Panel A. COE Estimated by Investment Banks

	Mean	SD	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
COE	15.25%	6.35%	10.24%	11.90%	13.50%	16.77%	22.50%

Panel B. COE Using Asset Pricing Models

CAPM_MONTHLY	11.78%	6.02%	5.44%	7.50%	10.72%	14.70%	19.64%
FF3_MONTHLY	14.49%	9.19%	4.88%	8.85%	13.35%	19.62%	25.98%

Panel C. Differences in COE Between Banks and Asset Pricing Models

	Mean	*t*-Value	Median	*p*-Value
Diff (Bank - CAPM_MONTHLY)	3.46%***	14.08	3.04%***	<0.001
Diff (Bank - FF3_MONTHLY)	0.75%**	2.11	0.62%	0.217

Panel D. Correlation Between COE Estimates from Banks and Asset Pricing Models

		1	2	3
INVESTMENT BANK	1	1.000		
CAPM_MONTHLY	2	0.292***	1.000	
FF3_MONTHLY	3	0.095***	0.441***	1.000

the factor betas using monthly returns during the 5-year period before the acquisition announcement.[10] Risk factor premiums are calculated using data from Kenneth French's data library (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The risk-free rate is the 10-year treasury bond yield, though our findings are qualitatively similar if we use the annualized T-bill rate. We estimate factor premiums over the 50-year period before the acquisition announcement year; as a robustness check, we compute risk factor premiums over the 20 years before the acquisition or over the entire CRSP history and obtain very similar results. Appendix Table A3 reports summary statistics for risk factor premiums. Panel B of Table 3 shows that depending on the model, the average (median) COE estimated by asset pricing models ranges from 11.78%–14.49% (10.72%–13.35%).

Panel C directly compares investment bank-estimated COE with those estimated by asset pricing models. The mean COE estimates from the asset pricing models range are 0.75–3.46 percentage points lower than investment banks' estimates. These differences are statistically significant at conventional levels.

Panel D of Table 3 shows that the correlations between costs of equity from investment banks compared with the asset pricing models are positive and

[10]In unreported analysis, we also consider betas constructed from daily returns, adjusted using the approach in Dimson (1979). They provide similar expected return estimates as those computed from monthly data. Further, when we consider the relation between bank COE and beta, our main analysis uses monthly betas, but we confirm that the relation continues to be positive though the coefficient on beta is lower and less significant if we use daily betas instead.

statistically significant, but relatively low. For example, the monthly CAPM gives the highest correlation of 0.29, and the correlations with the Fama–French 3-factor models are lower (0.10). Additionally, in unreported analysis, we find that fairness opinions from about 10% of sample deals discuss the "CAPM" or "Capital Asset Pricing Model." Taken as a whole, these results suggest that the costs of equity estimated by investment banks are somewhat related to those given by asset pricing models commonly used in academic research, but a substantial portion of the discount rates used in practice remains unexplained. We next consider how various firm characteristics relate to banks' COE estimates.

We present univariate sorts of investment bank estimated COE in Table 4. Consistent with the CAPM having some explanatory power, investment bank COE tends to rise with *BETA*. For example, COE is 17.52% on average for the highest beta quintile and 14.29% for the lowest. Additionally, the investment bank COE estimates monotonically decrease with *SIZE*, and the firms in the smallest size quintile have an estimated COE more than 7 percentage points higher than firms in the biggest quintile. This result is consistent with investment banks including a size premium when computing COE. However, the market-to-book (*M/B*) sorts are more ambiguous. Investment banks assign the highest COE of 17.35% for value firms (those in the lowest M/B quintile), but the second highest COE bin is the growth firm quintile (high M/B). These univariate *M/B* results provide weak evidence that investment banks consider the value premium for COE calculations.

Panel B of Table 4 illustrates how investment COE estimates vary by industry. The variation across industries is consistent with investment bankers considering industry volatility when assigning COE values. For example, the regulated utility industry is generally less volatile, and investment banks assign these firms the lowest costs of equity of 10.99% on average. In contrast, industries with more volatile cash flows or returns, such as Wholesale, Retail, Healthcare, and Medical, which includes pharmaceuticals; and Business Equipment, including technology firms, have the highest average COE values, ranging from 15.61% to 17.95%.

Panel C of Table 4 reports a correlation matrix. The univariate correlations are consistent with the sorting evidence in Panel A, as COE has a significant positive correlation with *BETA*, a negative one with *SIZE*, and an insignificant correlation with *M/B*. Some other variables, such as *RETURN VOLATILITY* also exhibit a strong correlation with COE. We next consider these relations in a multivariate context.

B. Multivariate Analysis

As previously motivated, we frame this analysis by studying how asset pricing variables relate to banks' COE estimates. We do so by estimating multivariate regressions of banks' COE estimates on firm characteristics that prior research suggests are related to expected returns.[11] It is important to consider the role of industry effects, but we also note that including industry-fixed effects may unjustifiably destroy significant relations. We therefore consider a variety of specifications that include no fixed effects, year fixed effects only, or both year and industry

[11]Our analysis could suffer from an errors-in-variables problem, as investment banks may compute cost of equity determinants differently than we do. This issue can lead to underestimated effects.

TABLE 4

COE by Firm Characteristics and Industry

Table 4 presents how banks' COE estimates are related to key firm characteristics and industries. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Panel A sorts firms into quintiles based on three firm characteristics: i) firm beta, estimated using the monthly returns over the 5 years before the acquisition, ii) firm size, measured as market capitalization, and iii) the market-to-book ratio. Panel B reports investment banks' choices of COE by industry using the Fama–French 12-industry classification. Panel C reports a correlation matrix, with *p*-values in parentheses. The sample period is from 1993 to 2017. Variable definitions are in Appendix A.

Panel A. Average COE by Firm Beta, Size, and Market-to-Book Ratio

	Mean	SD	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
BETA							
Low	14.29%	4.93%	10.00%	11.59%	13.00%	15.00%	20.56%
2	13.61%	5.43%	9.11%	11.00%	12.63%	14.77%	17.94%
3	14.97%	7.60%	10.00%	11.47%	13.00%	15.95%	21.25%
4	15.84%	6.40%	10.52%	11.93%	14.22%	18.01%	23.88%
High	17.52%	6.41%	11.21%	13.50%	16.00%	19.44%	25.52%
Size							
Low	19.07%	8.27%	12.00%	13.02%	17.00%	22.50%	27.57%
2	16.69%	6.74%	11.98%	13.00%	15.00%	18.06%	22.74%
3	15.17%	5.86%	11.01%	12.00%	13.80%	16.55%	20.00%
4	13.47%	3.78%	10.00%	11.05%	12.59%	14.73%	17.50%
High	11.81%	2.84%	8.82%	10.00%	11.50%	13.00%	15.36%
M/B							
Low	17.35%	8.74%	10.76%	12.59%	15.00%	19.00%	25.00%
2	14.41%	5.82%	10.14%	11.85%	13.06%	15.40%	20.00%
3	14.90%	5.45%	10.50%	11.54%	13.00%	16.00%	22.00%
4	13.76%	3.78%	10.00%	11.17%	13.00%	15.34%	18.20%
High	15.77%	6.57%	10.00%	11.62%	14.00%	18.00%	25.00%

Panel B. COE by Industry

Industry	Mean	SD	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
Utilities	10.99%	2.97%	8.00%	9.00%	10.33%	13.22%	15.08%
Chemicals	11.28%	2.38%	8.46%	9.68%	11.17%	12.08%	16.18%
Consumer Non-Durables	12.47%	3.61%	7.91%	9.71%	12.25%	15.75%	17.33%
Finance	13.67%	6.34%	10.24%	11.52%	13.00%	14.00%	16.00%
Telecom	14.17%	2.80%	11.00%	12.09%	13.48%	16.65%	17.95%
Consumer Durables	14.65%	4.02%	11.67%	11.91%	13.00%	17.50%	20.36%
Energy: Oil, Gas	15.42%	5.08%	11.54%	12.26%	13.62%	16.60%	20.98%
Manufacturing	15.58%	5.69%	11.00%	11.89%	13.52%	18.20%	23.63%
Wholesale, Retail	15.61%	5.16%	10.25%	12.08%	14.18%	18.52%	23.27%
Other – Mines, Hotels	15.88%	6.39%	10.24%	12.00%	14.53%	17.67%	24.51%
Business Equipment	16.93%	5.53%	11.00%	12.79%	15.78%	20.00%	25.00%
Healthcare, Medical	17.95%	8.98%	10.70%	11.94%	15.17%	20.62%	27.62%

