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ILLIQUIDITY AND STOCK RETURNS

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Abstract: A quarterly time series of the aggregate commission rate of NYSE trading for the period 1980-2003 is developed. The aggregate commission rate is of significant size, captures trading cost, and reflects market illiquidity. Consistent with financial theory, I find a positive relation between market returns and the aggregate commission rate. The impact of the aggregate commission rate on market returns survives a number of robustness checks and is significant after controlling for interest-rate factors, trading volume, and the variability of trading volume. Overall, the findings suggest that market-wide liquidity is a state variable important for asset pricing.

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INTRODUCTION

Commission costs influence security returns, selection, and pricing. Commission costs are of interest to portfolio managers, traders, and academicians studying market quality and efficiency. Market frictions and trading costs may help to explain some frequently observed anomalies, such as abnormal returns for stocks of small size or low price. A reliable time series of the aggregate commission rate serves as a good proxy for aggregate market illiquidity and reveals changes in market quality over time. It is also valuable in asset pricing (Jones, 2002). However, due to the lack of comprehensive data, most prior research relies on commission costs and other frictions estimated over relatively short time horizons.

Commission revenue is tracked for all NYSE member brokers' exchange equity trading and NYSE public trading volume. For the aggregate commission rate, the ratio of commission revenue to volume, I construct a quarterly time series for the period 1980-2003. The commission rate estimate closely matches estimates of institutional commission rates, for shorter time periods, reported by Berkowitz, Logue and Noser (1988), Jones and Lipson (2001), and Jones (2002). The aggregate commission rate has a strong correlation with other measures of illiquidity; it is comparable in size to half of the bid-ask spread of Dow Jones stocks and is highly correlated with the bid-ask spread, the absolute order imbalance, and the proportion of small trades of Dow Jones stocks.

Over time, the aggregate commission rate is significantly and positively related to the excess returns of the market portfolio of all NYSE/AMEX/NASDAQ stocks, after controlling for trading

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volume and interest rate factors. Average stock returns are positively related to trading volume and negatively related to the variability of trading volume. I conduct vector autoregression analysis to examine the dynamics among stock returns, the aggregate commission rate, and trading volume. The results show that the expected change in the aggregate commission rate and the expected change in volume are positively related to expected excess returns. The unexpected change in the aggregate commission rate and the unexpected change in volume are positively related to unexpected excess returns. This is consistent with theory and is significant and robust controlling for interest rate factors and seasonality. The unexpected change in volume is positively related to the unexpected change in the commission rate in the short term. Changes in volume and in the aggregate commission rate also track past market returns. Higher returns in the prior quarter attract more buyer-initiated volume in the current quarter, which increase trading costs and thus, the commission rate.

This paper complements prior research examining the determinants, structure and information content of commission costs. Edmister and Subramaniam (1982) examine the determinants and structure of institutional brokerage commission revenue following the May 1975 deregulation of commissions. Berkowitz et al. (1988) examine NYSE commission and execution costs of institutional investors. Jones and Lipson (2001) examine the effect of the June 1997 NYSE tick size reduction on trading costs of institutional traders. Jones (2002) constructs an annual time series of the aggregate commission rate from the NYSE minimum commission schedules for the period 1925-1967 and NYSE member brokerage commission income scaled by NYSE dollar volume for the period 1968-2000. However, Jones (2002) brokerage commission data includes commission income from equity trading in other exchanges and income from trading bonds and other securities. In addition, the NYSE dollar volume Jones uses to scale the brokerage commission income is total volume, which includes NYSE member trading that does not contribute to NYSE member brokerage commissions. My measure of the aggregate commission rate improves on Jones' measure and my results support Jones' suggestion that commission cost is an important determinant of equity returns.

This paper complements the recent development (see for example, Acharya and Pedersen (2005)) of relatively new measures of aggregate market liquidity within the context of asset pricing. The market microstructure literature establishes that liquidity is an important factor in price discovery. A market-wide liquidity shock should affect returns of all assets and the average returns of the aggregate market. Consistent with prior studies, my results show that aggregate market illiquidity is a systematic risk factored in asset pricing.

The remainder of this paper is organized as follows. Section II discusses the aggregate commission rate as a liquidity measure. Section III presents the empirical methodology. Section IV describes data. Section V documents the empirical results. Section VI summarizes the results.

COMMISSION COSTS AND ILLIQUIDITY

In this section, I review the relation between the aggregate commission rate and market illiquidity. In financial markets, liquidity is seen as the degree to which transactions of large size can be carried out in a timely fashion with minimal impact on prices. A good measure of liquidity should incorporate key elements of volume, time, and transaction costs.

Commissions vary over time and are not a constant proportion of stock price (Jones, 2002). Commission charges change substantially after May 1975. Both share price and transaction size are now determinants of the commission rate as a percentage of value traded (Edmister and Subramaniam, 1982). Per-share commissions are the dominant form of payment between brokers and institutional clients. The negotiated rate per share charged to institutional investors is dependent on the trade size and research provided by the broker, which is recently in the range of several cents per share. The relative market power of the broker and the client also determines the rate charged, which reflects the demand and supply of market liquidity. For profit maximization, brokers may charge a higher commission rate when trading volume is persistently higher and a lower commission rate when volume is persistently lower.

Commission rates charged to retail traders differ across brokers. Discount brokers charge a per-trade commission. Full-service brokers charge a percentage of assets fee, according to order size and price. Coler and Schaefer (1988) report that for both types of broker the commission charged as a proportion of trade value declines as a function both of trade size and share price traded. The commission rate, controlling for the number of shares traded, conveys information about trade size and market depth. In the context of market microstructure, small trade size is associated with low price volatility. Informed traders, who tend to camouflage their trading activity, choose trades close to the median size of trades of institutional investors (Barclay and Warner, 1993; Chan and Fong, 2000). Chan and Fong also report a positive relation between trade size and price impact. When the proportion of small trades increases, a liquidity trader’s larger size order faces higher price impact. Therefore, the higher commission per share due to the presence of more small trades coincides with higher trading costs and market illiquidity.

