Co-Movements in Bid–Ask Spreads and Market Depth

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Quoted spreads, quoted depth, and effective spreads move together with market- and industrywide liquidity. After controlling for well-known individual liquidity determinants, such as volatility, volume, and price, we found that common influences remain significant and material. For well-diversified size-based portfolios, more than half the variation in quoted spreads is explained by variations in market average trading costs. Daily movements in the average depth of the market explain more than 80 percent of depth variations in size-based portfolios.

When portfolios turn over frequently, transaction expenses can accumulate to produce a relatively large decrement in total return. Because money managers often trade several securities simultaneously, knowing whether trading costs are correlated among securities is important to them. Yet, research on trading costs has focused almost exclusively on individual securities. Typically, analysts do not think of illiquidity in a marketwide context, and the classic models of market microstructure involve a dealer in a single stock who provides immediacy at a cost that arises from inventory-holding risk (Stoll 1978) or because of the specter of trading with an investor with superior information (Glosten and Milgrom 1985). Empirical work also deals solely with the trading patterns of individual assets, most often equities sampled at high frequencies (see, for example, Wood, McInish, and Ord 1985).

We propose that illiquidity-induced trading costs should be correlated among securities for a variety of reasons. For example, if trading volume exhibits correlated changes in response to broad market movements, this pattern should induce a correlation in liquidity costs. Similarly, the cost of holding inventory could be correlated among securities because it depends, in part, on market interest rates. Also, the asymmetrical information view of the spread suggests that the imminent revelation of various types of information that is pertinent for most companies in an industry sector could influence the liquidity of several securities simultaneously.

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Sudden changes in systemwide liquidity appear to have been important in some well-known financial episodes. The international stock market crash of October 1987, for example, was associated with no identifiable major news event (see Roll 1988) but was characterized by a temporary reduction in liquidity. And during the summer of 1998, a liquidity crisis appears to have simultaneously affected several mid- to low-grade bonds. This crisis, in turn, seems to have precipitated financial distress in certain highly levered trading firms.[1]

We discuss the data we used to analyze whether trading costs are correlated among securities, present our findings that industry liquidity provides explanatory power over and above standard cross-sectional determinants of liquidity, and document that trading costs for size-based portfolios have a strong market component.

Data

We obtained transaction data for NYSE stocks from the Institute for the Study of Securities Markets for the most recently available calendar year (1992). To be included in the sample, a stock had to be continuously listed throughout 1992 on the NYSE and had to have traded at least once on at least 10 of the 254 trading days that year.

We deleted assets in the following categories: certificates, American Depositary Receipts, shares of beneficial interest, units, companies incorporated outside the United States, Americus Trust components, closed-end funds, and real estate investment trusts. To avoid price-scaling problems in interpreting bid–ask spreads, we excluded stocks if they split or paid a stock dividend during the year. We were left with 1,169 securities. To remove any undue influence of the minimum tick size, we deleted a stock on a day its average price fell below $2. Opening batch trades and transactions with special settlement conditions were excluded because they differ from normal trades and might be subject to distinct liquidity considerations. For obvious reasons, transactions reported out of sequence or after closing were not used.

For every transaction, we computed the following five liquidity measures: quoted spread (*QSPR*), proportional quoted spread (*PQSPR*), depth (*DEP*), effective spread (*ESPR*), and proportional effective spread (*PESPR*). These variables are defined in **Table 1**. We averaged each liquidity measure across all daily trades for each stock.