Panel C. Correlation Matrix

	1	2	3	4	5	6	7	8	9	10	11
1 COE	1.000										
2 BETA	0.235 (0.000)	1.000									
3 LARGE SIZE	−0.172 (0.000)	−0.005 (0.871)	1.000								
4 SMALL SIZE	0.345 (0.000)	−0.044 (0.184)	−0.323 (0.000)	1.000							
5 M/B	0.006 (0.863)	0.200 (0.000)	0.152 (0.000)	−0.226 (0.000)	1.000						
6 PAST RETURN	−0.046 (0.169)	−0.032 (0.341)	−0.020 (0.556)	0.038 (0.251)	0.059 (0.079)	1.000					
7 PROFITABILITY	0.121 (0.000)	0.201 (0.000)	−0.021 (0.531)	0.040 (0.234)	0.260 (0.000)	0.051 (0.127)	1.000				
8 INVESTMENT	0.022 (0.508)	0.064 (0.054)	−0.056 (0.095)	−0.136 (0.000)	0.125 (0.000)	−0.002 (0.960)	0.027 (0.418)	1.000			
9 FINANCIAL DISTRESS	0.322 (0.000)	−0.032 (0.339)	−0.143 (0.000)	0.284 (0.000)	−0.019 (0.580)	−0.157 (0.000)	−0.182 (0.000)	−0.092 (0.006)	1.000		
10 RETURN VOLATILITY	0.533 (0.000)	0.329 (0.000)	−0.181 (0.000)	0.289 (0.000)	0.041 (0.222)	0.137 (0.000)	0.198 (0.000)	0.072 (0.031)	0.385 (0.000)	1.000	
11 BID–ASK SPREAD (MEDIAN)	0.169 (0.000)	−0.088 (0.008)	−0.147 (0.000)	0.398 (0.000)	−0.151 (0.000)	0.134 (0.000)	−0.024 (0.476)	−0.130 (0.000)	0.252 (0.000)	0.306 (0.000)	1.000

TABLE 5

Firm Characteristics and Bank-Estimated COE

Table 5 presents estimates from OLS regressions of investment banks' COE estimates on target firm characteristics. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Column 5 reports coefficients on standardized independent variables. The definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the *t*-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Banks' COE Estimate				
	1	2	3	4	5
BETA	1.667***	0.653**	0.929***	0.762**	0.732***
	(6.72)	(2.50)	(3.31)	(2.23)	(3.31)
MIDDLE SIZE	1.208***	0.325	0.669*	0.887**	0.669*
	(3.26)	(1.04)	(1.72)	(2.48)	(1.72)
SMALL SIZE	5.067***	2.744***	2.662***	3.114***	2.662***
	(7.32)	(5.07)	(4.98)	(4.94)	(4.98)
M/B	0.096	0.030	0.040	0.013	0.109
	(1.19)	(0.35)	(0.51)	(0.19)	(0.51)
PAST RETURN		−0.011***	−0.015***	−0.012***	−0.618***
		(−3.24)	(−4.24)	(−3.54)	(−4.24)
PROFITABILITY		0.547	1.058	−0.697	0.297
		(0.67)	(1.32)	(−0.98)	(1.32)
INVESTMENT		0.522	−0.583	−1.035	−0.076
		(0.45)	(−0.64)	(−0.80)	(−0.64)
FINANCIAL DISTRESS		0.655**	0.410	0.835**	0.379
		(2.20)	(1.34)	(2.58)	(1.34)
RETURN VOLATILITY		1.388***	1.365***	0.818**	2.311***
		(5.57)	(5.81)	(2.51)	(5.81)
BID–ASK SPREAD (MEDIAN)		−0.077	0.053	0.140**	0.201
		(−1.29)	(0.78)	(2.18)	(0.78)
Constant	10.017***	13.391***	13.069***	18.776***	15.611***
	(27.55)	(5.26)	(4.44)	(5.36)	(17.09)
Year FE	No	No	Yes	Yes	Yes
Ind FE	No	No	No	Yes	No
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	877	861	861	861	861
Adjusted R^2	0.188	0.359	0.403	0.498	0.403

fixed effects. Standard errors are clustered by both industry and year. We group firms by industry using 3-digit SIC codes (Hoberg and Phillips (2010)). Table 5 presents estimated slope coefficients and associated *t*-statistics. The regression estimates confirm the univariate evidence from Table 4 that *BETA* is significantly and positively related to investment bank COE, while the inverse of *SIZE* also has a significant relation with COE.[12] *M/B* is not significantly related to bank COE.

Banks appear to include additional firm characteristics in their COE estimates, though in ways that contradict empirical asset pricing findings. For example, *FINANCIAL DISTRESS* and *RETURN VOLATILITY* tend to be significantly and positively related to bank-estimated COEs. In contrast, there is evidence in the asset

[12]In Appendix Table A4, we test whether banks incorporate betas of the target's peers as well as the bidder's beta in their COE estimates in columns 1–4. We find evidence suggesting that banks consider peer firms when estimating the target firm's cost of equity. When we include both target and bidder beta in the regressions the coefficients are positive but mostly not significant, potentially due to the high correlation between these variables. Additionally, in columns 5 and 6, we test whether acquirer or target firm past acquisition experience is related to banks COE estimates. We find that banks COE estimates are not significantly related to the merging parties' acquisition experience.

pricing literature that measures of distress and volatility are negatively related to future returns (i.e., the so-called "distress risk puzzle" and "volatility puzzle" (e.g., Dichev (1998), Griffin and Lemmon (2002), Ang et al. (2006), Penman, Richardson, and Tuna (2007), Campbell et al. (2008), and Garlappi, Shu, and Yan (2008))). *PAST RETURN* is negatively related to COE, consistent with banks assigning higher (lower) COE estimates to firms with recent poor (strong) performance. The empirical asset pricing literature documents that stocks with recent strong performance continue to outperform in the short term (i.e., momentum), and underperform in the long-term (i.e., reversal). We do not include *LEVERAGE* in the main analysis since many of the COE observations are extracted from WACC, which creates a mechanical relation with *LEVERAGE*. However, given that prior studies find a significant relation between leverage and management's COC estimates and analysts' COE estimates (Balakrishnan et al. (2021), Gormsen and Huber (2024)), we test the relation in Appendix Table A1. There we estimate whether leverage is related to investment banks' COE estimates for deals that directly disclose COE and find an insignificant relation.

Other firm characteristics shown by academic research to be related to future stock returns do not appear to significantly contribute to investment banker COE estimates. In addition to *M/B*, both *PROFITABILITY* and *INVESTMENT* are also insignificantly related to COE. There are several potential reasons why banker COE estimates differ from discount rates implied by academic research. One, practitioners may not closely follow the academic literature. Two, they may generally follow the research but are unsure that the variables are robust measures of risk. Three, some of the prominent academic findings, such as those related to *PROFITABILITY* or *INVESTMENT*, have come to light in recent years after many deals in our sample had already been completed; still, this particular explanation is silent on a variable such as market-to-book that has been studied in the asset pricing literature since before our sample begins in 1993.

We also study how stock liquidity relates to investment bank COE. There is a large literature suggesting that higher trading costs should positively relate to expected returns (e.g., Amihud and Mendelson (1986)), though the empirical evidence is mixed on whether stock liquidity is a priced firm characteristic (Amihud and Mendelson (1986), Ben-Rephael, Kadan, and Wohl (2015)). To examine whether investment banks incorporate liquidity in their COE estimates, we primarily use a measure of bid–ask to proxy for liquidity. We compute spreads from CRSP closing quotes (Chung and Zhang (2014)). Since liquidity has grown over time and the investment banker may consider it in relation to other stocks, we scale a stock's bid–ask spread by the yearly cross-sectional median. The regression results in Table 5 provide some evidence that the *BID–ASK SPREAD* is significantly and positively related to bank-estimated COEs, but only in the specification that includes year and industry fixed effects.

Since liquidity is multifaceted, and the literature has proposed many proxies (Goyenko, Holden, and Trzcinka (2009)), we consider additional liquidity measures, including the Amihud (2002) and zero returns measures. The *AMIHUD* measure, which is designed to capture the price impact associated with trading, is one of the most widely used liquidity proxies in the academic literature. The *ZEROS* variable, which computes the proportion of 0 return days in a stock over a period, is

a general trading frictions proxy, motivated by the idea that if trading costs are sufficiently high, the marginal investor may find it too costly to trade (Lesmond, Ogden, and Trzcinka (1999)). As with the spread, we scale these liquidity measures by their yearly cross-sectional median. We also consider a second approach, similar to what we do with firm size, that creates large, middle, and small indicator variables for each liquidity measure based on annual quartile sorts (the middle group includes the 2 middle quartiles). All three of the liquidity variables are measures of illiquidity, meaning higher values suggest lower liquidity (or higher trading costs).

We present regression evidence on the relation between the alternative liquidity measures and COE in Appendix Table A5. For each variable, we estimate regressions with and without industry-fixed effects. Since liquidity varies over time (Chen, Eaton, and Paye (2018)), we include year-fixed effects in all columns. We present results for the full sample (Panel A), NYSE/AMEX listings (Panel B), and NASDAQ listings (Panel C). We continue to find mixed evidence. For example, the Amihud measures, like the spread measures, tend to only have a significantly positive relation with bank COE when industry fixed effects are included, though the median-adjusted measures do a little better in the NYSE/AMEX sample. The zeros measures tend to have a significant and positive relation with bank COE, but that effect does not hold for every specification. As a final robustness check, we use the median-adjusted size, along with the median-adjusted trading costs measures, in Panel D. These results show that an alternative measure of firm size continues to have a significant and negative relation with COE and that the zeros measure remains significant while the other two liquidity measures lose significance. Overall, we find some support, albeit mixed, of a positive relation between trading costs and bank-estimated COE.