There is also a more direct relation; the aggregate commission rate proxies for illiquidity in that it accounts for the demand and supply of liquidity as well as transaction costs. Public orders subject to commission charges, originating off the floor reach the specialist electronically through the NYSE’s SuperDot system or are walked to the post by floor brokers. Hasbrouck, Sofinaos and Sosebee (1993) report that in 1992 about 75% of orders (28% of the executed NYSE share volume) reach specialists via SuperDot. Floor brokers tend to represent larger and more difficult to execute orders. Relatively small portfolio adjustments by large financial institutions are often too large for a specialist to absorb. These large blocks are often brought to the “upstairs market.” The “blocks” are then “chopped” and searches are initiated for counter-parties. These trades are reported to the relevant specialists on the floor after counter-parties are located and deals struck. The fee that broker firms charge for their service, thus, should account for their effort (transaction costs) and the supply and demand for their service.

Overall, the aggregate commission rate (ACR) reflects (1) trading volume, (2) the proportion of small orders, (3) the proportion of retail and institutional orders (ACR is higher when retail investors constitute a larger proportion of trading), and (4) the proportion of orders entered through discount brokers and full service brokers. Since all four factors convey information about market liquidity and trading costs, the aggregate commission rate proxies for aggregate market trading costs and illiquidity.

An alternate measure of liquidity is the bid-ask spread (Amihud and Mendelson, 1986 and Glosten and Milgrom, 1985). The bid-ask spread is associated with the adverse selection cost to the market dealer and compensates the market dealer for the order processing cost and liquidity risk associated with holding an illiquid asset. However, the bid-ask spread does not incorporate the key element of time or immediacy. The bid-ask spread also needs to be applied at a disaggregated level for segmented markets. As a practical matter, constructing systematic liquidity measures by aggregating microstructure data, such as the bid-ask spread, is costly and subject to the availability of transaction data.

Both the aggregate commission rate and the bid-ask spread reflect costs associated with matching buyers and sellers, adverse selection, and order processing. The aggregate commission rate accounts for the supply and demand for liquidity and transaction costs. Lee and Swaminathan (2000) suggest that a suitable proxy for liquidity should have a high correlation with other liquidity measures such as trade size and relative bid-ask spread. They argue that trading volume does not meet this requirement. Jones (2002) assembles an annual time series of the NYSE commission rate per value and the proportional bid-ask spread of Dow Jones stocks. These two series have a correlation of 24.3%. My aggregate commission rate has a substantially higher correlation; the bid-ask spread exhibits a correlation of 44.8% with the aggregate commission rate per share, and 67.3% with the aggregate commission rate per trade value. Furthermore, the aggregate commission rate is highly correlated with absolute order imbalance (72.7%) and with the proportion of small trades (66%). Thus, the aggregate commission rate is highly correlated with order processing costs and asymmetric information risk.

In summary, the aggregate commission rate reflects the key elements of volume, time, both processing and information costs, and serves as a useful proxy for trading cost and market illiquidity (also see Edmister and Subramanian, 1982). In addition, it has a high correlation with the bid-ask spread and other market illiquidity measures, which are harder to measure over a longer time period.

DATA

The Aggregate Exchange Commission Revenue of NYSE Member Brokers

The Securities Industry Association (SIA) provides NYSE member brokers' aggregate exchange commission revenue. The SIA derives this data from the SEC's Financial and Operational Combined Uniform Single Report regulatory filings and provides timely (quarterly) reporting on the U.S. securities industry's financials. Although NYSE brokers are relatively small in number (240 at year-end 2002), they include all major U.S. brokerage firms. Because NYSE brokers account for approximately 75% of the revenue, capital assets, and other financial parameters of the broker-dealers reporting to the SEC, the SIA databank accounts for a majority of the total financials of U.S. securities operations. In contrast, the SEC reports only annual data on all broker-dealers and with a substantial lag time.

I track the time series data of exchange commission revenue, which is the total quarterly commission income of all NYSE member brokers resulting from exchange equity transactions. The exchange equity commission revenue of NYSE member brokers has experienced substantial growth in the last two decades, from $1.12 billion in the first quarter of 1980 to $3.59 billion in the fourth quarter of 2003. The mean is $2.471 billion with a standard deviation of $0.117 billion (see Table 1).

Table 1
Summary of Data

The sample consists of quarterly observations from the first quarter of 1980 to the fourth quarter of 2003 for all variables. Excess market returns are quarterly returns (%) in excess of ¼ of three-month T-bill rate. Interest rates are quoted in percentage (%) and per annum. NYSE trading volume is in billions of shares. The aggregate commission rate (ACR) is defined as the aggregate exchange equity commission revenue of all NYSE member brokers divided by NYSE public share volume. The proportional aggregate commission rate is equal to ACR divided by the dollar volume weighted average share price, reported in percentage.

