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Liquidity and firm characteristics: Evidence from mergers and acquisitions ☆

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Abstract

We explore factors affecting liquidity by examining the relation between liquidity changes and changes in firm characteristics around mergers and acquisitions. We find that spreads decline as the number of analysts, number of shareholders, number of market makers, firm size, and volume increase or as volatility decreases. Increased volume and firm size, and decreased volatility, are associated with increased depth. We find no evidence diversifying and non-diversifying mergers affect liquidity differently. We note that mergers and acquisitions are associated with reductions, on average, in spreads but that the reductions are fully explained by the accompanying changes in firm characteristics.

JEL classification: G14; G34; D82

Keywords: Mergers and acquisitions; Liquidity; Market microstructure

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1. Introduction

A number of studies suggest links between firm characteristics and equity market liquidity. For example, it is well known that larger firms and those with greater trading volume have lower spreads and greater depth. Additional evidence suggests possible benefits from greater breadth of ownership, more competitive market making, greater analyst coverage, and less volatile returns. In addition, theoretical and empirical studies suggest a link between trading costs and operational diversification, though theoretical predictions often conflict and empirical evidence on this relation is inconclusive.

We provide additional evidence and new results on the relation between liquidity and firm characteristics by examining the relation between changes in firm characteristics and changes in trading costs around mergers and acquisitions. This approach provides a number of advantages. In contrast to other studies of liquidity changes around corporate events, we explore the relation between *individual firm changes* rather than just document the *average change* around the event.[1] This allows us to consider an extensive set of explanatory variables and establish a link between liquidity and specific firm characteristics even when more than one firm characteristic is changing.[2] This approach is particularly useful since many firm characteristics are related and are all likely to change around any chosen event. For example, increased analyst coverage is often accompanied by increased breadth of ownership. Also, in contrast to cross-sectional studies of liquidity, we can identify the reason for the variation in firm characteristics. Since mergers and acquisitions are unlikely to be driven by liquidity concerns, the relations we document are more likely to reflect the outcome of exogenous shocks to firm characteristics. Finally, by looking at changes to individual firms we hold constant various firm attributes, such as product market characteristics, thereby reducing the possibility that results are driven by omitted variables.

We examine mergers and acquisitions for the following reasons. First, mergers and acquisitions can lead to substantial changes in firm characteristics, including size, scope of operations, and level of involvement by market participants.[3] Second, some evidence on the relation between diversification and liquidity is provided by papers examining stock breakups and these studies have reached contradictory conclusions. Since mergers or acquisitions represent the same transformation in reverse, evidence from mergers and acquisitions may help resolve these contradictions. Third, as noted above, liquidity effects are not likely to be a deciding factor in these corporate transformations.[4] Finally, there are

[1] Amihud et al. (1999), Krishnaswami and Subramaniam (1999), and Gilson et al. (2001) document changes in the trading environment around events that change firm characteristics. Huson and MacKinnon (2003) employ an approach similar to ours in their analysis of spinoffs, but control for a much smaller set of firm characteristics.

[2] In effect, our methodology combines features of both event studies and cross-sectional regressions. It is most similar to studies that explain the cross-sectional determinants of announcement returns.

[3] An alternative approach would be to search for firms with significant changes in firm characteristics. Certainly, a sample constructed in that manner will contain many of the mergers and acquisitions in our sample. There are two drawbacks to this alternative approach. First, since the motivation for the change is unknown, it is more difficult to argue the changes in firm characteristics are exogenous. Second, if there is any variation in sensitivity of liquidity to firm characteristics based on the type of event studied, regression estimates could reflect variation across events rather than the relation between variables.

[4] In contrast, stock breakups are often specifically motivated by a desire to improve information transparency (Krishnaswami and Subramaniam, 1999). This may also partially explain the mixed results from stock breakup studies.

no existing studies that document the permanent liquidity changes associated with mergers and acquisitions.[5]

We find that spreads decline as analyst coverage, trading volume, or firm size increase, and as the variability of returns decreases. Increased breadth of ownership (number of shareholders) is associated with a reduction in quoted spreads, which reflects trading costs for small order sizes. We also find that depth measured in quoted shares or depth measured by the price response to volume (a measure of depth in the sense of Kyle, 1985) increases as volume or firm size increase or as variability of returns decreases. For Nasdaq-listed bidders, we find that spreads decline as the number of market makers increases. Since our method of analysis considers these sources of liquidity changes jointly, our results suggest that each of these variables has a significant independent effect on liquidity. Thus, for example, our results imply that analyst coverage benefits a firm beyond any effect analyst coverage may have on breadth of ownership.

We find no evidence that liquidity changes differ for diversifying and non-diversifying mergers, even though about a quarter of the mergers and acquisitions in our sample involve targets in unrelated business segments. Furthermore, we find no evidence that liquidity changes are related to characteristics of the bidding process that might reflect possible changes in the level of public information regarding the firm.

We also look separately at the adverse selection and order processing components of spreads.[6] Adverse selection results are generally similar to results for spreads: adverse selection declines with increases in analyst following, the number of shareholders, volume, and firm size; adverse selection increases with firm volatility. For Nasdaq firms, statistical relations are generally weaker, though we observe declines in adverse selection when volume increases and, more importantly, we observe a decrease in order processing costs when the number of market makers increases. These results suggest that most of the benefits from changes in firm characteristics are related to changes in the degree of information asymmetry. For example, our results suggest that increased number of shareholders leads to improved liquidity because more traders reduce information asymmetries, not because they reduce the costs to market makers from holding inventory or from executing trades. The only case where order processing is notably affected is when the number of market makers changes. In that case, our results suggest the improvement results from a reduction in market maker rents due to increased competition.

We document an improvement in liquidity, on average, around mergers and acquisitions.[7] Specifically, we find that spreads drop and that quoted depth increases for bidding firms. For example, the average bidder quoted spreads decline by about 7% after adjusting for changes in a control sample.[8] Notably, after controlling for changes in firm

[5]Jennings (1994) documents changes in liquidity only for target firms, only around merger announcements, does not document the permanent effects of the merger itself, and does not link these changes to firm characteristics.

[6]Adverse selection and order processing costs have been identified and examined in Demsetz (1968), Stoll (1978), Copeland and Galai (1983), and Huang and Stoll (1997), among others.

[7]These results are conservative for the following reason. Target firms are much less liquid, on average, than bidders. Thus, our merged firm includes the operations and assets of firms that were, on average, less liquid before the merger. Had we compared the merged firm to a weighted-average of bidder and target liquidity before the merger (similar to the weighting approach used in studies of announcement returns: see Bradley et al. 1988; Mulherin and Boone, 2000) our results would be more striking.

[8]All our results are based on the analysis of liquidity and firm characteristic changes after adjusting for changes in a control sample. This control is necessary due to the systematic improvement in liquidity provision over time

characteristics that might explain the average change, there is no remaining effect. In other words, mergers and acquisitions, in and of themselves, do not affect liquidity. Rather, it is the ability of mergers to transform a firm's operations and to attract market participants that matters. This result highlights the ability of our empirical method to document the determinants of liquidity changes around a corporate transformation.

