TRADING VOLUME AND CHANGES IN HETEROGENEOUS EXPECTATIONS

by

Larry H.P. Lang
Robert H. Litzenberger

(6-89)

RODNEY L. WHITE CENTER FOR FINANCIAL RESEARCH
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104-6367

Trading Volume and Changes in Heterogeneous Expectations

Larry H. P. Lang and Robert H. Litzenberger*

Abstract

A comparative static analysis of a competitive equilibrium under heterogeneous earnings expectations and constant absolute risk aversions demonstrates that unsystematic trading volume in response to a public information release is proportional to the change in relative heterogeneity of beliefs and is unrelated to either the dispersion of prior beliefs or the absolute change in the consensus expectation. In contrast, under homogeneous expectations and non-constant absolute risk aversions, total trading volume is a function of the absolute change in the consensus earnings expectation. Using a large number of individual analysts' annual earnings forecasts, the change in relative heterogeneity and the absolute change in the consensus expectation are measured around interim quarterly earnings reports and shown to possess predicted impacts on trading volume.

* Visiting Assistant Professor of Finance, Ohio State University and Edward Hopkinson Professor of Finance, The Wharton School, University of Pennsylvania, respectively. The authors would like to acknowledge the helpful comments from Warren Bailey, K.C. Chan, Chi-fu Huang, Francis Longstaff, Dave Mayers, Rene Stulz, Hal Varian, Ralph Walkling and participants of seminars at Ohio State University, University of Maryland and University of Wisconsin at Madison. Remaining errors are the sole responsibility of the authors.

Trading Volume and Changes in Heterogeneous Expectations

Section 1. Introduction:

The process of information dissemination and interpretation in security markets is complex and not directly observable. In a pioneering study of price changes and trading volume surrounding earnings announcements, Beaver (1968) finds significant price changes and trading volume during the announcement weeks (Foster (1978), Kieger (1972), Morse (1980, 1981) and Bamber (1986) find similar results). In interpreting his tests Beaver distinguishes between information altering the consensus expectation which affects prices and information altering individuals' heterogeneous expectations which affects volume. Beaver (1968, p68) remarks:

> *The relationships posited above are consistent with the economist's notion that volume reflects a lack of consensus regarding the price. The lack of consensus is induced by a new piece of information, the earnings report. Since investors may differ in the way they interpret the report, some time may elapse before a consensus is reached, during which time increased volume would be observed. If consensus were reached on the first transaction, there would be a price reaction but no volume reaction*

Verrecchia (1981) shows in a competitive equilibrium model that individuals will refrain from trading after information is disclosed only if they have either constant absolute risk aversions or HARA with identical cautiousness and homogeneous prior probability. Thus, the presence of a volume reaction does not imply that the information is interpreted differently by investors. For example, under homogeneous beliefs and HARA utility functions with different cautiousness across individuals, the demands of individuals for the market protfolio would be affected through the differential impact of a change in the consensus expectation on their global absolute risk aversion. Consistent with Verrecchia's analysis, Bamber (1986) and Ajinkya, Atiase and Gift (1987) provide empirical evidences of a positive association between trading volume and absolute change in mean earnings forecast.

Varian (1985) shows in a rational expectation model under heterogeneous prior beliefs and homogeneous interpretation of new information that trading volume has a positive association with the dispersion of prior beliefs. Consistent with Varian's model, a positive association between trading volume and the dispersion of analysts'

earnings forecasts is presented by Ajinkya, Atiase and Gift (1987) and Comiskey, Walkling and Weeks (1987). In contrast, Park (1988) and Ziebart (1987) find an insignificant association between volume and dispersion of analysts' forecasts. Under heterogeneous interpretations of public information, the Varian's model predicts that differences in interpretations of information also generate trading volume. We are not aware of any prior empirical studies that quantify the differences of interpretations of information.

In a comparative static analysis of a competitive equilibrium under heterogeneous earnings expectations and constant absolute risk aversions, proposition I predicts that the absolute change in stock price is positively correlated with the absolute change in the mean earnings expectation, but is not a function of the change in relative heterogeneity. Proposition II predicts that unsystematic trading volume is proportional to the change in relative heterogeneity. The change in relative heterogeneity variable may be viewed as a composite variable that accounts for both the dispersion of prior beliefs and differences in the interpretations of information, thus the prediction of proposition II is similar in spirit to the predictions of the form of Varian's model that incorporates differences in interpretation of information. Under homogeneous expectations and non-constant absolute risk aversions, proposition III predicts that total trading volume is a function of the absolute change in the consensus expectation. In this model, the positive association between total trading volume and the absolute change in the consensus expectation should be solely attributable to the positive association between market volume and the absolute change in the consensus expectation. If both heterogeneous expectations and non-constant absolute risk aversions are assumed, the impact of the absolute change in the consensus expectation can not be separated from the impact of the change in relative heterogeneity. However, the possibility that complex interactions result in both the change in relative heterogeneity and the absolute change in the consensus expectation having impacts on unsystematic trading volume can not be ruled out.

In testing the predictions of the competitive equilibrium model, expectational variables are measured using IBES survey data on individual analysts' annual earnings forecasts. This data base includes the forecasts of individual analysts and the dates when these forecasts were reported. These data permit calculations of the

change in relative heterogeneity and the absolute change in the consensus expectation based on pairs of individual analyst annual EPS (earnings per share) forecasts made by the same individual analysts before and after the interim quarterly earnings announcements.

Consistent with proposition I, there is a positive association between the absolute percentage change in stock price and the absolute change in the consensus expectation, and an insignificant association between the absolute percentage change in stock price and the change in relative heterogeneity.

Consistent with proposition II, there is a positive association between unsystematic trading volume and the change in relative heterogeneity. However, this relationship is not proportional. This non-proportionality could be attributable to errors of measurement in the estimate of the change in relative heterogeneity. Varian's fully revealing rational expectation model predicts that trading volume is related to the dispersion of individuals' prior beliefs; therefore, the standard deviation of analysts' earnings forecasts before interim quarterly earnings announcements is included as another explanatory variable to explain unsystematic trading volume. Evidence presented indicates that the standard deviation of analysts' earnings forecasts is neither significantly positive by itself nor significantly positive in combination with other variables.

