

Commonality in Liquidity: A Global Perspective*

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Abstract:

We conduct the first comprehensive study of commonality in liquidity using intraday spread and depth data from 47 stock exchanges. We show that commonality is a widespread, global phenomenon. Firm-level changes in spreads and depths are significantly influenced by exchange-wide changes in liquidity on the majority of the world's stock exchanges. Emerging Asian exchanges have exceptionally strong commonality, while those of Latin America exhibit little if any commonality. In contrast to previous NYSE-based results, we find that commonality in bid-ask spreads is most prevalent among small firms while commonality in depths increases monotonically with firm size. After documenting the pervasive role of commonality *within* individual exchanges, we examine commonality *across* exchanges. We extend the empirical model of Chordia, Roll, and Subrahmanyam (2000) and find the first empirical evidence of a distinct, global component in bid-ask spreads and depths. Changes in global spreads and depths have a significant effect on changes in liquidity at the exchange level. We show that while exchange size (total market capitalization) plays an influential role in the liquidity transmission process, global commonality is not driven by a subset of large exchanges.

JEL Classification: G10, G15

Keywords: Liquidity, Commonality, Bid-Ask Spreads, Depths

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1. Introduction

Commonality in liquidity refers to the impact of a common or market-wide liquidity factor on an individual firm, both in terms of bid-ask spreads and depths. Previous empirical research has shown that there exists a significant common component that influences firm-level liquidity. Simply stated, liquidity is subject to a spillover effect that influences other firms trading in the same market. Although there is some evidence of commonality on non-US exchanges (Fabre and Frino (2004) and Brockman and Chung (2002)), most previous studies investigate firms trading in the US (Chordia, Roll, and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001)). But regardless of the particular market investigated, all previous studies using intraday bid-ask spreads and depths are single-exchange studies. The purpose of our paper is twofold. First, we conduct a comprehensive investigation of commonality in liquidity for 47 stock exchanges using intraday spread and depth data. Second, we examine the impact of a global liquidity factor on spread and depth commonality at the level of the exchange. The size, scope, and cross-sectional variation of our database allow us to analyze several aspects of commonality that previous, single-exchange studies could not address.

It is important to understand secondary-market liquidity because of the various roles it plays in the capital markets. Liquidity encourages trading by reducing transaction costs. A market participant's ability to capture potential gains of trade depends directly on liquidity levels. There is an economic welfare benefit from liquid markets because trading is the mechanism through which information is impounded into prices. More

informative prices lead to more efficient allocations of capital across competing investments (Wurgler (2000)). Liquidity also plays a significant role in determining the firm's cost of capital. The more liquid the firm's stock, the lower the cost of capital (Amihud and Mendelson (1986), Brennan and Subrahmanyam (1996), Datar, Naik, and Radcliffe (1998), and Easley, Hvidkjaer, and O'Hara (2002)); and the lower the firm's cost of capital, the higher the market capitalization. For all of these reasons, there is considerable interest among managers, investors, exchange members, and regulators in understanding the determinants of secondary-market liquidity.

Most of the early liquidity studies analyze firm-specific determinants of liquidity. This line of research has shown that variations in price, volume, and volatility explain much of the cross-sectional variation in bid-ask spreads (Benston and Hagerman (1974), Stoll (1978), Barclay and Smith (1988), Franz, Rao, and Tripathy (1995), and Noronha, Sarin, and Saudagaran (1996)) and depths (Brockman and Chung (1999)). More recent research focuses on the common components of firm liquidity (i.e., changes in firm-level bid-ask spreads and depths caused by changes in market-level spreads and depths). This line of research has shown that individual firm liquidity is sensitive to changes in aggregate liquidity movements (Chordia, Roll, and Subrahmanyam (2000), Coughenour and Saad (2004), and Chordia, Sarkar, and Subrahmanyam (2005)). One implication of these findings is that sensitivity to aggregate liquidity movements might represent a systematic risk factor (Pastor and Stambaugh (2003), Acharya and Pedersen (2005), and Stahel (2003)).

Over the past three decades, capital markets have become increasingly globalized because of lower information technology costs and a movement toward deregulation and

free trade on the part of national governments. Concomitant with globalized capital movements are globalized liquidity movements. Commenting on these global movements, Peter Weinberg, former chief executive officer of Goldman Sachs International (2006), states that “liquidity and the movement of capital around the world have become so ubiquitous and pervasive that it is hard to know where London or New York begins and where Tokyo, Shanghai or Hong Kong leaves off.” A primary objective of our study is to examine the relation between liquidity changes in London or New York, for instance, and liquidity movements in Tokyo, Shanghai, Hong Kong, and the rest of the world.

To date, our knowledge of spread and depth co-movements is limited to empirical evidence from only a handful of individual stock exchanges (US, Hong Kong, and Australia).¹ This limitation means that many important questions remain unanswered. Is commonality in spreads and depths widespread across the world’s stock exchanges? Is commonality a more serious problem for emerging or developed markets? Does firm size or industry play a significant role in transmitting liquidity shocks across firms? Is there a global component to commonality in liquidity? We address these and related questions by accessing a global Bloomberg database that encompasses 1.47 billion transactions across 47 stock exchanges, 38 countries, and the six major regions as defined by Morgan Stanley Capital International (MSCI).

We divide our empirical investigation into two main sections. In the first section, we use the methodology of Chordia, Roll, and Subrahmanyam (2000) to measure

¹ Stahel (2003) uses monthly returns and turnover to investigate co-movement among the US, Japanese, and the UK stock markets. Stahel (2005) uses a weekly illiquidity measure to examine liquidity across 18 developed and emerging markets. No previous study, however, analyzes global commonality in bid-ask spreads or depths.

commonality in spreads and depths for each of our 47 stock exchanges. Our results verify that exchange-level commonality is a pervasive phenomenon across the globe. On most, but not all, exchanges individual firms' spreads and depths are significantly influenced by changes in the aggregate market's spreads and depths. Although most exchanges have a significant commonality component, there are also large cross-sectional variations among exchanges and geographic regions. The stock exchanges of Emerging Asia, for example, exhibit the strongest commonality in spreads, while the exchanges of North America have the strongest commonality in depths. Latin American stock exchanges exhibit very little commonality at the exchange level.

We also investigate the roles of firm size and industry within each of our exchanges. In contrast to Chordia, Roll, and Subrahmanyam's (2000) NYSE-based results, we find that commonality in bid-ask spreads is most prevalent among smaller firms. Depth commonality, on the other hand, exhibits a positive relation with firm size. Our industry results show that while commonality is significant in each of our ten global industries, there is considerable variation across industries. The Utilities industry, for example, is much less susceptible to commonality in spreads than the Consumer Cyclical industry. Comparing our global results to Chordia, Roll, and Subrahmanyam's (2000) NYSE findings, we find that the industry effect is much more prominent for NYSE firms than for the typical global firm.

Our global evidence shows definitively that commonality in liquidity is widespread *within* individual stock exchanges. In our second section, we examine the possible existence of commonality in liquidity *across* stock exchanges. Is exchange-level liquidity influenced by regional or global liquidity movements? Does the sensitivity of

exchange-level liquidity to global commonality depend on the size of the exchange? Are emerging markets more or less susceptible to global commonality than developed markets? To answer these and related questions, we extend the empirical model of Chordia, Roll, and Subrahmanyam (2000) in order to measure the impact of changes in global liquidity on changes in aggregate exchange-level liquidity. To the best of our knowledge, no previous study has examined global commonality in spreads and depths.

Our empirical tests generate several new findings. We find unambiguous support for the hypothesis that commonality in liquidity spills across national borders.

Movements in aggregate bid-ask spreads and depths on an individual exchange are significantly influenced by movements in spreads and depths at the global scale. We show that both developed and emerging markets are susceptible to global commonality, although developed markets are more sensitive to liquidity spillover effects than emerging markets. We also show that global commonality is not driven solely by regional co-movements. For developed markets, a larger portion of spread and depth commonality is attributable to regional as opposed to global (i.e., non-regional) sources. For emerging markets, the global source dominates the regional source. Finally, we show that the total market capitalization of the exchange plays a significant role in the liquidity transmission process.

In summary, our results verify that neither firm- nor exchange-level liquidity can be understood in isolation. Individual firm liquidity is significantly influenced by co-movements in the liquidity of all other firms traded on the same exchange. This result is widespread across most exchanges in the world. In a parallel manner, exchange-level liquidity is significantly influenced by co-movements in the global liquidity of all other

exchanges. This global commonality result holds even in the absence of the large, influential exchanges located in New York, London, and Tokyo.

In the next section, we discuss our database and method of analysis. In section three, we present and interpret our empirical findings. In section four, we summarize and conclude our study.

2. Data and Method of Analysis

We obtain trade and quote data from the Bloomberg financial information network. Bloomberg receives real-time bid and ask quotes and transaction data for stocks traded on global markets through a live feed directly from the exchanges. Intra-day data on the US exchanges, not available from Bloomberg due to data licensing restrictions, are obtained from the NYSE's Trade and Quote (TAQ) database. We compile intra-day bid-ask spread and depth measures over a 21-month period from October 1, 2002 to June 30, 2004 (i.e., 455 trading days). We require a minimum of 200 days with at least one trade during the sample period in order to eliminate inactively traded firms. Firms with market capitalization less than \$100 million and exchanges with less than ten sample firms are also excluded from our analysis. Our final sample contains 1.47 billion transactions across 47 stock exchanges, 38 countries, and the six major regions as defined by MSCI.² After calculating daily averages, we have 3,838,241 daily observations representing the number of firm-days with trades for all of our 9,427 firms.

² These 1.47 billion transactions are extracted from roughly 15 billion quote and trade observations over our 21-month sample period.

2.1. Descriptive Statistics

We present descriptive statistics for our global database in Table 1. We report the exchange, country, MSCI region, number of firms, total market capitalization, average dollar trading volume, average number of trades, percentage of days with trades, average relative effective spreads, and average dollar value depths.³ All averages are calculated on a per firm, per day basis. The developed-market group includes 16 European exchanges, four North American exchanges, and seven Pacific exchanges; the emerging-market group includes 11 Asian exchanges, four European, Middle Eastern, and African exchanges, and five Latin American exchanges.