Our results are related to a number of prior studies. Huson and MacKinnon (2003) suggest that firm level diversification improves liquidity whereas Gilson et al. (2001) suggest just the opposite. We provide results that are consistent with Krishnaswami and Subramaniam (1999) and Thomas (2002), who find no relation.[9] This is true even when we look at the adverse selection costs directly. Benston and Hagerman (1974) document that firms with more shareholders, lower volatility, or more market makers have lower spreads. However, they do not control for differences in size even though they note that size may drive the results. As in Wahal (1997), we provide evidence that changes in spreads are negatively related to changes in the number of market makers. However, we are the first to show that this result is driven by reductions in order processing costs, which suggests the effect is due to a reduction in market maker rents ensuing from increased competition. As in Brennan and Subrahmanyam (1995), Easley et al. (1998) and Irvine (2003), our results suggest that increased analyst following reduces adverse selection and trading costs. We demonstrate that breadth of ownership and firm size are also beneficial due to their effect on adverse selection costs, rather than reducing order processing costs. Finally, by considering multiple changes in firm characteristics simultaneously, our analysis establishes that the relations between firm characteristics and liquidity mentioned above are not driven by contemporaneous changes in other firm characteristics.

The paper is organized as follows. Section 2 surveys related theoretical and empirical research. Section 3 describes our sample and the measures of liquidity used in the analysis. Results are presented and discussed in Section 4 while Section 5 concludes the paper.

2. Liquidity and firm characteristics

Theoretical models of liquidity (trading costs) stress four determinants—the degree of trading interest in a stock, adverse selection, stock volatility, and competitiveness of market making. The greater the degree of trading interest in a stock, the greater the level of trading activity, and fixed trading costs can be therefore be allocated over a larger number of trades. This economy of scale reduces average trading costs. When traders have more information than liquidity providers, liquidity providers must recover their losses from trading with better informed counterparts (adverse selection costs) by increasing their average revenues—thereby increasing trading costs. When stocks are more volatile, inventory holding costs for liquidity providers are higher and these costs are passed along to traders. When market making is less than perfectly competitive, increases in competition

(*footnote continued*)
(see Jones, 2004). For example, the quoted spreads for bidders declined by about 15% while the control sample declined by about 8%—a control sample-adjusted decrease of 7%.

[9]Krishnaswami and Subramaniam (1999) do find that spinoffs lower adverse selection, but this effect is unrelated to the impact of the spinoff on firm diversification. They note that solving information problems is a commonly stated goal for spinoffs and their results provide strong support for this assertion. However, this link between spinoff decisions and information asymmetry is likely to confound attempts to explore the relation between firm characteristics and liquidity since changes in liquidity are endogenous.

will reduce trading costs. In this section, we discuss changes in firm characteristics, including market activity, which will impact these economic drivers of trading costs. Of course, changes in these firm characteristics may affect more than one economic driver.

Relatively larger firms will have a greater trading interest since more individuals and institutions will have positions in the firm.[10] Larger firms will also be more carefully scrutinized by both professional and unsophisticated analysts. The increased information gathering makes prices more efficient, thereby reducing adverse selection costs. By providing a larger pool of trades to offset adverse selection costs, increases in the breadth of ownership, particularly smaller shareholders, can offset additional adverse selection costs and lead to reduced spreads. We therefore expect increases in firm size, volume, and the number of shareholders to be negatively related to changes in spreads.

Prior empirical evidence supports these expectations. The earliest analyses of spreads acknowledge the effects of firm size and volume (see Benston and Hagerman, 1974; Stoll, 1978). As for shareholders, Amihud et al. (1999) link increased individual trading to improved liquidity, and Grullon et al. (2004) show that greater product advertising is associated with more extensive breadth of ownership and greater liquidity. Heflin and Shaw (2000) also examine ownership structure and find that increased block ownership reduces liquidity. They argue that the effect of blockholder ownership is a result of superior blockholder information, which leads to increased adverse selection. We note that increased blockholdings may also reduce the breadth of ownership (reduce the number of individual shareholders). Thus, the results of Heflin and Shaw (2000) are consistent with predictions based on breadth of ownership.

The expected impact of corporate diversification on liquidity is unclear. There are arguments and evidence supporting both a positive and negative relationship between diversification and liquidity. Chang and Yu (2004) suggest diversified firms have reduced adverse selection costs since firm-level prices are less sensitive to information asymmetries arising in individual divisions.[11] In addition, Benston and Hagerman (1974) point out that since market makers hold undiversified portfolios, corporate diversification reduces inventory holding costs by reducing volatility. The reduction in either adverse selection costs or inventory holding costs would reduce spreads for diversifying firms. Alternatively, Nanda and Narayanan (1999) suggest that allowing each of a diversified firm's divisions to trade independently facilitates price discovery by investors. More accurate market prices would mitigate adverse selection problems and improve liquidity. Note that price discovery arguments do not preclude offsetting diversification effects.

Empirical evidence on the relative importance of the two effects of diversification on liquidity is mixed. Papers examining stock breakups (spinoffs, equity carve outs, or targeted stock offerings) provide some evidence on this issue since breakups can significantly alter the scope of operations. Gilson et al. (2001) examine those breakups that lower firm diversification (eliminations of unrelated business lines) and find an increase in analyst following and increased quality of public information. Their results suggest an improvement in liquidity. However, Huson and MacKinnon (2003) examine spinoffs and find that those spinoffs that increase firm focus are associated with an increase

[10]Merton (1987) notes that individuals are more likely to hold shares of firms they are familiar with and that familiarity is positively related to firm size.

[11]Studies on security baskets' liquidity suggest a similar relationship, e.g., Subrahmanyam (1991) and Jegadeesh and Subrahmanyam (1993).

in trading costs. Krishnaswami and Subramaniam (1999) also examine spinoffs and find that adverse selection is reduced, on average. However, they find similar reductions for both focusing and non-focusing spinoffs, suggesting that diversification does not have any effect. Similarly, Thomas (2002) finds that adverse selection is no greater for conglomerates than for mimicking portfolios of non-conglomerate firms. Our analysis is of particular interest given the contradictory conclusions from prior research and because mergers and acquisitions change firm focus in a manner analogous to breakups (though in the opposite direction), but the decision to pursue a merger is not likely to be driven by information concerns as would be the case for breakups (Krishnaswami and Subramaniam, 1999).

Wahal (1997) documents that larger firms tend to be followed by a greater number of market makers and that more market makers are associated with lower spreads, a result that he attributes to increased competition among market makers. Thus, we expect the number of market makers to be negatively related to spreads. Furthermore, if increased competition among market makers is the source of the reduction, we expect to see a reduction in the order processing component of the spread. This is precisely the result we observe.