Under proposition III, the positive association between total trading volume and the absolute change in the consensus expectation is solely attributable to the impact of the absolute change in the consensus expectation on market volume. There is a significant positive association between total trading volume and the absolute change in the consensus expectation. There is also a significant positive association between market trading volume and the absolute change in the consensus expectation. It indicates the positive association between total trading volume and the absolute change in the consensus expectation is partially attributable to the impact of the absolute change in the consensus expectation on market volume. However, unsystematic trading volume also has a significant association with the absolute change in the consensus expectation. This suggests that complex interactions between the effects of heterogeneous expectations and changing global absolute risk aversion may result in both the change in relative heterogeneity and the absolute change in the

consensus expectation having impacts on unsystematic trading volume.

This paper is organized as follows, section 2 developes the competitive equilibrium model and analyzes its comparative static predictions, section 3 discusses the sample and measurement of variables, section 4 describes the empirical evidence and section 5 summarizes the study's findings.

Section 2. The Competitive Equilibrium and Trading Volume

Consider a single period economy with three tradable securities: stock in firm k, a market index fund, and a riskless asset. Assume that the returns on the kth firm's stock and the market portfolio are jointly normally distributed. Individuals are assumed to have heterogeneous beliefs concerning expected earnings for the kth firm but agree on variances, covariances and aggregate expected earnings on the market. The individual's portfolio problem is to maximize the expected utility of end of period wealth, subject to a budget constraint.

$$Max\ E_i[U_i(W_{i1})],\ \forall i \tag{1}$$

$$where\ W_{i1} = [(W_{i0} - z_{ik}V_k - z_{im}V_m)r_f + (z_{ik}Y_k + z_{im}Y_m)] \tag{2}$$

W_i = the wealth of individual i at time t, t=0,1

V_k = the market value of stock of the kth firm,

V_m = the market value of all stocks,

z_{ik} = the percentage of the kth firm's stock directly held by individual i,

z_{im} = the percentage of the market portfolio held by individual i,

Y_k = the kth firm's earnings,

Y_m = aggregate earnings for the market,

r_f = unity plus the risk-free rate.

Note that the ith individual's total fractional holdings of the kth firm's stock consists of his direct holding, z_{ik} and his indirect holding through his fractional ownership of the market portfolio, z_{im}.

Following Rubinstein (1973) and Huang and Litzenberger (1988, pp100-101) the first order conditions for individual i's portfolio equilibrium may be expressed as

$$\theta_i^{-1}(E_i(Y_k) - r_f V_k) = cov(Y_k, z_{ik}Y_k + z_{im}Y_m) \tag{3a}$$

$$\theta_i^{-1}(E_i(Y_m) - r_f V_m) = cov(Y_m, z_{ik}Y_k + z_{im}Y_m) \tag{3b}$$

where θ_i is the ith individual global absolute risk aversion; i.e. $\theta_i = -\frac{E[U_i''(W_{i1})]}{E[U_i'(W_{i1})]}$.

DEFINITION 1: Total trading volume in the kth firm's stock is one-half of the summation over all individuals of the absolute changes in their total fractional holdings of the kth firm's stock. Algebraically stated, total trading volume v_t is equal to $(1/2)\sum_{i=1}^{\infty}|\Delta(z_{ik} + z_{im})|$.

DEFINITION 2: Unsystematic trading volume in the kth firm's stock is one-half of the summation over all individuals of the absolute changes in the differences between their fractional holdings of the kth firm's stock and their fractional holdings of the market portfolio. Algebraically stated, unsystematic trading volume v_u is equal to $(1/2)\sum_{i=1}^{\infty}|\Delta z_{ik}|$.

DEFINITION 3: The consensus earnings expectation is the unweighted mean of individuals' earnings expectations. Algebraically stated, the consensus expectation $E_i(Y_k)$ is equal to $\sum_{i=1}^{\infty}E_i(Y_k)/I$.

Note that the definition of the consensus expectation in this paper differs from the conventional definition which weights individuals' expectations by their risk tolerances (see Rubinstein (1975) and Wilson (1968)). In a market with large number of individuals where beliefs are independent of global absolute risk aversions, these definitions are equivalent.

DEFINITION 4: The market price of risk is equal to the reciprocal of the summation of individuals' global absolute risk tolerance, i.e. $[\sum_{i=1}^{I}\theta_i^{-1}]^{-1}$

Proposition I concerns the determinants of stock price in the market with large number of individuals.

PROPOSITION I:

In the market with large number of individuals having heterogeneous beliefs that are independent of their global absolute risk aversions, the product of the stock price and riskless interest rate is equal to the consensus earnings expectation less the product of the market price of risk and the covariance of earnings with market earnings. Algebraically stated

$$\underset{I\to\infty}{plim}\ r_f V_k = \left\{E_c(Y_k) - cov(Y_k, Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{4a}$$

$$\underset{I\to\infty}{plim}\ r_f V_m = \left\{E_c(Y_k) - var(Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{4b}$$

(Proof): For market to clear, $\sum_{i=1}^{I} z_{ik} = 0$ and $\sum_{i=1}^{I} z_{im} = 1$. Summing over all I individuals and solving for the competitive equilibrium market value gives:

$$r_f V_k = \left\{\sum_{i=1}^{I}\theta_i^{-1}E_i(Y_k)/\sum_{i=1}^{I}\theta_i^{-1}\right\} - \left\{cov(Y_k, Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{5a}$$

$$r_f V_m = \left\{\sum_{i=1}^{I}\theta_i^{-1}E_i(Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} - \left\{var(Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{5b}$$

The first term in the braces of the right hand side (RHS) of relations (5a) and (5b) may be expressed as

$$E_c(Y_k) + \sum_{i=1}^{I}\left\{[E_i(Y_k) - E_c(Y_k)]\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{6a}$$

$$E_c(Y_m) + \sum_{i=1}^{I}\left\{[E_i(Y_m) - E_c(Y_m)]\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{6b}$$

Substituting (6a) and (6b) for the first term in braces in the RHS of (5a) and (5b) respectively gives

$$r_f V_k = E_c(Y_k) + \sum_{i=1}^{I}\left\{[E_i(Y_k) - E_c(Y_k)]\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}\right\} - \left\{cov(Y_k, Y_m)/\sum_{i=1}^{I}\theta_i^{-1}\right\} \tag{7a}$$

$$r_f V_m = E_c(Y_m) + \sum_{i=1}^{I} \left\{ [E_i(Y_m) - E_c(Y_m)]\theta_i^{-1} / \sum_{i=1}^{I} \theta_i^{-1} \right\} - \left\{ var(Y_m) / \sum_{i=1}^{I} \theta_i^{-1} \right\} \quad (7b)$$

Assuming that expectations are independent of individuals' global absolute risk aversions, as the number of individuals become large:

$$\underset{I \to \infty}{plim} \sum_{i=1}^{I} \left\{ [E_i(Y_k) - E_c(Y_k)]\theta_i^{-1} / \sum_{i=1}^{I} \theta_i^{-1} \right\} = 0 \quad (8a)$$

$$\underset{I \to \infty}{plim} \sum_{i=1}^{I} \left\{ [E_i(Y_m) - E_c(Y_m)]\theta_i^{-1} / \sum_{i=1}^{I} \theta_i^{-1} \right\} = 0 \quad (8b)$$

Therefore, taking the probability limits of (7a) and (7b), given the large market prices for the k-th firm's stock and for the aggregate market that are given in (4a) and (4b). Q.E.D.