Our descriptive statistics reveal considerable cross-sectional variation both within the six regions and (especially) across these regions. The number of actively traded firms varies from a low of 13 for the Budapest and Lima Stock Exchanges to a high of 1,515 for Nasdaq; total market capitalization ranges from \$6.8 billion for Korea's KOSDAQ to \$9,092.1 billion for the NYSE; average trading volume ranges from \$5.6 thousand on the Istanbul Stock Exchange to \$50,596.3 thousand on Switzerland's Virt-X; and the average number of daily trades varies from four on the Johannesburg Stock Exchange to 1,697 on KOSDAQ. Most exchanges have a large percent of days with active trades.

In the last two columns of Table 1, we report average relative effective spreads and average dollar depths. We define relative effective spreads as twice the absolute value of the transaction price deviation from the bid-ask midpoint, divided by the bid-ask midpoint. We define dollar depths (or depth in value) as the number of shares at the bid

³ We convert local currency amounts into US dollars using the daily historical spot exchange rates obtained from Bloomberg.

and ask prices multiplied by their corresponding prices (in US dollar terms).⁴ Over half of the exchanges in our sample have relative spreads that are less than one percent of the bid-ask midpoint. Only three stock exchanges (Jakarta, Sao Paulo, and Lima) have relative spreads that exceed two percent. Of the nine exchanges with relative spreads less than 0.5 percent, seven are located in Asia (Shanghai, Shenzhen, Bombay, National Stock Exchange of India, Tokyo, KOSDAQ, and the Korea Exchange), one in Europe (Virt-X), and one in North America (NYSE). Our dollar depth figures vary from a low of \$523 for the Istanbul Stock Exchange to \$827,649 for the electronic Virt-X.⁵

2.2. Method of Analysis

In the first section of our analysis, we apply the methodology of Chordia, Roll, and Subrahmanyam (2000) to our 47 stock exchanges. For each exchange, we test for commonality in liquidity using the following firm-by-firm time series regression:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t} \quad (1)$$

where $Liquidity_{F,t}$ is measured by either $Spread_{F,t}$ or $Depth_{F,t}$. $Spread_{F,t}$ is the average of intra-day relative effective bid-ask spreads for firm F on day t . Similarly, $Depth_{F,t}$ is the average of intra-day dollar depths for firm F on day t . $Volatility_{F,t}$ is the return volatility for firm F on trading day t and is measured as the average squared return. $Liquidity_{E,t}$ is an equal-weighted average of each corresponding liquidity measure for all firms trading

⁴ In addition to relative effective bid-ask spreads, we also test for commonality in liquidity using (1) effective spreads, (2) quoted spreads, and (3) relative quoted spreads. In addition to dollar depths, we also test for commonality using share depths. Our conclusions are unchanged by these alternative definitions of liquidity.

⁵ Our Bloomberg database does not include depth figures for two exchanges: the New Zealand Exchange and the London Stock Exchange.

on the same stock market.⁶ $Return_{E,t}$ is the equal-weighted average of the daily return for all firms trading on the same stock market. All dependent and independent variables are expressed in terms of proportional changes (denoted as Δ) in the variable across successive trading days. All exchange averages exclude the dependent-variable firm; that is, $Liquidity_{E,t}$ and $Return_{E,t}$ are calculated using all firms on the exchange except firm F . Our primary variable of interest is the contemporaneous coefficient on $\Delta Liquidity_{E,t}$ (i.e., β_1). A positive and significant β_1 would mean that exchange-level liquidity changes exert a substantial influence on firm F 's liquidity.

We also test for industry-wide commonality at the exchange level by using the following regression model:

$$\begin{aligned} \Delta Liquidity_{F,t} = & \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \\ & \gamma_1 \Delta Liquidity_{EI,t} + \gamma_2 \Delta Liquidity_{EI,t+1} + \gamma_3 \Delta Liquidity_{EI,t-1} + \\ & \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t} \end{aligned} \quad (2)$$

where $Liquidity_{EI,t}$ (i.e., exchange-level industry liquidity) is the equally-weighted average of the respective liquidity measure for all firms in the industry. All other variables are the same as defined above in model (1). Our primary variable of interest in regression model (2) is the contemporaneous coefficient on $\Delta Liquidity_{EI,t}$.

In the second section of our analysis, we extend the methodology of Chordia, Roll, and Subrahmanyam (2000) to capture the influence of global commonality on exchange-level liquidity. We test for a global commonality influence on exchange-level liquidity by estimating the following time series regression:

⁶ It is possible to use an equally-weighted average or a value-weighted average in constructing the market average. Although we report the equally-weighted results in subsequent sections, re-running our analysis using value-weighted averages does not alter our conclusions.

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t} \quad (3)$$

where $Liquidity_{G,t}$ and $Return_{G,t}$ are equal-weighted averages across all firms in our global database, except those firms trading on exchange E . The primary variable of interest in regression model (3) is the contemporaneous coefficient on $\Delta Liquidity_{G,t}$. A positive and significant β_1 would mean that global liquidity changes (excluding exchange E) exert a substantial influence on exchange E 's liquidity.

And finally, we test for regional effects in liquidity using the following regression model:

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \gamma_1 \Delta Liquidity_{R,t} + \gamma_2 \Delta Liquidity_{R,t+1} + \gamma_3 \Delta Liquidity_{R,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t} \quad (4)$$

where $Liquidity_{R,t}$ (i.e., regional liquidity) is the regional liquidity index computed on day t using an equal-weighted average of each corresponding liquidity measure for all firms trading on an exchange located in the same MSCI region as exchange E . All other variables are the same as defined above. Similar to regression (2) where we distinguish industry from exchange effects, regression (4) allows us to differentiate regional from global commonality influences.

In summary, our research method is designed to capture not only the existence of commonality in liquidity at various levels but also to identify the source of that commonality. We test for global commonality in exchange-level liquidity after eliminating all exchange-related commonality. The results of this analysis will provide answers to the unresolved issues discussed above. We turn next to these empirical results.

3. Empirical Results

We divide our empirical findings into two main sections. The first section investigates the pervasiveness of co-movements in liquidity by estimating Chordia, Roll, and Subrahmanyam's (2000) commonality measures for each of our 47 exchanges (regression models (1) and (2)). The second section examines commonality in liquidity at the global scale. We estimate global and regional commonality measures for aggregate exchange-level liquidity (regression models (3) and (4)). In both sections, we investigate the influence of size and industry on commonality.

3.1. Exchange-Level Commonality

In Table 2, we report the following relative effective bid-ask spread results for each of our 47 stock exchanges: average and median contemporaneous liquidity coefficients from regression model (1); the percent of firms with positive and significant coefficients, positive and insignificant coefficients, negative and insignificant coefficients, negative and significant coefficients; median sum of lead, lag, and contemporaneous coefficients; and the p -value of this sum. Unless otherwise stated, we use a significance level of five percent to differentiate significant from insignificant results.

Our findings in Table 2 provide strong support for the postulation that changes in the individual firm's bid-ask spreads are significantly influenced by a common (exchange-wide) liquidity factor. These results confirm that commonality in liquidity is ubiquitous across the world's stock exchanges. Forty-three of the 47 exchanges have a positive average contemporaneous coefficient, and 46 of the 47 exchanges have a

positive median coefficient.⁷ Forty-four exchanges have positive and significant coefficients that exceed the null hypothesis of five percent, 33 exchanges have ten percent or more of their firms with positive and significant coefficients, and 23 exchanges have 20 percent or more of their firms with positive and significant coefficients.⁸

Turning to the percent of firms with negative and significant contemporaneous coefficients, we find that only four exchanges (Vienna, Jakarta, Budapest, and Buenos Aires) exceed the null hypothesis of five percent. The Buenos Aires Stock Exchange is the only exchange with 10 percent or more of its firms (10.53%) exhibiting negative and significant coefficients. In addition to the asymmetry in significant coefficients, there is also a strong positive skewness in the percent of firms with insignificant coefficients. All exchanges but one (Santiago) have a higher proportion of firms with positive and insignificant coefficients relative to negative and significant coefficients. For well over half of the exchanges, the percent of firms with positive and insignificant coefficients is more than double the percent of firms with negative and insignificant coefficients.

The median values for the sum of lead, lag, and contemporaneous coefficients are overwhelmingly positive. The Santiago Stock Exchange is the only exchange with a negative median value (-0.1415), and it is insignificant at the five percent level (p -value = 0.222). Twenty-nine of the 46 exchanges with positive combined (SUM) coefficients are statistically significant at the five percent level, with 26 exchanges significant at the one percent level.

⁷ The four exchanges with negative average coefficients include the Stock Exchange of Thailand, Buenos Aires Stock Exchange, Sao Paulo Stock Exchange, and Santiago Stock Exchange. The only exchange with a negative median coefficient is the Santiago Stock Exchange.

⁸ The Budapest Stock Exchange, Santiago Stock Exchange, and JASDAQ are the only three exchanges on which less than five percent of firms have positive and significant contemporaneous coefficients.

Our global data and research design also enable us to identify cross-sectional differences in spread commonality across stock exchanges. Median contemporaneous coefficients range from a low of -0.1123 for the Santiago Stock Exchange to a high of 1.1251 for the London Stock Exchange. Besides London, there are eight other exchanges with contemporaneous coefficients greater than 0.50; these include the stock exchanges of Toronto, Nasdaq, Tokyo, Shanghai, Shenzhen, Bombay, Taiwan, and the National Stock Exchange of India. Several of these same exchanges also have a high percent of firms with significant coefficients. The stock exchanges of Shanghai, Shenzhen, Bombay, Taiwan, Virt-X, Istanbul, and the National Stock Exchange of India all have 80 percent or more of their firms with positive and significant coefficients. It is interesting to note that some of the strongest commonality-in-liquidity patterns appear in the emerging Asian markets.

In Table 3, we examine commonality in depth across 45 stock exchanges. These empirical results also provide strong support for the claim that changes in the individual firm's depths are significantly influenced by a common liquidity factor. Thirty-eight of the 45 exchanges have a positive average contemporaneous coefficient; 40 exchanges have a positive median coefficient. Forty-two exchanges have positive and significant coefficients that exceed the null hypothesis of five percent, while 36 exchanges have ten percent or more of their firms with positive and significant coefficients. Unlike our commonality-in-spreads findings, no stock exchange has negative and significant commonality coefficients exceeding five percent. The highest percent of negative and significant coefficients is only 3.85 percent from the Warsaw Stock Exchange. Similar to

our commonality-in-spreads findings, the weakest evidence for commonality is concentrated on the Emerging Latin American exchanges.

The median values for the sum of lead, lag, and contemporaneous depth coefficients are mostly positive and significant. Twenty-eight of the 39 exchanges with positive combined (SUM) coefficients are statistically significant at the five percent level, with 24 exchanges significant at the one percent level. Only two exchanges, Euronext Paris and the Athens Stock Exchange, have median SUM values (-0.0156, and -0.0074, respectively) that are significant at the five percent level.