We expect analyst coverage to reduce trading costs through a reduction in adverse selection. Admati and Pfleiderer (1988) provide a theoretical model of a market with endogenous information acquisition in which greater numbers of informed traders increase competition among themselves, which results in more revealing prices and lower adverse selection costs of trading. Brennan and Subrahmanyam (1995) and Easley et al. (1998) provide direct empirical evidence of a link between analysts and adverse selection.[12] In addition, Irvine (2003) links the initiation of coverage by analysts to lower spreads.

3. Description of sample and liquidity measures

We obtain the sample of mergers and acquisitions from the Securities Data Company (SDC) database. It includes mergers and acquisitions announced after April 27, 1993 and completed before September 9, 2003. The dates are set so that the pre-event window start date and post-event window end date are between January 1, 1993 and December 31, 2003. The earlier date corresponds to the availability of trade and quote data on the TAQ data sets, and the later date to the availability of the remaining data. The pre-event window is from 80 to 20 trading days prior to the announcement, and the post-event window from 20 to 80 trading days after the merger or acquisition is completed (the effective date). We exclude the 20 trading days before announcement through 20 days after effective date to ensure results are not driven by uncertainties related to the merger or acquisition process itself, such as the predictability of the deal, revelation of deal details, probability of completion, and portfolio rebalancing.

All firms are domestic and listed on one of the three major trading venues. We exclude mergers or acquisitions involving companies in the financial and utility sectors as well as those classified by SDC as being in 'other' sectors. We further restrict our sample to deals where the bidder owns 100% of shares after the transaction and where the deal value is at least $1 million. There are 1,464 mergers and acquisitions that meet these criteria. We then match this sample of bidders with CRSP and delete deals where the ratio of the deal value to the bidder's market value of equity (relative deal value) is less

[12]Brennan et al. (1993) find that stocks that are followed by many analysts react faster to common information.

Table 1
Summary statistics for merger sample

The sample includes mergers and acquisitions of publicly traded bidders and targets announced after 1993 and effective before 2003. The statistics presented are cross-sectional averages. Market value of equity of a particular firm is the average of the daily market capitalization during the pre-event window. Relative size is the deal value as a percentage of bidder's market capitalization. Stock offers include deals financed only with common stock, stock options, warrants or rights. Cash offers include deals financed only with cash or debt. Time to completion is the number of calendar days between announcement and effective date. Non-diversifying mergers or acquisitions are those where the bidder and target are in the same two digit SIC code. The last column contains indicators of statistical significance for the null hypothesis that the difference in means/medians of the non-diversifying and diversifying groups are identical. We present inferences based on *t*-tests, and on signed rank tests (in parenthesis), when different from *t*-test results.

	All	Non-diversifying	Diversifying
Number of observations	463	339	124
Size of firms			
Market value of bidder (000)	4,882,349	5,271,610	4,115,346
Market value of target–pre-event (000)	1,414,310	1,572,728	976,647
Relative size (%)	59.34	57.45	64.50
Deal characteristics			
Stock (% paid with only stock)	47.30	51.32	36.29***
Cash (% paid with only cash or debt)	24.62	22.42	30.64**$^{(+)}$
Tender (% tender offer)	23.33	21.83	27.42
Hostile (% hostile)	3.89	2.95	6.45$^{(+)}$
Nasdaq (% Nasdaq listed)	43.19	45.42	37.10
Time to Completion (number of days)	115	114	117

*** Significant at 1%, **significant at 5%, * significant at 10%.
$^{+++}$ Significant at 1%, $^{++}$significant at 5%, $^{+}$ significant at 10% based on signed rank test, reported only when different from *t*-test.

than 10%.[13] In order to minimize the effect of confounding events, we delete bidders with other deals on the mergers file of SDC that have a relative deal value greater than 5% and were announced or became effective during the study window. We also require that bidders must have traded for at least 1 year before and 1 year after the announcement and effective dates; that the bidder share price must be greater than $5; the bidder remains listed on the same exchange during the study period; and that the shares have a CRSP share code of 10 or 11 (common equity). Finally, we require that we have data available on the number of shareholders. Our final sample is composed of 463 bidders.

Table 1 contains summary statistics. The market value of equity is the average of the mean daily equity capitalization over the pre-event window. The average bidder has a market capitalization of $4,882 million. The target is significantly smaller—average market value of $1,414 million. The mean relative deal value is 59%. We define stock offers as those deals financed with common stock only or a combination of common stock and options, warrants or rights. Cash offers include cash only and mixtures of cash and debt. In our sample, 47% of mergers and acquisitions are financed with stock, 25% with just cash or debt, and the rest some combination of stock and cash. Furthermore, 23% of the sample is

[13]We use the deal value excluding liabilities so that relative deal value compares equity values to equity values. However, when SDC does not report the deal value excluding liabilities, we use the deal value that is given.

comprised of tender offers and 4% are hostile. Finally, 43% of bidders trade on Nasdaq, and the average time to completion is 115 calendar days. Mergers or acquisitions are classified as diversifying if bidder and target are in different industries based on two digit SIC codes. About 27% of the sample is classified as diversifying mergers or acquisitions.

In order to control for secular changes in market-wide liquidity, we match each firm to a control portfolio. Using portfolios, rather than individual firm matches, reduces the effects of noise and enables us to better capture time trends. We closely follow Barber and Lyon (1996) in generating control samples. We start off with all firms appearing on CRSP, Compustat and TAQ that are not in our sample, and have data available for all the variables of interest. We compute quarterly averages of market value of equity and relative effective spreads. We then match by the year and quarter of the pre-event window start date. We select our control portfolio using three successively weaker criteria. We initially match on exchange and two digit SIC code, and then include all firms whose market value of equity is within 30% of the study firm and whose spreads are within 10% (type 1 match). If we are unable to find any matches with these criteria, we relax the industry restriction (type 2 match). If we are still unable to find any matches, we relax the bounds for size to 50% (type 3 match). For each matched portfolio we use the median of the variables of interest to adjust our study sample.

Table 2 contains a description of our control portfolios, and relates them to our sample of bidders. The size of our portfolios averages 11 firms (a total of 5224 observations

Table 2
Summary statistics for control sample

This table summarizes the results of the matching procedure. We match each firm to a portfolio of firms. The matching procedure is based on measures taken during the year and quarter of the pre-event window start date. At a first pass we match on exchange, two digit SIC codes, the market value of equity for the matching firm must be within 30% and spreads within 10%. If we are not able to find any firm that satisfies these criteria, we relax the industry restriction. If we are still unable to find eligible candidates at a third and final pass, we relax the restriction for size to 50% and relax the exchange code restriction. Then for each sample portfolio we take the median of the variables of interest. We present cross-sectional means of market value of equity and spreads during the pre-event window for the main and control samples, along with their percentage differences. Next to the percentage differences, we include indicators of statistical significance for the null hypothesis that the difference in means/medians of the main and control samples are identical. Inferences based on t-tests and signed rank tests indicated no significant differences between control and study samples.