Note that the stock price is directly related to the consensus expectation and that the consensus is a simple average of individuals' heterogeneous beliefs. This implies that the following corollary

COROLLARY 1:
The absolute change of the stock price is positively correlated with the absolute change in the mean of individuals' beliefs.

The pricing relations given in (4a) and (4b) are based on a competitive equilibrium model in which individuals do not learn from prices. However our results are consistent with the noisy rational expectation model under which price is not a sufficient statistic for all available information. In a noisy rational expectation model $E_i(Y_k|V_k)$ replaces $E_i(Y_k)$ to account for the feedback from prices to expectations. Under these considerations, determination of prices requires knowledge of the conditional expectation functions, however, the empirical implications for our volume test are identical. The model avoids the Grossman and Stiglitz (1980) paradox if individuals do not have precise knowledge of the summation of the individuals' global risk tolerances.

DEFINITION 5: The change in relative heterogeneity is the mean absolute change of the deviations of individuals' EPS expectations from the consensus EPS expectation deflated by the unsystematic variance of earnings. Algebraically stated the change in relative heterogeneity, $|\Delta H|$, is equal to

$$|\Delta H| = \sum_{i=1}^{I} |\Delta \left\{ \frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2) var(Y_k)} \right\}| / I \tag{9}$$

where $R^2 = \frac{cov^2(Y_k, Y_m)}{[var(Y_k) var(Y_m)]}$, the coefficient of determination between the kth firm's earnings and aggregate earnings. The term $(1 - R^2) var(Y_k)$ is the unsystematic variance of the kth firm's earnings.

The second proposition relates to the determinants of unsystematic trading volume in the market with a large number of individuals having utility functions displaying constant absolute risk aversion. The assumption of constant absolute risk aversion abstracts from the impact of changes in expectations on individuals' global absolute risk aversions.

PROPOSITION II:
In the market with a large number of individuals having heterogeneous expectations and constant absolute risk aversions, unsystematic trading volume v_u is proportional to the change in relative heterogeneity. Algebraically stated

$$\underset{I \to \infty}{plim}\ v_u = (1/2) \left\{ \sum_{i=1}^{I} \theta_i^{-1} \right\} \sum_{i=1}^{I} |\Delta \left\{ \frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2) var(Y_k)} \right\}| / I \tag{10}$$

(Proof): Substituting the large market price given on the RHS of relation (9a) for V_k in relation (3a) yields:

$$\left\{ \theta_i^{-1} [E_i(Y_k) - E_c(Y_k)] \right\} + \left\{ [\theta_i^{-1} / \sum_{i=1}^{I} \theta_i^{-1}] cov(Y_k, Y_m) \right\} = cov(Y_k, z_{ik} Y_k + z_{im} Y_m) \tag{11}$$

Solving (11) for z_{ik} yields:

$$z_{ik} = \left\{\theta_i^{-1}[E_i(Y_k) - E_c(Y_k)]/var(Y_k)\right\} + \left\{[\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}]cov(Y_k, Y_m)/var(Y_k)\right\}$$

$$-\left\{z_{im}cov(Y_k, Y_m)/var(Y_k)\right\} \tag{12}$$

Substituting the large market price given on the RHS of relation (9b) for V_m in relation (3b), assuming homogeneous beliefs concerning the aggregate earnings Y_m and solving for z_{im} gives:

$$z_{im} = \left\{\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}\right\} - \left\{z_{ik}cov(Y_k, Y_m)/var(Y_m)\right\} \tag{13}$$

Substituting the RHS of relation (13) for z_{im} in relation (12) and solving for z_{ik} gives the ith individual's direct holdings of the kth stock:

$$z_{ik} = \theta_i^{-1}\left\{\frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2)var(Y_k)}\right\} \tag{14}$$

Relation (14) was derived under two risky assets and a safe asset. In the case of single risky asset and a safe asset, the solution is identical except for the omission of $(1 - R^2)$ term (see Huang and Litzenberger (1988, p269) and Park (1988, p10)).

Now consider the change in the ith individual direct holdings of the kth firm's stock induced by changing expectations in response to a public information event. Under constant absolute risk aversions, the change in ith individual's direct holdings in the kth firm's stock is

$$\Delta z_{ik} = \theta_i^{-1}\Delta\left\{\frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2)var(Y_k)}\right\} \tag{15}$$

Unsystematic trading volume is determined by taking absolute values of both sides of relation (15), summing over all individuals and dividing by two.

$$v_u = \sum_{i=1}^{I}|\Delta z_{ik}|/2 = \sum_{i=1}^{I}\theta_i^{-1}|\Delta\left\{\frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2)var(Y_k)}\right\}|/2 \tag{16}$$

Assuming that changes in individuals' earning expectations are independent of their absolute risk aversions, unsystematic trading volume in a market with large

number of individuals is determined by taking the probability limit as the number of individuals increases.

$$\underset{I\to\infty}{plim}\ v_u = (1/2)\Big\{\sum_{i=1}^{I}\theta_i^{-1}\Big\}\sum_{i=1}^{I}|\Delta\Big\{\frac{E_i(Y_k)-E_c(Y_k)}{(1-R^2)var(Y_k)}\Big\}|/I \tag{17}$$

Q.E.D.

The previous analysis of trading volume abstracts from the impact of changes in individuals' global absolute risk aversions which in turn has an impact on trading volume as shown by Verrecchia (1981).[1] It is not possible to disentangle the separate effects of the change in relative heterogeneity from the change in individuals' global absolute risk aversions (income effects). The assumption of constant absolute risk aversions makes the analysis tractable by focusing only on the change in relative heterogeneity (substitution effects) and abstracting from the change in individuals' global absolute risk aversion (income effects).

