

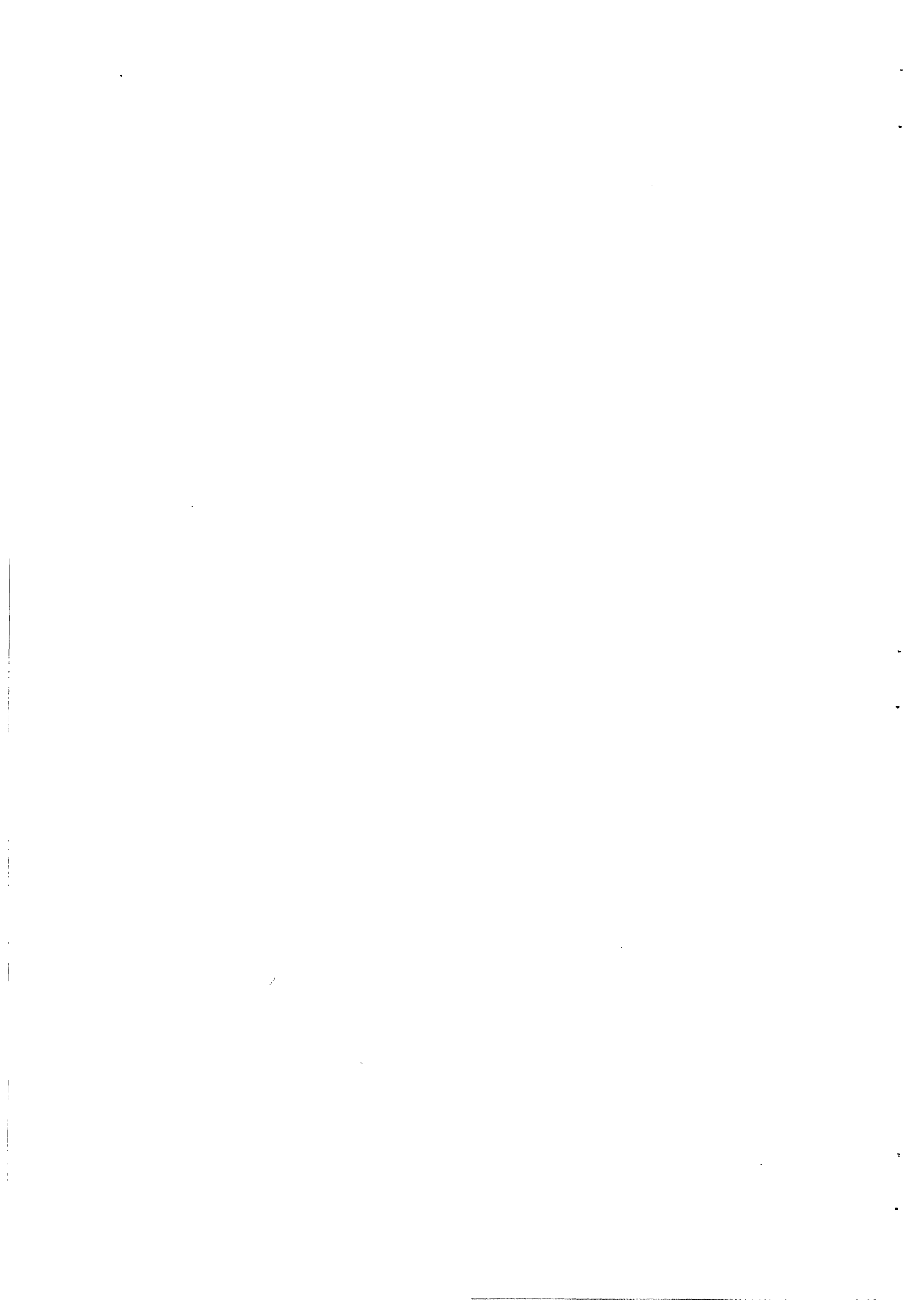
**Research Support
School of Business Administration**

Nov. 1994

**AN EMPIRICAL EXAMINATION OF INFORMATION,
DIFFERENCES OF OPINION, AND TRADING ACTIVITY
Working Paper #9405-34**

**Hendrik Bessembinder
Kalok Chan
Arizona State University**

**Paul J. Seguin
University of Michigan**



An Empirical Examination of Information, Differences of Opinion, and Trading Activity

Hendrik Bessembinder*

*College of Business
Arizona State University
Tempe AZ 85287-3906
(602) 965-8160*

Kalok Chan

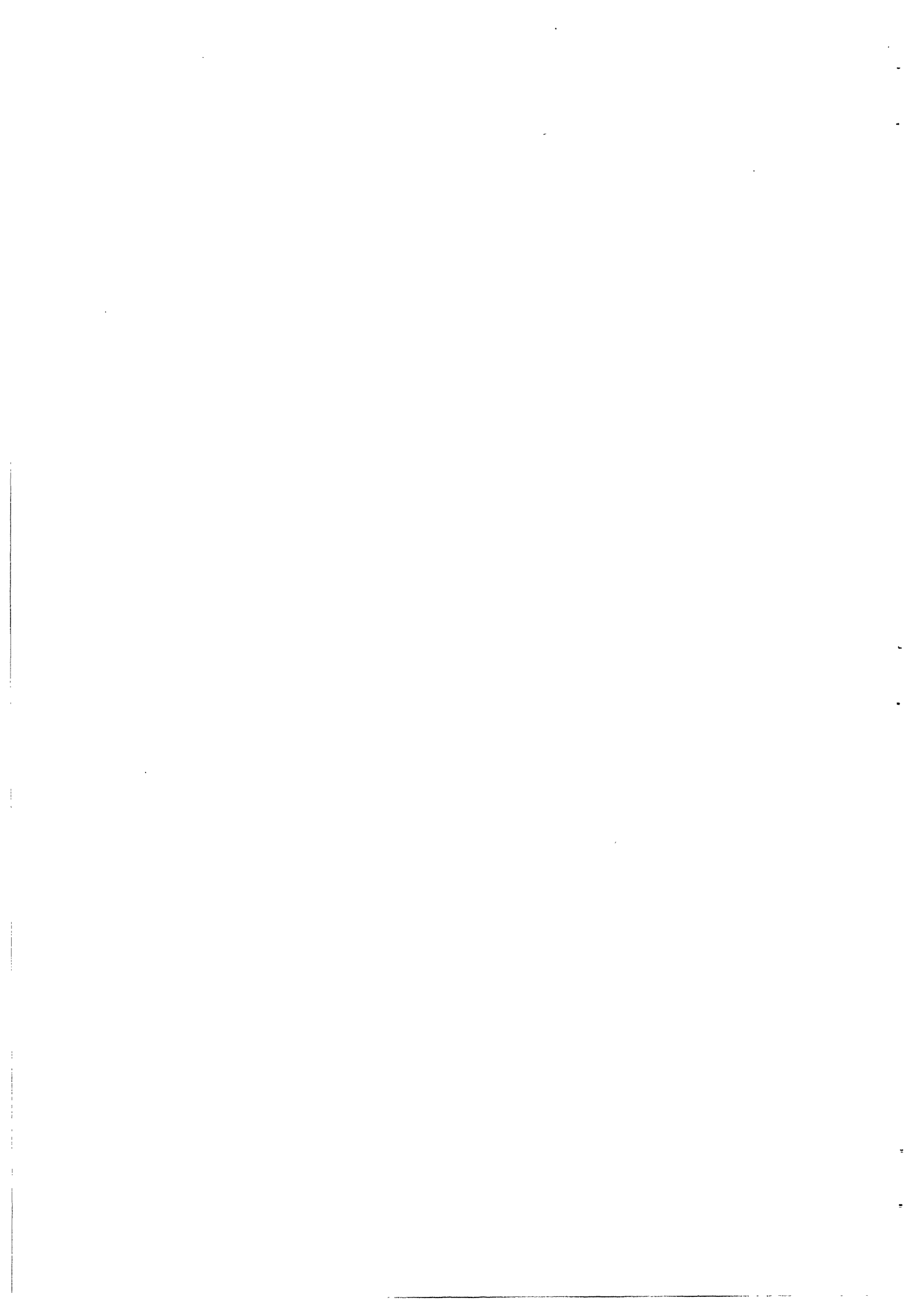
*College of Business
Arizona State University
Tempe AZ 85287-3906
(602) 965-6878*

Paul J. Seguin

*School of Business Administration
University of Michigan
Ann Arbor MI, 48109-1234
(313) 764-9286*

Initial Version: September 1993
This Version: November 7, 1994

* We thank Mason Gerety, Gautam Kaul, Michele LaPlante, Steve Slezak, Richard Smith, and seminar participants at Arizona State, Case Western Reserve and Ohio State Universities, the Universities of California-Riverside, Iowa, Michigan and Missouri and the City Polytechnic of Hong Kong.