	All match types	By matching procedure		
		Type 1	Type 2	Type 3
Sample sizes (observations)				
Study sample	463	254	197	12
Control sample	5224	881	4073	270
Market value of equity (000)				
Study sample	4,882,349	2,032,311	6,224,774	43,558,829
Control sample	4,379,419	1,881,408	5,789,119	31,707,992
Percentage difference	−4.72	−4.19	−5.29	−7.61
Relative effective spread (%)				
Study sample	0.88	1.01	0.68	1.30
Control sample	0.89	1.03	0.69	1.15
Percentage difference	1.63	2.20	1.25	−5.18

divided by 463 sample firms). We are able to match 254 firms with type 1 matches, 197 with type 2 matches, and 12 with type 3 matches. The results of *t*- and rank-tests for differences between mean/median size and spreads of our bidders and the mean/median across the control portfolios indicate that there are no statistically reliable differences between the controls and the bidders in the pre-event window.

The trading data is obtained from TAQ. We compute the National Best Bid or Offer (NBBO), and match prevailing quotes with transaction prices. The data are filtered for reporting errors using filters similar to those in Huang and Stoll (1996).[14] If a quote is excluded, we exclude the corresponding trades. We exclude opening and closing transactions.

Number of shareholders is obtained from Compustat. Whenever this particular variable is missing we hand collect this item from Standard and Poor's Stock Reports. The number of shareholders is obtained for the first available date immediately before announcement and immediately after the effective date. SIC codes are also extracted from Compustat because of evidence that these are a better reflection of the industry in which the firm operates (see Kahle and Walkling (1996)). Market capitalization, number of market makers and exchange listings are from CRSP. Number of market makers is limited to firms listed on NASDAQ. Finally, the number of different analysts following the firm is obtained from the IBES US detail history file. The number of analysts is computed as the number of different analysts making earnings reports during the window. When unable to find any analysts following the firm during an event window, we assign a value of zero to that window.[15]

We present both quoted and effective spreads (as well as the relative spreads, which are these values as a proportion of price). The quoted spread is the difference between ask and bid prices. The effective spread is twice the difference between execution prices and the mid-point of the prevailing quote at the time the trade is executed. We also present the quoted depth, which is the number of shares market makers are guaranteed to execute at their posted prices. Quoted spreads and depth are time-weighted within the day, and effective spreads are volume-weighted within the day. We examine the average across days in each study period.

In addition to quoted depth in shares, we measure depth using a measure based on Kyle (1985). Specifically, we follow Brennan and Subrahmanyam's (1995) implementation of the Glosten and Harris (1988) specification for this measure and refer to this as the Kyle measure of depth. This measure reflects the degree to which prices change in response to order flow. It is, therefore, an inverse measure of depth—higher values signify lower depth. We use the Madhavan et al. (1997) (henceforth MRR) method to decompose spreads into their adverse selection and order-processing components. MRR is a structural trade indicator model of intraday price movements that incorporates both public information shocks and microstructure effects. In this model, order flow is not assumed to be uncorrelated and the information asymmetry component is assumed to be proportional to

[14]Specifically, we exclude the following observations: non-positive prices or quotes, spreads greater than $4.00, trading prices or quotes with an absolute change of over 50% from the previous price or quote, trading prices more than 50% away from the mid-quote, quotes with zero sizes on either the bid or ask sides (this last rule is not applied to Nasdaq quotes before April 7, 1993 because these quote sizes are invalid and have been zero-filled).

[15]Of the 463 firms, 21 did not have an analyst report in the pre-event period, 20 did not have a report in the post-event period, and 29 did not show an analyst report in either. Setting a lack of a report to zero is consistent with Brennan and Subramaniam (1995) and Easley et al. (1998).

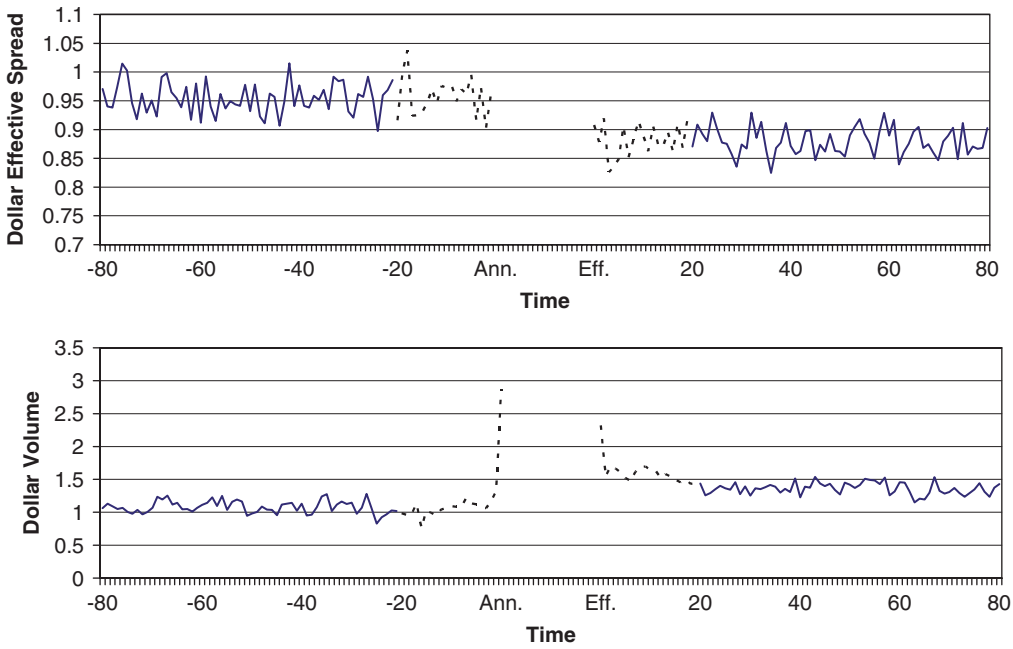

Fig. 1. Adjusted effective spread and trading volume around mergers and acquisitions. Daily cross-sectional average of the dollar effective spread and trading volume, divided by the daily average of a matched control sample, from 80 days before announcement through the day of the announcement, and from the day the merger or acquisition became effective through 80 days after. The gap in the middle corresponds to the period between announcement and effective date. The solid lines are the periods we study, while the dashed lines are excluded from the analysis.

the innovation in the order flow, and not the order flow itself. This is important because it allows one to properly separate adverse selection from inventory components.