Table 1. Definitions of Liquidity Variables

Liquidity Measure	Acronym	Definition	Units
Quoted spread	*QSPR*	$P_A - P_B$	U.S. dollars
Proportional quoted spread	*PQSPR*	$(P_A - P_B)/P_M$	None
Depth	*DEP*	$½(Q_A - Q_B)$	Shares
Effective spread	*ESPR*	$2\,\lvert P_t - P_M \rvert$	U.S. dollars
Proportional effective spread	*PESPR*	$2\,\lvert P_t - P_M \rvert / P_t$	None

Note: P denotes price, and the subscripts are as follows: t = actual transaction, A = ask, B = bid, and M = bid–ask midpoint. Q denotes the quantity guaranteed available for trade at the quotes. Thus, P_A and P_B denote, respectively, the specialist's ask and bid quotes guaranteed valid for Q_A and Q_B shares; $P_M \equiv ½(P_A + P_B)$ denotes the quote midpoint, and P_t is the actual transaction price at time t.

The next series of tables present our findings for the liquidity variables. **Table 2** presents descriptive statistics for the five liquidity measures. We found that, consistent with intuition, the effective spread was somewhat smaller than the quoted spread, reflecting trades within the posted quotes. **Table 3** shows that all the measures of spread were positively correlated with each other and negatively correlated with depth.

Table 2. Liquidity Variables: Cross-Sectional Statistics for Time-Series Means, 1992

Variable	Mean	Median	Standard Deviation
QSPR	0.3162	0.2691	1.3570
PQSPR	0.0160	0.0115	0.0136
DEP	3,776	2,661	3,790
ESPR	0.2245	0.1791	1.3051
PESPR	0.0111	0.0077	0.0132

Table 3. Cross-Sectional Means of Time-Series Correlations between Liquidity Measure Pairs for an Individual Stock, 1992

	QSPR	*PQSPR*	*DEP*	*ESPR*
PQSPR	0.844			
DEP	–0.396	–0.303		
ESPR	0.665	0.549	–0.228	
PESPR	0.555	0.699	–0.156	0.871

Table 4 contains descriptive statistics about daily percentage changes in the liquidity variables. The time-series/cross-sectional mean of the absolute value of the percentage change in the quoted spread is high—about 24 percent a day. Depth is far more volatile than spread.

Table 4. Absolute Daily Proportional Changes in Liquidity Variables, 1992
(cross-sectional statistics for time-series means)

Liquidity Variable	Mean	Median	Standard Deviation
|*DQSPR*|	0.2396	0.2373	0.0741
|*DPQSPR*|	0.2408	0.2386	0.0742
|*DDEP*|	0.7828	0.6543	0.4533
|*DESPR*|	0.3148	0.2976	0.1367
|*DPESPR*|	0.3196	0.2977	0.1811

Note: "D" preceding the acronym (e.g., *DQSPR*) denotes a proportional change in the variable across successive trading days; that is, for liquidity measure L, $DL_t \equiv (L_t - L_{t-1})/L_{t-1}$ for trading day t and $\lvert DL_t \rvert$ denotes the absolute value of the daily proportional change.

Cross-Sectional Commonality in Liquidity Measures

Previous research has found that individual-stock trading volume, volatility, and price are significant determinants of liquidity in the cross-section (see, for example, Benston and Hagerman 1974). Greater dollar volume for a stock reduces the likelihood that inventory of the stock will have to be carried for a long time, which should decrease spreads and increase depth. Individual-stock volatility, which increases the risk of holding inventory, should have the opposite effect. Furthermore, if informed traders earn greater profits in the more volatile stocks, spreads should be set higher in such stocks. The price level induces a simple scale factor; higher priced stocks should have higher spreads to normalize the per dollar cost of trading securities with different price levels.

Table 5 presents the results from a daily cross-sectional regression of the liquidity variables on individual-stock volatility, price, and trading volume. It also documents the marginal effect of the commonality proxy—industry liquidity.[2] As expected, individual volume (volatility) had a negative (positive) influence on spreads and the opposite influence on depth. The impacts were large and highly significant for all five liquidity constructs. Also, as anticipated, price and spread level were positively related, whereas depth fell with price. These results are consistent with those found in previous research. Most important, however, industry liquidity retained a strong influence on individual stock liquidity, even after accounting for volatility, volume, and price. All coefficients are positive and significant. Industry commonality is indeed an important characteristic of liquidity.