An Empirical Examination of Information, Differences of Opinion, and Trading Activity

ABSTRACT

We provide empirical evidence on the relations between trading volumes, measures of information flows and the cross-sectional divergences in beliefs or opinions. We find that while trading volumes of both individual equities and equity baskets are positively related to information flows, individual equity volume is more closely related to proxies for firm-specific information flows, but equity basket volume is more closely associated with market information proxies. This differential impact is most evident for small capitalization stocks, where firm-specific information flow is significantly related to volume while market-wide news has no explanatory power. We assert that the open interest of the S&P 500 futures contract represents a useful proxy for the divergences of traders' beliefs, and, consistent with recent theoretic models, find that volumes of both individual securities and the basket vary asymmetrically with changes in open interest.

“The literature on asset markets has, to a great extent, focused on explaining asset prices with only peripheral attention to trading volume” conclude Harris and Raviv (1993, p. 475). This statement is particularly pertinent for empirical work: despite the importance of the topic, surprisingly little empirical research has addressed the determinants of trading volume. However, several theoretic analyses of volume have recently emerged in the literature. Briefly, these theories suggest that trading volumes in financial markets are determined by (i) traders' exogenous liquidity needs, (ii) information flows; both public and private, (iii) cross-sectional differences in agents' opinions or assessments of intrinsic value, and (iv) the strategic interactions between informed and liquidity traders. However, the predictions of these theories have been subjected to little empirical scrutiny.

The objective of this study is to address this deficiency by empirically evaluating the determinants of trading activity in individual securities (all NYSE listed stocks), trading for individual equities stratified by firm size, and trading in a stock “basket” (the S&P 500 futures contract) during the period of May 1982 to December 1991. Our empirical results offer support for several theoretical models.

It has been well documented that volume, volatility and information flows are all highly contemporaneously correlated¹. Consistent with this evidence, we find that the trading volume of the overall NYSE, subgroups of stocks stratified by size and the S&P 500 futures basket are all positively correlated with our empirical proxies for information flows. However, we extend the analysis and offer several additional insights into the relations between volume and information flows. Specifically, we find that the relations between volume and information depend on whether the information is firm-specific or market-wide, and on the type of security traded (individual equities versus equity "baskets" or "small-cap" versus "large-cap" stocks).

To conduct this investigation, we construct separate empirical proxies for firm-specific and common or market-wide information flows. Ross (1989) shows that, in a frictionless market characterized by an absence of arbitrage opportunities, the rate of information flow is revealed by the degree of price volatility. Based on this intuition, we use the volatility of returns to a diversified equity portfolio as our proxy for the arrival rate of common or market information. We then construct a measure of the cross-sectional dispersion of individual security returns that is similar to the one created in Christie and Huang (1991), and use this cross-sectional measure as a proxy for the arrival rate of firm-specific information. We find that, consistent with the models of Subrahmanyam (1991) and Gorton and Pennacchi (1993), volume for individual stocks is more closely related to our proxy for firm-specific information while the volume of the stock basket is more closely associated with our proxy for market-wide information. The asymmetry is most pronounced for portfolios of small-capitalization equities, where trading volume varies closely with security-specific information flows, but is entirely unrelated to market wide information.

We also introduce what we assert to be a useful proxy for the divergence of traders' beliefs or opinions about market-wide information: the level of open interest in the S&P 500 futures contract. We provide empirical support for the theoretic work of Varian (1986), Harris and Raviv (1993) and Shalen (1993) by demonstrating that trading volumes in both individual equities and in the equity basket are positively related to this proxy for differences-of-opinion.

¹See Karpoff (1987) for a review, and Gerety and Mulherin (1992) and Bessembinder and Seguin (1993) for more recent evidence on the positive relation between trading volume and price volatility, and Mitchell and Mulherin (1994) for evidence on the relation between trading volume and measures of public information flows.

Finally, we allow for day-of-the-week effects in trading volumes and find evidence consistent with the predictions of models of strategic behavior by liquidity and informed traders, such as Admati and Pfleiderer (1988) and Foster and Viswanathan (1990). Our results are robust to several specification checks, including the use of equal- versus value-weighted indices, log transformations of volumes, and adjustments of cross-sectional dispersion measures to accommodate differences in systematic risk.

In the next section, we review the theoretic literature on the determinants of volume. In section 2, our empirical methods and data are introduced. Our empirical results and specification tests are performed in section 3. In the final section, some conclusions and suggestions for further work are provided.

1. Theoretic Determinants of Trading Volume

Trade in any asset occurs because of cross-sectional variation in traders' net demand for an asset. One key determinant of variation in demand for *financial* assets is cross-sectional differences in the information possessed by traders. However, differences in information alone do not guarantee that trading will occur. Grossman (1976) and Milgrom and Stokey (1982) show that each agent may realize that the willingness of a counterparty to trade may indicate that the counterparty has superior private information. This can lead to a "no-trade" equilibrium.

Since volume is, indeed, observed in financial markets, theoreticians have sought to identify sets of sufficient conditions that circumvent the no-trade equilibrium. Verrecchia (1981) shows that heterogeneity in tastes or endowments across traders can lead to trading, but only one "round" of trading is required. Foster and Viswanathan (1993) show that such heterogeneity can also lead to trading in response to public information announcements as agents rebalance their portfolios. Kyle (1985), Admati and Pfleiderer (1988) and Foster and Viswanathan (1990) circumvent the no-trade equilibrium by introducing "liquidity" traders: uninformed agents who transact solely to meet exogenous liquidity needs. With liquidity traders in the market, other agents have incentives to invest in information acquisition. Informed trading can occur in these models since prospective counterparties cannot perfectly distinguish informed from liquidity traders.

Trading can also occur when no agent has superior information, but agents differ in their assessment of common information. For example, in Varian (1986), traders differ in their

prior beliefs regarding value, while in Harris and Raviv (1993) and Shalen (1993), traders differ in their interpretation of common signals. Each of these models predicts that trading volume increases with the dispersion of traders' private valuations.

An additional branch of theoretic literature which we address concerns the trading behavior of agents who can trade either individual securities or a diversified "basket" of securities, such as an index or a futures contract based on an index. The intrinsic value of the basket is determined by information that is common (or systematic) across securities. Agents with information specific to individual or small groups of companies, (e.g. earnings announcement, dividend changes, merger proposals and industry-specific news) continue to trade individual securities. Subrahmanyam (1991) and Gorton and Pennacchi (1993) suggest that agents endowed with common information will prefer to trade the basket, rather than a portfolio of component stocks, for at least two reasons. First, explicit transaction costs for the basket can be substantially lower than those incurred by trading the portfolio of individual securities. Second, adverse selection costs are higher when trading individual securities since there is a greater chance that the counter-party has superior firm-specific information. Thus, the choice of trading individual securities versus the basket depends crucially on whether the information held by agents is firm-specific or common across securities.

Despite the intuitive appeal of these models and their predictions, we are aware of little empirical validation of models linking volume to information flows, beyond documentation of a positive volume-volatility relation. Such validation is the objective of the empirical work that follows.

2. Data and Empirical Methods

Investigating links between information flows and trading activity requires measures of information arrivals. Further, since traders can choose between trading individual securities or in diversified baskets of equities, it is important that we separately identify flows of market-wide and company-specific information. To test the veracity of differences-of-opinion models, we will also require some proxy for the cross-sectional dispersion of beliefs. Finally, it is important to employ control variables that accommodate previously identified regularities in volume such as the futures contract expiration and the day-of-the-week. In this section, we describe the empirical proxies and control variables used in our investigation.

