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Price-volume relationships and stock returns

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PRICE-VOLUME RELATIONSHIPS AND STOCK RETURNS

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ABSTRACT

It is popular among technical analysts to use high trading volume as a positive selection or filter criteria. Yet the findings in the finance literature are not clear on the predictive validity or even the direction of the impact of trading volume on stock returns. One stream of finance research finds that high changes in trading volume are associated with information asymmetry or differences in beliefs between traders, suggesting stock price reversals and return variances are higher with high trading volume. A second stream of research finds that high trading volume is attributed to informed trading, suggesting stock price reversals and return variances are lower with high trading volume. A third stream of research, modern portfolio theory, rejects the predictive validity of using past information. In this study, an alternative hypothesis is developed using an intuitive market demand and supply model, supporting the hypothesis that large price reactions coupled with normal trading volume are less likely to be reversed and are more stable than in the case of high trading volume. These hypothesizes are tested empirically and have important implications for investment analysts, and the controversies surrounding the meaning of trading volume.

INTRODUCTION

Financial economists have been studying the relationship between stock returns and trading volume for many years. Of particular interest to investors is whether information about trading volume is useful in helping forecast stock returns. It is common to see stock charts studied by investors displaying stock prices in the top portion of the chart and volume at the bottom. Many technical analysts use high trading volume as a criterion to filter and select stocks with promising returns. Yet, there is much controversy concerning the significance and predictive validity of trading volume. According to the efficient market hypothesis, past price or volume changes in a competitively traded financial market do not help predict future prices. However, recent studies have questioned the efficient market hypothesis and have supported the notion that stock market excess returns can be predicted by publicly available information (e.g., see Fama & French, 1995; Pesaran & Timmerman, 1995; Ferson & Harvey, 1993). With respect to trading volume, Lee and Swanminathan (2000) stated: "*The fact that a market statistic widely used in technical analysis can provide information about relative under- or over-valuation is surprising and is difficult to reconcile with existing theoretical work.*" (p.2019) Yet, their study finds that past trading volume can be used to predict future stock price momentum. Chen, et al. (2001) also finds volume to be useful in predicting changes in stock prices and volatility. Gervais, Kaniel, and Mingelgrin (2002) test and confirm an investment strategy using trading volume that realizes positive economic profits.

The objective of this study is to further examine and test the validity of using trading volume to forecast stock returns. This paper extends the work in this area in several ways. First, different schools of thought are categorized in terms of the way in which volume affects and predicts stock returns. Second, the impact of low, normal, and high volume associated with high,

stable, or low returns are examined. High (low) volume changes associated with high (low) returns are hypothesized to have different affects than with normal returns. Third, an intuitive demand and supply model of the market is used to explain price-volume relationships.

The paper proceeds as follows. First the relevant literature is reviewed. Second, a set of hypothesizes are formulated and the testing methodology described. Third, the empirical results are presented and analyzed. The final section discusses the implications and areas of future research.

LITERATURE REVIEW: VOLUME AND PRICE REACTIONS

Early research has found price and volume reactions to be similar, and consequently, have considered price and volume as substitute measures of market reaction. Several studies dating back to as early as 1970 demonstrate that there is a positive correlation between stock returns and daily trading volume (see Crouch (1970), Clark (1973), and Wood, McInish, and Ord (1985)). Positive correlations were also found between the variance of stock returns and trading volume (see Epps and Epps(1976), Morgan (1976), Westerfield (1977), Taugen and Pitts (1983)). The implication is that volume does not provide additional information from stock prices. Also, the suggestion that either high or low trading volume would have any predictive validity is inconsistent with the efficient market hypothesis.