Measures of Commonality in Portfolio Liquidity

In the previous section, we documented that commonality contributes additional cross-sectional explanatory power for liquidity over such individual stock attributes as trading volume, volatility, and price level. Here, we report evidence of empirical covariation between portfolio liquidity and marketwide liquidity. Our findings are relevant for investment managers who turn over their holdings frequently because they provide evidence of covariation in liquidity measures for size-based portfolios.

We first divided the sample into size quintiles based on market capitalizations at the end of 1991. Then, we calculated an equal-weighted average of each liquidity measure for each quintile on every trading day during 1992. The daily change from trading day $t-1$ to trading day t was our portfolio construct.

Table 6 reports regressions of each daily liquidity change on a marketwide equal-weighted liquidity change for all stocks *not* in the subject quintile. The percentage proportional quoted spreads (*DPQSPR*) and depth (*DDEP*) were found to have average R^2s of about 55 percent and 81 percent, respectively. Effective spreads, however, exhibited only modest explanatory power; the R^2s are below 4 percent. We are puzzled by the low explanatory power for the effective spread (*DESPR*) regressions; we speculate that the reason is noise in the effective spread measures that may come from using the midpoints of stale quotes to calculate these quantities.

Table 5. Individual Liquidity Determinants and Industry Commonality, 1992 (t-statistics in parentheses)

Cross-Sectional Variable	*QSPR*	*PQSPR*	*DEP*	*ESPR*	*PESPR*
STD	0.1268	0.1171	–0.1372	0.1295	0.1218
	(45.41)	(35.54)	(–17.45)	(32.49)	(27.98)
PRICE	0.3738	–0.6215	–0.9010	0.3296	–0.6669
	(108.8)	(–164.8)	(–103.2)	(54.96)	(–101.9)
DVOL	–0.0669	–0.0670	0.4127	–0.0523	–0.0525
	(–33.17)	(–33.99)	(129.4)	(–42.06)	(–43.23)
INDUSTRY	0.3333	0.1871	0.2737	0.2428	0.1413
	(30.75)	(29.49)	(13.11)	(29.63)	(30.36)
R^2 mean	0.290	0.810	0.432	0.216	0.735
R^2 median	0.288	0.806	0.422	0.208	0.733

Note: Individual stock liquidity measures (levels) were regressed cross-sectionally each trading day on the standard deviation of individual daily returns from the preceding calendar month (*STD*), the concurrent day's mean price level (*PRICE*), the day's dollar trading volume (*DVOL*), and an equally weighted liquidity measure of all stocks in the same industry (*INDUSTRY*). This approach is similar to the Fama and Macbeth (1973) method for returns. The *INDUSTRY* observation corresponding to an individual stock excluded that stock. Natural logarithmic transformations were used for all variables. Cross-sectional coefficients were then averaged across the 254 trading days in the sample. The R^2 was adjusted; the t-statistics were corrected for first-order autocorrelation.

Table 6. Portfolio Commonality in Liquidity by Size Quintile, 1992
(*t*-statistics in parentheses)