2.1 Information Flows

Ross (1989) shows that price volatility is positively related to the rate of information arrival in frictionless, efficient markets. Based on this intuition, we use measures of price volatility as proxies for information flows. We do not distinguish publicly announced information from private information revealed through the trading process. We do, however, distinguish between common and security-specific information flows and construct separate measures of each.

2.1.1 Common Information

We use measures of overall stock market volatility to proxy for common information flows. The metric we employ throughout is $|R_m^w|$, the absolute value of the CRSP value-weighted market return including dividends. One potential problem with this index is that the CRSP index includes all stocks listed on either the NYSE or the AMEX while our stock “bundle”, the S&P 500 index futures contract, is based on a portfolio of 500 stocks that comprise the S&P index. However, during our sample period the correlation between CRSP value-weighted market returns and percentage changes in the S&P 500 Index exceeded 0.99, suggesting that each proxy extracts essentially the same information.

2.1.2 Firm-Specific Information

We use absolute deviations of individual firm returns from market model expected returns as measures of firm-specific information flows. Capturing all firm-specific information potentially requires as many variables as firms. For tractability, we use the cross-sectional average of these absolute deviations, computed across all NYSE/AMEX firms on the CRSP file. In the absence of a theoretical reason to prefer one, we construct and investigate two aggregate measures of firm-specific information: MAD^{EW} is the equal-weighted average of the beta-adjusted differences between firm returns and the equal-weighted market return, or:

$$\frac{1}{N} \sum_{i=1}^N |R_{jt} - \beta_j R_{mt}^{EW}|$$

while MAD^{VW} is the value-weighted analog. In each case, betas are estimated using the previous year’s daily data. Previous versions of this paper used MADs that were not beta adjusted, with unchanged conclusions.

2.2 Differences of Opinion

We introduce a novel empirical proxy for “differences of opinions”: the open interest in the equity-index futures markets, which is the endogenously determined number of futures

contracts in existence. We view open interest as a potentially rich proxy for cross-sectional variation in agents' information sets or beliefs. Open interest reflects the cross-sectional variation in agents' net demand for positions in the equity basket, including that variation attributable to differences of opinion. Of course, open interest is an imperfect proxy for differences in opinion since open interest can also reflect variation in net demand due to differing endowments or tastes.

2.3 Control Variables

In determining the relations between information flows and volume, we control for two previously identified, non-informational sources of volume. First, to accommodate the empirical regularity that volumes vary by the day of the week, we include indicator variables for each trading day other than Wednesday. The regression intercept thus represents Wednesdays, while the daily indicators measure differences in volume relative to the Wednesday benchmark. We also control for variations in trading activity associated with the S&P 500 futures contract life cycle since it has been well documented that the period around contract expiration is associated with large changes in spot and futures volume and futures open interest.

2.4 Data Sources and Descriptive Statistics

We use daily trading volumes and open interests for all outstanding S&P 500 index futures contracts for the period May 1982 to December 1991. We obtained these data from the Columbia University Futures Center and from Data Resources Inc. We also use composite daily New York Stock Exchange trading volume for the same period. These data are from Schwert (1990) and from Data Resources Inc.². Finally, we employ daily return and volume data for individual firms from the Center for Research in Security Prices (CRSP) files.

In Table 1, we report overall and selected annual means of daily futures volume, open interest and NYSE volume, while Figure 1 displays annual means for NYSE volume and S&P 500 index futures volume and open interest. Mean daily share volumes for each of five portfolios formed on the basis of market capitalization are also reported. Futures volume and open interest are stated in terms of total contracts, though similar summary statements can be made for contract dollar values. The levels depicted in Figure 1 demonstrate the tremendous growth in futures trading activity experienced over the first half of our sample: daily futures volume, in terms of contracts traded, experienced year-on-year growth rates of 87.7%, 52.3%, 21.7% and 29.6% in the first four years we

²We thank G. William Schwert for this data.

examine. Open interest grew similarly, with the dollar values of daily open interest more than doubling in three of the first four years. In comparison, growth rates for NYSE volume during the same period are substantial but more modest. Following the stock market crash in 1987, both spot and futures volumes suffered setbacks. Since the 1987 peak, S&P futures and NYSE spot volumes have actually declined, while S&P futures open interest has increased, but at a slower rate than in the first half of the sample.

These descriptive statistics illustrate that volume and open interest series are not stationary, and that a substantial portion of the times series variation in trading activity is attributable to secular growth. Figure 2 displays annual means of our measure of common information flow and both the equal- and value-weighted measures of security-specific information flow. Notably, these measures of information flow do not display trend growth similar to that of trading volume. Accordingly, we do not attempt to explain the trend growth in trading activity, but rather seek to explain deviations around the trend. To do so, we detrend each volume and open interest variable and use the detrended variables in subsequent analysis. We report results obtained from first calculating the trend as a 40-day moving average (which does not require the trend to be a linear function of time), and then detrending each time series by subtracting its respective moving average. Below, we investigate the robustness of our results to the use of log transformed activity series, which are detrended by subtracting the moving average of the log transformed series.

Table 2 reports contemporaneous correlations among detrended volumes and open interest, as well as some of our control variables and measures of information flows. Results indicate that both futures and spot volumes are positively and significantly correlated with open interest and changes in open interest. This correlation provides initial support for the existence of an economic relation between open interest and trading activity. The correlation coefficient between futures trading volume and MAD^{EW} (.079) is roughly half the correlation between futures trading volume and the absolute market return (.217), suggesting that futures trading activity is more closely related to market volatility, which we argue is a proxy for the flow of common information, than to cross-sectional volatility, which is our proxy for the flow of firm-specific information. In contrast, the correlation coefficient of NYSE volume with MAD^{EW} (.432) is larger than the correlation with absolute market return (.397), suggesting that spot trading activity is more related to our proxy for firm-specific information flows than to flows of market-wide information. Correlations associated with the number of days until a futures contract expires support the need to control for the contract life cycle: all three activity variables are significantly negatively related to the days until expiration, with futures activity the most highly

correlated. However, each of these correlations is simple, not partial. Since several of the explanatory variables are correlated with each other, we use a multiple regression framework to estimate the marginal impacts of these variables on futures and NYSE volumes.

2.5 Model Specification

To estimate the relations between our set of explanatory variables and trading activity in individual stocks and stock baskets we use the following two equations:

$$DTFuturesVolume = \alpha_f + \beta_{f1}MADEW + \beta_{f2} |R_m^{vw}| + \sum_{j=1}^3 \gamma_{fj} D_{fj} |\Delta Opin| + \sum_{k=1}^6 \delta_{fk} C_{fk} + \varepsilon_f$$

$$DTSpotVolume = \alpha_s + \beta_{s1}MADEW + \beta_{s2} |R_m^{vw}| + \sum_{j=1}^3 \phi_{sj} D_{sj} |\Delta Opin| + \sum_{k=1}^6 \lambda_{sk} C_{sk} + \varepsilon_s$$

DTFuturesVolume is detrended trading volume in contracts for the S&P 500 futures market, DTSpotVolume is detrended trading volume in shares on the NYSE, and $|\Delta Opin|$ is the unsigned change in futures open interest. These three series are scaled in two ways to afford easier comparisons across series. First, both open interest and futures volume are stated in units of contracts, so their coefficients are directly comparable. Second, each of the three time series has been scaled by a constant multiple of the mean price for their respective markets to yield units that are, on average, order flows of \$1 million, so that coefficients are comparable across equations. We also include six variables that control for futures contract expiration and the day-of-the-week effects, C_j . Subscripts denoting time are omitted throughout. The hypothesis that a change in an explanatory variable is associated with equal dollar trading volumes in the spot and the futures can be assessed by comparing estimated coefficients across equations (1) and (2).

2.6 Empirical Predictions:

2.6.1 Information Flows

The arrival of common information should be reflected in an increase in $|R_m^{vw}|$ which, based on the theories reviewed above, implies increased futures trading volume and a positive estimate for β_{f2} . However, we also anticipate a positive estimate associated with $|R_m^{vw}|$ for spot volume for two reasons. First, the effects of innovations in common factors need not be homogenous across firms. If traders project that a macroeconomic innovation will affect individual firms differentially, they can exploit deviations by taking appropriate positions in

individual stocks. Second, futures trading based on common information may generate temporary price discrepancies that trigger index arbitrage activity, which requires trades on both the spot and futures markets.