4. Results

4.1. Average changes in liquidity and firm characteristics around mergers and acquisitions

In this section we characterize the trading environment of bidders and targets, and their respective changes, following the completion of mergers or acquisitions. Fig. 1 shows the dollar effective spread and trading volume (adjusted for the levels in the control sample) around mergers and acquisitions. This figure illustrates, also, the study windows. The first segment of each graph is the pre-event window. The next segment (dashed line) is the twenty days before the announcement. The break in the graph is the time from announcement to the effective date (which varies in length of time). Following this is the 20 day period after the effective date (dashed line) and, finally, our post-event study window. Notable in these graphs are the following. First, the shift from the pre-event to post-event windows looks like a regime change, rather than a trend.[16] This suggests that our control

[16]Due to an upward trend in adjusted price levels during the pre-merger period and a downward trend during the post-merger period, the *relative* effective spread shows an economically small but statistically significant trend

Table 3
Changes in liquidity around mergers and acquisitions

This table characterizes changes in liquidity around mergers or acquisitions. Statistics are given for bidders, the bidder control sample, and target firms. Quoted depth is the average of bid and ask quote sizes. The Kyle measure of depth is computed following Glosten and Harris (1988), as implemented by Brennan and Subrahmanyam (1995). We decompose spreads using the Madhavan et al. (1998, henceforth MRR) model. The proportional changes column contains the cross-sectional means of the paired log differences between the post- and the pre-event windows. We also present the adjusted change, which is the log change in bidder variables less the log change in the control group. In the columns characterizing the target, the proportional difference column represents the log difference between the target and the bidder. Inferences based on *t*-tests are indicated by each change, while inferences based on signed rank tests are indicated in parentheses only when different from *t*-test results.

	Bidder		Control			Target	
	Mean before	Proportional change (%)	Mean before	Proportional change (%)	Adjusted change	Mean before	Proportional difference (%)
Spreads							
Price	31.92	−7.35***	31.45	−5.87***	−1.48	18.98	−64.00***
Quoted spread ($)	0.21	−22.51***	0.21	−14.96***	−7.55***	0.24	+9.54***
Relative quoted spread (%)	1.11	−15.19***	1.12	−8.30***	−6.89***	2.41	+73.91***
Effective spread ($)	0.17	−18.67***	0.17	−13.07***	−5.60***	0.18	+5.90*
Relative effective spread (%)	0.88	−11.25***	0.89	−6.72***	−4.53***$^{(++)}$	1.89	+70.42***
Depth							
Quoted depth (shares)	2413	+7.00***$^{(++)}$	2291	−5.57***	+12.57***	2404	−11.64***
Kyle measure (×1,000)	2.17	−30.81***	2.50	−8.16**	−26.26***	3.45	−0.12
Spread components (MRR method)							
Adverse selection (θ, ×100)	1.23	−16.60***	1.18	−4.36**	−11.79***	1.27	−2.73
Order-processing (φ, ×100)	5.43	−20.70***	5.59	−14.01***	−6.87***	5.95	+8.71***$^{(++)}$

***Significant at 1%, **significant at 5%, * significant at 10% based on *t*-test.
$^{+++}$Significant at 1%, $^{++}$significant at 5%, $^{+}$ significant at 10% based on signed rank test, reported only when different from *t*-test.

portfolio is effectively capturing any time trends. Second, any unusual trading volume occurs just before the announcement and just after the effective date, suggesting the 20 day buffers are sufficient so that our results are not contaminated by event-related trading or behavior. And third, the changes appear to be permanent, with no return to pre-event levels.

Table 3 summarizes changes in liquidity around mergers and acquisitions. The bidder column presents the mean level in our pre-event study period and the mean proportional change to the post-event study period. We present the same statistics for the control group followed by the control-adjusted change. We also present the mean levels for the target in the pre-event period and the proportional difference between the target and the bidder. We use *t*-statistics to test the null hypothesis that the proportional changes are zero, and the results are indicated by superscripts next to the values of the differences. Additionally, we

(*footnote continued*)
downward in the pre-merger period and upward in the post-merger period, with a drop in between windows. Comparing average prices in the pre-merger and post-merger periods, we find that post-merger average prices were slightly lower, which would bias against finding a reduction in relative spreads.

report, in parentheses next to the *t*-test indicators, signed-rank tests when different from *t*-tests at conventional significance levels. Also note that for the Kyle measure of depth and for the spread decomposition components, the econometric models did not yield meaningful (positively signed) results in every case. Following prior research using these methods, we discarded these observations from our analysis.

We find that dollar and relative spreads decline and quoted depth increases. The changes for the bidder firms are large, but a part of the changes appears to be related to market wide changes since the control firms also see spread improvements. However, even after adjusting for market wide changes, the bidding firms show substantial improvement. For example, quoted spreads decline by 7.5% and effective spreads decline by 5.6%. Quoted depth in shares increases by 12.5% and the Kyle measure declines by 26.3%. As for the decomposition of spreads into adverse selection and order processing costs, we find that both components decline significantly. For the remainder of our analysis, we present results for dollar spreads, though results are similar for relative spreads.

Note that target firms are significantly less liquid than bidders; spreads are higher and depth is lower for target firms. For example, quoted spreads are about 9.5% higher for targets and effective spreads are about 6% higher. Depth in shares is about 12% lower for targets, though the Kyle measure of depth is no different between bidders and targets. However, one should keep in mind that the Kyle measure is computed in dollars and the share price of the target is lower than that of the bidder. Thus, trading volume moves prices relatively further for the target, which suggests less liquidity. Note that bidders are able to improve liquidity, on average, despite merging with less liquid partners.[17]

Table 4 summarizes changes in firm characteristics around mergers and acquisitions, including changes in market participation, trading activity, and firm size. The adjusted changes in these characteristics are also, generally, positive. We observe an increase in the number of shareholders and market makers, and an increase in trading activity and firm size. The statistics for the number of market makers reflects only the change for Nasdaq bidders, of which there were 200 in our sample. Note that we see no change, on average, in the number of analysts, but our method of analysis may still find an effect since the cross section of changes in liquidity may be related to the cross-section of changes in analyst coverage. As expected, the firm characteristics of the target firm relative to the bidder suggest that liquidity is lower for the target. In particular, on average, targets have fewer shareholders, fewer analysts, fewer market makers, lower trading activity, and are smaller firms.

4.2. Determinants of changes in liquidity around mergers and acquisitions

Results in the last section show that bidders improve their liquidity, on average, as the result of a merger or acquisition. We also observe changes in firm characteristics that are consistent with the liquidity improvement. Whether the changes in firm characteristics can explain the change in liquidity we explore in this section by regressing firm level changes in

[17]For the remainder of the paper, we compare the merged firm to the stand-alone bidder rather than a weighted average of the bidder and target. This ensures our results are not driven mechanically by the inclusion of the target.

Table 4
Changes in market participants and trading activity around mergers and acquisitions

This table characterizes changes in market participation. The number of shareholders is obtained for the first available date, but within one year, before the announcement and after the effective date. Number of analysts is the number of different analysts following a firm during the window. Number of market makers is the average number of market makers making the market for that firm. This measure is only available for Nasdaq listed firms. The proportional changes column contains the cross-sectional means of the paired log differences between the post- and the pre-event windows. We compute the change in number of analysts by adding one to each of the windows. We also present the adjusted change, which is the log change in bidder variables less the log change in the control group. In the columns characterizing the target, the proportional difference column represents the log difference between the target and the bidder. Inferences based on *t*-tests are indicated by each change, while inferences based on signed rank tests are indicated in parentheses only when different from *t*-test results.