Market Liquidity Variable	Smallest (*N* = 233)	2 (*N* = 234)	3 (*N* = 234)	4 (*N* = 234)	Largest (*N* = 234)
DQSPR (system-weighted R^2 = 0.152)					
Concurrent	0.185	0.187	0.223	0.231	3.940
	(6.05)	(4.87)	(6.82)	(6.58)	(7.66)
Lag	0.018	0.052	0.075	0.023	–0.651
	(0.62)	(1.46)	(2.48)	(0.71)	(–1.27)
Lead	0.020	0.010	0.030	0.058	–0.130
	(0.72)	(0.29)	(0.98)	(1.79)	(–0.25)
DPQSPR (system-weighted R^2 = 0.552)					
Concurrent	0.739	0.763	0.843	0.769	1.829
	(12.21)	(10.35)	(12.93)	(11.74)	(8.38)
Lag	–0.037	0.043	0.275	0.131	–0.316
	(–0.64)	(0.61)	(4.42)	(2.09)	(–1.46)
Lead	0.023	0.018	0.088	0.245	–0.343
	(0.40)	(0.25)	(1.42)	(3.93)	(–1.61)
DDEP (system-weighted R^2 = 0.811)					
Concurrent	0.637	0.835	1.062	1.110	1.013
	(9.47)	(12.35)	(19.22)	(19.77)	(17.59)
Lag	–0.080	0.208	0.028	–0.002	–0.034
	(–1.16)	(3.06)	(0.50)	(–0.03)	(–0.57)
Lead	–0.098	–0.037	0.015	0.044	0.143
	(–1.43)	(–0.55)	(0.27)	(0.77)	(2.41)
DESPR (system weighted R^2 = 0.036)					
Concurrent	0.015	0.003	0.016	0.033	2.477
	(0.70)	(0.27)	(1.47)	(3.08)	(1.84)
Lag	0.006	0.010	–0.003	–0.016	0.781
	(0.28)	(0.89)	(0.32)	(–1.54)	(0.61)
Lead	0.019	–0.000	0.015	–0.006	–0.611
	(0.94)	(–0.00)	(1.42)	(–0.59)	(–0.46)
DPESPR (system weighted R^2 = 0.039)					
Concurrent	0.020	0.011	0.026	0.033	5.280
	(1.13)	(0.91)	(1.79)	(2.49)	(1.82)
Lag	0.015	0.021	–0.002	–0.014	1.631
	(0.87)	(1.82)	(–0.14)	(–1.06)	(0.61)
Lead	0.010	–0.007	0.009	0.011	1.802
	(0.57)	(–0.59)	(0.66)	(0.86)	(0.66)

Note: Daily observations = 253. Daily proportional changes in each quintile's liquidity measure were regressed in time series on proportional changes in the equal-weighted liquidity measure for all stocks in the sample (the "market"). Market averages excluded the quintile-dependent variable. To allow for error correlations across quintiles, the system was estimated as a set of seemingly unrelated regressions. The lead, lag, and concurrent values of the equal-weighted market returns, the proportional change in the equally weighted squared portfolio return (a measure of change in return volatility), were additional regressors; coefficients are not reported.

Overall, the results in Table 6 indicate that simultaneous trades of several securities are likely to incur correlated trading costs. Furthermore, the trading costs of broadly diversified portfolio managers are likely to move together significantly through time. The results also suggest that the risks of unexpected changes in average liquidity contain a strong market component.

Conclusion

Even after accounting for well-known individual determinants of liquidity—such as trading volume, volatility, and price—commonality is a pervasive feature of liquidity. The liquidity of size-based portfolios covaries significantly with marketwide liquidity.

In continuing work (see Chordia, Roll, and Subrahmanyam 2000b), we are exploring the specific factors that cause liquidity to covary across securities. Co-movements in liquidity suggest that transaction expenses might be better managed with appropriate timing. Thus, our results indicate that a strategy of trading when average portfolio spreads are low can allow for increased portfolio turnover without compromising portfolio return performance.

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Notes

1. An article in the *Wall Street Journal* (1998) stated, "Illiquidity means it has become more difficult to buy or sell a given amount of any bond but the most popular Treasury issue. The spread between prices at which investors will buy and sell has widened, and the amounts in which Wall Street firms deal have shrunk across the board for investment grade, high-yield (or junk), emerging market and asset-backed bonds. . . . The sharp reduction in liquidity has preoccupied the Fed [U.S. Federal Reserve] because it is the lifeblood of markets."
2. The industry classifications follow Chalmers and Kadlec (1998). For more details, see Chordia, Roll, and Subrahmanyam (2000a).

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