We round out this multivariate analysis by reporting coefficients on standardized independent variables (other than indicator variables) in column 5 of Table 5 to facilitate comparisons of economic magnitude across variables. *SIZE* and *RETURN VOLATILITY* have the largest effects on banks' COE estimates. Being in the smallest size group is associated with a COE 2.7 percentage points higher, while a 1-standard-deviation increase in return volatility is associated with a COE 2.3 percentage points higher. The next two significant factors are *BETA* and *PAST RETURN*, with a 1-standard-deviation increase in *BETA* associated with a 73 basis point increase in COE, and a 1-standard-deviation increase in *PAST RETURN* corresponding to a 62 basis point decrease in COE estimates.

C. Bank-Estimated COE Versus COE Derived from Management Disclosures

We next assess how bank COE estimates compare to those derived from firm disclosures. Data on discount rates used by firm managers is not widely available, though there are a couple of hand-collected data sets: Graham and Harvey (2001) and Graham (2022) collect survey data from CFOs, and contemporaneous research by Gormsen and Huber (2023), (2024) estimates firm COC rates using voluntarily disclosures by management in earnings conference calls. The latter authors make their data publicly available at costofcapital.org, which allows us to analyze how COE rates estimated by investment banks compare to those derived from firm disclosures.

Gormsen and Huber collect COC data from a set of <1000 firms internationally, they model which equity risk factors relate to the disclosed COC for these firms, and then use the estimates to predict the COC for a broader set of over 15,000 firms from 2002 through 2021 or 2022. Thus, the use of this data set assumes that their projections accurately estimate the COC. The Gormsen and Huber database provides a firmwide COC, what the authors refer to as the perceived COC. We convert it to COE, labeled *COE MODELED FROM MANAGEMENT DISCLOSURES*, using an approach similar to how we converted investment bank computed WACC to COE, described in Section III.B. We match the bank COE to firms with management COE, which results in a sample of 402 observations.

In Table 6, we report OLS estimates of investment bank COE regressed on the COE derived from management disclosures. Column 1 provides univariate results suggesting a significantly positive relation, and the estimated slope coefficient suggests that a 1 percentage point increase in *COE MODELED FROM MANAGEMENT DISCLOSURES* translates to a 57 basis points (t-stat = 2.66) increase in bank

TABLE 6

The Choice of Discount Rates: Investment Banks Versus Managers

Table 6 presents OLS regression results of bank-estimated COE on COE disclosed by the firms themselves, which we label *COE MODELED FROM MANAGEMENT DISCLOSURES*. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Banks' COE Estimate			
	1	2	3	4
COE MODELED FROM MANAGEMENT DISCLOSURES	0.567***	0.215	0.226	0.304
	(2.66)	(1.27)	(1.39)	(1.47)
BETA		0.812**	1.068***	0.749
		(2.28)	(2.82)	(1.56)
MIDDLE SIZE		0.144	0.227	0.231
		(0.36)	(0.45)	(0.23)
SMALL SIZE		2.716***	2.361***	2.143*
		(6.29)	(4.49)	(1.91)
M/B		−0.037	−0.047	−0.026
		(−0.33)	(−0.42)	(−0.16)
PAST RETURN		−0.009	−0.013**	−0.012
		(−1.48)	(−2.31)	(−1.58)
PROFITABILITY		1.456*	2.011**	−0.302
		(1.73)	(2.41)	(−0.22)
INVESTMENT		0.818	0.137	−1.165
		(0.49)	(0.09)	(−0.49)
FINANCIAL DISTRESS		0.996***	1.073***	1.291***
		(4.11)	(3.54)	(3.46)
RETURN VOLATILITY		0.978***	0.974***	0.518*
		(4.14)	(4.05)	(1.65)
BID–ASK SPREAD (MEDIAN)		−0.009	0.071	0.133
		(−0.10)	(0.72)	(1.40)
Constant	7.779***	13.814***	10.960***	13.805
	(3.28)	(3.82)	(3.10)	(1.46)
Year FE	No	No	Yes	Yes
Ind FE	No	No	No	Yes
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	402	387	387	387
Adjusted R^2	0.138	0.448	0.489	0.578

COE. This relation, however, though still positive, is considerably weakened after controlling for firm characteristics, as well as industry and time effects. These alternative specifications, reported in columns 2–4 of Table 6, give estimated sloped coefficients on *COE MODELED FROM MANAGEMENT DISCLOSURES* ranging from 0.215 to 0.304, suggesting that the observed significant correlation shown in column 1 is largely explained by firm characteristics. Several variables including *SMALL SIZE*, *FINANCIAL DISTRESS*, and *RETURN VOLATILITY* continue to significantly relate to investment bank-estimated COE, even after controlling for *COE MODELED FROM MANAGEMENT DISCLOSURES.* These findings indicate the distinctness of the two COE estimates.

V. COE and Investment Bank Incentives in M&A Deals

We next focus on how investment bank incentives might impact the COE used by bankers in M&A transactions. The target firm's investment bank has an incentive to use a reasonable measure of the discount rate to avoid shareholder litigation and potential damage to its reputation. However, given the substantial uncertainty about the appropriate discount rate model as well as imprecision in estimating the chosen model (Fama and French (1997)), the bank has considerable latitude to choose a rate that could either overestimate or underestimate the target's value.[13]

Bebchuk and Kahan (1989) argue that investment banks are inherently conflicted because of their compensation structure, in which advisory fees are typically contingent on deal completion. This contingent fee structure creates incentives for investment banks to help execute deals by rubber-stamping management proposals. As a result, the bank may construct high discount rates to underestimate target value so that the final sale price looks more attractive for target shareholder approval. In contrast to legal scholars' dim view of bank valuations because of concerns of conflicts of interest, economists are more optimistic about its worth. This is because banks have their "reputation capital" at stake given that they are repeated players in the M&A markets. Indeed, empirical studies show that fairness opinion valuations are not driven by conflicts of interest, and the contingent payment fee structure does not affect the quality of their advisory services (Rau (2000), Calomiris and Hitscherich (2007), and Cain and Denis (2013)).

A. Investment Banks' Compensation Structure

We begin our exploration of the relation between investment bank incentives and their valuation analysis by studying whether bank compensation relates to their COE estimates. If an independent bank only provides the fairness opinion, it receives a non-contingent fee upon delivery of the fairness opinion. In contrast, if a bank also advises on the deal, it receives fees contingent upon the successful consummation of the merger, in addition to the fixed fee when it provides a fairness opinion. If the contingent pay incentive is binding, banks whose compensation is conditional on deal completion may set higher discount rates. Higher discount rates

[13]Growth rates are also an important determinant of DCF-derived valuations. However, in unreported analysis, we find low variation in bank estimates of growth rates across deals.

TABLE 7

Investment Banks' Fee Structure and COE Estimates

Panel A of Table 7 presents OLS regressions of investment banks' COE estimates on a bank contingent pay indicator, controlling for target firm characteristics. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Panel B reports summary statistics for 29 target firms that hire multiple banks, with one receiving contingent payment and another receiving non-contingent payment. We compare the COE estimates between banks receiving contingent and non-contingent fees. Definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the *t*-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

Panel A. Full Sample Analysis

	Banks' COE Estimate			
	1	2	3	4
CONTINGENT PAY	−1.988***	−0.733	−0.439	−0.715*
	(−2.91)	(−1.42)	(−0.87)	(−1.83)
BETA		0.700***	0.977***	0.807***
		(2.99)	(4.32)	(3.13)
MIDDLE SIZE		0.076	0.498	0.931**
		(0.26)	(1.48)	(2.53)
SMALL SIZE		2.484***	2.476***	3.032***
		(5.16)	(5.48)	(5.14)
M/B		−0.015	0.003	−0.021
		(−0.20)	(0.05)	(−0.28)
PAST RETURN		−0.009***	−0.013***	−0.010***
		(−2.62)	(−3.51)	(−2.59)
PROFITABILITY		0.866	1.277*	−0.376
		(1.34)	(1.90)	(−0.53)
INVESTMENT		0.279	−0.666	−0.836
		(0.28)	(−1.01)	(−0.67)
FINANCIAL DISTRESS		0.636**	0.389	0.786**
		(2.32)	(1.30)	(2.34)
RETURN VOLATILITY		1.388***	1.383***	0.898***
		(5.44)	(5.45)	(2.62)
BID–ASK SPREAD (MEDIAN)		−0.062	0.086	0.175**
		(−0.87)	(1.10)	(2.22)
Constant	16.402***	13.939***	12.706***	17.605***
	(20.27)	(5.82)	(4.70)	(7.65)
Year FE	No	No	Yes	Yes
Ind FE	No	No	No	Yes
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	974	926	926	926
Adjusted R^2	0.019	0.390	0.441	0.544

Panel B. Subsample of Deals with Both Contingent and Independent Fees

	N	Mean	SD	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
COE (CONTINGENT)	29	13.19%	3.86%	8.89%	10%	13.33%	14.60%	17%
COE (NON CONTINGENT)	29	13.31%	3.87%	8.80%	11.19%	12.50%	14.69%	17%

provide lower target valuation estimates, which could make the offer price look attractive for shareholder approval.[14]

We test how banks' COE estimates are related to the fee structure in Table 7, Panel A, where the key independent variable is an indicator variable equal to 1 if the

[14]Although SDC provides some information on the fee structure, it is often incomplete and inaccurate. We manually verify the contingent payment structure to ensure accuracy. In our sample, 83% of fairness opinions are provided by investment banks that also receive contingent fees, and 17% are provided by independent banks. The contingent fee percentage in our sample is very similar to Cain and Denis (2013) who report that 82.2% of target advisers receive contingent fees.

deal terms include contingent pay. We do not find evidence that contingent pay leads to higher bank COE estimates, which is inconsistent with contingent pay encouraging banks to push valuations lower to facilitate deal completion.[15] We provide further evidence in Panel B, where we identify 29 deals in which the target firm hired multiple banks with different compensation structures. In this refined sample, where multiple banks offer COE estimates for the same target firm, we compare the COE estimates between banks receiving contingent and non-contingent fees. The results provide evidence that the COE estimates remain remarkably similar across different compensation structures. The lack of a significant relation between COE estimates and the adviser's fee structure is consistent with prior studies that take a neutral view on the influence of advisers' fee structure in mergers (Rau (2000), Calomiris and Hitscherich (2007), and Cain and Denis (2013)).