The arrival of firm-specific information should be reflected in an increase in MAD^{EW} , the cross-sectional dispersion in prices, which, again relying on the theories reviewed above, implies increased spot trading and, hence, a positive estimate for β_{s1} . However, increases in firm-specific information may also result in increased futures activity if agents use futures contracts to hedge the systematic component of a spot position established to exploit firm-specific information.

2.6.2 Differences in Opinion

The models of Varian (1986), Harris and Raviv (1993), and Shalen (1993) imply that increased divergences of opinion are associated with increased trading volume. If so, we expect to observe a positive relation between changes in open interest and volumes.

It should be noted that changes in open interest can arise for reasons other than differences in opinion. For example, endowment changes may lead to changing hedging requirements and, thus, changes in open interest. Such changes are due to a mechanical relation between futures trading volume and open interest, and not due to information flows. Though futures contracts can be traded with no change in open interest, with the exception of contract expiration, increases or decreases in open interest require contracts to be traded, implying that any open interest change is automatically accompanied by futures trading volume. However, if open interest changes are due solely to endowment changes or other non-informational motivations, a decrease in open interest would be expected to increase the volume as much as an increase in open interest. On the other hand, if a rise (a decline) in open interest is due to divergence (convergence) of opinion, then a rise in open interest will be accompanied by greater volume than will a decline in open interest. Thus, the key test is not whether futures volume varies with absolute changes in open interest, but whether the effects of trading volume on open interest increases versus decreases are equal.

To investigate the potential asymmetries in volume responses to increases and decreases in open interest, we multiply the unsigned change in open interest by three separate open interest indicator variables. The first indicator variable equals one if open interest increases and zero otherwise. The second indicator variable equals one if open interest declines and zero otherwise. The third indicator equals one, and the other two are set to zero on contract

expiration days. Thus, the coefficient on the first indicator estimates the volume associated with open interest increases, while the coefficient on the second estimates volume associated with open interest decreases. The third coefficient is used to accommodate the unique relation between open interest and volume on expiration days.

2.7 Estimation

We obtain coefficient and standard error estimates using Generalized Method of Moments (GMM). Since the set of instruments we use is identical to the set of regressors, coefficient estimates are identical to those obtained by Ordinary Least Squares (OLS) estimation. However, standard errors, and therefore inferences, differ from those obtained using OLS because we employ the covariance matrix specified by Newey and West (1987a), using 10 lags. This procedure yields a covariance matrix that is consistent in the presence of conditional heteroskedasticity and autocorrelation.

We use the Wald statistic described by Newey and West (1987b) for joint hypothesis tests, including our cross-equation tests of the equality of coefficient estimates. We let k denote the number of parameters estimated for each of the two equations, B denote the $2k \times 1$ vector of coefficient estimates, and R the appropriate $N \times 2k$ restriction matrix for an N -dimensional test of $RB = 0$. The Wald test statistic for the joint hypothesis is computed as $Q = (RB)'(RWR)^{-1}RB$, where W is the $2k \times 2k$ covariance matrix of the parameter estimates as described by Newey and West (1987a). The test statistic Q is asymptotically distributed χ^2 with N degrees of freedom.

3. Results

In the first two columns of Table 3, we report results of estimating our spot and futures volume specifications respectively, while the third column reports χ^2 test statistics for the hypotheses that the coefficients are equal across equations. Panel A reports estimates obtained from using an equally-weighted mean of absolute cross-sectional return deviations, MAD^{EW} , while panel B reports selected results when a value-weighted MAD is employed.

3.1 Common Information

As predicted, the estimated effects of our proxy for common information, $|R_m^{vw}|$, on trading volume in both the individual equity and equity basket markets are positive and significant. However, the impact of market information on volumes is not symmetric across markets: the estimated effect of a 1% absolute market return on futures volume substantially exceeds that for spot volume (\$453 million to \$283 million), and the χ^2 test

statistic indicates that this difference is significant at the 10% level. These results are consistent with the reasoning that common information flows are associated with increased trading in both the spot and the future markets, but that the security basket is the preferred asset.

3.2 Security-Specific Information

We also observe a positive and highly significant relation between MAD^{EW} , our proxy for security-specific information, and spot market trading volume. However, in contrast to results for market-wide information, the estimated coefficient linking firm-specific information and trading volume for the basket is negative and statistically insignificant. The test statistics for the difference between the two estimates is significant at any standard significance level (p -value $< .001$). These findings are consistent with the reasoning that agents with firm-specific information choose to trade exclusively in individual securities rather than trading in the basket.

3.3 Differences of Opinion

As discussed above, we view changes in futures open interest as a proxy for changes in the dispersion of traders' beliefs or opinions. For futures volume, the point estimate on $|\Delta Opin|$ for days with declines in open interest is 0.1, implying that when futures open interest decreases by 10 contracts, futures volume increases by only 1 contract on average. In contrast, for days that experience increases in open interest, a one unit change in open interest is associated with a 2.53 unit increase in the basket trading volume. This asymmetry in the reaction of equity basket volume to open interest increases versus declines is verified by the "Test Increase=Decrease" χ^2 test statistic which is significant with a p -value less than .001. Combined, this evidence suggests that an increase in the dispersion of traders beliefs has a greater effect on futures trading volume than a comparable decline. This is consistent with the joint hypotheses that (i) changes in open interest proxy for changes in the divergence of opinion across traders, and (ii) this divergence is a determinant of trading volume³.

Finally, unsigned changes in open interest on S&P 500 futures contract expiration days are associated with a statistically significant decline in volume. This reflects the regularity that expiration reduces the number of contracts in existence without requiring trading volume,

³Since, with the exception of contract expirations, a unit change in open interest requires a unit of trading volume, it is tempting to compare the estimated effect of a change in open interest on futures volume to a benchmark of 1.0. However, detrended units are no longer directly comparable, resulting in a benchmark that varies over time, and which can be shown to be generally greater than one.

and the fact (discussed below) that expiration days are characterized by relatively light futures trading volume.

For NYSE volume, the estimated coefficient for ΔOpinI for days with increases in open interest is 1.077, while the coefficient for ΔOpinI for days with declines in open interest is 0.038. Again, the χ^2 test statistic rejects the hypothesis that the two coefficients are equal at a 0.001 level. The positive relation between open interest increases and spot trading volume supports the joint hypothesis that an increase in open interest signals more divergent beliefs across traders, and that such differences in beliefs is reflected in trading activity for individual equities. However, a decrease in futures open interest, which proxies for a decline in the dispersion of investors beliefs, does not appreciably affect NYSE volume.

Unsigned changes in open interest on S&P 500 futures contract expiration days are significantly positively related to spot market volume. This can be attributed to the previously documented empirical regularities of large reductions in open interest and large increases in spot market trading on contract expiration days (see Bessembinder and Seguin (1992)), though the results here suggest that spot volumes are greater still when a greater number of futures positions are unwound.

3.4 Contract Life Cycle

The estimated effects of both contract life cycle variables (days-to-expiration and an expiration day dummy) on futures volume are negative and significant. The negative coefficient estimate on days-to-expiration indicates that futures volume increases as contract expiration nears. The expiration day indicator is associated with a negative coefficient which suggests that futures volumes on expiration days are roughly \$685 million less than would be expected. For NYSE volumes, the point estimate on days-to-expiration is insignificant, while the point estimate on the expiration day indicator is statistically significant and, consistent with Stoll and Whaley (1987), indicates volume on expiration days that is approximately \$633 million above normal. These results, which are confirmed by the associated χ^2 test statistics, imply that the futures contract life cycle affects basket trading volume throughout the life cycle, while effects on spot market volume are confined to expiration days. Though not reported, these results are robust to alternative specifications including use of the square root of days-to-expiration or $\ln(.5 + \text{days-to-expiration})$.

3.5 Daily Indicators

Consistent with the findings of Jain and Joh (1988), we document an inverted U-shaped pattern for volumes in both markets across the five trading days of the week, with trading activity in each market highest on Wednesdays and lower on Mondays and Fridays. There are, however, systematic differences in the weekly trading pattern across the futures and spot markets. Relative to the volume of individual equities, basket volumes are higher early in the week and lower later in the week. The cross-equation χ^2 test statistics indicate that these cross-equation differences are statistically significant on Tuesdays, Thursdays and Fridays⁴.