Prior empirical studies indicate that the absolute change in the consensus expectation has a significant positive association with trading volume. An impact of the absolute change in the consensus expectation on trading volume is motivated in the current study through a model that assumes homogeneous beliefs but allows for non-constant absolute risk aversions and heterogeneous cautiousness. This abstracts from the substitution effects under heterogeneous expectations and focuses on the income effect. Consistent with Verrecchia's analysis, the following proposition demonstrates that under homogeneous beliefs, information can have an impact on trading volume.

[1] The above analysis also did not analyze the cause of changes in individuals' earnings expectations. The subsequent empirical work examines the change in relative heterogeneity in response to a public information release. The diverse impact of a public information release on changes on individuals' earnings expectations may be attributable to differences in production functions for private information (See Marshall (1974))

PROPOSITION III:

Based on the first order Taylor's expansion, in the market with a large number of individuals having homogeneous expectations and non-constant absolute risk aversions, total trading volume v_t is an increasing function of the absolute change in the consensus expectation:

$$\underset{I\to\infty}{plim}\ v_t \approx \Big\{\sum_{i=1}^{I}\Big|\frac{d[\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}]}{d[E_c(Y_k)]}\Big|\Big\}|\Delta[E_c(Y_k)]|/2 \tag{18}$$

(Proof): Under homogeneous expectations it follows from relation (14) that $z_{ik}=0$ and the ith individual total demand for the kth stock, $z_{ik}+z_{im}$, may be expressed as

$$z_{ik}+z_{im}=\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1} \tag{19}$$

The change in the ith individual's total demand for the kth stock can be approximated by first order Taylor's expansion:

$$\Delta(z_{ik}+z_{im}) \approx \Big\{\sum_{i=1}^{I}\frac{d[\theta_i^{-1}/\sum_{i=1}^{I}\theta_i^{-1}]}{d[E_c(Y_k)]}\Big\}\Delta[E_c(Y_k)]/2 \tag{20}$$

Taking absolute values and summing over all individuals gives relation (18).

Q.E.D.

Relation (18) shows that total trading volume v_t in the kth stock which would be positively correlated with the absolute change in the consensus expectation. Under homogeneous beliefs, all individuals hold the market portfolio and unsystematic trading volume is zero. Therefore, proposition III does not imply a positive association between unsystematic trading volume and the absolute change in the consensus expectation. The positive association between total trading volume and the absolute change in the consensus expectation is solely attributable to the positive association between market volume and the absolute change in the consensus expectation.

Both the assumptions of constant absolute risk aversions (made in proposition II) and homogeneous expectations (made in proposition III) abstract from the interactions among changes in individuals' absolute risk aversions, changes in the

consensus expectation, and changes in individuals' earnings expectations relative to the consensus. If both heterogeneous expectations and non-constant absolute risk aversions are assumed, the impact of the absolute change in the consensus expectation can not be separated from the impact of the change in relative heterogeneity. However, the possibility that complex interactions result in both the change in relative heterogeneity and the absolute change in the consensus expectation having impacts on unsystematic trading volume can not be ruled out.

Section 3. Sample and Estimations of Variables:

Proposition I relates the market value of the firm to the consensus earnings expectation and Corollary I relates the absolute change in stock price to the absolute change in the consensus expectation. Proposition II relates unsystematic trading volume to the change in relative heterogeneity, and proposition III relates total trading volume to the absolute change in the consensus expectation. Both the change in relative heterogeneity and the absolute change in the consensus expectation involve individuals' expectations which are not directly observable.

The change in relative heterogeneity and the absolute change in the consensus expectation are estimated based on individual analysts forecasts of annual earnings around interim quarterly earnings announcements. The calculation of the numerator of the change in relative heterogeneity requires forecasts of individual analysts which are obtained from the detail IBES (Institutional Brokers Estimate System) deta base provided by Lynch, Jones and Ryan Co. This detail data base is available over the period from 1983 through 1986, it comprises the raw data of forecasts of individual analysts and dates they were reported. The same data base is also used to calculate the consensus expectations before and after interim quarterly earnings announcements.[2] The calculation of the denominator of the change in relative heterogeneity requires a sufficiently long time series estimate of the unsystematic variance of earnings, it is estimated based on the IBES consensus data which covers the period from 1976 to 1987.

The criteria for including firms/interim earnings announcements in our sample relate to the requirements for an accurate estimate of the change in relative heterogeneity and an accurate estimate of the absolute change in the consensus expectation.

---

[2] The detail forecasts are available about three fifth of the 48 months in the sample period with missing months throughout the sample period. To account for the missing month problem to obtain the closest forecasts around interim quarterly earnings announcements, firms with non-missing months one month before and one month after the month of earnings announcements (i.e. three consecutive months) are selected. The detail data base contains more than million records, to reduce the sample size to a manageable level, firms with total analysts 20 or above (include both active and inactive analysts) followed are selected.

1. Firms/interim earnings announcements are included in our sample if 10 or more active analysts who make forecasts both within the period of the two months before and within the period of two months after announcement date.

2. The sample in the fourth quarter is excluded.

3. Firms whose fiscal year end do not correspond to the calendar year end are excluded.

The first criterion relates to the large number of pairs of pre-announcement and post-announcement analysts' forecasts that are required for the reliable estmation of the change in relative heterogeneity and the absolute change in the consensus expectation. This criterion assures that the consensus expectation is based only on recently updated analysts' forecasts. [3] The second criterion ensures the comparable current fiscal year end earnings forecasts before and after the interim earnings announcements; i.e. analysts start to forecast the following fiscal year end earnings after the fourth quarter. The third criterion is necessary to calculate the non-systematic earnings variance term in the change in relative heterogeneity variable.

Screening based on the previous discussed criteria, the final sample consists 266 events for 101 firms covering the period from April 1984 to March 1986. The company names, the associated industry names and other characteristics are listed in Appendix A. Most of the companies listed in Appendix A are large firms, the ratio of capitalized market value of each company to total NYSE market value ranging from 0.03 percent to 4.5 percent with an average 0.25 percent. The total market value of these 101 firms constitue 25 percent of the total market value of NYSE. Although firms are in 49 four digit SIC industry groupings, almost half the firms are concentrated in 10 four digit SIC industry groupings. The concentration of our sample in large firms in specific industries raises the possibility that analysts' forecasts in those industries may be more similar to each other than the forecasts of individuals are to each other. Under these conditions, the change in relative heterogeneity variable based on analysts' forecasts may not fully reflect the change

[3] Firms in our sample are followed by a large number of analysts who frequently update their forecasts. This may result in a sample of firms for which analysts' forecasts that are more volatile than typical firms.

in relative heterogeneity of individuals. This would bias our tests toward finding insignificant results.