	Bidder		Control			Target	
	Mean before	Proportional change (%)	Mean before	Proportional change (%)	Adjusted change	Mean before	Proportional change (%)
Market participants							
Number of shareholders (000)	14.46	+25.94***	44.93	+3.47***$^{(+)}$	+22.47***	6.07	−65.32***
Number of analysts	9.75	+2.47	8.37	+1.06$^{(+)}$	+1.41	5.48	−58.14***
Number of market makers (Nasdaq)	23.50	+17.31***	21.33	+6.97***	+10.34***	17.44	−32.80***
Trading activity and firm size							
Daily volume (000)	633	+48.53***	546	+13.19***	+35.34***	299	−86.26***
Daily dollar volume (000)	27,052	+40.70***	23,817	+5.77**$^{(+++)}$	+34.93***	8,295	−149.93***
Number of trades/per day	632	+47.46***	576	+18.92***	+28.54***	248	−91.43***
Market value of equity (000)	4,882,349	+21.14***	4,379,419	+2.83*$^{(++)}$	+18.31***	1,414,310	−136.76***

***Significant at 1%, **significant at 5%, * significant at 10%.
$^{+++}$Significant at 1%, $^{++}$significant at 5%, $^{+}$ significant at 10% based on signed rank test, reported only when different from *t*-test.

liquidity measures on changes in firm characteristics around the merger or acquisition. We can also assess whether these variables account for all the changes in liquidity associated with these firm transformations.

Our regressions of the dependent variables in Table 3 include as explanatory variables all the characteristics in Table 4. Additional explanatory variables are described below. All variables have been adjusted for changes in a control sample as described in the previous section with the exception of variables related to the nature of the deal or for the indicator variable that the merger is diversifying.

About 25% of our sample bidders merge or acquire targets that are in a different industry (defined by two-digit SIC codes).[18] We include an indicator variable for those mergers that are diversifying.[19] We also include a measure of the change in the standard deviation of returns. Higher volatility will affect the willingness of market makers to hold inventory and investors to acquire costly private information (Demsetz, 1968).

[18]Here and throughout the paper, our results are qualitatively similar whether we distinguish industries based on two- or three-digit SIC code classifications.

[19]Results are similar if we use the correlation between the bidder industry and the target industry (which would be equal to 1 for same industry mergers). The correlation was calculated as follows. We formed equally weighted industry portfolios of monthly returns from 1990 to 1992 and then computed the correlation coefficient between bidder and target industry portfolios.

Hietala et al. (2003) note that merger and acquisition negotiations reveal information that allows more accurate stand-alone valuations of the bidder and target. Similarly, bidding firms who pay for a merger and acquisition using shares in the merged firm will have to reveal additional information to shareholders of the target firm. These changes in the extent of public information may reduce the degree of information asymmetry and, therefore, trading costs. Assuming these effects are long-lived, we expect that longer negotiations or stock purchases will lead to reductions in adverse selection. Thus, we include the length of negotiations and an indicator for mergers and acquisitions that include stock.[20] On the other hand, Hansen (1987) notes that bidders offer stock when there is high uncertainty about the target's value. This is done so that the target bears some of the risk of overpayment. A stock acquisition may, therefore, be associated with increased adverse selection as the target is added to the merged firm. In this case, we would expect stock purchases to be associated with increased adverse selection.

We make the following adjustment to volume. Volume is highly correlated with other explanatory variables leading to problems of multicollinearity. As in Graham et al. (2004) and Mansi et al. (2004), we orthogonalize volume to the number of analysts, market makers (only for Nasdaq regressions), firm size, and shareholders in a first stage regression and use the residuals in our analysis.[21]

We also include a number of control variables. The first is the relative size of the merger and is equal to the log of the ratio of the deal value to bidder market value during the pre-event window. This variable acknowledges that larger mergers may have commensurately larger effects on the dependent variables. The second is the log change in price. Market makers typically take prices into consideration when setting spreads and depths, since holding costs and position risks are related to the dollar level of the commitment (Demsetz, 1968). Of course, dollar spreads do not move in direct proportion to changes in price due to fixed dollar effects such as the effects of trading increments (tick size). Nevertheless, dollar spreads will generally rise and share depth fall as share price levels increase (Demsetz, 1968; Benston and Hagerman, 1974; Stoll, 1978). Finally, we control for industry effects by including indicator variables for the eight census bureau groupings of SIC codes (to simplify our presentation, coefficients and statistics for these indicators are not reported).

Given the control variables, we run the following regression for each liquidity measure where i denotes a single merger and ε is an error term.

$$\begin{aligned}\log(\Delta Liquidity_i) = {} & \beta_0 + \beta_1 \log(\Delta \#Analysts_i) + \beta_2 \log(\Delta \#Shareholders_i) \\ & + \beta_3 \log(\Delta VolumeResidual_i) + \beta_4 \log(\Delta EquityMarketValue_i) + \beta_5 \log(\Delta \sigma_i) \\ & + \beta_6 IndicatorDiversifying_i + \beta_7 IndicatorStock_i + \beta_8 TimeToCompletion_i \\ & + \beta_9 \log(DealRelativeSize_i) + \beta_{10} \log(\Delta \mathrm{Price_i}) + \beta_{11} IndicatorNasdaq_i + \varepsilon_i.\end{aligned}$$

The industry indicators are omitted for simplicity. Standard errors are corrected for heteroscedasticity.

[20]It is possible that the length of negotiations is only relevant for stock acquisitions, which suggests an interaction between these two variables. Results with the interaction provide conclusions similar to those without and we have omitted the interaction specification to simplify our exposition.

[21]If volume is not orthogonalized in this manner, the only major change in our results is that firm size is no longer significant in our regressions.

Table 5
Cross-sectional analysis of liquidity changes—all bidders

OLS regressions of log changes in spreads and spread components on determining changes in firm characteristics. Variable changes are adjusted by subtracting the log changes in the control group from the log changes in the bidder variables. Quoted depth is the average of bid and ask quote sizes. The Kyle measure of depth is computed following Glosten and Harris (1988), as implemented by Brennan and Subrahmanyam (1995). We decompose spreads using the Madhavan, Richardson and Roomans (1998, henceforth MRR) model. Independent variables are Log Δ # Analysts (before computing the change we add one to the number of different analysts following the firm since some observations are equal to zero), Log Δ # Shareholders, Log Δ Market Value of Equity, Log Δ Variation of Returns (change in the standard deviation of daily CRSP returns), an indicator for when target and bidder are in different two-digit SIC codes, an indicator for when the deal includes common stock, stock options, warrants or rights, Time to Completion (number of days between announcement and effective dates), Log Relative Size (the log of the proportion of deal value to bidder's market capitalization during pre-event window), Log Δ Price (change in average transaction prices), and an indicator for whether the firm is listed on NASDAQ. The regressions also include Log Δ $ Volume Residual, which is the residual of a regression of Log Δ $ Volume (change in dollar volume) on Log Δ # Analysts, Log Δ # Shareholders, and Log Δ Market Value of equity. The results of this regression are (all coefficients significant, adjusted R^2 of 0.38):

Log Δ $ Vol = 0.128 + 0.362(Log Δ # Analysts) + 0.127(Log Δ # Shareholders) + 1.023(Log Δ MV Equity).