Descriptive Statistics

	Mean	Standard Deviation	Minimum	Maximum
Excess Return of Value-weighted Total Market, $ERVW_t$	1.755	8.801	-24.580	20.188
Excess Return of Equal-weighted Total Market, $EREW_t$	2.259	11.742	-30.627	31.096
Excess Return of Value-weighted NYSE Stocks	1.800	7.966	-24.097	18.929
Excess Return of Equal-weighted NYSE Stocks	2.006	9.220	-26.670	26.813
Credit Spread	2.164	0.561	1.300	3.820
Term Spread	0.166	0.307	-0.690	0.940
Three-month T-bill Rate	6.429	3.172	0.920	15.020
NYSE broker exchange equity commission ($bil)	2.471	0.117	0.790	5.510
NYSE Share Volume (bil)	26.446	27.386	2.269	99.189
NYSE Share Turnover Rate	0.155	0.049	0.071	0.287
Coefficient of Variation of daily NYSE Share Volume	0.178	0.059	0.090	0.449
Aggregate Commission Rate ($/share)	0.110	0.061	0.027	0.272
Proportional Aggregate Commission Rate (%)	0.236	0.137	0.071	0.567
First order log difference of quarterly NYSE share volume, $\Delta NYSE_t$	0.035	0.105	-0.277	0.295
First order log difference of quarterly NYSE share volume turnover rate, $\Delta TURN_t$	0.010	0.103	-0.310	0.295
First order difference of the coefficient of variation of the daily NYSE trading volume in quarter t, $\Delta NYSECV_t$	0.000	0.077	-0.271	0.302
First order log difference of the Aggregate Commission Rate, ΔACR_t	-0.023	0.065	-0.180	0.206

NYSE Trading Volume

I use NYSE share volume to proxy for market trading activity. Trading volume increases from 3 billion shares in the first quarter of 1980 to 86 billion shares in the fourth quarter of 2003. Mean share volume is 26 billion with a standard deviation of 27 billion. Since the level of trading volume is non-stationary in the sample period, the logarithm changes of trading volume better reveal the direction and magnitude of market trading activity. Turnover is often used to measure volume (Jain and Joh, 1988; Campbell, Grossman, and Wang, 1993). I estimate the turnover rate of NYSE stocks, which is equal to the quarterly share volume normalized by the quarterly average number of shares of NYSE stocks. Average turnover is 0.155 with a standard deviation of 0.049. This turnover is used as an alternate measure of market activity. I use the logarithm change over each quarter in my empirical analysis.

Varying persistence in trading volume may reflect varying market sentiment. I calculate the coefficient of variation of daily NYSE trading volume for each quarter to estimate the variability of trading volume. The mean coefficient of variation is 0.178 with a standard deviation of 0.059. I use the change in the coefficient of variation to proxy for the change in the second moment of trading volume.

The Aggregate Commission Rate

The aggregate commission rate is determined from the aggregate commission revenue and the trading volume that contributes to the commission revenue. Since NYSE members trade for their own accounts, not all NYSE volume contributes to exchange commissions. The NYSE provides monthly share and dollar volume on the exchange, and total member purchases and sales. The total member volume consists of specialist purchases and sales, purchases and sales of non-specialists originating on the floor, and purchases and sales of non-specialists originating off the floor. I aggregate NYSE member purchases and sales into a quarterly measure, then subtract the sum of quarterly member purchases and sales from two times the quarterly NYSE share volume. This contributing volume is used to scale the quarterly equity commissions to obtain the one-way aggregate commission rate per share as follows:

$$ACR_t = \frac{NYSE\ Member\ Brokers'\ Exchange\ Equity\ Commissions}{2 \times NYSE\ Share\ Volume - NYSE\ Member\ Purchases\ and\ Sales} \tag{1}$$

I calculate the volume weighted average execution price as the quarterly NYSE dollar volume scaled by NYSE share volume. The aggregate commission rate per share divided by this average execution price is the proportional commission rate on value:

$$Proportional\ ACR_{t\,x} = \frac{ACR_t}{NYSE\ Dollar\ Volume / NYSE\ Share\ Volume} \tag{2}$$

The time series mean of the NYSE aggregate commission rate is 11.0¢ per share, which is 0.236% of price for the sample period 1980-2003 (Table 1). The commission rate exhibits a high standard deviation of 6.1¢ or 0.137%. Not surprisingly, the NYSE commission rate is declining through the sample period, from 25.1¢ (0.58%) in early 1980 to 2.9¢ (0.07%) at the end of 2003.

My aggregate commission rate estimates are consistent with reported estimates of institutional commission rates. For example, Berkowitz et al. (1988) estimate 1985 institutional commission costs on NYSE trading as 0.18%, and my aggregate commission rate estimate is 0.31%. Jones and Lipson (2001) find an average institutional commission rate of 0.119% for

NYSE trades for the second and third quarters of 1997, which is the same as my estimate of the aggregate commission rate for this time period.

My aggregate commission rate is comparable to the half bid-ask spread and price impact reported in prior research. For example, Bessembinder and Kaufman (1997) report that the effective half spread and price impact (measured at one-day horizon) of all NYSE stocks in 1994 are 0.394% and 0.297%, respectively. The corresponding estimates for large NYSE stocks are 0.229% and 0.185%. My estimate of the NYSE aggregate commission cost for 1994 is 0.19% (6.25¢/share).

Data and Statistics

To estimate market excess returns (ER_t) I subtract the quarterly percentage three-month treasury bill rate effective at the beginning of the quarter from the percentage returns of the market portfolio of all NYSE/AMEX/NASDAQ stocks, cum dividend. I check the market portfolio using both value-weighted and equal-weighted methods.

Table 1 provides summary statistics of the data. The mean excess return of the value-weighted (equal-weighted) market portfolio is 1.755% (2.259%) during the period with a standard deviation of 8.801% (11.742%). The higher mean and standard deviation of the equal weighted market portfolio are expected since smaller stocks have higher expected returns and risk. NYSE stocks also have returns and risks comparable to those of the total market. The credit spread, the annual BAA rates minus the 10-year Treasury rates, averages 2.164%, while the term spread, the 30-year Treasury rate minus the 3-month Treasury bill rate, averages 0.166%.