Similar to the cross-sectional differences in spread commonality, we find considerable variation in depth commonality across stock exchanges. Median contemporaneous coefficients vary from a low of -0.0212 for the Sao Paulo Stock Exchange to a high of 1.3870 for the Spanish Continuous Market. In addition to the Spanish exchange, there are 11 other exchanges with contemporaneous median coefficients greater than 0.50; six of these 11 exchanges are located in Emerging Asia.⁹

In Table 4, we aggregate our spread and depth findings by geographic region and by emerging versus developed markets. Panel A reports the bid-ask spread results at the global, developed, and emerging market levels. We use the MSCI categories to further divide our developed markets into European, North American, and Pacific regions; and our emerging markets into Asian, Latin American, and Europe, Middle East, and Africa regions. Panel B follows the same format for depths.

⁹ As a robustness check, Chordia, Roll, and Subrahmanyam (2000) test for cross-equation dependencies by running time series regressions on the residuals of paired companies. They report that the mean level of dependency is insufficient to significantly affect their overall results. We apply the same method and run time series regressions on the residuals of randomly arranged adjacent companies. At the 5% level, the proportion of significant *t*-values are 4.32 and 4.27 percent for our spread and depth residual regressions, respectively. These figures are lower than the comparable numbers, 12.33 and 11.73 percent, reported by Chordia, Roll, and Subrahmanyam (2000).

Turning to the results in Panel A, we find that the average (median) contemporaneous spread coefficient is 0.5986 (0.4271). These positive coefficients are significant at the five percent level for 48.78 percent of the firms in our global database. The median of the combined lead, lag, and contemporaneous coefficient is 0.4327 and highly significant. We find this same general pattern in the developed markets, where the average (median) contemporaneous spread coefficient is 0.6036 (0.3733). Almost 43 percent of the developed market firms have positive and significant coefficients. Among the three regions, North American firms are more susceptible to commonality in liquidity than their European counterparts.

For the emerging markets, the average (median) contemporaneous spread coefficient is 0.5845 (0.5677). Over 66 percent of the emerging market firms have positive and significant coefficients. In sharp contrast to the developed markets, emerging markets exhibit large variations in spread commonality. There is no evidence of spread commonality in the Latin American region, whether one looks at the average or median contemporaneous coefficients, percent of firms with significant coefficients, or the combined lead, lag, and contemporaneous coefficient. The Asian emerging market, on the other hand, has the largest commonality coefficients (average, median, and combined) and the highest percent of significant coefficients across all regions including the developed markets.

In Panel B, we report parallel results for our depth measures. The average (median) contemporaneous depth coefficient is 0.6205 (0.5204), and these coefficients are significant for 41.54 percent of global firms. The median of the combined lead, lag, and contemporaneous coefficient is 0.5343 and highly significant. Similar to the spread

results in Panel A, the developed market's contemporaneous and combined coefficients are positive and highly significant. Again, the North American firms appear to be more susceptible to commonality in liquidity than their European counterparts. Unlike the spread results in Panel A, all emerging markets display significant commonality in depth liquidity, with the exception of Latin America's combined coefficient. The emerging areas of Europe, Middle East, and Africa, in particular, have large and highly significant contemporaneous depth coefficients.

3.1.1. Exchange-Level Commonality: Size Effects

In Table 5, we examine the relation between firm size (i.e., market capitalization) and commonality. Our spread results in Panel A show that average, median, and combined (SUM) coefficients are overwhelmingly positive and significant across all size quintiles. Firms in second-smallest size quintile (Quintile 2) have the highest mean and median coefficients (0.7231 and 0.6164, respectively), while firms in the largest size quintile (Quintile 5) have the smallest mean and median coefficients (0.3986 and 0.2142, respectively). These global findings are in stark contrast to previous size-based results looking at NYSE firms. Chordia, Roll, and Subrahmanyam's (2000) find that large NYSE firms have the highest commonality-in-spread coefficients. On the other hand, these global commonality-in-spread coefficients are consistent with the size-based findings for an order-driven, non-US stock exchange (e.g., the Stock Exchange of Hong Kong) in Brockman and Chung (2002).

Our Panel B depth results show that average, median, and combined (SUM) coefficients are positive and significant across all size quintiles. Firms in the largest size quintile have the highest mean and median coefficients (0.7416 and 0.6876, respectively),

while firms in the smallest size quintile have the smallest mean and median coefficients (0.5016 and 0.3339, respectively). Unlike the spreads results in Panel A, our depth results show a clear, monotonically-increasing relation between firm size and commonality in depths.

Overall, these findings show that commonality is prevalent across all firm sizes; small firms are more susceptible to commonality in spreads than large firms, but large firms experience more commonality in depths than small firms.

3.1.2. Exchange-Level Commonality: Industry Effects

We report exchange-level commonality by industry (regression model (2)) in Table 6. The spread results in Panel A reveal positive and highly significant mean, median, and SUM coefficients. The percent of firms with positive and significant contemporaneous spread coefficients (at the five percent level) varies from a low of 32.51 percent for Utilities to a high of 58.65 percent for Consumer Non-Cyclicals. Every industry has a highly significant and positive median sum of lead, lag, and contemporaneous coefficients (all p -values less than 0.001). The Consumer Cyclical industry has the highest mean, median, and SUM coefficients (0.7532, 0.6164, and 0.6103, respectively), while the Utilities industry has the lowest mean, median, and SUM coefficients (0.2932, 0.1216, and 0.1345, respectively).

In Panel B, we report commonality in depth by industry. Similar to the Panel A results, the mean and median contemporaneous depth coefficients are all positive and highly significant. The percent of firms with positive and significant contemporaneous depth coefficients varies from a low of 23.44 percent for the Basic Material industry to a

high of 74.23 percent for Utilities. All of the combined SUM coefficients are positive and significant at the five percent level.

Looking across the results in Panels A and B, we find some evidence of substitution between spread and depth commonalities. That is, the Utilities industry exhibits the weakest commonality in spreads, but also shows the strongest commonality in depths. The Consumer-related industries (both Cyclical and Non-Cyclical) have the strongest commonality in spreads, and relatively weak commonality in depths. This same pattern is also apparent in our Table 5 size-based results. The smallest (largest) firms are subject to the strongest (weakest) commonality-in-spread liquidity, while the largest (smallest) firms are susceptible to the strongest (weakest) commonality-in-depth liquidity. We are not aware of any market microstructure theory that would predict this empirical pattern.

In addition to categorizing our commonality results by industry, we also estimate commonality in liquidity at the industry level while controlling for commonality in liquidity at the exchange level (i.e., regression model (2)). We report the spread coefficients in Panel A of Table 7, and the depth coefficients in Panel B. For the global spreads results in Panel A, our average (median) contemporaneous coefficient related to industry commonality is 0.1064 (0.0334). Over ten percent of all firms have positive and significant contemporaneous coefficients, and the SUM coefficient of 0.0344 is highly significant. We find similar results for both the 27 developed and 20 emerging markets. The median coefficients are 0.0340 and 0.0304, respectively, and they are significant for 10.07 and 11.73 percent of all in-sample firms.

For the global depth results in Panel B, our average (median) contemporaneous coefficient related to industry commonality is 0.1315 (0.0749). Over 13 percent of all firms have positive and significant contemporaneous coefficients, and the SUM coefficient of 0.0799 is highly significant. Again, we find similar results for both the developed and emerging markets. The median coefficients are 0.0787 and 0.0662, respectively, and they are significant for 12.80 and 14.42 percent of in-sample firms.

Overall, the results in Table 7 demonstrate that there is a significant industry component in firm-level liquidity. The industry component is present in spreads and depths, as well as in developed and emerging markets. However, industry-level commonality is not as influential as the exchange-level component in terms of average, median, or SUM coefficient magnitudes or significance levels. Comparing our global findings to Chordia, Roll, and Subrahmanyam's (2000) NYSE findings, we note that the industry effect is much more prominent for NYSE firms than for the typical global firm. For three of their five liquidity measures, Chordia, Roll, and Subrahmanyam (2000) find that contemporaneous and SUM industry coefficients are larger than the respective exchange-level (i.e., NYSE) coefficients. The industry coefficients for NYSE firms are also much larger than for our global firms.¹⁰ Although these differences could be related to the specialist market structure (Coughenour and Saad (2004)), further research is certainly warranted.

¹⁰ Their industry-related spread (SUM) coefficients for NYSE firms range from a low of 0.259 for relative effective spreads to a high of 0.527 for quoted spreads. Their industry-related depth (SUM) coefficient for NYSE firms is 0.480. In contrast, none of our comparable spread coefficients is larger than 0.0375, and none of our depth (SUM) coefficients is larger than 0.0854.

3.2. Global Commonality

Our exchange-level results provide direct evidence that the commonality in liquidity found in previous studies for the NYSE is in fact a pervasive phenomenon across most of the world's stock exchanges. We also document cross-sectional variations in commonality at the level of the individual exchange, geographic region (e.g., Pacific, Latin America), developed versus emerging market, size-based quintiles, and industry. We turn now to examining commonality at the global scale. Our primary objective in this section is to determine whether commonality in liquidity has a natural boundary at the exchange's frontier, or whether it spills over onto other exchanges.

3.2.1. Global Commonality: Comovement across Exchanges

In Table 8, we investigate the global scope of commonality in liquidity. We use regression model (3) to estimate changes in aggregate exchange liquidity attributable to changes in global liquidity (i.e., excluding the exchange of interest). Panel A reports our spread results and Panel B provides our depth results. The average (median) contemporaneous spread coefficient is 0.1753 (0.1764) across all stock exchanges. This coefficient is positive and significant at the five percent level for 44.68 percent of our exchanges. It is negative and significant for 2.13 percent of exchanges. The median sum of lead, lagged, and contemporaneous coefficients is 0.2275, and it is highly significant. These findings represent unambiguous evidence of global commonality in bid-ask spreads.

We investigate global commonality in more detail by dividing our 47 exchanges into 27 developed markets and 20 emerging markets. This partition allows us to analyze separately the global components in developed versus emerging markets, although it also

reduces the power of our tests by creating two small samples. The developed markets average (median) contemporaneous spread coefficient is 0.2494 (0.2440). Almost 60 percent of these coefficients are positive and significant, and none is negative and significant. The SUM coefficient (0.2546) is significant at the one percent level. Our emerging markets results are similar in significance, if smaller in magnitude. The emerging markets average (median) contemporaneous spread coefficient is 0.0752 (0.1296). Twenty-five percent of these coefficients are positive and significant, and five percent are negative and significant. The median SUM coefficient (0.1234) is significant at the five percent level. Overall, we find that changes in bid-ask spreads strongly covary across both developed and emerging markets.