Standard errors are adjusted for heteroscedasticity. The numbers in brackets are the *p*-values of the *t*-tests for the null hypothesis that the coefficients are equal to zero.

	Log Δ Spreads		Log Δ Depth		Log Δ Spread Components (MMR)	
	Quoted	Effective	Shares	Kyle measure	Adverse selection	Order processing
Intercept	−0.047	−0.049	0.070	0.127	0.006	−0.067
	[0.207]	[0.182]	[0.322]	[0.468]	[0.956]	[0.316]
Market participants and trading activity						
Log Δ # Analysts	−0.106***	−0.093***	0.055	−0.035	−0.163*	−0.034
	[0.002]	[0.002]	[0.218]	[0.802]	[0.082]	[0.472]
Log Δ # Shareholders	−0.060**	−0.031	−0.009	0.031	−0.140**	0.013
	[0.010]	[0.138]	[0.778]	[0.791]	[0.018]	[0.685]
Log Δ $ Volume Residual	−0.139***	−0.104***	0.256***	−0.415***	−0.421***	0.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.992]
Operations						
Log Δ Market Value of Equity	−0.096**	−0.077**	0.333***	−1.031***	−0.307**	0.138**
	[0.023]	[0.034]	[0.000]	[0.000]	[0.027]	[0.039]
Log Δ Variation of Returns	0.182***	0.256***	−0.120*	0.453**	0.513***	0.081
	[0.000]	[0.000]	[0.100]	[0.022]	[0.000]	[0.142]
Indicator Diversifying	0.012	0.028	0.048	−0.212*	0.125	−0.011
	[0.603]	[0.196]	[0.299]	[0.090]	[0.160]	[0.804]
Indicator Stock Included	−0.012	−0.023	0.100**	0.043	−0.140	−0.069
	[0.620]	[0.315]	[0.027]	[0.747]	[0.131]	[0.203]
Time to Completion (× 1000)	0.101	0.231	−0.224	−1.105	0.134	0.148
	[0.583]	[0.118]	[0.517]	[0.104]	[0.830]	[0.417]
Other Controls						
Log (Relative Size)	−0.024*	−0.019	0.006	0.032	−0.023	−0.029
	[0.069]	[0.154]	[0.810]	[0.641]	[0.648]	[0.230]
Log Δ in Price	0.534***	0.546***	−0.881***	2.183***	1.175***	0.034
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.674]
Indicator Nasdaq	−0.066***	−0.041**	−0.212***	0.240	−0.022	−0.106***
	[0.003]	[0.048]	[0.000]	[0.115]	[0.794]	[0.004]
Adjusted R^2	0.48	0.52	0.39	0.33	0.27	0.06
Number of observations	463	463	463	373	426	426

***Significant at 1%, **significant at 5%, * significant at 10% based on *t*-test.

Table 6
Cross-sectional analysis of liquidity changes—Nasdaq bidders

OLS regressions of log changes in spreads and spread components on determining changes in firm characteristics for NASDAQ listed bidders. Variable changes are adjusted by subtracting the log changes in the control group from the log changes in the bidder variables. Quoted depth is the average of bid and ask quote sizes. The Kyle measure of depth is computed following Glosten and Harris (1988), as implemented by Brennan and Subrahmanyam (1995). We decompose spreads using the Madhavan et al. (1998, henceforth MRR) model. Independent variables are Log Δ # Analysts (before computing the change we add one to the number of different analysts following the firm since some observations are equal to zero), Log Δ # Shareholders, Log Δ # Market Makers, Log Δ Market Value of Equity, Log Δ in Variation of Returns (change in the standard deviation of daily CRSP returns), an indicator for when target and bidder are in different two-digit SIC codes, an indicator for when the deal includes common stock, stock options, warrants or rights, Time to Completion (number of days between announcement and effective dates), Log Relative Size (the log of the proportion of deal value to bidder's market capitalization during pre-event window), and Log Δ Price (change in average transaction prices). The regressions also include Log Δ $ Volume Residual, which is the residual of a regression of Log Δ $ Volume (change in dollar volume) on Log Δ # Analysts, Log Δ # Shareholders, Log Δ # Market Makers, and Log Δ Market Value of equity. The results of this regression are (all coefficients significant, except intercept and Log Δ # Shareholders, adjusted R^2 of 0.50):

Log Δ $ Vol = 0.083 + 0.470(Log Δ # Analysts) + 0.103(Log Δ # Shareholders) + 0.870(Log Δ # Market Makers) + 1.053(Log Δ # MV Equity)

Standard errors are adjusted for heteroscedasticity. The numbers in brackets are the *p*-values of the *t*-tests for the null hypothesis that the coefficients are equal to zero.

	Log Δ Spreads		Log Δ Depth		Log Δ Spread Components (MMR)	
	Quoted	Effective	Shares	Kyle measure	Adverse selection	Order processing
Intercept	−0.079	−0.010	−0.059	0.919**	−0.103	−0.119*
	[0.147]	[0.854]	[0.417]	[0.042]	[0.661]	[0.098]
Market participants and trading activity						
Log Δ # Analysts	−0.118**	−0.107**	0.026	−0.026	−0.282	−0.009
	[0.013]	[0.017]	[0.594]	[0.924]	[0.112]	[0.878]
Log Δ # Shareholders	−0.047	−0.022	−0.030	−0.065	−0.032	0.001
	[0.101]	[0.430]	[0.306]	[0.739]	[0.762]	[0.986]
Log Δ $ Volume Residual	−0.138***	−0.099***	0.110***	−0.339	−0.376***	−0.027
	[0.000]	[0.000]	[0.001]	[0.276]	[0.001]	[0.370]
Log Δ Number of Market Makers	−0.429***	−0.394***	0.037	0.911	−0.609	−0.359***
	[0.000]	[0.000]	[0.697]	[0.161]	[0.101]	[0.000]
Operations						
Log Δ Market Value of Equity	−0.169***	−0.119**	−0.003	−0.887*	−0.088	0.028
	[0.005]	[0.034]	[0.960]	[0.083]	[0.719]	[0.691]
Log Δ Variation of Returns	0.229***	0.291***	−0.110*	0.929*	0.515**	0.090
	[0.000]	[0.000]	[0.064]	[0.065]	[0.037]	[0.232]
Indicator Diversifying	−0.048	−0.008	0.047	−0.185	0.191	0.013
	[0.189]	[0.815]	[0.312]	[0.635]	[0.322]	[0.807]
Indicator Stock Included	−0.059	−0.077*	0.125**	−0.559	−0.289	−0.071
	[0.199]	[0.045]	[0.023]	[0.166]	[0.188]	[0.246]
Time to Completion (× 1000)	0.670**	0.441*	−0.339	−0.875	1.552	0.118
	[0.020]	[0.081]	[0.393]	[0.665]	[0.312]	[0.718]
Other controls						
Log (Relative Size)	−0.036*	−0.011	0.026	0.248	−0.088	−0.020
	[0.098]	[0.591]	[0.278]	[0.172]	[0.400]	[0.481]
Log Δ in Price	0.654***	0.645***	−0.334***	2.370***	0.860***	0.308***
	[0.000]	[0.000]	[0.000]	[0.002]	[0.005]	[0.000]