The Bid-Ask Spread, Order Imbalance, Small Trade Ratio, and Commission Rate

Theory predicts that the size of bid-ask spreads is a positive function of asymmetric information in trading. To proxy illiquidity, the aggregate commission rate should covary with the bid-ask spread. Using NYSE TAQ data, I estimate daily the average quoted bid-ask spread normalized by the mid-quote of each Dow stock. I aggregate this daily measure into a quarterly measure for each stock and then take the cross-sectional average of all 30 Dow stocks to proxy the average bid-ask spread for the market.

Previous studies find that order imbalances may contain information. Kyle (1985) and Admati and Pfleiderer (1988) show that net order flow induces price changes. In their models, market makers infer asymmetric information from net order flow. Since informed traders are one-side traders, a higher intensity of informed trading naturally causes greater order imbalance. The clustering of one-side trading, informed or not, causes market illiquidity and higher trading costs. Therefore, order imbalances may proxy for market illiquidity. Empirical studies (see, for example, Chan and Fong, 2000; Chordia et al., 2002) have found that order imbalances contain information that can explain intradaily price movements.

There are relatively few studies on the effect of trade size and results differ depending on research design. While Grundy and McNichols (1989) and Kim and Verrecchia (1991) show that informed traders prefer to trade large amounts at any given price, Barclay and Warner (1993) and Chan and Fong (2000) find that informed traders tend to camouflage their trades among median size trading. In the presence of a large number of small trades, market depth is reduced and commission cost per share increases. Therefore, a higher proportion of small trades may coincide with higher illiquidity (for medium or large size trading) and higher realized commission cost per share.

Trades are classified into buys and sells using the Lee and Ready (1991) method; trades at prices above the midpoint of the bid and ask are classified as buys and those below the midquote are sells. Trades at mid-quote are classified using a "tick test". The order imbalance is set equal to the total number of sells minus the total number of buys. I then divide the absolute value of the order imbalance by the total number of trades each day. For the classification of small trades, I follow the approach of Barclay and Warner (1993), and Chan and Fong (2000) to define orders with less than 500 shares as small trades. I then calculate the ratio of small trades to total trades for each day. I then aggregate the daily order imbalance and small trade ratio of each Dow stock into a quarterly measure and take the cross-sectional average of the 30 Dow stocks to obtain a quarterly measure of order imbalance and a small trade ratio.

Table 2 reports the statistics of the three market microstructure variables and their correlations with the aggregate commission rate, trading volume, and turnover. I choose a sample period of Jan.1, 1993 to June 30, 2001, because the NYSE TAQ database begins in 1993 and price decimalization begins in April 2001. The average bid-ask spread of the Dow stocks is 0.449% with standard deviation of 0.098%. The aggregate commission rate for the same sample period is 6.6¢/share with a standard deviation of 1.5. The proportional commission rate is 0.136% with a standard deviation of 0.045%. The spread and commission rate exhibit a similar level of variability measured by coefficient of variation. The one-way percentage commission rate is 60% of the half bid-ask spread (0.225%). The commission rate and bid-ask spread share a similar time trend and their relative size remains comparable during this sample period. The bid-ask spreads in the first quarter of 1993 and the second quarter of 2001 are 0.623% and 0.470%, respectively, while the aggregate commission rates are 0.270% (9.25¢/share) and 0.115% (4.13¢/share), respectively.

Panel B of Table 2 reports correlations for key variables. As expected, the aggregate commission rate exhibits strong correlations of 0.448, 0.727 and 0.660 with the bid-ask spread, order imbalance, and small trade ratio. The correlation between the proportional commission rate and bid-ask spread is 0.673. All correlation coefficients are significant at the 1% level. This lends strong support to the role of the commission rate as an illiquidity measure. NYSE trading volume and turnover are also significantly and negatively related to the bid-ask spread, order imbalance, and small trade ratio. When market liquidity is high, i.e. high trading volume and a low commission rate, small trades occupy a small proportion of total volume.

RESEARCH DESIGN

There are several ways to develop a return generating process for the aggregate stock market. Chen, Roll and Ross (1986) price the aggregate equity market based on the present value model. Alternatively, a number of risk factors may explain market returns. In this paper, I follow Chordia, Subrahmanyam and Anshuman (2001); returns are generated by an L-factor approximate factor model:

Table 2
Commission Rate and Market Microstructure Variables

Statistics reported in this table are for the sample period January 1, 1993-June 30, 2001. The average bid-ask spread (normalized by mid-quote), order imbalance, and small trade ratio of the Dow Jones 30 stocks are calculated from NYSE TAQ data and then aggregated to quarterly measures. Panel A reports the descriptive statistics for the variables. Panel B reports the Pearson correlations (p-value in parentheses) for the microstructure variables, NYSE share volume ($NYSE_t$) in billions the NYSE share turnover rate ($TURN_t$) and Aggregate Commission Rate (ACR_t) in dollars, and the proportional ACR_t as a percentage.

Panel A. Descriptive Statistics

	Bid-Ask Spread$_t$	Order Imbalance$_t$	Small Trade Ratio$_t$	NYSE$_t$	TURN$_t$	ACR$_t$	Proportional ACR$_t$
Mean	0.449%	0.156	0.622	36.878	0.173	0.066	0.136%
Standard Deviation	0.098%	0.031	0.018	19.034	0.034	0.015	0.045%

Panel B. Pearson Correlations of the Key Variables (p-values in parentheses)