Turning to the depth results in Panel B, we see that the average (median) contemporaneous depth coefficient is 0.0674 (0.0352) across all stock exchanges. This coefficient is positive and significant for 26.67 percent of our exchanges, and negative and significant for 4.44 percent of our exchanges. The median SUM coefficient is 0.0750, and it is significant at the one percent level.

The developed markets average (median) contemporaneous depth coefficient is 0.0711 (0.0404). Thirty-two percent of these coefficients are positive and significant, while only four percent are negative and significant. The SUM coefficient (0.1055) is positive and significant at the 5.2 percent level. The emerging-markets average (median) contemporaneous depth coefficient is 0.0628 (0.0325). Twenty percent of these coefficients are positive and significant, and five percent are negative and significant. The median SUM coefficient (0.0614) is positive but insignificant at conventional levels (p -value = 0.115).

Overall, our Table 8 findings represent the first empirical evidence of global commonality in spreads and depths. Global commonality in spreads and depths significantly affects both developed and emerging markets, with some evidence that its impact is strongest on the developed market exchanges.¹¹

3.2.2. Global Commonality: Size Effects

In Table 9, we report global commonality coefficients by exchange size in order to test whether commonality is restricted to exchanges of a given size. We divide all 47 exchanges into small, medium, and large categories based on their total market capitalizations. The spread results in Panel A demonstrate that while spread commonality is significant across all exchange sizes, larger exchanges are more sensitive to liquidity spillover than small exchanges. The average (median) contemporaneous coefficient increases from 0.1664 (0.1296) for small exchanges to 0.2011 (0.2075) for large exchanges. Similarly, the percent of exchanges with positive and significant coefficients is 31.25 percent for small exchanges and 68.7 percent for large exchanges, with medium size exchanges somewhere in between. In contrast to Table 5's firm-size results where spread commonality decreases with size, our exchange-based results show that spread commonality increases with size.

The depth results in Panel B reveal that depth commonality is significant across all exchange sizes. Small exchanges are relatively more sensitive to depth-related liquidity spillover than large exchanges. The average (median) contemporaneous coefficient decreases from 0.0926 (0.0812) for small exchanges to 0.0329 (0.0348) for

¹¹ Following Chordia, Roll, and Subrahmanyam (2000), we test for cross-equation dependencies by running time series regressions on the residuals of paired exchanges. At the 5% level, the proportion of significant t -values are 6.52 and 9.09 percent for our spread and depth residual regressions, respectively. These figures are lower than the firm-level NYSE results reported in Chordia, Roll, and Subrahmanyam (2000).

large exchanges. Similarly, the percent of exchanges with positive and significant coefficients is 31.25 percent for small exchanges and 20.00 percent for large exchanges, with medium exchanges in between. Again, in contrast to Table 5's firm-size results where depth commonality increases with size, our exchange-based results show that depth commonality decreases with size.

The size of the exchange, in terms of market capitalization, appears to play a significant role in liquidity transmission. Larger exchanges experience greater spillover effects in the spread dimension, while smaller exchanges experience greater spillover effects in the depth dimension. The main finding in Table 9, however, is that all exchange sizes are susceptible to global commonality in liquidity.

3.2.3. Global Commonality: Regional Effects

In Table 10, we apply regression model (4) in order to measure any regional effects on commonality. Similar to our analysis of clusters of firms (by industry) on exchange-level commonality in Table 7, we examine clusters of exchanges (by MSCI region) on global commonality in Table 10. We report separate global and regional coefficients for all world exchanges, developed markets, and emerging markets. For the global (regional) spread results in Panel A, our average contemporaneous coefficient is 0.1231 (0.1142), and our median coefficient is 0.1135 (0.0475). The regional contemporaneous coefficients are smaller and less significant than their global counterparts. The regional SUM coefficient is 0.0540 with a p -value of 0.243, while the global SUM coefficient is 0.1852 with a p -value of 0.001. For all exchanges combined, regional commonality plays a smaller (though still significant) role than global commonality.

We find very different results, however, when we compare the developed market mix of regional versus global commonality to the emerging market mix. The regional component in developed markets is larger and equally significant as the global component. The average global (regional) contemporaneous coefficient is 0.1553 (0.1934), and the median global (regional) coefficient is 0.1553 (0.1873). The global SUM coefficient is larger (0.2327 versus 0.1837) but less significant (p -values = 0.052 versus 0.006) than the regional SUM coefficient. In contrast, we find only weak evidence for regional commonality in spreads for the emerging markets. The average (median) contemporaneous coefficient is 0.0073 (0.0003), while the SUM coefficient is negative and insignificant. Developed markets are clearly more affected by changes in regional markets' spreads than emerging markets.

In Panel B, we analyze the separate impacts of global and regional liquidity on depth commonality. For global (regional) depth across all exchanges, we find an average contemporaneous coefficient of 0.0479 (0.0751), and a median coefficient of 0.0344 (0.0398). The regional contemporaneous coefficients are larger and more significant than their global counterparts, although this relation does not hold for the SUM coefficients. Turning to the developed-versus-emerging market coefficients, we find a similar pattern to the spread results in Panel A. The regional source of commonality is larger and more significant than the global source of commonality for the developed markets. The average global contemporaneous coefficient for developed markets is 0.0398, compared to an average regional coefficient of 0.1234. Similarly, the median global coefficient is 0.0248 and the median regional coefficient is 0.0546. While 12 percent of the global coefficients are positive and significant at the five percent level, 32 percent of the

regional coefficients are positive and significant. The SUM coefficients give mixed results, with a smaller but more significant regional SUM coefficient.

In the emerging markets, the regional source of commonality is smaller than the global source of commonality. The average global contemporaneous coefficient for emerging markets is 0.0580, compared to an average regional coefficient of 0.0147; the median global coefficient is 0.0482 and the median regional coefficient is only 0.0035. The regional SUM coefficient is negative and insignificant, while the global SUM coefficient is positive and insignificant.

Overall, these results demonstrate that a significant source of commonality in liquidity among exchanges is attributable to regional effects. This regional effect, while significant for spreads and depths across developed and emerging markets, does not fully account for global commonality. That is, there is a separate and distinct source of commonality in liquidity that spills over from exchanges outside of one's MSCI region. For developed markets, a larger portion of commonality in both spreads and depths comes from regional sources. For emerging markets, the global (non-regional) source dominates.

3.2.4. Global Commonality: Robustness

In Table 11, we test the robustness of our global commonality results by redefining the global liquidity portfolio.¹² We rerun the results in Table 8 after excluding the effect of several influential exchanges; NYSE, Nasdaq, the London Stock Exchange, and the Tokyo Stock Exchange. It is possible that the significant global commonality reported in Table 8 is due to the influence of one or more of these large exchanges. We

¹² In addition to analyzing various definitions of global liquidity portfolios, we also test the robustness of our global commonality findings after controlling for industry effects. There remains a significant global commonality component in exchange-level liquidity after accounting for industry effects.

select the four largest exchanges in the world; the smallest of the four, the London Stock Exchange, has more than twice the market capitalization of the fifth largest exchange, Euronext Paris.

In Panel A of Table 11, we show that excluding the NYSE, Nasdaq, or London Stock Exchange from the global liquidity portfolio (on an individual basis) has little impact on the magnitude or significance of the average, median, or SUM liquidity coefficients. Excluding the Tokyo Stock Exchange, on the other hand, reduces substantially the magnitude and significance of all liquidity coefficients. After excluding all four exchanges, the average (median) contemporaneous coefficient falls to 0.0987 (0.0864) from a value of 0.1705 (0.1745) with all exchanges included. We find a similar reduction in the SUM coefficient from 0.2275 to 0.0907.

Our Panel B results mirror those in Panel A. Although there is more variation in the depth effects of individual exchange exclusions, the largest change from any single exchange continues to be from the Tokyo Stock Exchange. The average (median) contemporaneous coefficient changes from 0.0899 (0.0277) with all exchanges included to 0.0154 (0.0488) with the four large exchanges excluded. The SUM coefficient changes from 0.0623 to 0.0744.

In summary, there is a clear reduction in the magnitudes and significance levels for spread commonality after excluding the four largest exchanges. There is some reduction in magnitudes and significance levels for depth commonality as well, although this pattern is not as regular (e.g., the average coefficient increases, while the median coefficient decreases). The main point, however, is that commonality in global liquidity remains significant for both spreads and depths after excluding any influence from the

largest global exchanges. Global commonality is not driven solely from New York, London, or Tokyo.

4. Summary and Conclusions

Previous empirical research finds a common exchange-level component that influences firm-level liquidity, both in terms of bid-ask spreads and depths. Although most of the empirical evidence is restricted to firms trading on a US exchange (Chordia, Roll, and Subrahmanyam (2000), Hasbrouck and Seppi (2001), and Huberman and Halka (2001)), there is limited evidence of commonality on non-US exchanges (Fabre and Frino (2004) and Brockman and Chung (2002)). All previous studies that examine commonality in intraday spreads and depths are single-exchange studies.

Our study contributes to this literature in two primary ways. First, we conduct the first comprehensive investigation of commonality in liquidity using intraday spread and depth data from 47 stock exchanges. Second, we examine the impact of a global liquidity factor on spread and depth commonality. Given the size and scope of our Bloomberg database, we are able to analyze several aspects of commonality that previous, single-exchange studies could not address. These unresolved issues include the pervasiveness of spread and depth commonality, the cross-sectional variation in commonality among exchanges and regions, and the possible existence of a global liquidity factor.

Our empirical results confirm that exchange-level commonality is a widespread phenomenon across the globe. For most exchanges in our sample, the individual firm's bid-ask spreads are significantly influenced by changes in the aggregate market's bid-ask spreads. Similarly, changes in the individual firm's depths are significantly influenced by

changes in exchange-level depths. Our cross-sectional results show that the Emerging Asia stock exchanges exhibit exceptionally strong commonality in spreads and depths, while the stock exchanges of Latin American have little, if any, commonality at the exchange level.