Table 6 (*continued*)

	Log Δ Spreads		Log Δ Depth		Log Δ Spread Components (MMR)	
	Quoted	Effective	Shares	Kyle measure	Adverse selection	Order processing
Adjusted R^2	0.61	0.64	0.27	0.32	0.16	0.30
Number of observations	200	200	200	119	172	172

***Significant at 1%, **significant at 5%, * significant at 10% based on *t*-test.

Our results are presented in Table 5 for all bidders and in Table 6 for Nasdaq bidders. The tables present three groupings of results: those for spreads, depth and the decomposition of spreads.[22] Note that, as expected and reported in the table description, the change in volume is significantly related to the change in analyst following, number of market makers, firm size, and number of shareholders. As noted previously, not all estimates of the Kyle or spread decomposition provide meaningful numbers, so we provide sample sizes for each regression.

Consider Table 5, which presents our analysis for all bidders. Looking at market participants and trading activity, we find that both quoted and effective spreads are negatively related to the number of analysts and volume. Quoted spreads are negatively related to the number of shareholders. As for depth, only changes in volume are related to changes in depth. Furthermore, all three of these variables are related to the adverse selection component of the spread in a manner consistent with their relation to quoted spreads. We observe no relation to order processing costs. In general, increases in all three of these variables are associated with improved liquidity, and the benefits appear to be related to reductions in adverse selection.

Looking at operating characteristics, we find that increased firm size reduces spreads and increases depth. An increase in size also reduces the adverse selection component of the spread but, unexpectedly, is positively related to order processing costs. An increase in the volatility of returns is associated with an increase in spreads, a reduction in depth, and an increase in adverse selection. None of the other operating variables is significant with the exception of the indicator that stock was included and the indicator for diversifying mergers. When stock is included, we observe an increase, on average, in quoted depth but no relation to other liquidity measures. For diversifying mergers, we observe an improvement in the Kyle measure of depth, though the effect is just barely significant (9% level). Again, there is no relation to other liquidity measures. In general, the results suggest that size and volatility matter to liquidity, but the limited evidence on the other variables suggests that the effect on liquidity is negligible.

Looking at the control variables, we find that the change in price has the expected sign—an increase in price is associated with higher spreads and lower depth. We note that there is a significantly larger average decline in spreads for Nasdaq bidders and the reduction

[22]The structural model that decomposes spreads also generates an estimate of the quoted and effective spreads based on that model. Results for regressions using the estimated quoted and effective spread from this model are similar to those for quoted and effective spreads measured directly.

appears to be related to order processing costs. There is also a reduction, on average, in quoted depth for Nasdaq firms. We examine Nasdaq firms separately in the next set of regressions.

Finally, we note that the intercepts for all the liquidity measures are not significantly different from zero. Thus, the changes in the firm characteristics we have included in our analysis fully explain the average changes in liquidity documented earlier. There is no separate effect from mergers or acquisitions beyond what is suggested by prior research on liquidity determinants.

Table 6 presents the multivariate analysis for only Nasdaq firms. There are two reasons for this analysis. First, the number of market makers is only available for Nasdaq firms since on the NYSE the analogous function is filled by a specialist (one for each stock) and an unrecorded and varying number of floor brokers. Second, the significant coefficient on the Nasdaq indicator in the prior regression suggests that Nasdaq bidder spreads typically decline with a merger or acquisition. This may be a unique characteristic of Nasdaq events or it may reflect the fact that coefficients in our regressions differ across NYSE and Nasdaq firms. In the latter case, a regression for just Nasdaq bidders would allow the coefficients to vary. It is possible, therefore, that there is no Nasdaq effect (the intercept of the regression would not be reliably different from zero in a Nasdaq regression) and that changes in firm characteristics can fully explain changes in liquidity for Nasdaq bidders.

Looking at the effect of increased market makers, the principal question addressed in this regression, we see that an increase in the number of market makers is associated with a reduction in quoted and effective spreads. More interestingly, we see that the increase is also negatively related to the magnitude of the order processing component of the spread but not related to adverse selection. This suggests that an increase in the number of market makers leads to greater competition and more dissipation of market maker profits. Once again, the effect of increased market making is observed even when we account for an increase in the number of analysts, the number of shareholders, and firm size.

We also find that there is no unexplained reduction in spreads for Nasdaq bidders—the intercepts are not significantly different from zero in these regressions. We do, however, observe an increase in the Kyle measure, which suggests lower depth, and a reduction in order processing costs. However, these effects seem to be sufficiently weak that they do not affect spreads. Results for other variables are similar to the full sample with the exception of the relation between spreads and the number of shareholders, which is insignificant (the p-value is 10.1%), and the relation between adverse selection and the changes in the number of both analysts and shareholders. Note that the sample of Nasdaq bidders is about half the size of the full sample so that power is lower and this may explain the weaker results, especially for the adverse selection component of the spread.

Taken together, the multivariate analysis suggests that changes in firm characteristics affect liquidity. In particular, the evidence suggests that firms benefit from any increase in analysts, shareholders, volume, firm size, and market makers. Changes in firm diversification, on the other hand, have no effect on liquidity nor does the merger process appear to reveal information that would affect liquidity.

5. Summary and conclusions

We examine the relation between firm characteristics and liquidity by examining mergers and acquisitions. In particular, we examine the relation between individual changes in firm

characteristics and the resulting changes in liquidity. This provides an analysis that implicitly controls for firm characteristics that might lead to omitted variable biases in cross-sectional studies. This approach also allows us to consider multiple relations simultaneously.

We find beneficial effects from increases in analyst following, breadth of ownership, volume, firm size and market making. Whereas prior studies of analyst following provide evidence on what drives the relation by linking analyst following to a beneficial reduction in adverse selection, we contribute analogous evidence for other firm characteristics. For example, an increase in the number of shareholders appears to reduce adverse selection costs, not the costs to liquidity providers from processing orders. Most notably, we find that increased market making reduces order processing costs, suggesting that the benefits are related to reduced rents as a result of increased competition.

We find little evidence that the degree of firm diversification affects liquidity. This result is of particular importance since prior studies of diversification are far from agreement on its impact. Our analysis also fills a notable gap in this regard since a number of diversification studies have examined stock breakups, which typically reduce firm size and may substantially increase firm focus. Mergers have not been examined in this respect but are essentially the same transformation in reverse—they typically increase firm size and may substantially increase firm diversification.

Finally, we note that mergers and acquisitions improve liquidity, on average, but that the improvements are fully explained by the accompanying changes in firm characteristics. Thus, a merger or acquisition, in and of itself, will not permanently change firm liquidity—it is the characteristics of the accompanying transformation that matter.

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