	Bid-AskSpread$_t$	Order Imbalance$_t$	Small Trade Ratio$_t$
NYSE$_t$	-0.323	-0.779	-0.654
	(0.055)	(0.000)	(0.000)
TURN$_t$	-0.416	-0.762	-0.684
	(0.012)	(0.000)	(0.000)
ACR$_t$	0.448	0.727	0.660
	(0.006)	(0.000)	(0.000)
Proportional ACR$_t$	0.673	0.690	0.578
	(0.000)	(0.000)	(0.000)

$$R_t = E(R_t) + \sum_{k=1}^{L} \beta_k f_{kt} + \varepsilon_t \ , \tag{3}$$

where R_t is the return on the aggregate stock market at time t, and f_{kt} is the return on the kth factor at time t. The quarterly return of the aggregate stock market may exhibit autocorrelation. The expected return for each period, $E(R_t)$, thus should include the risk free return and an autoregressive term from previous quarters. Relaxing the zero mean assumption on the risk factors, Model (3) is thus expanded to the interest rate adjusted model with inclusion of N past returns and an intercept:

$$ER_t = \beta_0 + \sum_{k=1}^{K} \beta_k f_{kt} + \sum_{i=1}^{N} \theta_{t-i}\varepsilon_{t-i} + \varepsilon_t \ , \tag{4}$$

where $ER_t = R_t - R_{Ft}$ is the aggregate market excess return at time t.

The logarithm changes of the aggregate commission rate and trading volume are included as risk factors. Since both the aggregate commission rate and trading volume are persistent over time and have a nonstationary trend, their logarithm changes represent the direction and magnitude of market illiquidity and trading activities. I also include other prevailing risk factors. The interest rate is a traditional proxy that captures the state of investment opportunities (Chen, Roll and Ross, 1986; Ferson and Harvey, 1991). Fama and French (1993) identify the term spread and credit spread as two bond-market risk factors. Changes in interest rates may influence margin requirements and short-selling constraints. This implies that trading activities may be related to changes in short-term interest rates. Increases in the long-term Treasury bond yield and the credit spread may also cause investors to reallocate assets between equity and debt. To account for these effects, I include changes in the term spread, credit spread and the short-term interest rate in addition to trading activity and liquidity factors. I include the market return residuals of the previous quarters in the analysis to control for the auto-correlation of returns.

Whether market liquidity is endogenous to market trading activity and returns is an important issue with respect to market quality. Since illiquidity is a substantial risk factor that concerns investors, answers to these questions have important implication in dynamic portfolio management. Arguably, liquidity is driven by the supply of shares. From a shareholder's viewpoint, commission cost is priced when a buy decision is initially made. Intuitively, buyers are more sensitive to liquidity risk. I examine the temporal dynamics among market returns, trading activity and the commission rate. Toward this end, I perform vector autoregression (VAR). Quarter dummies are included to check possible seasonal effects and I examine the variables of past quarters in the VAR analysis. The model is constructed as follows:

$$\begin{pmatrix} ERVW_t \\ \Delta NYSE_t \\ \Delta ACR_t \end{pmatrix} = A + B \cdot \begin{pmatrix} \Delta CSPR_t \\ \Delta TSPR_t \\ \Delta TBIL_t \end{pmatrix} + C \cdot \begin{pmatrix} Q2 \\ Q3 \\ Q4 \end{pmatrix} + \sum_{i=1}^{N} \Theta_i \xi_{t-i} + \zeta_t \qquad (5)$$

where $\zeta_t \sim N(0_{3,1}, \Sigma_{3,3})$ and A is the intercept. The order of lags is chosen by the AIC.

EMPIRICAL RESULTS

Contemporaneous Relation: Aggregate Liquidity, Trading Activity, and Market Returns

Hasbrouck and Seppi (2001) and Chordia, Roll, and Subrahmanyam (2000) document correlated movements in liquidity and suggest that aggregate liquidity may be a systematic factor that impacts asset pricing. Theory suggests that an additional component of long-run return is required whenever financial assets are influenced by systematic risks. If there is a common factor associated with non-diversifiable liquidity risk, the long-run aggregate market returns need to compensate for such systematic risk.

I examine the contemporaneous relation between stock market returns, trading activity and the aggregate commission rate. The aggregate commission rate captures two components of illiquidity, the exogenous liquidity shock due to technology advancement and market structure change, and the effective trading cost endogenous to trading activity. Because larger trading volume reduces unit commission cost, all else remaining the same, the aggregate commission rate captures the liquidity information reflected in trading volume.

Table 3 summaries the contemporaneous relation among NYSE trading volume, the aggregate commission rate, and market returns, controlling for the interest rate risk factors and past returns. I am also interested in the impact of the variability of trading volume on market returns. Hence, I include the standard deviation of daily NYSE volume normalized by the

Table 3

Regressions of Excess Market Returns on NYSE Volume and Aggregate Commission Rate

The dependent variables of the regressions are the excess returns of the Market Portfolio and NYSE stocks (value-weighted and equal-weighted), respectively. $\Delta NYSE_t$ is the logarithm change of quarterly NYSE trading volume; $\Delta NYSECV_t$ is the change rate of the coefficient of variation of the daily NYSE trading volume in quarter t; ΔACR_t is the logarithm change of the aggregate commission rate; $\Delta CSPREAD_t$ is the first order difference of the credit spread between Moody's BAA rate and the 10-year Treasury Bond rate; $\Delta TSPREAD_t$ is the first order difference of the term spread between the 30-year Treasury Bond rate and the 3-month Treasury Bill rate; $\Delta TBIL_t$ is the first order difference of the 3-month Treasury Bill rate. Standard errors are in parentheses. Excluding the first order lag, or including higher order lags, doesn't qualitatively change the regression estimates. Standard errors are reported in parentheses.