Though our original motivation for including day-of-the-week indicators was to control for previously identified patterns in trading volumes, we believe that the cross-market differences in these indicators can be interpreted in the framework of recent models where liquidity trader behave strategically. For example, Admati and Pfleiderer (1988) and Foster and Viswanathan (1990) assert that the lack of trading opportunities over the weekend prevents traders from acting on the information they accumulate. Thus, their information advantage (relative to liquidity traders) is greatest at the resumption of trading. Liquidity traders with discretion over the timing of their trades have incentives to defer their trades until later in the week when the private information is already reflected in prices. Their analysis predicts lower trading volumes on Mondays, a prediction that they, and now we, empirically verify.

We extend their intuition and argue that, if private information accumulated over the weekend non-trading period regarding the overall market is less valuable or more perishable than the private firm-specific information accumulated over the weekend, then discretionary traders of the basket have a relatively smaller incentive to defer their trades compared to discretionary spot traders. This implication is consistent with our finding that futures volume is higher relative to spot volume early in the week, but declines through the week as more discretionary traders with firm-specific information defer their trades.

3.6 Tests of Robustness

3.6.1 Mean Absolute Deviation

Absent theoretic or empirical guidelines, we chose a measure of total firm-specific information that weights each firm equally. As a test of the robustness of this decision, we re-estimated the above specification using the value-weighted average of unsigned

⁴In this specification, the differences in dollar volume are not statistically significant, though below we observe that the difference on Mondays is statistically significant when stated in percentage terms.

deviations of individual returns from the value-weighted market return as our measure of firm-specific information flow. As most point estimates are not meaningfully altered by this adjustment, in Panel B of Table 3 we report only the coefficients associated with MAD and the absolute value of the market return. As in Panel A, our proxy for firm-specific information flow is significantly related to the combined volume of individual securities, but not to the volume of the basket. Again, our proxy for the flow of common information is significantly related to volume in both markets, though, as above, the effect on the volume of the basket is greater at a 10% significance level.

3.6.2 Non-normality of Volume and the Crash of '87⁵

In Table 4, we report estimates of specifications that accommodate two potential criticisms of our previous specifications. First, Ajinkya and Jain (1989) report that trading volume is not normally distributed, but that log transformed volume adheres more closely to the properties of the normal distribution. Specification tests (not reported) confirm this regularity in our sample. Hence, in Table 4, we report results obtained when we use log transformed volumes. As above, volumes are detrended. For this analysis, we detrend by subtracting from each log series the 40-day moving average of the log series. Our conclusions are identical if we instead divide each raw volume number by its 40-day moving average and then take the log of the quotient⁶.

The results using log-transformed volume series, which appear in Panel A of Table 4, indicate that our results are robust to the non-normality of volume. As above, our proxy for the flow of common information is significantly related to trading activity of individual securities and the security basket, though the significantly larger coefficient associated with basket volume suggests that the basket is the preferred security for trading on common information. Again, our proxy for firm-specific information is statistically unrelated to basket trading activity, but it is positively and significantly related to the volume of individual securities.

In each market, we observe that increases in open interest are associated with greater volume than are declines in open interest, with each difference statistically significant. This

⁵We thank the participants at The Ohio State University for outlining these potential concerns and suggesting some of the robustness tests performed.

⁶Though conclusions are unchanged, point estimates do differ between the two specifications. In the specification used in Table 4, we subtract the average of the log series, which is the sample counterpart of $E\{\ln(x)\}$, while in the alternative, we subtract the log of the moving average, which is the sample counterpart of $\ln(E\{x\})$. Using the moments of the lognormal distribution, $E\{\ln(x)\} = \ln(E\{x\}) - .5\text{Var}\{\ln(x)\}$.

is again consistent with the joint hypothesis that open interest proxies for the degree of differences-in-opinion and that these differences are related to trading activity. Finally, we again observe that basket volume is high early in the week and low later in the week compared to individual equity volumes, with statistically significant differences on each day. As above, we interpret this finding as being consistent with the joint hypothesis that liquidity traders defer trades until the value of private information is dissipated, and that common information is either less valuable or more perishable than firm-specific information.

The second potential criticism we address stems from the market break in October '87. The period surrounding the crash was characterized by unprecedented volumes, changes in open interest, and volatility. Thus, it could be argued that this period is responsible for numerous outliers in our dataset and that, perhaps, these outliers could somehow be "driving" our results. Also, in reaction to the crash, several regulatory initiatives were introduced that significantly affected the market trading mechanisms considered here. Of greatest pertinence, regulations were introduced that potentially affected the linkage between the spot and futures markets. Thus, it could be argued that the market structure differed significantly in the post-crash period.

To address these concerns, we partition our sample as of November 1, 1987 and obtain parameter estimates for each sub-sample. Panel B reports results based on data from the pre-crash sub-period and the week of the market break itself, while the post-crash data are used for results reported in panel C.

All but one of our results hold across sub-periods: in each sub-period (i) open interest increases have a greater effect on volume in both markets than do open interest decreases (ii) basket volume is relatively higher than individual share volume early in the week and lower later in the week, (iii) the flow of firm-specific information affects volume in the spot market only, and (iv) the basket is the preferred security for trading on common information. The only aberration is that while common information is positively related to spot volume in the full and post-crash samples, the coefficient estimate for the first subsample is indistinguishable from zero. It is unclear whether this result is due to outliers associated with the crash, or whether regulatory changes following the crash altered the relative costs of the two markets as venues for trading common information.

3.6.3 Firm Size

To this point, we have treated individual firms as being fungible. However, as has been well documented, firms that differ by the market value of outstanding equity, or "size", vary along a number of important microstructure dimensions, including risk, transactions costs, or, as suggested by Conrad, Gultekin and Kaul (1991), relevant information sets. To investigate whether the results for the NYSE as a whole are robust across firms of varying market capitalization, we create five annually-rebalanced, size-ranked portfolios and calculate share volume aggregated across all component securities for each of the five portfolios. As above, we use log transformed share volume, and detrend each volume series.

In Table 5, we report results obtained when we regress each portfolio volume on the same control variables and information proxies employed earlier. As above, our proxy for the flow of firm-specific information is positively and significantly related to the trading volume for each of the five portfolios. However, this coefficient declines monotonically as firm size increases, indicating that firm-specific information has a larger proportional effect on the volume of small firms.

Surprisingly, our proxy for the flow of market-wide information is positive and significant only for the portfolio of the largest firms. Coefficients for the remaining firms are either insignificant or negative. Though not reported, this result holds when we use the absolute value of the equal-weighted market return as the proxy for market-wide information flows. It is well established that the prices of small firms do respond to market-wide information—as demonstrated by their large betas but it appears that these price reactions occur without significant volume shocks. This result is consistent with Brennan, Jegadeesh, and Swaminathan (1993), Chan (1993), Lipson, Kaul and Jones (1994) and Mech (1993) who argue that prices can change in the absence of trading volume, perhaps due to market makers or specialists altering their prices upon observing changes in the prices of large firms or an equity basket.

There are at least two potential explanations for the differential effect of market information on the volumes of individual firms that vary by size. First, if market-wide information has differing implications for individual stocks, arbitrageurs will trade based on these discrepancies, but only in those stocks where the costs of transacting are low. Since large stocks generally have lower transactions costs, such arbitrage activity may be concentrated in those issues. Second, we document that the basket is the preferred venue for trading

based on market-wide information flows. However, this futures activity may trigger program trades, either for arbitrage or portfolio insurance, which typically involve spot market orders. Since large stocks generally have lower transactions costs, program trades may be concentrated in those issues.

Finally, two of our regularities are pervasive across the five portfolios. The inverted U-shape in volume occurs in all five portfolios, though the weekly pattern is not significant for the smallest firms portfolio. Second, we note that the relation between open interest changes and volume is pervasive; for all five portfolios increases in open interest are associated with larger volume than are decreases.