We investigate the importance of firm size and industry within each of our 47 stock exchanges. We find that commonality in bid-ask spreads is strongest among small firms, in contrast to previous NYSE-based results. Depth commonality, on the other hand, exhibits a positive and monotonic relation with firm size. Our industry results show that while commonality is significant in each industry, there is considerable variation across industries. Utilities, for example, tend to have less commonality in spreads than other industries, while the basic materials industry is less sensitive to commonality in depths. We also show that industry-level commonality is significantly weaker than exchange-level commonality across our 47 exchanges. This finding is different from previously-reported NYSE results showing that industry effects often dominate exchange effects.

After documenting the pervasive role of commonality *within* individual stock exchanges, we turn our attention to examining commonality *across* stock exchanges. We extend the empirical model of Chordia, Roll, and Subrahmanyam (2000) in order to measure the impact of changes in intraday global liquidity on changes in aggregate exchange-level liquidity. Our findings represent the first empirical evidence for the existence of global commonality in spreads and depths.

We find unambiguous support for the hypothesis that commonality in liquidity spills over the national border. Movements in aggregate bid-ask spreads and depths on

an individual exchange are significantly influenced by movements in spreads and depths at the global scale. The global commonality in liquidity component that we find for spreads and depths is significant in both developed and emerging markets. Comparing the two market categories, we show that developed markets experience more liquidity spillover than emerging market. We also find that liquidity spillover extends beyond the regional level. Again, developed markets appear to be more susceptible to regional commonality influences than emerging markets. For developed markets, a larger portion of depth and spread commonality comes from regional sources. For emerging markets, the non-regional (i.e., global) source dominates. Finally, we show that the total market capitalization of the exchange plays a significant role in the liquidity transmission process.

In summary, our results verify that neither firm- nor exchange-level liquidity can be understood in isolation. Individual firm liquidity is partly determined by an exchange-level commonality component, and aggregate exchange liquidity is partly determined by a global commonality component. Future research is needed to understand the causes of global liquidity co-movements, as well as to identify the channels through which liquidity changes on one exchange affect the liquidity on another.

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Table 1: Descriptive Statistics

#	Exchange	Country	Region	Number of Firms	Total Market Cap. (Billion US\$)	Trading Volume (Thousand US\$)	Number of Trades	% of Days with Trades	Relative Effective Spread	Total Depth in Value (US\$)
1	Vienna Stock Exchange	Austria	Europe	27	25.3	1,100.1	26	94%	0.0088	120,603
2	Copenhagen Stock Ex.	Denmark	Europe	60	81.7	2,942.5	91	95%	0.0093	145,705
3	Helsinki Stock Exchange	Finland	Europe	62	152.1	7,487.1	163	94%	0.0105	146,615
4	Euronext Paris	France	Europe	221	913.0	12,388.5	502	69%	0.0092	191,320
5	Deutsche Boerse	Germany	Europe	134	579.8	25,033.9	369	98%	0.0082	61,895
6	Frankfurt Stock Exchange	Germany	Europe	41	63.1	317.5	20	82%	0.0170	35,308
7	Athens Stock Exchange	Greece	Europe	90	52.6	772.4	177	99%	0.0080	130,324
8	Irish Stock Exchange	Ireland	Europe	25	56.7	5,617.8	36	95%	0.0122	136,911
9	Borsa Italiana	Italy	Europe	121	408.6	13,786.8	611	98%	0.0075	40,307
10	Oslo Stock Exchange	Norway	Europe	52	47.9	4,018.2	113	92%	0.0127	140,424
11	Euronext Lisbon	Portugal	Europe	28	44.5	2,988.2	158	95%	0.0093	299,436
12	Spanish Continuous Market	Spain	Europe	86	360.2	18,071.4	430	98%	0.0058	465,967
13	Stockholm Stock Exchange	Sweden	Europe	117	264.3	8,636.2	237	97%	0.0090	476,574
14	Swiss Exchange	Switzerland	Europe	106	137.0	727.1	42	91%	0.0111	89,735
15	Virt-X	Switzerland	Europe	26	472.4	50,596.3	1,121	100%	0.0021	827,649
16	London Stock Exchange	UK	Europe	550	1,852.6	5,315.3	57	96%	0.0139	N/A
17	Toronto Stock Exchange	Canada	N-America	314	567.8	3,990.7	240	97%	0.0085	585
18	American Stock Exchange	USA	N-America	55	40.6	2,198.0	169	98%	0.0115	52,798
19	NASDAQ	USA	N-America	1,515	2,137.7	6,938.5	688	99%	0.0060	21,243
20	New York Stock Exchange	USA	N-America	1,475	9,092.1	20,690.6	729	100%	0.0041	57,880
21	Australian Stock Exchange	Australia	Pacific	199	406.5	4,276.4	177	98%	0.0066	153,750
22	Hong Kong Exchange	Hong Kong	Pacific	225	566.7	8,689.9	151	96%	0.0108	606,525
23	JASDAQ	Japan	Pacific	59	14.9	921.3	69	93%	0.0111	43,288
24	Osaka Securities Exchange	Japan	Pacific	70	80.1	2,568.4	121	90%	0.0068	58,794
25	Tokyo Stock Exchange	Japan	Pacific	1,201	1,873.8	4,754.5	164	91%	0.0049	146,937
26	New Zealand Exchange	New Zeal.	Pacific	33	65.5	869.5	32	98%	0.0076	N/A
27	Singapore Exchange Ltd	Singapore	Pacific	105	151.6	2,061.0	86	98%	0.0104	381,579
28	Shanghai Stock Exchange	China	Asia	598	271.3	779.6	183	98%	0.0025	13,202
29	Shenzhen Stock Exchange	China	Asia	527	191.3	755.1	204	98%	0.0026	12,682
30	Bombay Stock Exchange	India	Asia	119	104.8	701.1	505	98%	0.0035	2,695

Table 1: Descriptive Statistics (Continued)

#	Exchange	Country	Region	Number of Firms	Total Market Cap. (Billion US\$)	Trading Volume (Thousand US\$)	Number of Trades	% of Days with Trades	Relative Effective Spread	Total Depth in Value (US\$)
31	National Stock Ex. of India	India	Asia	111	102.2	1,512.1	501	98%	0.0025	3,425
32	Jakarta Stock Exchange	Indonesia	Asia	32	25.4	1,199.5	137	96%	0.0295	469,623
33	KOSDAQ Market Division	Korea	Asia	16	6.8	6,489.1	1,697	100%	0.0040	54,332
34	Korea Exchange	Korea	Asia	140	176.2	6,430.0	1,037	99%	0.0039	111,408
35	Bursa Malaysia	Malaysia	Asia	160	106.4	606.5	60	97%	0.0094	92,281
36	Philippine Stock Exchange	Philippines	Asia	27	30.4	290.3	44	93%	0.0183	70,642
37	Taiwan Stock Exchange	Taiwan	Asia	289	212.4	5,763.2	221	99%	0.0053	294,005
38	Stock Ex. of Thailand	Thailand	Asia	80	49.5	2,202.8	203	96%	0.0094	193,232
39	Budapest Stock Exchange	Hungary	Europe-MEA	13	12.0	1,745.2	127	96%	0.0124	27,841
40	Warsaw Stock Exchange	Poland	Europe-MEA	26	22.9	987.1	156	96%	0.0084	49,190
41	Johannesburg Stock Ex.	South Africa	Europe-MEA	74	145.9	717.2	4	82%	0.0100	149,975
42	Istanbul Stock Exchange	Turkey	Europe-MEA	59	39.2	5.6	883	100%	0.0098	523
43	Buenos Aires Stock Ex.	Argentina	Latin America	19	87.4	456.6	103	97%	0.0116	23,169
44	Sao Paulo Stock Exchange	Brazil	Latin America	45	90.1	649.9	66	86%	0.0238	31,987
45	Santiago Stock Exchange	Chile	Latin America	43	42.4	508.2	19	85%	0.0180	25,770
46	Mexican Stock Exchange	Mexico	Latin America	39	146.4	2,318.3	84	93%	0.0124	118,985
47	Lima Stock Exchange	Peru	Latin America	13	10.0	103.0	10	86%	0.0276	235,586
All Exchanges Combined		All	All	9,427	22,382.4	7,593.6	378	96%	0.0067	105,646

Note: This table presents for each sample exchange, the name, country, region (MSCI), number of listed firms, total market capitalization in billions of US\$, and several descriptive statistics computed over the period October 1, 2002 to June 30, 2004. The MSCI regions are *Europe* (Developed Markets - Europe), *N-America* (Developed Markets - North America), *Pacific* (Developed Markets - Pacific), *Asia* (Emerging Markets - Asia), *Europe-MEA* (Emerging Markets – Europe, Middle East, and Africa), and *Latin America* (Emerging Markets - Latin America). *Trading Volume (Thousand US\$)* is the average value of shares traded per day and per firm measured in thousands of US\$, *Number of Trades* is the average number of transactions per day and per firm, *% of Days with Trades* is the percent of trading days with at least one transaction, *Relative Effective Spread* is the effective spread (i.e., twice the absolute trading price deviation from the bid-ask midpoint) divided by the bid-ask midpoint, and *Total Depth in Value* is the number of shares at the bid and ask multiplied by their respective prices converted in US\$. Each trading activity and liquidity measure is averaged across day for each firm, and then their mean is computed across firms.