Panel A. Excess returns of value-weighted portfolios

	Total Market Returns			NYSE Returns	
Independent	(A)	(B)	(C)	(D)	(E)
Intercept	1.152	1.042	3.491***	2.824***	2.772***
	(0.885)	(0.866)	(0.691)	(0.772)	(0.718)
NYSE Volume ($\Delta NYSE_t$)	22.009***	24.717***		13.349	12.026
	(8.315)	(8.271)		(7.670)	(7.175)
Variation of NYSE Volume ($\Delta NYSECV_t$)		-23.350**		-22.888**	-21.063**
		(11.680)		(10.711)	(10.053)
Aggregate Commission Rate (ΔACR_t)			72.008***	65.390***	57.569***
			(12.131)	(12.510)	(11.697)
$\Delta CSPREAD_t$	-7.142**	-6.04	-4.458	-4.262	-4.087
	(3.271)	(3.259)	(2.808)	(2.854)	(2.667)
$\Delta TSPREAD_t$	-11.717	-10.968	-9.225	-8.495	-1.932
	(7.620)	(7.491)	(6.683)	(6.490)	(6.063)
$\Delta TBIL_t$	-1.665	-1.702	-1.661	-1.774**	-1.29
	(1.021)	(1.003)	(0.897)	(0.876)	(0.819)
ε_{t-1}	-0.055	-0.061	-0.184	-0.198	-0.209
	(0.111)	(0.112)	(0.109)	(0.110)	(0.110)
R^2	0.181	0.22	0.36	0.411	0.363
AIC	613.765	611.5	592.3	589.1	577.6

** : Significant at the 5% level.

***: Significant at the 1% level.

Panel B. Excess returns of equal-weighted portfolios

	Total Market Returns			NYSE Returns	
Independent	(A)	(B)	(C)	(D)	(E)
Intercept	0.753	0.565	4.042***	2.626***	2.245***
	(1.041)	(0.997)	(0.871)	(0.917)	(0.797)
NYSE Volume ($\Delta NYSE_t$)	37.102***	41.943***		27.242***	21.354***
	(10.120)	(9.555)		(8.853)	(7.829)
Variation of NYSE Volume ($\Delta NYSECV_t$)		-48.701***		-47.250***	-31.771***
		(13.519)		(12.168)	(10.867)

table 2 contd.

Independent	Total Market Returns (A)	(B)	(C)	NYSE Returns (D)	(E)
Aggregate Commission Rate (ΔACR_t)			89.333*** (15.191)	74.119*** (14.474)	51.877*** (12.781)
$\Delta CSPREAD_t$	-13.850*** (3.967)	-11.292** (3.765)	-10.210*** (3.518)	-9.780*** (3.307)	-8.573*** (2.917)
$\Delta TSPREAD_t$	-20.450** (9.239)	-19.097** (8.651)	-17.473** (8.371)	-16.161** (7.540)	-4.41 (6.641)
$\Delta TBIL_t$	-2.529** (1.241)	-2.560** (1.159)	-2.478** (1.123)	-2.758*** (1.012)	-2.354*** (0.894)
ε_{t-1}	-0.095 (0.111)	-0.066 (0.112)	-0.173 (0.109)	-0.146 (0.111)	-0.178 (0.111)
R^2	0.33	0.423	0.445	0.565	0.438
AIC	647.6	636.6	631.2	614.1	592.7

** : Significant at the 5% level.

***: Significant at the 1% level.

average daily volume of the quarter in the regressions to study the influence of the second moment of trading volume on average market returns.

If trading activity proxies market liquidity, one would expect a negative relation between the level of trading volume and market returns since increases in trading volume would mean lower liquidity risk, which should command a lower return. If the variability of liquidity is to be priced— i.e., investors are risk averse and dislike the variability of liquidity—greater variability of liquidity should command a higher expected return. As such, one would expect a positive relation between the second moment of trading volume and the expected market returns.

Panel A reports the analysis on the excess returns of the value-weighted market portfolio. Columns A and B report the regression focusing on trading volume. They present a significantly positive relation between the level of trading volume and market returns. It is consistent with the usual observation that volume tends to be higher when stock prices are increasing than when prices are falling (e.g., Campbell, Grossman, and Wang, 1993). Complementing the cross-sectional results of Chordia, Subrahmanyam, and Anshuman (2001), I find a negative time series relation between the variability of trading volume and market returns. The regressions have high R-square ratios (0.181 and 0.220) that indicate a relatively high degree of goodness-of-fit.

These results suggest that the short-run dynamic changes of trading volume are more related to market sentiment than to market liquidity. It is usually observed that market returns are driven by active trading. In this context, the level of trading volume reflects investor confidence, and the variability of daily trading volume reflects the disagreement in investor confidence. High and persistent volume represents strong market sentiment, and low and variable volume represents market pessimism. Thus, I suggest that market sentiment explains the market returns' positive correlation with volume and negative correlation with the variability of volume.

Column C reports the regression results using the aggregate commission rate as an illiquidity proxy. The aggregate commission rate exhibits a positive and significant relation with market returns. The coefficient is 72.008, significant at the 1% level. The R-square ratio is 0.360, higher than those in Columns A and B, indicating a better degree of goodness-of-fit. The positive relation between the aggregate commission rate and the market return indicates that illiquidity does impact asset returns.

To give a broader picture of the market return generators, I include both trading activity and illiquidity factors in the regression and report the results in Column D. I find that the effect of the aggregate commission rate remains economically and statistically significant after controlling for trading activity and other factors. The standard deviation of ΔACR_t is 0.065 in the sample and the sensitivity of returns to the change in the aggregate commission rate is 65.390 (Table 3, Panel A, Column D). This implies that, an increase (decrease) of one standard deviation in the aggregate commission rate is associated with a 4.25% increase (decrease) in the quarterly market premium. Market returns retain a positive correlation with the level of trading volume and a negative correlation with the variation of trading volume as reported in Column B. The R-square ratio is 0.411, which indicates an improved goodness-of-fit relative to the regressions in Columns A, B and C. As a robustness check, I run the same model with the excess returns of the value weighted NYSE stocks as the dependent variable. The results reported in Column E are similar to those of the regression using the total market excess returns as the dependent variable. The results in Columns D and E suggest that an appreciable fraction of the time-series variation of market returns is captured by trading activity and market liquidity.