4. Conclusion

In this study, we construct empirical proxies for rates of information flow, and use them to test some implications of recent theories of trading volume. Consistent with the implications of Foster and Viswanathan (1993), Kyle (1985) and Ross (1988), we find that trading volume in both the spot and futures markets varies positively with proxies for information flows. Also, consistent with Gorton and Pennacchi (1993), and Subrahmanyam (1991), we find that the choice of trading venue depends on the nature of the information: those with firm-specific information trade primarily on the spot equity market. In contrast, those with market-wide information trade in both the spot and a basket with lower transactions costs, but the effect on the volume of the basket is larger, indicating a preference for that security.

We also investigate trading volume for portfolios of firms based on market capitalization. We find that only the largest firms demonstrate a reliably positive volume reaction to increased flows of common or market-wide information. For smaller firms, our evidence indicates that price reactions to common information shocks are accomplished without trading, as predicted by Brennan, Jegadeesh, and Swaminathan (1993), Chan (1993), Lipson, Kaul and Jones (1994) and Mech (1993). In contrast, while firm-specific information affects volumes for all firms, firm-specific information has the largest proportional effect on volumes of small firms.

We also investigate the role of cross-sectional divergences of opinion as a determinant of trading volume, as suggested by Varian (1986), Harris and Raviv (1993), Shalen (1993), and others. We argue that open interest represents a useful empirical proxy for the

dispersion of traders' beliefs, and show that trading volume in both the spot and the future rises as a function of our proxy for differences of opinion. This finding is consistent with the joint hypothesis that (i) changes in open interest proxy for changes in the divergence of opinion or belief across traders, and (ii) this divergence is a determinant of trading volume.

Finally, we find evidence consistent with models of strategic behavior by liquidity or uninformed traders. Consistent with previous studies, we find that trading volumes in both the spot and the basket tend to be relatively low early and late in the week. However, we also document that day-of-the-week effects are asymmetric across markets, with lower futures volume relative to spot volume late in the week. If common information is less valuable or more perishable than firm-specific information, then this result is consistent with the strategic behavior predictions of Foster and Viswanathan (1990).

References

- Ajinkya, B. and P. Jain, 1989, "The Behavior of Daily Stock Market Trading Volume," *Journal of Accounting and Economics* 11, 331-359.
- Admati, A. and P. Pfleiderer, 1988, "A Theory of Intraday Patterns: Volume and Price Variability," *Review of Financial Studies* 1, 3-40.
- Bessembinder, H. and P.J. Seguin, 1992, Futures-Trading Activity and Stock Price Volatility, *Journal of Finance* 47, 2015-2034.
- _____ and P.J. Seguin, 1993, "Price Volatility, Trading Volume, and Market Depth: Evidence from Futures Markets," *Journal of Financial and Quantitative Analysis* 28, 21-39.
- Brennan, M.J., Jegadeesh, N., and B. Swaminathan, 1993, Investment Analysis and the Adjustment of Stock Prices to Common Information, *Review of Financial Studies* 6, 799-824.
- Chan, K., 1993, Imperfect Information and Cross-Autocorrelation Among Stock Prices, *Journal of Finance* 48, 1211-1230.
- Christie, W.G. and R.D. Huang, 1991, "Equity Return Dispersions," Unpublished Working Paper, Vanderbilt University.
- Clark, P., 1973, "A Subordinate Stochastic Process Model with Finite Variance for Speculative Prices," *Journal of Financial Economics* 10, 407-432.
- Conrad, J., M.N. Gültekin, and G. Kaul, 1991, "Asymmetric Predictability of Conditional Variances," *Review of Financial Studies* 4, 597-622.
- Foster, F.D. and S. Viswanathan, 1990, "A Theory of Interday Variations in Volumes, Variances, and Trading Costs in Securities Markets," *Review of Financial Studies* 3, 593-624.
- _____ and S. Viswanathan, 1993, "The Effects of Public Information and Competition on Trading Volume and Price Volatility," *Review of Financial Studies* 6, 23-56.
- Gerety, M.S. and J.H. Mulherin, 1992, "Trading Halts and Market Activity: An Analysis of Volume at the Open and the Close," *Journal of Finance* 47, 1765-1784.
- Gorton, G. and G. Pennacchi, 1993, "Security Baskets and Index-Linked Securities," *Journal of Business* 66, 1-28.
- Grossman, S. J., 1976, "On the Efficiency of Competitive Stock Markets when Traders have Diverse Information," *Journal of Finance* 31, 573-585.
- Harris, M. and A. Raviv, 1993, "Differences of Opinion Make a Horse Race," *Review of Financial Studies* 6, 473-506.
- Karpoff, J. M., 1987, "The Relation between Price Changes and Trading Volume: A Survey," *Journal of Financial and Quantitative Analysis* 22, 109-126.

- Jain, P. and G. Joh, 1988, "The Dependence Between Hourly Prices and Trading Volume," *Journal of Financial and Quantitative Analysis* 23, 269-284.
- Jones, C.M., Kaul, G., and M.L. Lipson, 1994, Information, Trading and Volatility, *Journal of Financial Economics* 36, 127- 154.
- Kyle, A.S., 1985, "Continuous Auctions and Insider Trading," *Econometrica* 53, 1315-1335.
- Mech, T., 1993, Portfolio Return Autocorrelation, *Journal of Financial Economics* 34, 307-344.
- Milgrom, P. and N. Stokey, 1982, "Information, Trade, and Common Knowledge." *Journal of Economic Theory* 26, 17-27.
- Mitchell, M. and J.H. Mulherin, 1994, "The Impact of Public Information on the Stock Market," *Journal of Finance* 49, 923-950.
- Neal, R., 1992, "Direct Tests of Index Arbitrage Models," Working Paper, Department of Finance, Kansas City Federal Reserve Bank.
- Newey, W. and K. West, 1987a, "A Simple Positive Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica* 55, 703-715.
- _____ and K. West, 1987b, Hypothesis Testing with Efficient Method of Moments Estimation, *International Economic Review* 23, 777-787.
- Ross, S., 1989, "Information and Volatility: The No-Arbitrage Martingale Approach to Timing and Resolution Irrelevancy," *Journal of Finance* 44, 1-18.
- Schwert, G., 1990, "Stock Volatility and the Crash of '87," *Review of Financial Studies* 3, 77-102.
- Shalen, C.T., 1993, "Volume, Volatility, and the Dispersion of Beliefs," *Review of Financial Studies* 6, 405-434.
- Stoll, H. and R. Whaley, 1987, "Program Trading and Expiration-day Effects," *Financial Analysts Journal* 43, 16-28.
- Subrahmanyam, A., 1991, "A Theory of Trading in Stock Index Futures," *Review of Financial Studies* 4, 17-51.
- Varian, H.R., 1986, "Differences of Opinion and the Volume of Trade," Working paper, University of Michigan, Ann Arbor.
- Verrecchia, R.E., 1981, "On the Relationship between Volume Reaction and Consensus of Investors: Implications for Interpreting Tests of Information Content," *Journal of Accounting Research* 19, 271-283.

Table 1: Daily Means for S&P Futures Volume, Open Interest, Aggregate NYSE Volume, and Equity Portfolio Volumes, May 1982 to December 1991.

	Overall Daily Mean	1982 Daily Mean	1987 Daily Mean	1991 Daily Mean
S&P Futures Volume (Contracts)	50,389	17,080	75,249	48,541
S&P Open Interest (Contracts)	92,402	12,025	124,214	152,841
Aggregate NYSE Volume (Million Shares)	137.22	71.24	188.96	179.65
Size-Ranked Portfolio Volume (Shares per firm)^a				
1 (Smallest)	6,326	2,167	8,900	10,380
2	10,739	5,456	15,869	15,473
3	22,606	11,402	30,319	32,749
4	56,585	28,844	82,953	70,161
5 (Largest)	218,665	112,103	309,866	258,408

^a Portfolio 1 (5) is comprised of the 20% of firms with the smallest (largest) market capitalization at the end of the prior year.