Total daily trading volume in a given stock is measured as the number of shares traded divided by the number of shares outstanding. Total daily trading volume for the market portfolio is measured as the market value of all stocks traded on the NYSE divided by the total market value of all firms listed in the NYSE. Unsystematic daily trading volume in a given stock is measured as the component of total volume in that stock that is unrelated to the total market volume. The kth firm's trading volume is regressed on the market trading volume over the 80 trading days ending 10 trading days prior to earnings announcement day. The systematic component of the daily trading volume is determined as the sum of intercept and the product of slope and total daily market volume. Unsystematic daily volume is determined by subtracting systematic trading volume from total trading volume. Unsystematic trading volume on the day that a given interim earnings report appeared in the Wall Street Journal is added to unsystematic trading volume on the previous trading day in order to account for the possibility that the announcement appeared in the Dow Wire Service that day.[4]

The change in relative heterogeneity was defined as

$$|\Delta H| = \sum_{i=1}^{I} |\Delta \left\{ \frac{E_i(Y_k) - E_c(Y_k)}{(1 - R^2)var(Y_k)} \right\}| / I \tag{21}$$

Since IBES data provides earnings per share (EPS) forecasts rather than earnings forecasts, it is useful to express the change in relative heterogeneity on an equivalent EPS basis:

$$|\Delta H| = \sum_{i=1}^{I} |\Delta \left\{ \frac{E_i(X_k) - E_c(X_k)}{(1 - R^2)var(X_k)n_k} \right\}| / I \tag{22}$$

where $Y_k = X_k n_k$, X_k is EPS of firm k, n_k is the number of shares of firm k, $R^2 = cov(X_k, X_m)^2 / var(X_k) var(X_m)$, and X_m is the market value weighted EPS.

The term in the numerator, $E_i(X_k) - E_c(X_k)$ is estimated from the IBES detail data base by matching individual analysts before and after interim earnings

[4] Daily trading volume and shares outstanding data for individual stocks and for NYSE as a whole are provided by the Rodney White Center University of Pennsylvania.

announcements. The term in the denominator,$(1-R^2)var(X_k)$, is estimated by using the definitional relations, $var(X_j) = E(X_j - E_c(X_j))^2$, $j = k, m$ and $cov(X_k, X_m) = E(X_k - E_c(X_k))(X_m - E_c(X_m))$. Since a sufficiently long time series forecasts of individuals' analysts is not available, the terms in the denominator are estimated based on the IBES consensus data. The estimate of X_k is the realized current fiscal year end EPS reported in the IBES consensus tape, the estimate of X_m is the market value weighted average of X_k, $E_c(X_k)$ is estimated as the mean EPS forecasts reported in the IBES consensus data base,[5] $E_c(X_m)$ is estimated as the market value weighted average $E_c(X_m)$. The terms $X_j - E_c(X_j)$, $j = k, m$ are estimated both one month before and one month after earnings announcement month from 1976 to 1984.[6] $E[X_k - E_c(X_k)]^2$, $E[X_m - E_c(X_m)]^2$ and $E[X_k - E_c(X_k)][X_m - E_c(X_m)]$ are estimated as a time series average from 1976 to 1984.[7]

To provide an appropriately scaled proxy for the absolute change in the consensus expectation, the absolute percentage change of consensus earnings forecasts before and after interim earnings announcements is calculated. Since Varian's fully revealing rational expectation model predicts that trading volume is related to the dispersion of individuals' prior beliefs, the standard deviation of analysts' earnings forecasts before interim earnings announcements is calculated and used as an additional explanatory variable to explain trading volume.

Note that the maximum values of the change in relative heterogeneity, the absolute change in the consensus expectation and the standard deviation of earnings forecasts are 42.74 (11 standard deviations from the mean), 3.32 (15 standard deviations from the mean) and 3.51 (14 deviations from the mean) respectively. This serious outlier problem could distort our results. To reduce the impact of large measurement errors on our estimates in previous three variables, outliers beyond two

---

[5] The IBES consensus data reports those non-updated mean forecasts which not only comprises analysts who satisfy our selection criteria, but also comprises those analysts who made forecasts within a year ago but have never revised their forecasts since then.

[6] $X_j - E_c(X_j)$, $j = k, m$ are also estimated one month before and in the current month of earnings announcement, similar results are obtained.

[7] Note that the value of $X_j - E_c(X_j)$, $j = k, m$ decreases toward the current fiscal year end. Since we first identify the month of quarterly earnings announcements for each sample, calculate $X_j - E_c(X_j)$ in one month before and one month after earning announcement month, and to make a time series average from 1976 to 1984. A stable $X_j - E_c(X_j)$, $j = k, m$ over time is obtained.

standard deviations from the mean are trimmed (winsorized) to two standard deviations. Since similar significant results are obtained for these three variables with and without trimming, only the estimates using the winsorized variables are reported.

To test the hypothesized positive association between the price change and the absolute change in the consensus expectation (proxied by the absolute percentage change in consensus earnings forecasts), the absolute percentage change in stock price from two day before Wall Street Journal Index day to the day of the Wall Street Journal Index day is calculated. The summary statistics of above variables are reported in Table 1.

Section 4. Empirical Results:

Proposition I and corollary I predict a positive association between the absolute percentage change in stock price and the absolute change in the consensus expectation, and no association between the absolute percentage change in stock price and the change in relative heterogeneity. The correlation coefficient between the absolute percentage change in stock price and the absolute change in the consensus expectation is significantly positive at the 5 percent level (See Table 2). The correlation coefficient between the absolute percentage change in stock price and the change in relative heterogeneity is insignificant. This evidence is consistent with the predictions of corollary I.

Proposition II predicts that unsystematic trading volume is positively associated with the change in relative heterogeneity. The correlation coefficient between these two variables is significantly positive at the 1 percent level (See Table 2). Note that proposition II also predicts that unsystematic trading volume is proportional to the change in relative heterogeneity which implies a zero intercept. The regression results in Table 3 show a significantly positive impact of the change in relative heterogeneity on unsystematic trading volume (See Table 3a) and total trading volume (See Table 3b), but not on market volume (See Table 3c) which is consistent with proposition II. However, this relationship is not proportional (the intercept is significant), which is inconsistent with proposition II. The significant positive intercept may be attributable to errors of measurement in the relative heterogeneity which would bias the slope coefficient downward and intercept upward.