More recently, studies have shown trading volume to behave quite differently than stock price movements and does provide different information. Conceptually Kim and Verrecchia (1991) have argued price changes are associated with the market's *average* beliefs, while trading volume is the *sum* of all individual trades. Hiemstra and Jones (1994) provide empirical support that more can be learned about the stock market by examining both stock prices and volume than by concentrating only on price dynamics. Evidence of non-linear causality from volume to stock returns is found. Volume serves as a proxy for information flow, and there is a positive autocorrelation between trading volume and absolute stock returns. Bamber and Cheon (1995) demonstrate that earnings announcements that cause high trading volume with small price changes are followed by price increases. Stickel and Verrecchia (1994) present evidence that price changes are more likely to be reversed following low trade volume than high volume. They argue high trading volume indicates that the increase in demand comes from informed investors. High volume is claimed to cause information fueling and diffusion (Daniel et al. (1998); Hong and Stein (1999)). Informed trading implies that price changes are less likely to be reversed. In contrast, low volume is associated with uninformed or liquidity motivated trading. Therefore, price changes with low volume are more likely to be reversed, because they result from some temporary effect which is not accurately related to the information. Consistent with this study, Gervais, Kaniel, and Mingelgrin (2002) find that stocks with high (low) trading volume over a day or week tend to appreciate (depreciate) over the next month. It is hypothesized that the high-volume premium is a result of the stock's increased visibility. (Referred to as information fueling or diffusion in Lee and Swaminathan (2000))

These conclusions are inconsistent with several studies showing that high volume is associated with differences of opinion among investors. Bamber (1995) found price and volume reactions to be very

different for 20-24 percent of the sample of 8,180 earnings announcements between 1986 to 1989. Trading volume reaction was shown to be relatively high (compared to price reaction) when an announcement created a greater divergence of opinion between individual investors. The study concluded earnings announcements that cause high volume relative to price movements are related to: (1) more divergent earnings forecasts by analysts; (2) large number of analysts; and (3) higher random-walk unexpected earnings relative to analysts-based unexpected earnings. Harris and Raviv (1991) suggest that even if all traders are homogeneously informed, differences in opinion are the only factor explaining high trading volume. These findings are consistent with many past studies indicating volume reaction is directly related to the degree of asymmetric information or differences in beliefs. This implies that trading volume would be relatively low if there were no differences in beliefs among traders (see Kim & Verrecchia, 1991; Holthausen & Verrrecchai, 1990). Campbell, Grossman, and Wang (1993) find that price changes with high trading volume will more likely be reversed than with low trading volume. Kramer (1999) argues that high trading volume is a source of risk because it increases the traders' marginal transaction cost. Lee and Swaminathan (2000) find that firms with high (low) volume experience significantly lower (higher) future returns. The reason given is based on investor misperceptions about future earnings. Analysts give lower (higher) long-term earnings growth forecasts for low (high) volume stocks, but firms with low (high) trading volume experience significantly better (worse) future operating performance.

Low trading volume has also been shown to occur with asymmetric information. George, Kaul, and Nimalendran (1994) demonstrate that trading volume can be *negatively* related to the degree of information asymmetry in a specialist market with endogenous transaction costs. This is supported by an earlier study by Black (1986). More recently, a study by Chae (2002) shows that decreases in trading volume occurs before earnings announcements due to information asymmetry. This would imply that price changes associated with low trading volume will more likely be reversed owing to information asymmetry or low visibility.

DEMAND AND SUPPLY MODEL

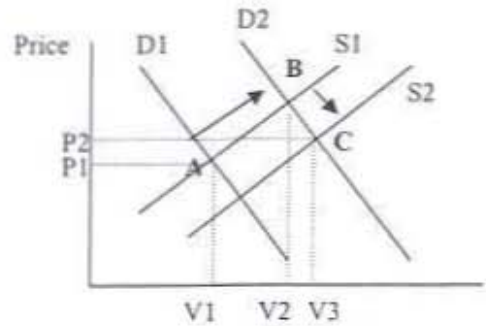
The different schools of thought and their price-volume relationships can be explained intuitively with a simple demand and supply analysis. The demand and supply model is also applied to develop an alternative view that is referred to as the "symmetric information" hypothesis. With symmetric information it is assumed there is consistency in beliefs among investors.