Table 2: Pearson Correlation Coefficients

	<u>NYSE Volume</u>	<u>Futures Open Interest</u>	<u>Absolute Change Open Interest</u>	<u>Days to Contract Expiration</u>	<u>Mean Absolute Return Deviation</u>	<u>Absolute Market Return</u>
Futures Volume	.462*	.393*	.024	-.413*	.079*	.217*
NYSE Volume		.121*	.191*	-.034	.432*	.397*
Futures Open Interest			-.147*	-.617*	.114*	.080*
Absolute Change Open Interest				.010	.104*	.107*
Days to Contract Expiration					-.000	.030
Mean Absolute Return Deviation						.545*

* Denotes a coefficient at least twice as large as its approximate standard error.

Note: Each volume series has been detrended by subtracting its own 40-day moving average.

Table 3: Determinants of Equity Trading Volumes Measured in Contracts and Shares. Standard errors based on the Newey-West procedure are in parentheses.

	<u>S&P Futures Volume</u>	<u>NYSE Volume</u>	<u>Test Coefficients Equal: χ^2 [p-value]</u>
PANEL A: Equal-Weighted MAD			
Intercept	1692.23* (457.23)	-1542.08* (361.84)	49.39 [.000]
<u>Information Flow Variables</u>			
Mean Absolute Cross-Sectional Return Deviation (MAD)	-259.12 (259.63)	819.98* (201.88)	17.81 [.000]
Absolute Market Return	453.22* (111.41)	282.62* (44.34)	2.77 [.096]
Absolute Change in Open Interest			
Non-Expiration Increase	2.530* (.321)	1.077* (0.175)	23.13 [.000]
Non-Expiration Decrease	0.102 (.106)	0.038 (0.044)	0.30 [.585]
S&P Contract Expiration	-0.319* (.139)	0.462* (0.115)	23.77 [.000]
Test Increase=Decrease: χ^2 [p-value]	57.81 [.000]	34.69 [.000]	
<u>Control Variables</u>			
Days to Expiration	-44.42* (2.91)	0.03 (1.76)	267.94 [.000]
Expiration Indicator	-685.16* (299.99)	632.83* (225.69)	12.53 [.000]
Monday Indicator	-645.22* (74.74)	-704.84* (45.74)	0.81 [.368]
Tuesday Indicator	25.51 (68.03)	-169.60* (41.57)	13.16 [.000]
Thursday Indicator	-263.94* (69.72)	-35.08 (39.74)	14.90 [.000]
Friday Indicator	-830.34* (79.84)	-208.25* (47.04)	89.89 [.000]
Test All Daily Indicators=0: χ^2 [p-value]	173.80 [.000]	266.04 [.000]	
Regression \bar{R}^2	.323	.321	
PANEL B: Value-Weighted MAD			
Mean Absolute Cross-Sectional Return Deviation (MAD)	486.36 (378.55)	1684.95* (158.81)	9.91 [.002]
Absolute Market Return	244.01* (100.50)	93.46* (36.98)	2.71 [.099]

* Denotes a coefficient at least two times as large as its standard error.

Note: Each volume series is detrended by subtracting its own 40-day moving average, and is scaled by the mean price so that units are order flows of \$1 million. Specifications reported on Panel B also include Open Interest and Control Variables as regressors; coefficient estimates are not meaningfully altered and are not reported.

Table 4: Determinants of Daily Equity Trading Activity Measured in Logs of Share or Contract Volume. Standard errors are in parentheses.

	Panel A: 5/82 to 12/91				Panel B: 5/82 to 10/87				Panel C: 11/87 to 12/91			
	Futures Volume	NYSE Volume	Test ^b χ^2 [p-value]	Futures Volume	NYSE Volume	Test ^b χ^2 [p-value]	Futures Volume	NYSE Volume	Test ^b χ^2 [p-value]			
Intercept	0.249* (.072)	-0.242* (.033)	78.16 [.000]	0.165* (.063)	-0.361* (.070)	109.63 [.000]	0.310* (.079)	-0.199* (.058)	81.64 [.000]			
Information Flow Variables												
Mean Absolute Cross-Sectional Return Deviation	-.013 (.039)	.145* (.019)	27.73 [.000]	0.028 (.036)	0.249* (.043)	50.83 [.000]	-0.036 (.039)	0.098* (.030)	24.27 [.000]			
Absolute Market Return	.070* (.019)	.037* (.009)	7.32 [.007]	0.035* (.014)	0.000 (.007)	6.12 [.013]	0.118* (.016)	0.057* (.012)	25.48 [.000]			
Absolute Change in Open Interest												
Non-Expiration Increase	3.564* (.354)	2.173* (.279)	23.83 [.000]	3.038* (.342)	1.718* (.294)	27.05 [.000]	6.522* (.877)	2.611* (.742)	22.48 [.000]			
Non-Expiration Decrease	0.670* (.194)	0.406* (.117)	2.43 [.119]	0.459* (.206)	0.221 (.113)	1.70 [.192]	1.412* (.297)	0.045 (.206)	20.30 [.000]			
S&P Contract Expiration	-0.298 (.204)	-0.163 (.233)	0.19 [.666]	-0.552* (.224)	-0.391 (.211)	0.42 [.518]	-0.050 (.386)	0.646* (.248)	2.88 [.090]			
Test Increase = Decrease: χ^2 [p-value]	66.19 [.000]	41.42 [.000]		52.05 [.000]	27.16 [.000]		39.11 [.000]	12.35 [.000]				
Control Variables												
Days to Expiration	-0.769* (.056)*	-.033* (.035)*	231.73 [.000]	-0.576* (.071)*	-0.036* (.044)*	95.96 [.000]	-1.030* (.083)*	-0.035* (.050)*	182.25 [.000]			
Expiration Indicator	-0.146* (.051)	0.250* (.037)	39.74 [.000]	0.036 (.059)	0.161* (.043)	5.04 [.025]	-0.362* (.071)	0.275* (.039)	78.99 [.000]			
Monday Indicator	-0.108* (.013)	-0.163* (.009)	26.81 [.000]	-0.116* (.016)	-0.167* (.011)	16.49 [.000]	-0.101* (.019)	-0.149* (.014)	7.56 [.006]			
Tuesday Indicator	0.006 (.011)	-0.037* (.008)	25.75 [.000]	0.004 (.014)	-0.037* (.010)	16.77 [.000]	0.006 (.017)	-0.037* (.011)	9.15 [.003]			
Thursday Indicator	-0.042* (.012)	-0.009 (.008)	12.09 [.001]	-0.046* (.016)	-0.013 (.010)	6.75 [.009]	-0.049* (.017)	-0.001 (.011)	11.27 [.001]			
Friday Indicator	-0.155* (.014)	-0.056* (.010)	76.14 [.000]	-0.203* (.018)	-0.070* (.013)	100.66 [.000]	-0.104* (.022)	-0.047* (.015)	9.59 [.002]			
Test All Daily Indicators=0: χ^2 [p-value]	217.87 [.000]	394.16 [.000]		200.61 [.000]	274.34 [.000]		63.74 [.000]	141.27 [.000]				
Regression \bar{R}^2	.287	.261		.250	.350		.377	.218				