Under proposition III, the predicted positive association between total trading volume and the absolute change in the consensus expectation is attributable to the impact of the absolute change in the consensus expectation on market volume. As reported in Table 2, unsystematic trading volume, total trading volume and market volume all have significant positive associations with the absolute change in the consensus expectation. The regression results in Table 3 show a significantly positive impact of the absolute change in the consensus expectation on market volume (t = 1.94) and on total trading volume (t = 3.69). This indicates that the positive association between total trading volume and the absolute change in the consensus

expectation is partially attributable to the impact of the absolute change in the consensus expectation on market volume. However, unsystematic trading volume also has a significant positive association with the absolute change in the consensus expectation ($t = 3.57$). Complex interactions under heterogeneous beliefs and non-constant absolute risk aversion may result in both the change in relative heterogeneity and the absolute change in the consensus expectation having impacts on unsystematic trading volume.

Previous studies have shown a positive association between trading volume and the absolute price change. [8] This raises the possibility that our previous results may be attributable to the change in relative heterogeneity and/or the absolute change in the consensus expectation proxying for the absolute price change. To evaluate this possibility, the absolute percentage change in stock price is included as a third independent variable, the coefficient on the absolute percentage change in stock price is significantly positive at 1 percent level (See Table 3). However, as reported in Table 3*a* and 3*b*, there is no impact on the general level or significance of either the coefficient on the change in relative heterogeneity or the coefficient on the absolute change in the consensus expectation.

Under homogeneous interpretation of new information, Varian's fully revealing rational expectation model predicts that unsystematic trading volume is related to the dispersion of individuals' prior beliefs; therefore, the standard deviation of analysts' earnings forecasts before interim quarterly earnings announcements is included as another explanatory variable. As reported in Table 4, the regression coefficients on the standard deviation of analysts' earnings forecasts is neither significantly positive by itself nor uniformly significantly positive in combination with other variables. The only significant coefficient is the one in combination with the change in relative heterogeneity, which is marginally significant at the 5 percent level.

[8] Clark (1973), Tauchen and Pitts (1983), Epps (1975), Epps and Epps (1976) and Karpoff (1984) have shown that there is a positive association between trading volume and the absolute or square price change over a fixed time interval.

Section 5. Conclusion:

In a comparative static analysis of a competitive equilibrium under heterogeneous earnings expectations and constant absolute risk aversions, proposition I and corllary I predict that the absolute change in stock price is positively correlated with the absolute change in the mean earnings expectation, but is not a function of the change in relative heterogeneity. Proposition II predicts that unsystematic trading volume is proportional to the change in relative heterogeneity, but is unrelated to the dispersion of individuals' prior beliefs. Under homogeneous expectations and non-constant absolute risk aversions, proposition III predicts that total trading volume is a function of the absolute change in the consensus expectation. In this model, the positive association between total trading volume and the absolute change in the consensus expectation should be solely attributable to the positive association between market volume and the absolute change in the consensus expectation. Both the assumptions of constant absolute risk aversions (made in proposition II) and homogeneous expectations (made in proposition III) abstract from the interactions among changes in individuals' absolute risk aversions, changes in the consensus expectation, and changes in individuals' earnings expectations relative to the consensus. If both heterogeneous expectations and non-constant absolute risk aversions are assumed, the impact of the absolute change in the consensus expectation can not be separated from the impact of the change in relative heterogeneity. However, the possibility that complex interactions result in both the change in relative heterogeneity and the absolute change in the consensus expectation having impacts on unsystematic trading volume can not be ruled out.

Consistent with proposition I and corollary I , there is a significant positive association between the absolute percentage change in stock price and the absolute change in the consensus expectation, and an insignificant association between the absolute percentage change in stock price and the change in relative heterogeneity.

Consistent with proposition II, there is a positive association between unsystematic trading volume and the change in relative heterogeneity. However, this relationship is not proportional. This non-proportionality could be attributable to errors of measurement in the estimate of the change in relative heterogeneity. Varian's fully

revealing rational expectation model predicts that trading volume is related to the dispersion of individuals' prior beliefs; therefore, the standard deviation of analysts' earnings forecasts before interim earnings announcements is included as another explanatory variable to explain unsystematic trading volume. Evidence presented indicates that the standard deviation of analysts' earnings forecasts is not significantly positive by itself and is generally not significantly positive in combination with other variables.

Under proposition III, the positive association between total trading volume and the absolute change in the consensus expectation is solely attributable to the impact of the absolute change in the consensus expectation on market volume. Evidences presented indicate significant positive impacts of the absolute change in the consensus expectation on total trading volume and market volume. This suggests that the positive association between total trading volume and the absolute change in the consensus expectation is partially attributable to the impact of the absolute change in the consensus expectation on market volume. However, unsystematic trading volume also has a significant positive association with the absolute change in the consensus expectation. This suggests that complex interactions under heterogeneous expectations and non-constant absolute risk aversion may result in both the change in relative heterogeneity and the absolute change in the consensus expectation having impacts on unsystematic trading volume.

Reference:

Ajinkya, B, R. Atiase, and M. Gift, "Volume of Trading and the Dispersion in Financial Analysts' Earnings Forecasts," 1986, University of Florida Working Paper.

Bamber, L. "The Information Content of Annual Earnings release; A Trading Volume Approach," *Journal of Accounting Research,* 24(1986), 40-56.

Beaver, W., "The Information Content of Annual Earnings Announcement," *Journal of Accounting Research,* 6(1968), 67-92.

Clark, P.K., "A Subordinate Stochastic Process Model with Finite Variance for Speculative Prices," *Econometrica,* 41(1973), 135-155.

Comiskey, E., R. Walkling and M. Weeks, "Dispersion of Expectation and Trading Volume," *Journal of Business Finance and Accounting,* 14(1987), 229- 239.

Epps, T.W., "Security Price Changes and Transaction Volumes: Theory and Evidence," *American Economic Review,* 65(1975), 586-597.

Epps, T.W. and M.L. Epps, "The Stochastic Dependence of Security Price Changes and Transaction Volumes: Implications for the Mixture-Distribution Hypothesis," *Econometrica,* 44(1976), 305-321.

Foster, G., "Stock Market reactions to Estimates of Earnings Per Share by Company Officials," *Journal of Accounting Research,* (1973), 25-37.

Grossman, S., "On the Efficiency of Competitive Stock Markets Where Traders Have Diverse Information," *Journal of Finance,* 51(1976), p573-586.

Grossman, S. and J. Stiglitz, "On the Impossibility of Informationally Efficient Markets," *American Economic Review,* 70(1980), 393-408.

Huang, C. and Robert H. Litzenberger, *Foundations for Financial Economics,* North-Holland, New York, 1988.