As a robustness check, I conduct the same analysis on the excess returns of the equal-weighted total market portfolio and report the results in Panel B. The explanatory power of trading volume, variability of trading volume and the aggregate commission rate remain significant. The main differences are significant relations with the interest rate factors and higher R-squares than those in Panel A.

Turnover is also a popular measure of trading volume. I replace the logarithm change in NYSE trading volume with the change in turnover of all NYSE shares in the preceding regressions. Table 4 reports the results of the regressions on the excess returns of value-weighted and equal-weighted market portfolios. The coefficient estimates are consistent with those in Table 3. The turnover rate is significantly related to market returns, while the variability of trading volume is negatively related to market returns. After controlling for the trading volume variables, the aggregate commission rate is positively and significantly related to market returns.

Overall, my results show that market returns are positively related to the aggregate commission rate over time controlling for trading volume and the interest rate variables. In contrast, market returns are positively related to trading volume and negatively related to the variability of trading volume.

Dynamics among Market Returns, Trading Activity, and Commission Rate

As stated earlier, trading activity measures such as trading volume are often used to proxy for liquidity in previous studies. Theory is mute on either the positive relation between the level of trading volume and market returns or the negative relation between the variability of trading

Table 4

Regressions of Excess Market Returns on NYSE Turnover and Aggregate Commission Rate

The dependent variables of the regressions are the excess returns of the value-weighted and equal-weighted total market portfolios, respectively. $\Delta TURN_t$ is the logarithm change of the quarterly NYSE shares turnover rate; $NYSECV_t$ is the coefficient of variation of the daily NYSE trading volume in quarter t; ΔACR_t is the logarithm change of the aggregate commission rate; $\Delta CSPREAD_t$ is the first order difference of the credit spread between Moody's BAA rate and the 10-year Treasury Bond rate; $\Delta TSPREAD_t$ is the first order difference of the term spread between the 30-year Treasury Bond rate and the 3-month Treasury Bill rate; $\Delta TBIL_t$ is the first order difference of the 3-month Treasury Bill rate. Standard errors are in parentheses. Excluding the first order lag, or including higher order lags, doesn't qualitatively change the regression estimates. Standard errors are reported in parentheses.

	Value-weighted Market Portfolio		Equal-weighted Market Portfolio	
Independent	(A)	(B)	(C)	(D)
Intercept	1.589**	3.057***	1.626	3.384***
	(0.792)	(0.710)	(0.902)	(0.847)
NYSE Volume Turnover ($\Delta TURN_t$)	32.982***	16.992**	46.033***	26.076**
	(9.043)	(8.880)	(10.786)	(10.497)
Variation of NYSE Volume ($NYSECV_t$)	-34.744***	-28.620***	-63.414***	-54.771***
	(12.162)	(11.391)	(14.745)	(13.423)
Aggregate Commission Rate (ΔACR_t)		61.592***		73.742***
		(12.958)		(15.325)
$\Delta CSPREAD_t$	-6.694**	-4.647	-11.957***	-9.819***
	(3.198)	(2.877)	(3.812)	(3.406)
$\Delta TSPREAD_t$	-11.599	-9.115	-20.024**	-16.983**
	(7.310)	(6.490)	(8.698)	(7.689)
$\Delta TBIL_t$	-1.927**	-1.867**	-2.753**	-2.786***
	(0.985)	(0.877)	(1.174)	(1.038)
ε_{t-1}	-0.057	-0.178	-0.108	-0.164
	(0.112)	(0.111)	(0.111)	(0.111)
R^2	0.257	0.415	0.414	0.546
AIC	607.3	588.5	638	617.8

** : Significant at the 5% level.
***: Significant at the 1% level.

volume and market returns. Most previous studies on the dynamics between volume and returns examine the contemporaneous and inter-temporal relations between trading volume and absolute returns (volatility) or between volume and the autocorrelation of returns (e.g., Karpoff, 1987; Jain and Joh, 1988; Hiemstra and Jones, 1994). However, there is evidence on the dynamic relation between trading volume and returns. Using monthly data, Lee and Swaminathan (2000) document that the relation between trading volume and expected returns depends on the stocks' prior performance. Gervais, Kaniel and Mingelgrin (2001) document that stocks experiencing unusually high (low) trading volume over a period of one day to a week tend to appreciate (depreciate) in the following month. In this subsection, I examine the temporal dynamics among market returns, trading activity and the commission rate modeled in (5).

Table 5 summarizes the results of the VAR analysis on trading volume and market returns. Panel A reports the parameter estimates. Expected market returns are not significantly related to lag trading volume and the commission rate. In contrast, trading volume and the aggregate

Table 5

VAR Analysis on Excess Market Returns, NYSE Volume, and Aggregate Commission Rate

The dependent variables are the Excess returns of value-weighted Market portfolio, the logarithm change of NYSE Volume, and the logarithm change of the aggregate commission rate. The explanatory variables include $\Delta CSPREAD_t$, $\Delta TSPREAD_t$, $\Delta TBIL_t$, and the first two orders of lagged excess returns, logarithm change of NYSE Volume, and the logarithm change of the aggregate commission rate. Q2, Q3, and Q4 are the dummies for the second, third and fourth quarters of a year, respectively. The order of lagged variables is chosen by AIC. Standard errors are in parentheses.