B. COE in Manager Buyout Deals

We next consider whether investment banks' COE estimates are different for a subset of deals subject to potentially severe conflicts of interest, MBOs. Management participates in buying the firm in MBOs, and their interests are likely to diverge from the target shareholders who are bought out. Though managers have a duty to negotiate the highest price possible for their shareholders, they also have incentives as purchasers to pay the lowest price possible.

Empirical evidence suggests that target managers do indeed engage in activities that depress stock prices and lower acquisition costs in buyout deals. For example, Perry and Williams (1994) find evidence that management manipulates accounting accruals to reduce reported earnings. Hafzalla (2009) provides evidence that managers selectively release negative disclosures to denigrate their firm just before a buyout transaction. Furthermore, Bargeron, Schlingemann, Stulz, and Zutter (2008) and Officer, Ozbas, and Sensoy (2010) find that target shareholders receive significantly lower premiums in buyout deals. Motivated by the above literature, we examine whether investment banks' COE estimates are higher in MBOs.

The regression results in Table 8 suggest that bankers' COE estimates are substantially higher in MBO deals. The statistically significant MBO effect ranges from 4.1 to 5.6 percentage points in various specifications. These results are consistent with managers and the banks they hire increasing discount rates in valuation analyses to negotiate a lower price with the target shareholders who are bought out in MBOs.

C. Bank Reputation and COE

In this section, we conduct additional analyses to test whether bank reputation has a significant impact on their COE estimates. The literature provides

[15]If anything, the relation between contingent pay and bank COE estimates is negative in some specifications. A negative relation could be driven by the fact that big banks, which are typically the ones who receive contingent compensation, tend to estimate lower COEs (higher valuations), possibly for a reputation of working in the best interest of their clients (see Table 9).

TABLE 8

Management Buyouts and COE Estimates

Table 8 presents OLS regression analysis of the effects of management buyout (MBO) deals on investment banks' COE estimates. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. The main independent variable is MBO, an indicator variable that equals 1 if the deal is a management-participated buyout transaction. We also control for non-management participated buyouts and private strategic bidders in columns 2 to 4. Definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the *t*-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Average COE			
	1	2	3	4
MBO	5.015*	4.118**	4.315**	5.584***
	(1.74)	(2.10)	(2.17)	(2.62)
BETA		0.708***	0.998***	0.852**
		(2.69)	(3.54)	(2.47)
MIDDLE SIZE		0.335	0.712*	0.884**
		(1.10)	(1.81)	(2.27)
SMALL SIZE		2.703***	2.650***	3.032***
		(4.96)	(5.09)	(4.53)
MTB		0.046	0.064	0.026
		(0.52)	(0.78)	(0.39)
PAST RETURN		−0.011***	−0.014***	−0.011***
		(−2.92)	(−3.65)	(−2.76)
PROFITABILITY		0.548	0.845	−0.789
		(0.74)	(1.08)	(−1.25)
INVESTMENT		0.659	−0.532	−0.695
		(0.58)	(−0.57)	(−0.59)
FINANCIAL DISTRESS		0.676**	0.423	0.842***
		(2.25)	(1.40)	(2.67)
RETURN VOLATILITY		1.338***	1.300***	0.774**
		(5.50)	(5.49)	(2.41)
BID–ASK SPREAD (MEDIAN)		−0.072	0.063	0.142**
		(−1.18)	(0.91)	(2.19)
BUYOUT (NON-MANAGEMENT)		−0.121	0.785*	0.565
		(−0.27)	(1.92)	(1.37)
PRIVATE STRATEGIC BIDDER		0.298	0.777	0.394
		(0.43)	(1.14)	(0.63)
Constant	14.997***	13.505***	13.296***	18.843***
	(28.88)	(5.26)	(4.50)	(5.43)
Year FE	No	No	Yes	Yes
Ind FE	No	No	No	Yes
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	899	861	861	861
Adjusted R^2	0.017	0.368	0.416	0.515

mixed evidence on the effect of investment bank reputation. Although early empirical studies fail to find that investment bank reputation generates positive outcomes (e.g., Bowers and Miller (1990), Michel, Shaked, and Lee (1991), Servaes and Zenner (1996), Rau (2000)), more recent studies report that firms do benefit by hiring more reputable banks in M&As (e.g., Bao and Edmans (2011), Golubov, Petmezas, and Travlos (2012)). In addition, Cain and Denis (2013) show that top-tier advisors produce lower absolute valuation errors than lower-tier advisors. If it is costly for reputable banks to lose their standing, they might provide lower COE estimates to increase the offer price. Moreover, maintaining their reputation can help banks attract future business from other potential target firms. To test the reputation hypothesis, we construct a reputation measure based

on the number of times the bank was hired to advise M&A deals during our sample period.[16] We create an indicator variable, *Top 5 Bank Dummy*, that equals 1 if the investment bank is one of the following top 5 banks: Goldman Sachs (#1), Morgan Stanley (#2), Credit Suisse (#3), JP Morgan Chase (#4), and Citi (#5). There are 271 instances in which an advisor is considered a top 5 bank in our sample.

We present the bank reputation effect in Table 9. Overall, Table 9 shows that the top 5 investment banks' COE estimates are 1.00–1.41 percentage points lower than non-top 5 banks in the multivariate regressions. These coefficient estimates are statistically significant at the 1% level. However, there is a potential selection issue because reputable banks may choose to represent less risky targets, which makes it difficult to assess causal inference.

D. COE and Deal Premiums

Prior research finds a relation between investment banks' valuation analysis and M&A deal outcomes (Eaton et al. (2022)). Is the investment bank's choice of COE in DCF analysis associated with target shareholder wealth effects? Ex-ante, the predicted relation between bank discount rate and deal premiums is uncertain. We would expect a negative relation if, all else equal, high discount rates provide lower bank-estimated valuations that limit negotiated premiums received by target shareholders. Alternatively, we would expect no relation, in multivariate analysis, if variation in discount rates is explained by firm and deal characteristics. We present OLS regression estimates in Table 10 based on alternative deal premium measurement windows (Eaton, Liu, and Officer (2021)). Panel A reports that the coefficients on COE are insignificant regardless of the measurement windows.

In Panel B, we investigate how estimation precision affects the relation between the COE and premiums. A precise discount rate may provide a more meaningful valuation estimate and be more likely to impact deal premiums. We perform this test by interacting COE with a precision indicator, which equals 1 if the COE value provided by the investment bank is a specific number instead of a range. For this analysis, we standardize COE so that the mean is 0 and the standard deviation is 1. We find that the coefficients on the interaction term are negative and significant for specifications that do not include industry-fixed effects (columns 1 and 3). However, the coefficients become insignificant, although still negative, after we include industry-fixed effects in columns 2 and 4.

These results suggest that there is weak evidence that, all else equal, the value received by target shareholders is lower when the COE estimates are high and precise. However, the weak statistical significance prevents us from making any definitive conclusions. Moreover, we exercise caution in claiming causality, as this analysis studies associations.

[16] We track mergers between investment banks during our sample period. If Bank A acquires Bank B in year t, we compute the number of M&A deals advised by each bank separately before year t and compute combined number of deals after year t to rank advisors.