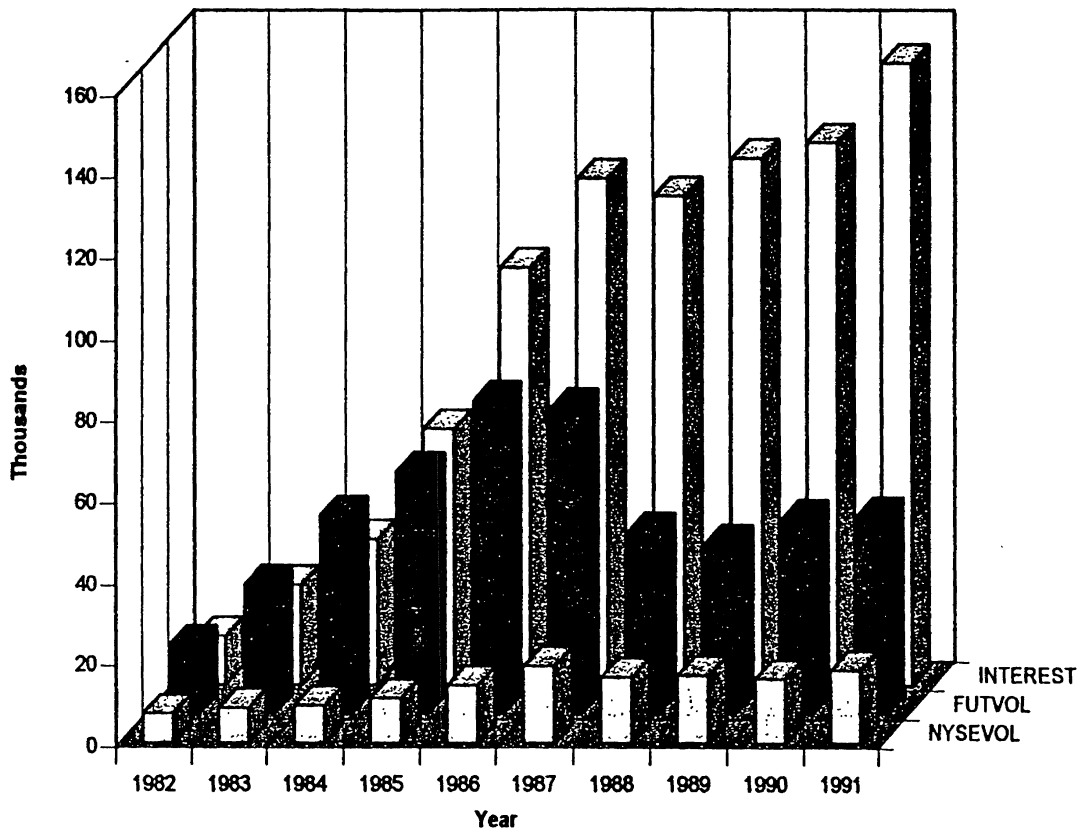
Note: Each log volume series is detrended by subtracting its own 40-day moving average.

* $\times 10^{-2}$

^a Test of hypothesis that coefficient is equal across futures and NYSE.

^b Denotes a coefficient at least two times as large as its standard error.

Figure 1: Mean Daily Trading Volume in Contracts and Shares/10,000



Note: NYSEVOL is NYSE share volume in units of 10,000 shares. FUTVOL is S&P futures volume in contracts. Interest is S&P futures open interest in contracts.

Table 5: Determinants of Daily Log Share Volume for Portfolios of Firms Sorted Based on Market Capitalization. Portfolio 1 (5) is comprised of the 20% of firms with the smallest (largest) market capitalization at the end of the prior year. Standard errors based on the Newey-West procedure are in parentheses. (May 1982 to December 1991)

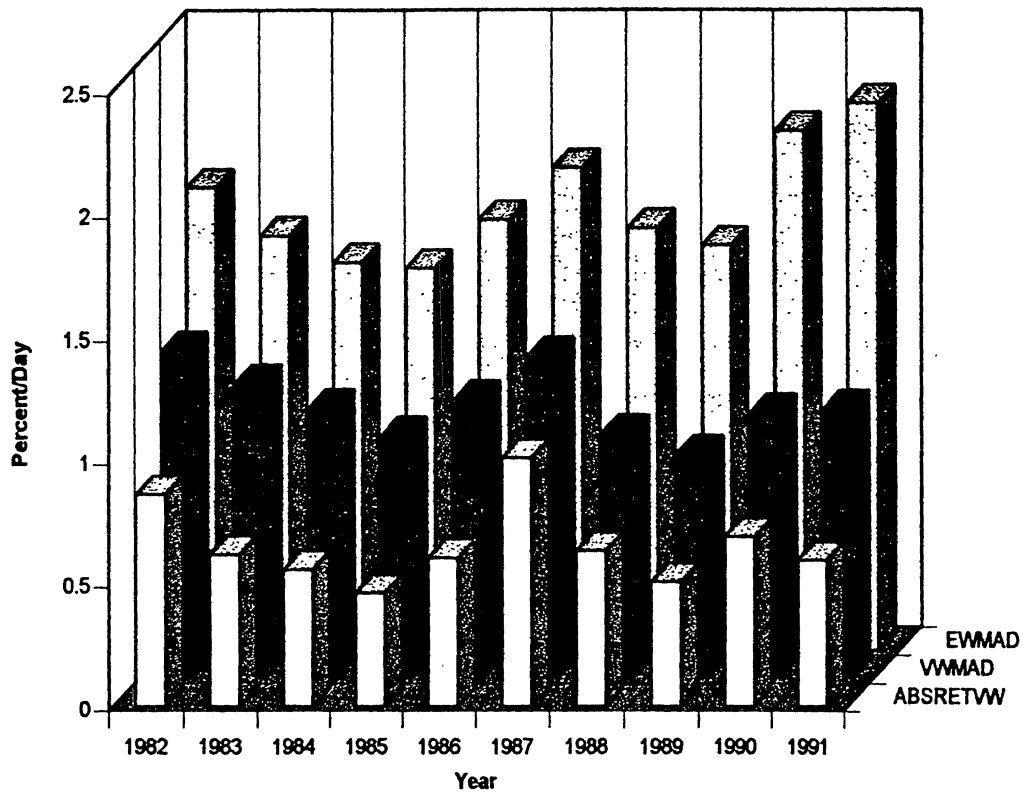
	Portfolio					Test Coefficients Equal: χ^2 [p-value]
	1	2	3	4	5	
Intercept	-0.311* (.054)	-0.321* (.038)	-0.312* (.032)	-0.257* (.032)	-0.213* (.036)	11.39 [.023]
Information Flow Variables						
Mean Absolute Cross-Sectional Return Deviation	0.222* (.029)	0.212* (.022)	0.195* (.018)	0.166* (.018)	0.124* (.021)	19.82 [.001]
Absolute Market Return	-0.027* (.011)	-0.017* (.008)	-0.003 (.006)	0.011 (.007)	0.047* (.011)	26.19 [.000]
Absolute Change in Open Interest						
Non-Expiration Increase	1.602* (.435)	1.858* (.323)	1.712* (.311)	1.789* (.284)	2.189* (.288)	5.91 [.207]
Non-Expiration Decrease	0.671* (.284)	0.391* (.190)	0.181 (.183)	0.357* (.159)	0.452* (.120)	6.90 [.141]
S&P Contract Expiration	-0.573 (.382)	-0.743* (.322)	-0.158 (.267)	0.066 (.172)	-0.256 (.220)	33.20 [.000]
Test Increase=Decrease: χ^2 [p-value]	4.71 [.030]	22.38 [.000]	25.16 [.000]	25.18 [.000]	37.36 [.000]	
Control Variables						
Days to Expiration	-0.224** (.067)*	-0.124** (.044)*	-0.035** (.040)*	-0.043* (.038)	-0.027* (.037)	13.95 [.007]
Expiration Indicator	0.125 (.097)	0.240* (.086)	0.116* (.057)	0.056 (.045)	0.269* (.037)	100.04 [.000]
Monday Indicator	-0.036* (.015)	-0.064* (.010)	-0.115* (.009)	-0.149* (.009)	-0.164* (.010)	111.91 [.000]
Tuesday Indicator	-0.008 (.013)	-0.010 (.008)	-0.023* (.007)	-0.033* (.008)	-0.038* (.008)	11.41 [.024]
Thursday Indicator	0.014 (.013)	-0.005 (.009)	-0.001 (.008)	-0.008 (.008)	-0.016* (.008)	7.44 [.114]
Friday Indicator	-0.013 (.016)	-0.039* (.010)	-0.051* (.010)	-0.066* (.010)	-0.061* (.010)	13.18 [.010]
Test All Daily Indicators=0: χ^2 [p-value]	7.53 [.110]	49.14 [.000]	174.97 [.000]	324.12 [.000]	325.25 [.000]	
Regression \bar{R}^2	.083	.162	.202	.213	.238	

Note: Each log volume series is detrended by subtracting its own 40-day moving average. Specifications reported on Panel B also include Open Interest and Control Variables as regressors; coefficient estimates are not meaningfully altered, and are not reported.

* $\times 10^{-2}$

** Denotes a coefficient at least two times as large as its standard error.

Figure 2: Mean Daily Market Volatility



Note: ABSRETVW is the absolute value of the return to the CRSP value-weighted index. EWMAD is the simple cross-sectional mean of absolute deviations of security returns from predicted market model returns, while VWMA is the value-weighted cross-sectional mean of absolute deviations of security returns from predicted market model returns.