Table 2: Exchange-Level Commonality – Spread Results

		Average Coef.	Median Coef.	% Firms with >0 Coef. Signif. 5% Level	% Firms with >0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Signif. 5% Level	Median SUM_E Coef.	p-value (Median SUM_E Coef.)
<i>Europe</i>									
1	Vienna Stock Exchange	0.2041	0.2464	29.63%	40.74%	22.22%	7.41%	0.1361	0.248
2	Copenhagen Stock Ex.	0.1958	0.1918	16.67%	58.33%	25.00%	0.00%	0.2456	0.006
3	Helsinki Stock Exchange	0.1673	0.0885	12.90%	58.06%	27.42%	1.61%	0.0344	0.374
4	Euronext Paris	0.2115	0.1347	7.73%	60.00%	31.36%	0.91%	0.1663	0.000
5	Deutsche Boerse	0.2065	0.2484	25.56%	53.38%	21.05%	0.00%	0.3845	0.000
6	Frankfurt Stock Exchange	0.2871	0.0696	5.13%	48.72%	43.59%	2.56%	0.0084	1.000
7	Athens Stock Exchange	0.2054	0.2099	23.33%	64.44%	11.11%	1.11%	0.1166	0.001
8	Irish Stock Exchange	0.2409	0.2274	52.00%	36.00%	12.00%	0.00%	0.2886	0.000
9	Borsa Italiana	0.0614	0.0198	5.79%	57.02%	36.36%	0.83%	0.0318	0.001
10	Oslo Stock Exchange	0.1075	0.0372	13.46%	42.31%	42.31%	1.92%	0.0098	0.489
11	Euronext Lisbon	0.2687	0.1596	25.00%	60.71%	14.29%	0.00%	0.1381	0.000
12	Spanish Cont. Market	0.1337	0.1845	30.59%	54.12%	15.29%	0.00%	0.1821	0.000
13	Stockholm Stock Exchange	0.0644	0.0391	10.26%	54.70%	31.62%	3.42%	0.0544	0.042
14	Swiss Exchange	0.1817	0.2195	8.49%	65.09%	25.47%	0.94%	0.2602	0.003
15	Virt-X	0.3384	0.3283	80.77%	15.38%	3.85%	0.00%	0.4916	0.000
16	London Stock Exchange	1.2183	1.1251	42.07%	47.42%	9.96%	0.55%	1.2318	0.000
<i>North America</i>									
17	Toronto Stock Exchange	0.7902	0.6675	57.56%	35.69%	6.75%	0.00%	0.7724	0.000
18	American Stock Exchange	0.2900	0.0665	22.64%	50.94%	26.42%	0.00%	0.0295	0.419
19	NASDAQ	0.9248	0.6995	72.98%	24.30%	2.72%	0.00%	0.6661	0.000
20	New York Stock Exchange	0.3550	0.2022	20.73%	55.46%	22.86%	0.96%	0.1796	0.000
<i>Pacific</i>									
21	Australian Stock Exchange	0.5880	0.3581	58.08%	33.84%	8.08%	0.00%	0.2629	0.000
22	Hong Kong Exchange	0.1662	0.0703	8.89%	59.56%	28.44%	3.11%	0.0594	0.016
23	JASDAQ	0.1229	0.0515	1.69%	59.32%	37.29%	1.69%	0.0612	0.795
24	Osaka Securities Exchange	0.2336	0.1677	17.14%	61.43%	17.14%	4.29%	0.1588	0.006
25	Tokyo Stock Exchange	0.8011	0.5388	64.15%	29.15%	6.62%	0.08%	0.5187	0.000
26	New Zealand Exchange	0.1671	0.1139	12.12%	57.58%	30.30%	0.00%	0.1089	0.487
27	Singapore Exchange Ltd	0.1341	0.0813	15.24%	56.19%	23.81%	4.76%	0.1140	0.006

Table 2: Exchange-Level Commonality – Spread Results (Continued)

		Average Coef.	Median Coef.	% Firms with >0 Coef. Signif. 5% Level	% Firms with >0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Signif. 5% Level	Median SUM_E Coef.	p-value (Median SUM_E Coef.)
	<i>Emerging – Asia</i>								
28	Shanghai Stock Exchange	0.7586	0.7273	82.61%	14.38%	3.01%	0.00%	0.6746	0.000
29	Shenzhen Stock Exchange	0.7472	0.6996	86.91%	11.20%	1.90%	0.00%	0.6492	0.000
30	Bombay Stock Exchange	0.5414	0.5608	80.67%	16.81%	2.52%	0.00%	0.8396	0.000
31	National Stock Ex. of India	0.6590	0.6679	91.89%	8.11%	0.00%	0.00%	0.7834	0.000
32	Jakarta Stock Exchange	0.2293	0.0571	18.75%	53.13%	21.88%	6.25%	0.0431	0.597
33	KOSDAQ Market Division	0.1620	0.1339	62.50%	31.25%	6.25%	0.00%	0.1551	0.021
34	Korea Exchange	0.4534	0.3993	63.57%	31.43%	5.00%	0.00%	0.3597	0.000
35	Bursa Malaysia	0.3290	0.1755	22.50%	55.63%	21.25%	0.63%	0.2371	0.000
36	Philippine Stock Exchange	0.2803	0.0121	11.11%	48.15%	37.04%	3.70%	0.0477	0.248
37	Taiwan Stock Exchange	0.9136	0.8789	84.78%	13.15%	1.73%	0.35%	0.8345	0.000
38	Stock Ex. of Thailand	-0.0031	0.0150	7.50%	61.25%	30.00%	1.25%	0.0093	0.314
	<i>Emerging – Europe MEA</i>								
39	Budapest Stock Exchange	0.0455	0.0322	0.00%	69.23%	23.08%	7.69%	0.0648	0.581
40	Warsaw Stock Exchange	0.2055	0.1287	11.54%	73.08%	15.38%	0.00%	0.1365	0.076
41	Johannesburg Stock Ex.	0.0792	0.2116	9.59%	54.79%	34.25%	1.37%	0.2936	0.416
42	Istanbul Stock Exchange	0.4611	0.4747	83.05%	15.25%	1.69%	0.00%	0.7464	0.000
	<i>Emerging – Latin America</i>								
43	Buenos Aires Stock Ex.	-0.1441	0.0077	5.26%	47.37%	36.84%	10.53%	0.0160	1.000
44	Sao Paulo Stock Exchange	-0.0599	0.0670	6.98%	51.16%	39.53%	2.33%	0.0376	1.000
45	Santiago Stock Exchange	-0.1196	-0.1123	2.44%	31.71%	63.41%	2.44%	-0.1415	0.222
46	Mexican Stock Exchange	0.1013	0.0506	7.69%	61.54%	30.77%	0.00%	0.0213	0.337
47	Lima Stock Exchange	0.1774	0.0003	7.69%	46.15%	46.15%	0.00%	0.0940	0.581

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the relative effective spread of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of the liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_1 , along with

the percent of firms for which β_l is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_E = \beta_l + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_E) = 0.

Table 3: Exchange-Level Commonality – Depth Results

		Average Coef.	Median Coef.	% Firms with >0 Coef. Signif. 5% Level	% Firms with >0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Signif. 5% Level	Median SUM_E Coef.	p-value (Median SUM_E Coef.)
<i>Europe</i>									
1	Vienna Stock Exchange	0.2112	0.2036	22.22%	59.26%	18.52%	0.00%	0.3353	0.019
2	Copenhagen Stock Ex.	0.0162	0.1236	16.67%	45.00%	35.00%	3.33%	0.0289	0.519
3	Helsinki Stock Exchange	-0.0068	0.0007	4.84%	46.77%	48.39%	0.00%	-0.0154	0.098
4	Euronext Paris	0.0269	0.0021	8.60%	44.34%	47.06%	0.00%	-0.0156	0.031
5	Deutsche Boerse	0.2082	0.2059	21.19%	52.54%	26.27%	0.00%	0.1663	0.342
6	Frankfurt Stock Exchange	0.4283	0.0631	20.00%	46.67%	33.33%	0.00%	0.0205	0.000
7	Athens Stock Exchange	-0.0066	-0.0028	4.44%	40.00%	55.56%	0.00%	-0.0074	0.015
8	Irish Stock Exchange	0.1832	0.1800	12.00%	64.00%	24.00%	0.00%	0.2481	0.001
9	Borsa Italiana	0.3874	0.2955	25.21%	54.62%	20.17%	0.00%	0.2976	0.001
10	Oslo Stock Exchange	0.1832	0.2495	30.77%	48.08%	21.15%	0.00%	0.1893	0.000
11	Euronext Lisbon	0.3709	0.2937	37.04%	51.85%	11.11%	0.00%	0.1277	0.087
12	Spanish Cont. Market	3.5136	1.3870	72.00%	16.00%	12.00%	0.00%	1.5532	0.000
13	Stockholm Stock Exchange	0.2392	0.3424	43.97%	41.38%	12.93%	1.72%	0.4571	0.000
14	Swiss Exchange	-0.0185	0.1017	5.77%	52.88%	39.42%	1.92%	-0.0962	0.382
15	Virt-X	0.3195	0.3243	73.08%	23.08%	3.85%	0.00%	0.2450	0.003
16	London Stock Exchange	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<i>North America</i>									
17	Toronto Stock Exchange	0.8905	0.8420	54.31%	35.14%	9.90%	0.64%	1.0900	0.000
18	American Stock Exchange	0.0110	-0.0061	9.09%	36.36%	54.55%	0.00%	-0.0386	0.590
19	NASDAQ	0.8254	0.7291	28.68%	53.58%	17.42%	0.33%	0.7468	0.000
20	New York Stock Exchange	0.7703	0.7951	47.43%	41.19%	11.10%	0.27%	0.8407	0.000
<i>Pacific</i>									
21	Australian Stock Exchange	0.2654	0.1305	25.51%	49.49%	22.96%	2.04%	0.0291	0.023
22	Hong Kong Exchange	0.3208	0.3558	48.44%	37.78%	12.89%	0.89%	0.3799	0.000
23	JASDAQ	0.1310	0.0512	8.47%	57.63%	33.90%	0.00%	0.0872	0.067
24	Osaka Securities Exchange	0.0520	0.0359	10.14%	50.72%	39.13%	0.00%	0.1142	0.120
25	Tokyo Stock Exchange	0.5136	0.5047	39.95%	47.71%	12.01%	0.33%	0.5321	0.000
26	New Zealand Exchange	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	Singapore Exchange Ltd	0.3126	0.2785	40.95%	48.57%	10.48%	0.00%	0.3107	0.000

Table 3: Exchange-Level Commonality – Depth Results (Continued)