TABLE 9

Bank Reputation and COE Estimates

Table 9 presents a regression analysis of the relation between COE and investment bank effects, controlling for target firm characteristics. The main independent variable is *Top 5 Bank dummy*, an indicator variable that equals 1 if the investment bank is one of the following top 5 banks: Goldman Sachs (#1), Morgan Stanley (#2), Credit Suisse (#3), JP Morgan Chase (#4), and Citi (#5), and 0 otherwise. We construct the bank effects measures based on the number of times the bank was hired to advise M&A deals during our sample period. We track mergers between investment banks during our sample period. If Bank A acquires Bank B in year *t*, we compute the number of M&A deals advised by each bank separately before year *t*, and compute the combined number of deals after year *t* to rank advisors. The definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the *t*-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	COE			
	1	2	3	4
TOP 5 BANK DUMMY	−2.773***	−1.409***	−1.004***	−1.090***
	(−6.50)	(−7.93)	(−5.20)	(−4.32)
BETA		0.692***	1.012***	0.907***
		(2.84)	(4.09)	(2.92)
MIDDLE SIZE		0.068	0.563	0.710*
		(0.22)	(1.51)	(1.93)
SMALL SIZE		2.085***	2.249***	2.543***
		(3.97)	(4.48)	(4.02)
MTB		0.032	0.054	0.027
		(0.45)	(0.81)	(0.44)
PAST RETURN		−0.010***	−0.013***	−0.009**
		(−2.81)	(−3.53)	(−2.44)
PROFITABILITY		0.655	0.809	−0.802
		(0.88)	(1.10)	(−1.30)
INVESTMENT		0.309	−0.618	−0.595
		(0.33)	(−0.81)	(−0.55)
FINANCIAL DISTRESS		0.600**	0.356	0.762**
		(2.16)	(1.27)	(2.48)
RETURN VOLATILITY		1.363***	1.309***	0.792***
		(5.69)	(5.68)	(2.59)
BID–ASK SPREAD (MEDIAN)		−0.076	0.076	0.158**
		(−1.12)	(1.02)	(2.14)
MBO		3.278*	3.474*	4.688**
		(1.83)	(1.92)	(2.38)
BUYOUT (NON-MANAGEMENT)		−0.291	0.562	0.552
		(−0.73)	(1.46)	(1.53)
PRIVATE STRATEGIC BIDDER		0.249	0.668	0.386
		(0.40)	(1.06)	(0.70)
Constant	15.540***	13.630***	13.031***	15.668***
	(26.93)	(5.77)	(4.75)	(6.88)
Year FE	No	No	Yes	Yes
Ind FE	No	No	No	Yes
Cluster	Ind &Year	Ind &Year	Ind &Year	Ind &Year
Observations	1015	965	965	965
Adjusted R^2	0.053	0.390	0.437	0.539

VI. Concluding Remarks

This article analyzes how discount rates are computed in practice. Although discount rates have been studied extensively in the academic literature and are used ubiquitously in practice, we have a limited understanding of how finance professionals actually estimate the COE. We provide novel evidence by exploiting M&A regulatory filings and hand-collecting COE estimates used in DCF valuation analysis by target firm investment banks.

TABLE 10

The Choice of Discount Rates and Deal Premiums

Table 10 presents results on how investment banks' COE estimates are related to deal premiums. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. We use two alternative premium measures: Premium (−63), measured as the offer price from SDC relative to target stock price 63 trading days before the merger announcement (columns 1 and 2), and Premium (−84), measured as the offer price from SDC relative to target stock price 84 trading days before the merger announcement (columns 3 and 4). In Panel A, the main independent variable is the banks' COE estimates (COE). In Panel B, we interact COE with a precision indicator, which equals 1 if the COE value provided by the investment bank is a specific number instead of a range, and 0 otherwise. For Panel B, we standardize COE so that the mean is 0 and the standard deviation is 1. All control variables in Panel A are also included in Panel B but are not reported for brevity. Definitions of all variables are in Appendix A. Deal Premium, COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry, and the *t*-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

Panel A. COE and Deal Premiums

	PREMIUM (−63)		PREMIUM (−84)	
	1	2	3	4
COE	−0.315	−0.184	0.042	0.468
	(−0.78)	(−0.33)	(0.08)	(0.73)
BETA	2.151	−0.124	−1.038	−3.045
	(0.86)	(−0.04)	(−0.40)	(−1.32)
MIDDLE SIZE	−0.730	4.630	1.848	8.879
	(−0.21)	(1.18)	(0.46)	(1.53)
SMALL SIZE	13.224**	16.277**	14.415**	18.642**
	(2.41)	(2.30)	(2.34)	(2.18)
MTB	−0.155	−1.235*	−0.486	−1.120*
	(−0.24)	(−1.96)	(−0.76)	(−1.91)
FINANCIAL DISTRESS	−2.539	−1.159	−4.453**	−4.342
	(−1.64)	(−0.40)	(−2.02)	(−1.21)
RETURN VOLATILITY	2.867	1.718	2.730	1.745
	(1.51)	(0.75)	(1.41)	(0.64)
BID–ASK SPREAD (MEDIAN)	0.227	0.046	0.199	−0.054
	(0.54)	(0.08)	(0.57)	(−0.09)
SAME INDUSTRY	4.758	3.998	2.325	3.135
	(1.56)	(0.98)	(0.85)	(0.85)
TENDER OFFER	2.317	2.154	3.589	5.625
	(0.36)	(0.26)	(0.44)	(0.51)
TOEHOLD	−0.720	−10.984	7.719	−2.427
	(−0.13)	(−1.11)	(1.01)	(−0.24)
STOCK DEAL	−8.530**	−4.568	−8.042**	−3.124
	(−2.19)	(−1.17)	(−2.22)	(−0.87)
CASH DEAL	5.736	10.198**	5.741	11.974**
	(1.44)	(2.02)	(1.30)	(2.46)
PUBLIC BIDDER	8.335***	5.982*	10.553***	8.915*
	(3.04)	(1.68)	(3.34)	(1.96)
Constant	67.993***	32.611	28.530	−15.560
	(4.38)	(1.55)	(1.25)	(−0.53)
Year FE	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes
Cluster	Ind &Year	Ind &Year	Ind &Year	Ind &Year
Observations	834	834	834	834
Adjusted R^2	0.102	0.138	0.095	0.137

Panel B. COE, Estimation Precision, and Deal Premiums

COE (STANDARDIZED)	−0.353	−0.095	1.705	3.462
	(−0.17)	(−0.03)	(0.58)	(1.01)
COE × PRECISE	−15.801***	−8.930	−15.828**	−8.340
	(−2.86)	(−1.34)	(−2.39)	(−1.12)
PRECISE INDICATOR	−1.490	1.412	0.840	3.050
	(−0.36)	(0.30)	(0.22)	(0.75)
Year FE	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes
Cluster	Ind &Year	Ind &Year	Ind &Year	Ind &Year
Observations	834	834	834	834
Adjusted R^2	0.113	0.141	0.106	0.139

Investment bank COE estimates differ from those implied by commonly employed asset pricing models, such as the CAPM or the Fama–French models. Bank COE estimates are substantially higher, with the difference ranging from 0.8 to 3.5 percentage points. Still, banks incorporate some aspects of these models, as beta and the inverse of size are positively related to bank COE estimates. However, bank-estimated COEs contradict empirical academic evidence in many ways. We show that distress risk and volatility tend to be positively related to bank COE. The empirical asset pricing literature finds the opposite signs on relations between these variables and future stock returns. Further, other common predictors of expected return, including the market-to-book ratio, profitability, and investment, are unrelated to banks' COE estimates. There is some evidence, albeit mixed, that stock illiquidity is positively related to COE. Past returns tend to be negatively related to bank COE, which is consistent with evidence on long-run reversals.

Our article also studies how COE estimated by investment banks relates to COE estimates derived from firm disclosures. We find that COE estimates modeled from firm management disclosure are positively related to COE estimated by banks, but the relation weakens once we include firm characteristics in the regression specifications. Further several firm characteristics, such as size, financial distress, and volatility continue to relate to bank COE, even after controlling for management-modeled COE estimates.

We also examine the role investment bank incentives play in estimating COE in M&A deals. We explore situations in which bank conflicts of interest might play a role. Though we do not find evidence of higher discount rates and lower valuations for deals where bank compensation is contingent on deal completion, we do find that bank COE values are substantially higher for MBO deals, even after controlling for firm and deal characteristics and industry-fixed effects. This result is consistent with managers and the banks they hire increasing discount rates in valuation analyses to negotiate a lower price with the target shareholders who are bought out in MBOs.

In summary, our article connects the extensive asset pricing literature with evidence from the field. Moreover, our unique setting allows us to investigate potential incentive effects that affect banks' COE estimates, which adds to the literature on managerial conflicts of interest in corporate takeovers.

Appendix A. Variable Definitions

All Compustat firm characteristics are measured yearly before the merger announcement.

ACQUIRER EXPERIENCE An indicator variable that equals 1 if the acquirer has made another acquisition over a 5-year window.

AMIHUD (MEDIAN) Amihud's illiquidity ratio is calculated as $\frac{1}{D_{it}}\sum_{t=1}^{D_{it}}\frac{|R_{itd}|}{VOLD_{itd}}$, where R_{itd} is the stock return of firm i on day d of year t, $VOLD_{itd}$ is the corresponding daily volume in dollars, and D_{it} is the number of days for which data are available for stock i in year t. We then scale this measure by the median of Amihud's illiquidity ratio of the CRSP universe in the corresponding year.

AMIHUD (LARGE/MIDDLE) The Large (Middle) indicator variable is equal to 1 if the target's Amihud (before adjusted for median) is in the top (middle 2) quartiles.

BETA Monthly stock returns during the 60-month period ending 3 months before the deal announcement date are used to estimate firm beta (i.e., month −63, to month −4).

The dependent variable of the estimation model is the excess stock return, and the independent variable is the Fama and French market excess return. We also estimate the firm beta using the past 1 year of daily stock returns as a robustness check.