Karpoff, J., "The Relationship Between Price Changes and Trading Volume: A Survey," *Journal of Financial and Quantitative Analysis,* 22(1987), 109-126.

Kieger, J., "An Empirical Investigation on NYSE Volume and Price Reaction to the Announcement of Quarterly Earnings," *Journal of Accounting Research,* 10(1972), 113-128.

Mayshar, J., "On Divergence of Opinion and Imperfections in Capital Markets," *American Economic Review,* 73(1983), 114-128.

Marshall, J., "Private Incentives and Public Information," *American Economic Review,* 64(1974), 373-390.

Morse, D., "Asymmetrical Information in Securities Markets and the Trading Volume," *Journal of Financial and Quantitative Analysis,* 15(1980), 1129- 1148.

Morse, D., "Price and Trading Volume Reaction Surrounding Earnings Announcements: A Closer Examination," *Journal of Accounting Research,* 2(1981), 374-383.

Park, Y.S., "Forecast of Earnings and Trading Volume," 1988, Rodney White Center Working Paper, University of Pennsylvania.

Rubinstein, M., "The Fundamental Theorem of Parameter-Preference Security Valuation," *Journal of Financial and Quantitative Analysis,* 1(1973), 61-70.

Rubinstein, M., "Security Market Efficiency in an Arrow-Debreu Economy," *American Economic Review,* 65(1975), 812-824.

Tauchen, G. and M. Pitts, "The Price-Variability-Volume Relationship on Speculative Markets," *Econometrica,* 51(1983), 485-505.

Varian, H., "Difference of Opinion in Financial Markets," 1985, University of Michigan Working Paper.

Verrecchia, R., "On the Relationship Between Volume Reaction and Consensus of Investors: Implications for Interpreting Tests of Information Content," *Journal of Accounting Research,* 19(1981),271-283.

Wilson, R., "The Theory of Syndicates," *Econometrica,* 36(1968), 119-132.

Ziebart, D., "An Empirical Investigation of the Association Between Discordance of beliefs and Trading Activity: Some Preliminary Findings," 1987, University of Illinois Working Paper.

APPENDIX (page 1): List of Sample Firms

	Company Name	SIC Code[a]	Number of Analysts[b]	Percentage of NYSE
1	Ocean Drilling	1311	17	0.07
2	Halliburton	1389	27	0.21
3	Freeport McMoran	1499	10	0.07
4	Anheuser Busch	2082	13	0.20
5	Coca Cola	2086	16	0.55
6	Pepsico	2086	15	0.24
7	Georgia-Pacific	2400	20	0.15
8	Champion Intern.	2600	12	0.08
9	Minnesota mining	2649	29	0.55
10	Gannett	2711	10	0.22
11	Times Mirror	2711	23	0.16
12	American Cyanamid	2800	15	0.15
13	Du Pont	2800	30	0.71
14	Monsanto	2800	38	0.21
15	Rohm and Haas	2800	21	0.09
16	Union Carbide	2800	29	0.20
17	American Home	2830	21	0.46
18	Merck	2830	25	0.41
19	Schering Plough	2830	23	0.11
20	Squibb	2830	21	0.17
21	Warner Lambert	2830	16	0.16
22	Abbott Lab	2834	23	0.30
23	Bristo Myers	2834	19	0.43
24	Johnson and Johnson	2834	37	0.40
25	Lilly (ELI)	2834	22	0.28
26	Pfizer Inc	2834	30	0.41
27	Smithkline	2834	31	0.28
28	Sterling	2834	18	0.11
29	UpJohn	2834	35	0.15
30	Avon	2844	19	0.11
31	Williams Cos	2870	18	0.06
32	Betz Lab	2890	13	0.03
33	Philips Pete	2911	26	0.27
34	Standard Oil	2911	25	0.65
35	Sun	2911	19	0.32
36	Texaco	2911	24	0.52
37	Unocal	2911	24	0.38
38	Union Pacific	2911	12	0.06
39	Coastal	2911	12	0.06
40	Mobil	2911	17	0.70
41	Aluminum Co. Am.	3330	20	0.16
42	Reynold Metals	3330	29	0.04
43	Caterpillar	3531	23	0.25
44	Smith Intern.	3533	23	0.03
45	Cincin. Milacron	3540	11	0.04
46	Ingersoll Rand	3560	18	0.05
47	General Eclectric	3600	23	1.50
48	Cooper Inc.	3610	19	0.08
49	TRW	3662	18	0.15
50	Texas Instrument	3674	40	0.18

APPENDIX (page 1 Continued): List of Sample Firms

	Company Name	SIC Code[a]	Number of Analysts[b]	Percentage of NYSE
51	AMP	3679	20	0.40
52	IBM	3680	43	4.50
53	NCR	3680	27	0.15
54	Amdahl	3682	15	0.03
55	Cray Resh	3682	14	0.06
56	Ford Motor	3711	22	0.45
57	General Dynamic	3721	13	0.18
58	McDonnell Doug.	3721	14	0.14
59	Northrop	3721	18	0.15
60	Lockheed	3760	13	0.17
61	Baxter Travenol	3841	34	0.12
62	Bard C R	3841	15	0.02
63	Eastman Kodak	3861	28	0.75
64	Xerox	3861	15	0.21
65	Burlington N.	4011	19	0.22
66	Cons. Freightway	4210	24	0.06
67	Southwest Airls	4511	17	0.04
68	GTE	4811	26	0.48
69	United Tele.	4811	20	0.11
70	CBS	4830	22	0.18
71	Dominion Res.	4911	10	0.14
72	Public Svc.	4911	10	0.04
73	Teco Energy	4911	14	0.05
74	Tenneco	4922	22	0.40
75	Transco Energy	4922	22	0.08
76	Enserch	4923	13	0.07
77	Baltimore Gas	4931	14	0.09
78	Cons. Edison	4931	12	0.21
79	Pacificorp	4931	10	0.11
80	McDonald	5812	11	0.32
81	Wendys	5812	11	0.05
82	Barnett Banks	6022	10	0.03
83	Morgan J.P.	6022	20	0.20
84	Bank of America	6025	26	0.17
85	First Bank	6025	12	0.06
86	First Chicago	6025	22	0.07
87	First City Bank	6025	14	0.03
88	Manu. Hanover	6025	14	0.08
89	Security Pacific	6025	20	0.11
90	Texas Comm. Bank	6025	25	0.09
91	Wells Fargo	6025	16	0.05
92	Capital HLDG	6312	13	0.05
93	Jefferson Pilot	6312	14	0.06
94	Torchmark	6312	14	0.08
95	Chubb	6332	27	0.05
96	Continental	6332	15	0.12
97	General Res.	6332	23	0.16
98	USF and G	6332	24	0.10
99	Hilton	7011	25	0.10
100	Warner Comm.	7810	16	0.11
101	Hospital Co. of Am.	8060	25	0.21

[a] Four digit SIC Industry code.