Panel A: The Parameter Estimates

Independent	Total Market Excess Returns ($\Delta ERVW_t$)	NYSE Volume ($\Delta NYSE_t$)	Effective Commission Rate (ΔAGR_t)
Intercept	0.999	0.093***	-0.048***
	(2.154)	(0.022)	(0.016)
$\Delta CSPREAD_t$	-4.547	0.052	-0.036
	(3.585)	(0.036)	(0.026)
$\Delta TSPREAD_t$	-9.943	-0.061	-0.059
	(8.900)	(0.090)	(0.065)
$\Delta TBIL_t$	-0.677	-0.028	-0.001
	(1.612)	(0.016)	(0.012)
Q2	-1.309	-0.122***	0.005
	(2.726)	(0.028)	(0.019)
Q3	-2.014	-0.123***	0.034
	(3.312)	(0.034)	(0.024)
Q4	3.470	-0.022	0.041
	(2.815)	(0.029)	(0.021)
$ERVW_{t-1}$	-0.050	.0035***	.0027***
	(0.137)	(.0014)	(.0010)
$ERVW_{t-2}$	-0.147	0.001	-.0021
	(0.162)	(0.001)	(.0012)
$\Delta NYSE_{t-1}$	13.465	-0.176	0.112
	(11.336)	(0.115)	(0.082)
$\Delta NYSE_{t-2}$	21.764	-0.066	-0.040
	(10.940)	(0.111)	(0.080)
ΔACR_{t-1}	-5.320	-0.354	-0.285**
	(19.074)	(0.193)	(0.139)
ΔACR_{t-2}	10.006	-0.115	0.158
	(19.800)	(0.201)	(0.145)
Univariate R^2	0.195	0.393	0.245

** : Significant at the 5% level.

***: Significant at the 1% level.

Panel B. Correlation Matrix of Residuals (p-value in parentheses)

	$ERVW_t$	$\Delta NYSE_t$	ΔACR_t
$ERVW_t$	1.000		
$\Delta NYSE_t$	0.336	1.000	
	(<0.001)		
ΔACR_t	0.557	0.310	1.000
	(<0.001)	(<0.001)	

commission rate are significant and positively related to past quarter market returns controlling for the interest rate factors.

Panel B reports the correlation matrix of the residuals (unexpected shocks) of the dependent variables. The unexpected change in volume is positively related to market return surprises, with a correlation of 0.336. The unexpected change in the aggregate commission rate has a positive correlation of 0.557 with market return surprises. Shocks in trading volume and the aggregate commission rate exhibit a positive correlation of 0.310. All correlations are significant at the 1% level.

The results in these two panels are intriguing and encouraging: High stock returns trigger greater trading volume and the expected surge in trading volume leads to strong demand for shares and a higher commission rate. On the other hand, interest in trading declines following a market downturn, other things the same, resulting in lower trading volume and lower commission cost. This implies that brokerage companies may cut commission quotes to encourage trading following market downturns. For example, in the fourth quarter of 1987, the stock market lost 23%. In the following quarter, NYSE trading volume declined 31% while the aggregate commission rate dropped 14%. The stock market lost 14.9% in the third quarter of 1990. In the following quarter, NYSE volume declined 1% while the aggregate commission rate dropped 12%. More recently, the stock market lost 12.6% in the second quarter of 2002. In the following quarter, NYSE volume surged 12% while the aggregate commission rate declined 18%. Although these examples seem to suggest only a weak, if any, relation between trading volume and past market returns, they suggest that brokerage firms may substantially reduce the commission rate following a market downturn. Brokerage companies attempt to alleviate the detrimental impact of a market downturn on trading liquidity (and brokerage commission income).

Overall, trading volume and the aggregate commission rate are expected to follow past market returns. Unexpected trading volume and unexpected commission costs are positively related to unexpected market returns.

SUMMARY

I develop a reliable quarterly time series of the aggregate commission rate for NYSE trading for the period of 1980-2003. I document a strong and positive relation between average stock returns and the commission rate. The impact of the aggregate commission rate on market returns survives a number of robustness checks and is significant both statistically and economically after controlling for interest-rate risk factors and trading volume. A change of one standard deviation in the aggregate commission rate corresponds to a 4.25% change in the quarterly stock market returns. Overall, my findings support the hypothesis that market-wide liquidity impacts asset pricing and is a priced state variable. The liquidity premium plays an important role in the time series variation of market returns.

I document a positive relation between stock market returns and trading volume, and a negative relation between stock market returns and the variability of trading volume. I suggest that this relation is caused by market momentum: higher and persistent trading volume represents strong market sentiment and hence results in higher stock market returns.

My findings have important implications to academics and direct applications to investment practice. For example, a portfolio manager can construct a tracking portfolio (or an Exchange Traded Fund (ETF)) according to my estimate of the quarterly aggregate commission rate, using the method suggested by Breeden, Gibbons, and Litzenberger (1989). Although the aggregate commission rate is best measured quarterly, the constructed tracking portfolio, based on maximum correlation with the recorded commission rate, will display strong sensitivities to market illiquidity and move with the market in real time. Such a tracking portfolio can be utilized to hedge market liquidity risk.

In addition, a number of recent studies, such as Acharya and Pedersen (2005), suggest that liquidity is priced when included in a standard asset pricing model, such as the Fama-French (1993) three-factor model. My liquidity measure could also be used in light of these asset pricing applications, and has the further advantage of being intuitive and based on readily available (and cost-free) data.

This study also has possible implications for the options and futures markets. Just as the CBOE (Chicago Board Options Exchange) has created futures and options that trade based on the CBOE Volatility Index (VIX), options and futures that trade based on the market's expectations of future liquidity could be devised.

Finally, since liquidity is priced in that it is negatively correlated with expected performance, speculators (such as hedge funds) could take advantage of this finding by constructing certain portfolios. For example, a long-short portfolio that buys assets with high liquidity that is expected to decrease and shorts assets with low liquidity that is expected to increase would have the advantage of being relatively immune to large market moves but would benefit from changes in liquidity over time.

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