BETA (TARGET PEER) To calculate the beta based on target peer firms, we use the comparable companies identified in Eaton, Guo, Liu, and Officer (2022) and Guo, Liu, Tu (2023). For the 13% of deals where investment banks only use the DCF approach, we identify potential peers based on based on industry, size, and market-to-book ratio. Specifically, we keep 9 firms with the closest M/B within a size range of 50%–150% in the same target industry based on the Fama–French 12 industry classification. After obtaining comparable peers, we estimate comparable firms' unlevered beta, then compute the average unleveraged beta among all the identified peer firms before applying the company's leverage to get the levered beta.

BID–ASK SPREAD (MEDIAN) The spread is the difference between the closing ask and closing bid from the daily CRSP file, scaled by the bid–ask midpoint. This measure is computed each calendar year as the average of the daily observations. We then scale this measure by the median of Bid–Ask Spread of the CRSP universe in the corresponding year.

BID–ASK SPREAD (LARGE/MIDDLE) The Large (Middle) indicator variable is equal to 1 if the target's Bid–Ask Spread (before adjusted for median) is in the top (middle 2) quartiles.

BUYOUT (NON-MANAGEMENT) An indicator variable that equals 1 if the deal is a non-management buyout deal, and 0 otherwise.

CAPM_MONTHLY COE from the CAPM using β estimated from monthly stock returns over a 5 year-window. The risk-free rate is the 10-year treasury bond return from Federal Reserve Economic Data (FRED). Market premium is the average annual market excess return over the 50-year period before the acquisition announcement year.

CASH DEAL An indicator variable is equal to 1 if the bidder uses cash as the only method of payment, and 0 otherwise.

COE COE is used by the investment bank in the merger filings. In cases where the advisor discloses the precise point estimate of COE, we use that number. In cases where the advisor uses a range instead of the precise point, we use the mid-point as the COE estimate. In cases where the advisor only discloses the estimate of WACC, we back out the COE by computing weights and cost of debt using information from Compustat. Specifically, we use the standard model of WACC to derive the COE $r_{WACC} = \frac{E}{V} r_E + \frac{D}{V} r_D (1 - t_c)$, where r_{WACC} is the WACC estimate disclosed by the bank. We follow Frank and Shen (2016) to measure parameters in the equation. The cost of debt, r_D, is the calculated as [Item XINT/(Item DLTT + Item DLC)]. The weight of debt is calculated as the value of the debt divided by the value of the firm ([Item DLTT + Item DLC]/[Item AT + (Item PRCC * Item CSHO) − Item SEQ − Item TXDB]). The weight of equity is 1 minus the weight of debt. The corporate tax rate, t_c is calculated as [Item TXT/Item PI]. t_c value is set to 35% if it is missing, above 1, or below 0; r_E is the COE we want to derive. We take average of COEs by each investment bank if multiple investment banks provide COE for a deal.

CONTINGENT PAY An indicator variable equal to 1 if the target firm's advisor receives either percentage fees or flat fees paid upon successful consummation of the merger, and 0 otherwise.

DEAL VALUE Value of the deal, measured in millions.

FF3_MONTHLY COE from the Fama and French 3-factor model. It is estimated in a similar way as CAPM_monthly.

FINANCIAL DISTRESS Raw failure score following Campbell, Hilscher, and Szilagyi (2008).

INVESTMENT The change in gross property, plant, and equipment plus the change in inventories divided by lagged total assets (Stambaugh, Yu, and Yuan (2012)).

LEVERAGE Book value of debt is scaled by the book value of assets.

COE MODELED FROM MANAGEMENT DISCLOSURES COE is estimated from management's disclosures from conference calls (Gormsen and Huber (2023), (2024)). We source perceived COC data from costofcapital.org and convert it to COE using a similar procedure we employ for converting bank WACC to COE. We use the most recent management-estimated COE preceding the merger deal and require that it is from the year of or the year before the deal.

MARKET CAP Market value of equity in millions.

M/B Market value of equity is divided by the book value of equity.

MBO An indicator variable that equals 1 if the deal is a management buyout deal, and 0 otherwise.

PRIVATE STRATEGIC BIDDER An indicator variable that equals 1 if the deal involves a private strategic bidder (i.e., the bidder is a private operating firm or a subsidiary), and 0 otherwise.

PAST RETURN Cumulative abnormal return, adjusted by the market value-weighted return, over the 252 trading days ending 3 months before the deal announcement date (i.e., returns from day −315 to −63, where day 0 is the merger announcement date).

PUBLIC BIDDER An indicator variable is equal to 1 if the bidder status reported by SDC is "Public," and 0 otherwise.

PREMIUM The offer price obtained from SDC relative to the target stock price 63 trading days or 84 trading days before the merger announcement.

PROFITABILITY Sales minus the cost of goods sold, scaled by total assets (Stambaugh et al. (2012)).

RETURN VOLATILITY Stock return volatility, is calculated as the standard deviation of daily returns over the 252 trading days ending 3 months before the deal announcement date.

SAME INDUSTRY An indicator variable is equal to 1 if the acquirer and the target firm share the same 3-digit Standard Industrial Classification Code (SIC), and 0 otherwise.

SIZE (MEDIAN) The natural logarithm of the market capitalization of the target firm, is scaled by the median market capitalization of all firms in the COMPUSTAT universe for the corresponding year.

MIDDLE (LARGE/SMALL) SIZE The middle (large/small) indicator variable equals 1 if the target's market capitalization is in the middle 2 (top/bottom) NYSE size quartiles.

MIXED An indicator variable that equals 1 if the total consideration is paid by both stock and cash, and 0 otherwise.

STOCK DEAL An indicator variable that equals 1 if the total consideration is paid by stock, and 0 otherwise.

TARGET EXPERIENCE An indicator variable that equals 1 if the target has made another acquisition over a 5-year window.

TENDER OFFER An indicator variable that equals 1 if the deal is classified as a tender offer, and 0 otherwise.

ZEROS (MEDIAN) The sum of 0 return days, is divided by the total number of trade days. This measure is computed each calendar year. We then scale this measure by the median of Zeros of the CRSP universe in the corresponding year.

ZEROS (LARGE/MIDDLE) The Large (Middle) indicator variable is equal to 1 if the target's Zeros measure (before adjusted for median) is in the top (middle 2) quartiles.

APPENDIX TABLE A1

Additional Analysis of COE Estimates

Table A1 presents estimates from OLS regressions of investment banks' COE estimates on target firm characteristics. This table presents analysis only for COEs that are disclosed directly in the merger filings; it omits observations where we derive COE from disclosed WACC. The definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Banks' COE Estimate			
	1	2	3	4
BETA	1.288***	0.651**	1.007***	0.795***
	(4.03)	(2.12)	(3.33)	(2.72)
MIDDLE SIZE	0.556	−0.102	0.517	0.227
	(1.29)	(−0.29)	(1.62)	(0.80)
SMALL SIZE	2.448***	0.687	1.150**	0.850*
	(4.24)	(1.34)	(2.34)	(1.79)
M/B	0.130	0.119	0.095	0.145
	(0.84)	(0.77)	(0.64)	(0.83)
LEVERAGE	−0.017	−0.618	0.199	0.325
	(−0.02)	(−0.74)	(0.23)	(0.34)
PAST RETURN		−0.008	−0.014	−0.002
		(−1.01)	(−1.60)	(−0.32)
PROFITABILITY		−0.752	0.574	−2.925
		(−0.44)	(0.35)	(−1.13)
INVESTMENT		−0.326	−0.746	2.815
		(−0.15)	(−0.34)	(0.79)
FINANCIAL DISTRESS		0.591*	0.117	0.625*
		(1.74)	(0.39)	(1.73)
RETURN VOLATILITY		0.858**	0.818**	0.365
		(2.11)	(2.06)	(1.08)
BID–ASK SPREAD (MEDIAN)		−0.001	0.101**	0.138***
		(−0.02)	(2.17)	(3.11)
Constant	10.042***	14.078***	11.038***	17.395***
	(13.34)	(5.11)	(4.89)	(5.49)
Year FE	No	No	Yes	Yes
Ind FE	No	No	No	Yes
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	356	351	351	351
Adjusted R^2	0.145	0.298	0.388	0.501

APPENDIX TABLE A2

Additional Analysis of the Random Sample and the SDC Target Sample

Table A2 reports additional analysis of our random sample, the SDC target firms, and the CRSP/Compustat. Panel A compares deal characteristics for the 4149 SDC M&A deals and our final sample of 899 deals. Panel B compares firm characteristics between the final sample and the CRSP/Compustat public firm population from fiscal 1994 to 2017. See Appendix A for variable definitions. "*t-stat*" is the *t*-value of two sample *t*-tests that test the null that the means of the two samples are equal. ***, **, * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Comparing SDC Full Sample and the Final Random Sample

	Mean	Median	Mean	Median	Diff	*t*-Stat
	1	2	3	4		
	SDC Full Sample		Random			
	(N = 4149)		(N = 899)		1–3	
DEAL VALUE	2213.09	414.28	2371.44	405.76	−158.35	−0.64
PUBLIC BIDDER	0.74	1.00	0.73	1.00	0.01	0.60
TENDER OFFER	0.14	0.00	0.12	0.00	0.01	1.11
TOEHOLD	0.04	0.00	0.05	0.00	−0.01	−0.77
SAME INDUSTRY	0.48	0.00	0.49	0.00	−0.02	−0.99
CASH DEAL	0.42	0.00	0.43	0.00	0.00	−0.52
STOCK DEAL	0.27	0.00	0.27	0.00	−0.01	0.15
MIXED	0.31	0.00	0.30	0.00	0.01	0.41