		Average Coef.	Median Coef.	% Firms with >0 Coef. Signif. 5% Level	% Firms with >0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Not Signif. 5% Level	% Firms with <0 Coef. Signif. 5% Level	Median SUM_E Coef.	p-value (Median SUM_E Coef.)
	<i>Emerging – Asia</i>								
28	Shanghai Stock Exchange	0.7824	0.7322	67.89%	27.26%	4.85%	0.00%	0.8356	0.000
29	Shenzhen Stock Exchange	0.6710	0.6546	58.06%	37.00%	4.74%	0.19%	0.7436	0.000
30	Bombay Stock Exchange	0.4048	0.3514	22.88%	55.08%	21.19%	0.85%	0.4325	0.000
31	National Stock Ex. of India	0.5089	0.3833	31.82%	55.45%	11.82%	0.91%	0.4998	0.000
32	Jakarta Stock Exchange	0.3030	0.3302	48.28%	44.83%	3.45%	3.45%	0.2391	0.215
33	KOSDAQ Market Division	0.2610	0.3055	50.00%	31.25%	18.75%	0.00%	0.3990	0.021
34	Korea Exchange	0.1680	0.1747	30.71%	51.43%	17.86%	0.00%	0.1204	0.001
35	Bursa Malaysia	1.4947	1.0664	97.50%	1.87%	0.63%	0.00%	1.0759	0.000
36	Philippine Stock Exchange	0.2937	0.3128	37.04%	48.15%	14.81%	0.00%	0.3401	0.000
37	Taiwan Stock Exchange	0.5963	0.5566	71.63%	25.26%	3.11%	0.00%	0.5997	0.000
38	Stock Ex. of Thailand	0.7348	0.7574	72.50%	21.25%	6.25%	0.00%	0.8965	0.000
	<i>Emerging – Europe MEA</i>								
39	Budapest Stock Exchange	0.1861	0.2313	46.15%	23.08%	30.77%	0.00%	0.4057	0.267
40	Warsaw Stock Exchange	0.2139	0.2790	42.31%	38.46%	15.38%	3.85%	0.1974	0.169
41	Johannesburg Stock Ex.	1.0312	0.8344	35.82%	43.28%	19.40%	1.49%	1.2190	0.047
42	Istanbul Stock Exchange	0.8078	0.8865	88.14%	8.47%	3.39%	0.00%	0.8645	0.000
	<i>Emerging – Latin America</i>								
43	Buenos Aires Stock Ex.	0.3334	0.3094	47.37%	52.63%	0.00%	0.00%	0.5166	0.001
44	Sao Paulo Stock Exchange	0.3434	-0.0212	6.67%	35.56%	57.78%	0.00%	0.0025	0.766
45	Santiago Stock Exchange	-0.0468	0.1577	17.07%	41.46%	39.02%	2.44%	0.0800	0.761
46	Mexican Stock Exchange	-0.0297	-0.0054	5.13%	33.33%	61.54%	0.00%	-0.0149	0.108
47	Lima Stock Exchange	-0.0016	-0.0017	7.69%	30.77%	61.54%	0.00%	0.0004	1.000

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the total depth in value of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of the liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_i , along with the

percent of firms for which β_l is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_E = \beta_l + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_E) = 0.

Table 4: Exchange-Level Commonality

	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_E coefficient	p-value (Median SUM_E coefficient)
Panel A: Spread								
World (All Exchanges)	0.5986	0.4271	48.78%	37.52%	13.06%	0.64%	0.4327	0.000
Developed Markets:								
Europe	0.4992	0.2526	24.81%	53.03%	21.18%	0.98%	0.2776	0.000
North America	0.6529	0.4563	47.88%	39.42%	12.28%	0.42%	0.4447	0.000
Pacific	0.6123	0.3426	49.58%	37.42%	12.10%	0.90%	0.3558	0.000
All Developed Markets	0.6036	0.3733	42.59%	42.27%	14.45%	0.69%	0.3783	0.000
Emerging Markets:								
Asia	0.6586	0.6357	73.61%	20.44%	5.67%	0.29%	0.6134	0.000
Europe, Middle East, Africa	0.2276	0.3010	34.50%	45.03%	19.30%	1.17%	0.4628	0.000
Latin America	-0.0255	0.0100	5.81%	47.74%	43.87%	2.58%	0.0083	0.874
All Emerging Markets	0.5845	0.5677	66.52%	23.92%	9.07%	0.49%	0.5703	0.000
Panel B: Depth								
World (All Exchanges)	0.6205	0.5204	41.54%	42.60%	15.46%	0.40%	0.5343	0.000
Developed Markets:								
Europe	0.3610	0.0815	22.78%	45.38%	31.31%	0.53%	0.0444	0.000
North America	0.7946	0.7638	38.86%	46.38%	14.41%	0.36%	0.8082	0.000
Pacific	0.4232	0.3979	37.40%	47.17%	14.89%	0.54%	0.3827	0.000
All Developed Markets	0.6082	0.4924	35.54%	46.43%	17.59%	0.44%	0.4828	0.000
Emerging Markets:								
Asia	0.6876	0.6141	60.65%	32.47%	6.69%	0.19%	0.6828	0.000
Europe, Middle East, Africa	0.7559	0.6952	56.36%	28.48%	13.94%	1.21%	0.7638	0.000
Latin America	0.1191	0.0011	14.01%	38.22%	47.13%	0.64%	0.0025	0.428
All Emerging Markets	0.6553	0.5792	57.33%	32.57%	9.81%	0.29%	0.6496	0.000

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the relative effective spread (Panel A) and the total depth in value (Panel B) of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_l , along with the percent of firms for which β_l is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_E = \beta_l + \beta_2 + \beta_3$) and the p-value of a sign test testing whether $Median(SUM_E) = 0$.

Table 5: Exchange-Level Commonality: Results by Size Quintile

	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_E coefficient	p-value (Median SUM_E coefficient)
Panel A: Spread								
Quintile 1 (Smallest Firms)	0.6909	0.5215	45.14%	38.89%	15.06%	0.91%	0.5648	0.000
Quintile 2	0.7231	0.6164	56.91%	32.75%	9.87%	0.48%	0.5990	0.000
Quintile 3	0.6744	0.5267	57.04%	31.98%	10.61%	0.37%	0.5357	0.000
Quintile 4	0.5062	0.3702	48.35%	37.57%	13.45%	0.64%	0.3558	0.000
Quintile 5 (Largest Firms)	0.3986	0.2142	36.46%	46.43%	16.31%	0.80%	0.2176	0.000
Panel B: Depth								
Quintile 1 (Smallest Firms)	0.5016	0.3339	27.26%	46.97%	24.69%	1.09%	0.3305	0.000
Quintile 2	0.5930	0.4742	34.93%	47.26%	17.35%	0.45%	0.5324	0.000
Quintile 3	0.6318	0.5446	39.44%	44.05%	16.39%	0.11%	0.5519	0.000
Quintile 4	0.6362	0.5711	44.22%	43.82%	11.72%	0.23%	0.5728	0.000
Quintile 5 (Largest Firms)	0.7416	0.6876	62.14%	30.69%	7.05%	0.12%	0.6574	0.000

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the relative effective spread (Panel A) and the total depth in value (Panel B) of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_1 , along with the percent of firms for which β_1 is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_E = \beta_1 + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_E) = 0. Results are presented by size-quintile.

Table 6: Exchange-Level Commonality: Results by Industry

Industry (Number of Firms)	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM _E coefficient	p-value (Median SUM _E coefficient)
Panel A: Spread								
Basic Material (769)	0.6387	0.4677	40.55%	43.44%	15.49%	0.52%	0.5158	0.000
Communications (732)	0.6998	0.5522	47.18%	36.86%	14.86%	1.10%	0.5880	0.000
Consumer Cyclical (1,642)	0.7532	0.6164	55.24%	33.31%	10.59%	0.86%	0.6103	0.000
Consumer Non-Cyclic. (1,590)	0.6993	0.5840	58.65%	30.56%	10.48%	0.32%	0.5694	0.000
Diversified (137)	0.5909	0.5090	56.93%	32.85%	10.22%	0.00%	0.4809	0.000
Energy (310)	0.6643	0.4991	55.34%	35.92%	8.74%	0.00%	0.5189	0.000
Financial (1,570)	0.5513	0.4159	51.31%	35.28%	13.02%	0.38%	0.4040	0.000
Industrial (1,731)	0.4469	0.2867	41.45%	41.86%	15.76%	0.93%	0.2777	0.000
Technology (662)	0.4252	0.2081	35.66%	48.71%	15.02%	0.61%	0.2174	0.000
Utilities (284)	0.2932	0.1216	32.51%	50.53%	15.90%	1.06%	0.1345	0.000
Panel B: Depth								
Basic Material (769)	0.4937	0.3061	23.44%	48.54%	26.91%	1.11%	0.2820	0.000
Communications (732)	0.4991	0.3504	28.34%	47.48%	23.15%	1.04%	0.3502	0.000
Consumer Cyclical (1,642)	0.5740	0.4467	34.05%	46.72%	18.71%	0.52%	0.4982	0.000
Consumer Non-Cyclic. (1,590)	0.6311	0.5251	38.09%	44.26%	17.31%	0.34%	0.5441	0.000
Diversified (137)	0.6795	0.6122	41.41%	44.53%	14.06%	0.00%	0.5578	0.000
Energy (310)	0.6223	0.5188	38.64%	42.71%	18.31%	0.34%	0.4588	0.000
Financial (1,570)	0.6011	0.5636	40.86%	45.86%	13.00%	0.27%	0.5625	0.000
Industrial (1,731)	0.7000	0.6150	51.52%	38.58%	9.83%	0.06%	0.6172	0.000
Technology (662)	0.7479	0.6987	67.77%	27.93%	4.13%	0.17%	0.6696	0.000
Utilities (284)	0.7928	0.7817	74.23%	19.23%	6.54%	0.00%	0.7101	0.000

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the relative effective spread (Panel A) and the total depth in value (Panel B) of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_1 , along with the percent of firms for which β_1 is positive and significant at the 5% confidence level (t-statistic >

1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_E = \beta_1 + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_E) = 0. Results are presented by industry.

Table 7: Exchange-Level and Industry Commonality

		Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_i coefficient	p-value (Median SUM_i coefficient)
Panel A: Spread									
World (All Exchanges)	β_1	0.4966	0.3377	29.91%	49.61%	19.32%	1.16%	0.3157	0.000
	γ_1	0.1064	0.0334	10.50%	47.65%	38.58%	3.27%	0.0344	0.000
All Developed Markets	β_1	0.4796	0.2864	24.58%	52.88%	21.23%	1.32%	0.2710	0.000
	γ_1	0.1254	0.0340	10.07%	48.09%	38.79%	3.05%	0.0331	0.000
All Emerging Markets	β_1	0.5456	0.4855	45.26%	40.22%	13.81%	0.71%	0.4527	0.000
	γ_1	0.0518	0.0304	11.73%	46.38%	37.98%	3.91%	0.0375	0.000
Panel B: Depth									
World (All Exchanges)	β_1	0.4983	0.4052	27.02%	50.01%	21.89%	1.09%	0.3932	0.000
	γ_1	0.1315	0.0749	13.25%	47.66%	36.10%	3.00%	0.0799	0.000
All Developed Markets	β_1	0.4690	0.3644	21.99%	52.28%	24.47%	1.25%	0.3122	0.000
	γ_1	0.1468	0.0787	12.80%	47.91%	36.53%	2.77%	0.0854	0.009
All Emerging Markets	β_1	0.5753	0.4934	40.23%	44.01%	15.09%	0.67%	0.5439	0.000
	γ_1	0.0912	0.0662	14.42%	47.01%	34.95%	3.62%	0.0711	0.000

Note: Firm-by-firm (9,427) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{F,t} = \alpha + \beta_1 \Delta Liquidity_{E,t} + \beta_2 \Delta Liquidity_{E,t+1} + \beta_3 \Delta Liquidity_{E,t-1} + \gamma_1 \Delta Liquidity_{EL,t} + \gamma_2 \Delta Liquidity_{EL,t+1} + \gamma_3 \Delta Liquidity_{EL,t-1} + \delta_1 Return_{E,t} + \delta_2 Return_{E,t+1} + \delta_3 Return_{E,t-1} + \delta_4 \Delta Volatility_{F,t} + \varepsilon_{F,t}$$

$Liquidity_{F,t}$ is the relative effective spread (Panel A) and the total depth in value (Panel B) of firm F on day t . $Liquidity_{E,t}$ is the exchange-level liquidity index and $Return_{E,t}$ is the exchange-level return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms trading on the same exchange, except firm F . $Liquidity_{EL,t}$ is the industry-level liquidity index computed on day t using an equal-weighted average of each corresponding liquidity measure for all firms in firm F 's industry. $Volatility_{F,t}$ is the return volatility for firm F on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level and industry-level liquidity betas β_1 , and γ_1 , along with the percent of firms for which β_1 , or γ_1 , is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the

concurrent, lead and lag coefficient estimates ($SUM_E = \beta_1 + \beta_2 + \beta_3$ and $SUM_{EI} = \gamma_1 + \gamma_2 + \gamma_3$) and the p-value of a sign test testing whether Median (SUM_E) = 0 and Median (SUM_{EI}) = 0.