Asymmetric Information

Demand and supply analysis will first be used to illustrate graphically price and volume relationships given differential beliefs between traders, and then contrasted with symmetric beliefs. Suppose an economic event causes an optimistic market demand reaction for a stock, as shown in Figure 1 by a shift in demand from D1 to D2. Assuming no change in supply, both price and trading volume increase from point A to B. But if stock owners interpret the event pessimistically, and sell stock, increaseing supply from S1 to S2, point C becomes the new equilibrium. In this case, a divergence of opinion between buyers and sellers causes a relatively large increase in

trading volume. The extent of the price increase depends on the relative shifts in demand and supply.

FIGURE 1
Demand & Supply with Asymmetric Beliefs

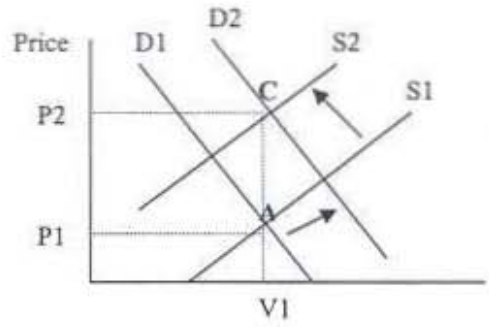


An intriguing question is why different and opposing strategies occur between buyers and sellers? Andreassen (1988) argues that different people pay attention to different aspects of the same information, and that the same investment rule causes different results if applied to one aspect as opposed to another. For example, when stock price rises, some people may believe that it is now above the average and it will soon fall, but others focus on price velocity and form positive expectations about the stock's future. It has also been argued that owners of stock may be more optimistic than non-owners.

Symmetric Information

Now consider price and volume reactions assuming the same beliefs between traders. Suppose an economic event causes an optimistic market demand and supply reaction for a stock, as shown in Figure 2 by a simultaneous upward shift in demand to the right, D1 to D2, and supply to the left, S1 to S2. The new equilibrium moves from point A to point C. In this situation, relatively high price changes occur with no change in volume, i.e. volume remains at normal levels. This point of view suggests that a large increase in price coupled with normal trading volume stems from agreement of opinion. Consistent with the literature on asymmetric information, agreement of opinion suggests there is less uncertainty in the information provided.

FIGURE 2
Demand & Supply with Symmetric Beliefs



Symmetric beliefs imply that price changes (high or low) with normal trading volume are less likely to be reversed owing to greater consistency (less uncertainty) surrounding the information.

IMPLICATIONS OF PAST RESEARCH AND HYPOTHESIZES

The literature review provides a basis to categories the past research findings into three schools of thought with corresponding implications in terms of the impact of trading volume on future returns. The three schools of thought are referred to as: full information, asymmetric information, and efficient markets. The assumption of symmetric beliefs, evaluated with a demand and supply model in this paper provides a fourth testable point of view.

The "Full Information" school suggests that high trading volume is associated with higher levels of awareness, visibility, and information diffusion and fueling. Based on this school of thought it is hypothesized that price changes associated with high volume will be maintained and the probability of a price reversal and variances in returns will be less than in the case of normal or low volume.

The "Asymmetric Information causing high volume" school suggests that high volume is due to differences of opinion or disagreement in beliefs. Many studies argue that differences in beliefs create uncertainty, causing trading volume to increase. Based on this school of thought it is hypothesized that price changes associated high volume would more likely be reversed and have higher variances in returns than in the case of normal or low volume.

The "Asymmetric Information causing low volume" school suggests that low trading volume is created by differences of opinion or disagreement in beliefs. According to these studies, the uncertainty caused by differences of opinion would reduce trading, not increase it. Based on this school of thought it is hypothesized that price changes associated low volume would more likely be reversed and have higher variances in returns than in the case of normal or high volume.

The "Symmetric Information" hypothesis developed using a demand and supply model in this paper argues that consistent beliefs between traders would cause trading volume to remain at normal levels. Consistent with the literature on asymmetric information, agreement of opinion suggests there is less uncertainty in the information provided. Less uncertainty would lead to the hypothesis that a price change (high or low) with normal trading volume is less likely to be reversed and have lower variances in returns (relative to high or low volume) owing to symmetric beliefs surrounding the information.