Panel B. Comparing Final Sample of 899 Deals and the CRSP/Compustat Population

	Mean	Median	Mean	Median	Diff	*t*-Stat
	1	2	3	4		
	Compustat/CRSP		Random			
	(N = 172,676)		(N = 899)		1–3	
BETA	0.98	0.89	1.03	0.91	−0.04	−0.97
MARKET CAP	3257.78	235.99	1641.32	274.63	1616.47	3.03***
MTB	5.26	1.78	4.90	1.76	0.36	0.09
PROFITABILITY	0.27	0.22	0.28	0.22	−0.01	−0.21
INVESTMENT	0.08	0.03	0.05	0.01	0.03	0.60
PAST RETURN	0.07	0.02	0.05	0.01	0.02	1.00
RETURN VOLATILITY	0.03	0.03	0.03	0.03	0.00	2.39**
FINANCIAL DISTRESS	−7.06	−7.37	−7.30	−7.41	0.24	1.61

APPENDIX TABLE A3

Risk Factor Premiums

Table A3 reports risk factor premiums. "*RISK-FREE RATE*" is the 10-year T-bond return. "*MARKET PREMIUM*" is the average annual market excess return over the 50-year period before the acquisition announcement year. "*SIZE PREMIUM*" is the average annual 'small minus big' portfolio over the 50-year period before the acquisition announcement year. "*VALUE PREMIUM*" is the average annual 'high minus low' portfolio over the 50-year period before the acquisition announcement year.

	Mean	SD	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl
RISK-FREE RATE	4.46%	1.66%	2.14%	3.22%	4.61%	5.87%	6.57%
MARKET PREMIUM	6.68%	0.66%	5.70%	6.30%	6.59%	7.00%	7.54%
SIZE PREMIUM	3.07%	0.40%	2.43%	2.93%	3.17%	3.34%	3.55%
VALUE PREMIUM	5.55%	0.44%	4.85%	5.33%	5.60%	5.90%	6.03%

APPENDIX TABLE A4

Target Peer Beta, Bidder Beta, Acquisition Experience, and Bank-Estimated COE

Table A4 presents results from OLS regressions of investment banks' COE estimates on target peer beta, bidder beta, and target and bidder acquisition experience, plus other target firm attributes. Target peer beta is defined in detail in Appendix A. Target and bidder acquisition experience is defined by a dummy variable that equals 1 if the target or the bidder has done an acquisition in the past 5 years before the merger. The dependent variable is the bank-estimated COE. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. The definitions of all variables are in Appendix A. COE, *PAST RETURN*, and *RETURN VOLATILITY* are all in percent. Standard errors are clustered by both year and industry. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Banks' COE Estimate					
	1	2	3	4	5	6
BETA	0.332	0.458*	0.576**	0.468	0.934***	0.839***
	(1.27)	(1.83)	(2.11)	(1.60)	(3.10)	(2.91)
MIDDLE SIZE	0.857*	1.019*	1.024*	0.998	0.706	0.977
	(1.83)	(1.74)	(1.75)	(1.38)	(1.43)	(1.54)
SMALL SIZE	2.823***	3.084***	2.529***	2.493**	2.762***	3.111***
	(5.22)	(4.09)	(3.88)	(2.37)	(4.21)	(3.57)
M/B	0.038	0.029	0.134	0.015	0.046	0.032
	(0.49)	(0.47)	(1.20)	(0.15)	(0.57)	(0.54)
PAST RETURN	−0.012***	−0.012***	−0.013**	−0.012**	−0.015***	−0.012***
	(−3.90)	(−4.22)	(−2.48)	(−2.37)	(−4.85)	(−4.44)
PROFITABILITY	0.646	−0.373	1.001	−0.417	0.968	−0.383
	(0.85)	(−0.31)	(1.46)	(−0.39)	(1.14)	(−0.34)
INVESTMENT	−0.604	−0.995	0.173	−0.168	−0.563	−0.924
	(−0.65)	(−1.49)	(0.15)	(−0.23)	(−0.57)	(−1.22)
FINANCIAL DISTRESS	0.504*	0.646**	0.254	0.628	0.397	0.649**
	(1.74)	(2.05)	(0.79)	(1.32)	(1.34)	(2.08)
RETURN VOLATILITY	1.049***	0.699***	1.465***	0.934***	1.359***	0.836***
	(5.01)	(3.03)	(5.43)	(4.83)	(6.85)	(3.69)
BID–ASK SPREAD (MEDIAN)	0.100	0.175***	0.054	0.138***	0.066	0.165***
	(1.61)	(3.17)	(0.73)	(2.94)	(1.02)	(2.91)
BETA (TARGET PEER)	2.294***	1.697***				
	(4.81)	(3.24)				
BETA (BIDDER)			0.450*	0.280		
			(1.66)	(0.76)		
ACQUIRER EXPERIENCE					−0.448	0.151
					(−1.39)	(0.47)
TARGET EXPERIENCE					0.472	0.283
					(1.22)	(0.70)
Constant	12.040***	15.863***	5.272*	9.390*	12.836***	16.580***
	(3.86)	(4.57)	(1.91)	(1.89)	(4.46)	(4.63)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	No	Yes	No	Yes	No	Yes
Cluster	Ind & Year	Ind & Year	Ind & Year	Ind & Year	Ind & Year	Ind & Year
Observations	861	861	592	592	861	861

APPENDIX TABLE A5

Stock Liquidity and Bank-Estimated COE

Table A5 presents estimates from OLS regressions of investment banks' COE estimates on alternative stock liquidity measures, controlling for target firm characteristics. If a target firm hires multiple banks, the firm's COE is calculated as the average across all banks' estimates. Panel A reports the regression estimates for the full sample. Panel B(C) reports the regression estimates for target firms listed on the NYSE/AMEX (NASDAQ). Panel D uses the median-adjusted size instead of the rank variables. Definitions of all variables are in Appendix A. COE is in percent. Controls include variables listed in Table 5. Standard errors are clustered by both year and industry. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. All continuous variables are winsorized at the 1st and 99th percentile.

	Banks' COE Estimate											
	1	2	3	4	5	6	7	8	9	10	11	12
Panel A. Relation Between Investment Bank COE and Stock Liquidity												
AMIHUD MIDDLE	0.542	0.811										
	(1.54)	(1.63)										
AMIHUD LARGE	0.535	1.328***										
	(0.85)	(6.02)										
BID–ASK SPREAD MIDDLE			0.340	0.298								
			(0.83)	(0.56)								
BID–ASK SPREAD LARGE			0.785	0.895								
			(1.05)	(1.26)								
ZEROS MIDDLE					−0.106	0.158						
					(−0.38)	(0.80)						
ZEROS LARGE					1.147	1.636***						
					(1.60)	(2.81)						
AMIHUD (MEDIAN)							0.001	0.001*				
							(0.84)	(1.68)				
BID–ASK SPREAD (MEDIAN)									0.053	0.140**		
									(0.78)	(2.18)		
ZEROS (MEDIAN)											0.568***	0.646***
											(3.03)	(3.07)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cluster	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both
Observations	861	861	861	861	861	861	861	861	861	861	861	861
Adjusted R^2	0.402	0.498	0.403	0.493	0.409	0.502	0.404	0.497	0.403	0.498	0.413	0.506

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APPENDIX TABLE A5 (continued)

Stock Liquidity and Bank-Estimated COE

Panel B. Relation Between Investment Bank COE and Stock Liquidity (NYSE/AMEX)

AMIHUD MIDDLE	0.665*	0.711										
	(1.83)	(0.93)										
AMIHUD LARGE	0.662	1.754										
	(0.69)	(1.04)										
BID–ASK SPREAD MIDDLE			0.588	0.692								
			(1.30)	(0.88)								
BID–ASK SPREAD LARGE			1.811*	1.359								
			(1.69)	(0.77)								
ZEROS MIDDLE					0.397	1.163						
					(0.76)	(1.50)						
ZEROS LARGE					1.666***	1.854**						
					(2.83)	(2.12)						
AMIHUD (MEDIAN)							0.009***	0.009*				
							(4.64)	(1.93)				
BID–ASK SPREAD (MEDIAN)									0.506***	0.518***		
									(4.05)	(2.87)		
ZEROS (MEDIAN)											0.668***	0.367
											(2.73)	(0.80)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cluster	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both
Observations	320	320	320	320	320	320	320	320	320	320	320	320
Adjusted R^2	0.321	0.280	0.329	0.279	0.329	0.285	0.344	0.290	0.354	0.304	0.338	0.281

Panel C. Relation Between Investment Bank COE and Stock Liquidity (Nasdaq)