[b]9 The number of active analysts.

[c]Percentage of each company's market value to total NYSE market value.

TABLE 1

Summary Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum
v_u	0.060	0.212	-0.662	1.420
v_t	0.306	0.235	0.019	1.758
v_m	0.226	0.045	0.171	0.409
$\lvert\Delta H\rvert$	1.119	3.846	0.002	42.74
$\lvert\Delta C/C\rvert$	0.061	0.219	0.000	3.322
$\lvert\Delta P/P\rvert$	0.023	0.021	0.000	0.104
σ_B	0.062	0.248	0.000	3.514

v_u is unsystematic trading volume, v_t is total trading volume, v_m is market volume, $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price, σ_B is the standard deviation of earnings forecasts before earnings announcements.

TABLE 2

Correlation Coefficients Between Variables

	v_u [a]	v_t	v_m	$\|\Delta H\|$	$\|\Delta C/C\|$	$\|\Delta P/P\|$	σ_B
v_u	1.000	0.768[b]	-.054	0.214[b]	0.215[c]	0.322[b]	0.090
v_t		1.000	0.137[c]	0.181[b]	0.221[c]	0.376[b]	0.120
v_m			1.000	-.006	0.119	0.124[c]	0.006
$\|\Delta H\|$				1.000	0.003	0.013	-.046
$\|\Delta C/C\|$					1.000	0.172[b]	0.609[b]
$\|\Delta P/P\|$						1.000	0.110[c]
σ_B							1.000

[a] v_u is unsystematic trading volume, v_t is total trading volume, v_m is market volume, $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price, σ_B is the standard deviation of earnings forecasts before earnings announcements.

[b] Significant at the 1 percent level.

[c] Significant at the 5 percent level.

TABLE 3a

Unsystematic Trading Volume Regressions

	Intercept	$\|\Delta H\|$	$\|\Delta C/C\|$	$\|\Delta P/P\|$	R^2
1	0.0383	0.0263			0.042
	(2.71)	(3.57)			
2	0.0108	0.0263	0.5652		0.085
	(0.69)	(3.64)	(3.64)		
3	-.0501	0.0258	0.4331	2.9879	0.165
	(−2.61)	(3.74)	(2.88)	(5.11)	
4	-.0356	0.0258		3.2779	0.141
	(−1.90)	(3.69)		(5.61)	
5	0.0328		0.5669		0.043
	(2.21)		(3.57)		
6	-.0145			3.3065	0.100
	(−.80)			(5.53)	
7	-.0291		0.4334	3.0162	0.123
	(−1.55)		(2.81)	(5.03)	

[a] R^2 is adjusted for degree of freedom.

[b] $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price.

[c] The number in the bracket is the t-statistics. The critical value at 5 percent level is 1.645, the critical value at 1 percent level is 2.33.

TABLE 3b

Total Trading Volume Regressions

	Intercept	$\|\Delta H\|$	$\|\Delta C/C\|$	$\|\Delta P/P\|$	R^2
1	0.2848	0.0247			0.029
	(18.0)	(2.98)			
2	0.2533	0.0246	0.6475		0.074
	(14.4)	(3.04)	(3.74)		
3	0.1729	0.0240	0.4730	3.9435	0.188
	(8.23)	(3.17)	(2.87)	(6.16)	
4	0.1888	0.0240		4.2602	0.166
	(9.19)	(3.13)		(6.66)	
5	0.2739		0.6490		0.045
	(16.6)		(3.69)		
6	0.2083			4.2868	0.138
	(10.5)			(6.59)	
7	0.1925		0.4733	3.9698	0.160
	(9.42)		(2.83)	(6.09)	

[a] R^2 is adjusted for degree of freedom.

[b] $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price.

[c] The number in the bracket is the t-statistics. The critical value at 5 percent level is 1.645, the critical value at 1 percent level is 2.33.

TABLE 3c

Market Trading Volume Regressions

	Intercept	$\|\Delta H\|$	$\|\Delta C/C\|$	$\|\Delta P/P\|$	R^2
1	0.2263	-.0002			-.004
	(73.6)	(−.098)			
2	0.2231	-.0002	0.0667		0.007
	(64.0)	(−.104)	(1.94)		
3	0.2184	-.0002	0.0564	0.2324	0.014
	(49.2)	(−.127)	(1.62)	(1.72)	
4	0.2203	-.0002		0.2702	0.008
	(51.3)	(−.126)		(2.02)	
5	0.2230		0.0666		0.010
	(69.4)		(1.94)		
6	0.2201			0.2700	0.012
	(53.9)			(2.02)	
7	0.2182		0.0564	0.2322	0.018
	(51.5)		(1.62)	(1.72)	

[a] R^2 is adjusted for degree of freedom.

[b] $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price.

[c] The number in the bracket in the t-statistics. The critical value at 5 percent level is 1.645, the critical value at 1 percent level is 2.33.

TABLE 4

Unsystematic Trading Volume Regressions with Dispersion of Prior Beliefs

	$\lvert\Delta H\rvert$	$\lvert\Delta C/C\rvert$	$\lvert\Delta P/P\rvert$	σ_B	R^2
1				0.1832	0.004
				(1.48)	
2	0.0269			0.2037	0.049
	(3.65)			(1.67)	
3	0.0262		3.2028	0.1394	0.142
	(3.74)		(5.45)	(1.15)	
4	0.0255	0.5145	2.9912	-.1029	0.163
	(3.69)	(2.73)	(5.11)	(−.72)	
5		0.5404	3.0202	-.1351	0.123
		(2.80)	(5.04)	(−.92)	
6		0.6698		-.1298	0.042
		(3.35)		(−.85)	

[a] R^2 is adjusted for degree of freedom.

[b] $|\Delta H|$ is the change in relative heterogeneity, $|\Delta C/C|$ is the absolute change in the consensus expectation, $|\Delta P/P|$ is the absolute percentage in stock price, σ_B is the standard deviation of earnings forecasts before earnings announcements.

[c] The number in the bracket is the t-statistics. The critical value at 5 percent level is 1.645, the critical value at 1 percent level is 2.33.