Table 8: Global Commonality

	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_G coefficient	p-value (Median SUM_G coefficient)
Panel A: Spread								
World (All Exchanges)	0.1753	0.1764	44.68%	38.30%	14.89%	2.13%	0.2275	0.000
Developed Markets	0.2494	0.2440	59.26%	25.93%	14.81%	0.00%	0.2546	0.006
Emerging Markets	0.0752	0.1296	25.00%	55.00%	15.00%	5.00%	0.1234	0.041
Panel B: Depth								
World (All Exchanges)	0.0674	0.0352	26.67%	46.67%	22.22%	4.44%	0.0750	0.008
Developed Markets	0.0711	0.0404	32.00%	40.00%	24.00%	4.00%	0.1055	0.052
Emerging Markets	0.0628	0.0325	20.00%	55.00%	20.00%	5.00%	0.0614	0.115

Note: Exchange-by-exchange (47) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t}$$

$Liquidity_{E,t}$ is the exchange-level average relative effective spread (Panel A) and total depth in value (Panel B) of exchange E on day t . $Liquidity_{G,t}$ is the global liquidity index and $Return_{G,t}$ is the global return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms, except those firms trading on exchange E . $Volatility_{E,t}$ is the return volatility for firms trading on exchange E on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_i , along with the percent of firms for which β_i is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_G = \beta_1 + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_G) = 0.

Table 9: Global Commonality and Exchange Size

	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_G coefficient	p-value (Median SUM_G coefficient)
Panel A: Spread								
Small Markets	0.1664	0.1296	31.25%	50.00%	18.75%	0.00%	0.2564	0.077
Medium Markets	0.1572	0.1765	33.33%	46.67%	13.33%	6.67%	0.1282	0.119
Large Markets	0.2011	0.2075	68.75%	18.75%	12.50%	0.00%	0.2410	0.021
Panel B: Depth								
Small Markets	0.0926	0.0812	31.25%	50.00%	18.75%	0.00%	0.1344	0.077
Medium Markets	0.0758	0.0315	28.57%	28.57%	35.71%	7.14%	0.0481	0.607
Large Markets	0.0329	0.0348	20.00%	60.00%	13.33%	6.67%	0.0635	0.077

Note: Exchange-by-exchange (47) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t}$$

$Liquidity_{E,t}$ is the exchange-level average relative effective spread (Panel A) and total depth in value (Panel B) of exchange E on day t . $Liquidity_{G,t}$ is the global liquidity index and $Return_{G,t}$ is the global return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms, except those firms trading on exchange E . $Volatility_{E,t}$ is the return volatility for firms trading on exchange E on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_i , along with the percent of firms for which β_i is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_G = \beta_1 + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_G) = 0. Results are presented for the 16 smallest exchanges, 15 medium-size exchanges, and 16 largest exchanges.

Table 10: Global and Regional Commonality

		Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_i coefficient	p-value (Median SUM_i coefficient)
Panel A: Spread									
World (All Exchanges)	β_l	0.1231	0.1135	25.53%	59.57%	10.64%	4.26%	0.1852	0.001
	γ_l	0.1142	0.0475	23.40%	46.81%	25.53%	4.26%	0.0540	0.243
All Developed Markets	β_l	0.1553	0.1553	33.33%	51.85%	11.11%	3.70%	0.2327	0.052
	γ_l	0.1934	0.1873	33.33%	48.15%	18.52%	0.00%	0.1837	0.006
All Emerging Markets	β_l	0.0797	0.1012	15.00%	70.00%	10.00%	5.00%	0.1844	0.012
	γ_l	0.0073	0.0003	10.00%	45.00%	35.00%	10.00%	-0.0131	0.263
Panel B: Depth									
World (All Exchanges)	β_l	0.0479	0.0344	13.33%	53.33%	31.11%	2.22%	0.0725	0.040
	γ_l	0.0751	0.0398	26.67%	46.67%	24.44%	2.22%	0.0083	0.560
All Developed Markets	β_l	0.0398	0.0248	12.00%	52.00%	36.00%	0.00%	0.0908	0.122
	γ_l	0.1234	0.0546	32.00%	48.00%	20.00%	0.00%	0.0397	0.052
All Emerging Markets	β_l	0.0580	0.0482	15.00%	55.00%	25.00%	5.00%	0.0675	0.263
	γ_l	0.0147	0.0035	20.00%	45.00%	30.00%	5.00%	-0.0113	0.263

Note: Exchange-by-exchange (47) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \gamma_1 \Delta Liquidity_{R,t} + \gamma_2 \Delta Liquidity_{R,t+1} + \gamma_3 \Delta Liquidity_{R,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t}$$

$Liquidity_{E,t}$ is the exchange-level average relative effective spread (Panel A) and total depth in value (Panel B) of exchange E on day t . $Liquidity_{G,t}$ is the global liquidity index and $Return_{G,t}$ is the global return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms, except those firms trading on exchange E . $Liquidity_{R,t}$ is the regional liquidity index computed on day t using an equal-weighted average of each corresponding liquidity measure for all firms trading on an exchange located in the same region as exchange E . $Volatility_{E,t}$ is the return volatility for firms trading on exchange E on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_l , along with the percent of firms for which β_l is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_G = \beta_1 + \beta_2 + \beta_3$ and $SUM_R = \gamma_1 + \gamma_2 + \gamma_3$) and the p-value of a sign test testing whether Median (SUM_G) = 0 and Median (SUM_R) = 0.

Table 11: Global Commonality: Adjustment for Large Markets

	Average Coef.	Median Coef.	% Firms with >0 Coefficient Signif. 5% Level	% Firms with >0 Coeff. Not Signif. 5% Level	% Firms with <0 Coeff. Not Signif. 5% Level	% Firms with <0 Coefficient Signif. 5% Level	Median SUM_G coefficient	p-value (Median SUM_G coefficient)
Panel A: Spread								
World	0.1753	0.1764	44.68%	38.30%	14.89%	2.13%	0.2275	0.000
World but NYSE	0.1911	0.1936	42.55%	42.55%	14.89%	0.00%	0.2633	0.003
World but NASDAQ	0.1621	0.1835	44.68%	40.43%	14.89%	0.00%	0.2130	0.000
World but London Stock Ex.	0.1679	0.1829	44.68%	42.55%	8.51%	4.26%	0.2313	0.000
World but Tokyo Stock Ex.	0.1269	0.1480	36.17%	44.68%	17.02%	2.13%	0.1571	0.008
World but Four Largest Ex.	0.0969	0.0864	34.04%	42.55%	23.40%	0.00%	0.0907	0.040
Panel B: Depth								
World	0.0674	0.0352	26.67%	46.67%	22.22%	4.44%	0.0750	0.008
World but NYSE	0.0800	0.0522	24.44%	51.11%	22.22%	2.22%	0.0877	0.003
World but NASDAQ	0.1066	0.0813	28.89%	53.33%	17.78%	0.00%	0.1144	0.000
World but London Stock Ex.	0.0670	0.0344	22.22%	51.11%	22.22%	4.44%	0.0717	0.008
World but Tokyo Stock Ex.	0.0474	0.0249	17.78%	42.22%	35.56%	4.44%	0.0525	0.144
World but Four Largest Ex.	0.0922	0.0832	44.44%	42.22%	13.33%	0.00%	0.0875	0.003

Note: Exchange-by-exchange (47) time-series regressions of liquidity measures are estimated using:

$$\Delta Liquidity_{E,t} = \alpha + \beta_1 \Delta Liquidity_{G,t} + \beta_2 \Delta Liquidity_{G,t+1} + \beta_3 \Delta Liquidity_{G,t-1} + \delta_1 Return_{G,t} + \delta_2 Return_{G,t+1} + \delta_3 Return_{G,t-1} + \delta_4 \Delta Volatility_{E,t} + \varepsilon_{E,t}$$

$Liquidity_{E,t}$ is the exchange-level average relative effective spread (Panel A) and total depth in value (Panel B) of exchange E on day t . $Liquidity_{G,t}$ is the global liquidity index and $Return_{G,t}$ is the global return computed on day t using an equal-weighted average of each corresponding liquidity measure and return, respectively, for all firms, except those firms trading on exchange E and firms listed on NYSE, NASDAQ, London Stock Exchange, or Tokyo Stock Exchange. $Volatility_{E,t}$ is the return volatility for firms trading on exchange E on day t and is measured as the squared return for the day. The symbol Δ preceding a variable name denotes a proportional change in the variable across successive trading days. We present the average and median coefficient estimate of the exchange-level liquidity beta β_1 , along with the percent of firms for which β_1 is positive and significant at the 5% confidence level (t-statistic > 1.645), positive and not significant at the 5% confidence level, negative and not significant at the 5% confidence level, and negative and significant at the 5% confidence level, respectively. We report in the last two columns the median of the sum of the concurrent, lead and lag coefficient estimates ($SUM_G = \beta_1 + \beta_2 + \beta_3$) and the p-value of a sign test testing whether Median (SUM_G) = 0.