AMIHUD MIDDLE	0.032	0.494										
	(0.04)	(0.41)										
AMIHUD LARGE	0.395	1.136										
	(0.54)	(1.16)										
BID–ASK SPREAD MIDDLE			0.252	−0.035								
			(0.72)	(−0.09)								
BID–ASK SPREAD LARGE			0.574	0.445								
			(0.70)	(0.73)								
ZEROS MIDDLE					−0.472	−0.539**						
					(−1.35)	(−2.20)						

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APPENDIX TABLE A5 (continued)

Stock Liquidity and Bank-Estimated COE

ZEROS LARGE					0.967	1.115						
					(1.08)	(1.27)						
AMIHUD (MEDIAN)							0.001	0.001*				
							(1.13)	(1.91)				
BID–ASK SPREAD (MEDIAN)									0.060	0.155**		
									(0.79)	(2.40)		
ZEROS (MEDIAN)											0.589**	0.708***
											(2.44)	(2.72)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Cluster	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both	Both
Observations	541	541	541	541	541	541	541	541	541	541	541	541
Adjusted R^2	0.384	0.521	0.384	0.521	0.393	0.533	0.388	0.530	0.386	0.529	0.396	0.537

Panel D. Relation Between Investment Bank COE and Stock Liquidity (continued)

	Banks' COE Estimate					
	1	2	3	4	5	6
BETA	1.041***	0.848**	1.026***	0.851**	1.081***	0.859***
	(3.64)	(2.49)	(3.54)	(2.44)	(3.80)	(2.61)
SIZE (MEDIAN)	−0.737***	−0.947***	−0.751***	−0.921***	−0.548***	−0.783***
	(−5.29)	(−5.78)	(−4.86)	(−5.15)	(−3.58)	(−3.84)
M/B	0.066	0.032	0.065	0.030	0.070	0.034
	(0.84)	(0.48)	(0.83)	(0.46)	(0.88)	(0.52)
PAST RETURN	−0.015***	−0.011***	−0.015***	−0.011***	−0.016***	−0.012***
	(−4.32)	(−3.21)	(−3.95)	(−3.17)	(−4.82)	(−3.27)
PROFITABILITY	0.920	−1.072*	0.895	−1.130*	0.921	−1.278**
	(1.16)	(−1.80)	(1.13)	(−1.91)	(1.18)	(−2.24)
INVESTMENT	−0.625	−1.196	−0.663	−1.130	−0.394	−0.999
	(−0.70)	(−0.98)	(−0.77)	(−0.92)	(−0.44)	(−0.82)
FINANCIAL DISTRESS	0.344	0.766**	0.348	0.762**	0.303	0.733**
	(1.15)	(2.33)	(1.15)	(2.34)	(1.01)	(2.28)
RETURN VOLATILITY	1.270***	0.707**	1.280***	0.695**	1.329***	0.779***

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APPENDIX TABLE A5 (continued)

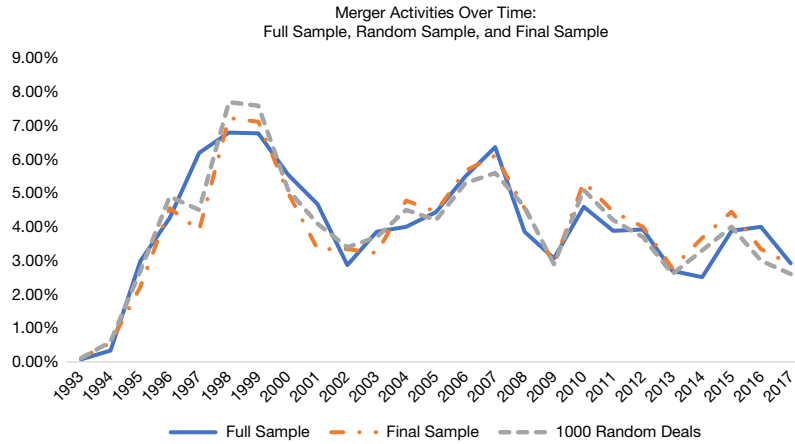
Stock Liquidity and Bank-Estimated COE

	(5.77)	(2.55)	(5.68)	(2.31)	(6.50)	(3.06)
AMIHUD (MEDIAN)	0.000	0.001				
	(0.25)	(0.95)				
BID–ASK SPREAD (MEDIAN)			−0.007	0.064		
			(−0.10)	(0.93)		
ZEROS (MEDIAN)					0.463**	0.461*
					(2.28)	(1.91)
Constant	15.206***	21.552***	15.208***	21.440***	13.959***	20.309***
	(5.40)	(6.37)	(5.38)	(6.37)	(4.68)	(6.06)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	No	Yes	No	Yes	No	No
Cluster	Both	Both	Both	Both	Both	Both
Observations	861	861	861	861	861	861
Adjusted R^2	0.408	0.509	0.408	0.508	0.414	0.513

APPENDIX FIGURE A1

Merger Activities over Time

Figure A1 plots merger activity over time for the full SDC sample (before we randomly select deals with keywords in the EDGAR filings related to discount rate), the randomly generated sample of 1,000 deals, and our final sample. Deals are grouped each year based on the announcement date reported by SDC. The percentage of deals in each year is calculated by using the number of deals in each year divided by the total number of deals for the full sample, randomly generated sample, and our final sample.



Appendix B. Examples of Banks' Choice of COE

Appendix B lists three examples of investment banks' use of COE or weighted average COC.

Example 1. COE (point estimate)

Target firm: PSS World Medical Inc.
Announcement year: 2012
Advisor: Goldman Sachs

Merger filing: DEFM14A
https://www.sec.gov/Archives/edgar/data/920527/000119312513014730/d439167ddefm14a.htm

Illustrative Present Value of Future Share Price Analysis

Goldman Sachs performed illustrative analyses of the present value of the future price per share of common stock of the Company, using the Forecasts. Goldman Sachs calculated an illustrative range of implied present values per share of Company common stock based on hypothetical future share prices for Company common stock. For purposes of this analysis, Goldman Sachs derived hypothetical future share prices for Company common stock by applying the next 12-month P/E multiples ranging from 13.0× to 17.0× to the Company's estimated EPS (per the Forecasts) for each calendar year from 2013 through 2016 (which were estimated to be $1.29, $1.77, $2.13 and 2.45

for each respective calendar year). The next 12 month P/E multiples ranging from 13.0× to 17.0× were derived by Goldman Sachs utilizing its experience and professional judgment, taking into account current and historical trading data of the Company and selected companies which exhibited similar business and financial characteristics to the Company. Goldman Sachs then discounted these future share prices to Dec. 31, 2012, **using a discount rate of 8.6%, reflecting an estimate of the Company's cost of equity**, derived by application of the CAPM, which takes into account certain Company-specific metrics, including the Company's target capital structure and historical beta, as well as certain financial metrics for the United States financial markets generally.

Example 2. COE (range estimate)

Target firm: Jefferson Bancorp, Florida
Announcement year: 1996
Advisor: Tucker Anthony Inc.

Merger filing: S-4
https://www.sec.gov/Archives/edgar/data/92339/0000950144-96-008572.txt

DCF Analysis

The projected cash flows of Jefferson were comprised of the dividends per share paid in fiscal years ended Dec. 31, 1997 through 2001 plus the terminal value of Jefferson Common Stock at fiscal year-end 2001 calculated as described below. **The cash flows were discounted at a range of rates from 12.0% to 16.0%.** Based upon Tucker Anthony's experience and judgment, Tucker Anthony believes that holders of Jefferson Common Stock would typically seek returns within the indicated range of discount rates, in view of Jefferson's operating projections, historical performance, financial condition, and market capitalization, among other matters.

Example 3. WACC (range estimate)

Target firm: IMS Health Holdings Inc.
Announcement year: 2016
Advisor: Goldman Sachs

Merger filing: DEFM14A
https://www.sec.gov/Archives/edgar/data/1595262/000119312516683386/d195446ddefm14a.htm

Illustrative DCF Analysis

Goldman Sachs performed an illustrative DCF analysis on IMS Health on a standalone basis using the Forecasts and on the pro forma combined company using the Forecasts and the Synergies.

IMS Health Standalone. Utilizing illustrative discount rates **ranging from 6.0% to 7.0%** (derived by application of the CAPM, which requires certain company-specific inputs, including the company's target capital structure weightings, the cost of

long-term debt, after-tax yield on permanent excess cash, if any, future applicable marginal cash tax rate and a beta for the company, as well as certain financial metrics for the United States financial markets generally), **reflecting estimates of IMS Health's weighted average cost of capital**, Goldman Sachs discounted to present value as of Mar. 31, 2016 i) certain projected cash flows for IMS Health for the 9 months ending Dec. 31, 2016 and for the fiscal years ending Dec. 31, 2017 through Dec. 31, 2021, such projected cash flows as approved for Goldman Sachs' use by IMS Health management after being calculated by Goldman Sachs using information set forth in the Forecasts, and ii) a range of illustrative terminal values for IMS Health as of Dec. 31, 2021 derived by applying perpetuity growth rates ranging from 2.0% to 3.0% to a terminal year estimate of the projected cash flows to be generated by IMS Health, such estimate as approved for Goldman Sachs' use by IMS Health management after being calculated by Goldman Sachs using information set forth in the Forecasts (which analysis implied exit terminal year EBITDA multiples ranging from 12.0× to 20.0×).

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