The "Efficient Market" school or modern portfolio theory suggests that neither high nor low trading volume would have any predictive validity. Modern portfolio theory contends that daily stock price changes are random and cannot be predicted by past information. The future is unknown and stock prices change very quickly to company disclosures, public news releases, and other economic events.

Table 1 summarizes the four testable hypothesizes concerning the impact of trading volume.

DATA AND RESEARCH METHODOLOGY

The database of the Center for Research in Security Prices (CRSP) is used, consisting of listed stocks on the NYSE, AMEX, and NASDAQ exchanges over the past ten years. For testing and control purposes, the database is limited to the NYSE, including about 2,600 listed stocks in the database. The investment models are tested for two selected years: 1989 and 1995. This time period encompasses both a stable market and bull market.

In each of the chosen years, 12 trading days are selected at random, one from each month. On each random day selected, a set of stocks is chosen that best fit the following three categories: (1) high positive or negative price performance with high volume; (2) high positive or negative price performance with low volume; and (3) high positive or negative price performance with normal volume.

Price performance is measured as the 1 day total return in stock price. Consistent with Campbell, Grossman, and Wang (2001), volume is measured by turnover,

which is the ratio of the number of share traded to the number of outstanding shares.	High (low)

TABLE 1
Testable Hypothesizes

Full Information Hypothesis:	*Large price changes (+/-) are less (more) likely to be reversed and have lower (higher) variance in returns with high (low) trading volume.*
Asymmetric Information Hypothesis:	*Large price changes (+/-) are more likely to be reversed and have higher (lower) variance in returns with either high (+/-) trading volume.*
Symmetric Information Hypothesis:	*Large price changes (+/-) are less likely to be reversed and have lower (higher) variance in returns with normal trading volume compared to high trading volume.*
Efficient Market Hypothesis:	*Past trading volume has no affect on future stock price reversals or variances in returns.*

stock price performance is defined as one standard deviation above (below) the mean daily return. The high (low) performers are then separated by volume turnover levels: high, low, or normal. High (low) volume is defined as one standard deviation above (below) the mean daily volume measured by turnover.

After the three portfolios are selected, the total return of each stock in the next trading day is used to determine the frequency of price reversals and the variance of the returns in each portfolio. In the case of the high positive (negative) price performance portfolio, a *reversal* is defined to occur if the return changes direction from positive to negative, or vice-versa.

RESULTS AND DISCUSSION

Tables 2 and 3 summarize the results of the study for the years 1989 and 1995. The year 1995 was a growth year for the market, while 1989 was a stable year with little growth in prices. The data is segmented in two parts: high stock returns (+/-) with normal volume on day 1 versus high stock returns with high volume on day 1. The focus is to compare the reversals and return variances on the second trading day (day 2) of the high return *normal* volume group with the high return *high* volume group. The comprehensive New York Stock Exchange (NYSE) results serve as a benchmark.

The first test compares the next day reversals and return variances of the *normal* volume group to the NYSE. In Table 2 (1995), out of the 12 selected trading days, 5 next day reversals were statistically significant, but 3 were greater and 2 were lower than the NYSE. There was no consistent direction, and aggregate reversals for 1995 were not significant. In Table 3 (1985), 4 next day reversals were significant with 3 being greater than the NYSE. But

again, the aggregate reversals for 1985 were not significant. However, next day *variances* were highly significant and greater than the NYSE variances in almost all cases for both 1989 and 1995. Aggregating all trading days, the return variances in the high return normal volume group were significantly higher than the NYSE for both years 1989 and 1995.

The second test compares the next day reversals and return variances of the *high* volume to the *normal* volume group. In Table 2 (1995) only 2 out of the 12 reversals were statistically significant at the 0.05 level. In Table 3 (1989), only 1 out of the 12 reversals were significant at the 0.05 level. However, next day return variances of the high volume compared to the normal volume group were again statistically significant in most cases. In 1995, 10 out of 12 variances were statistically significant and greater than the variances in the normal volume group. Similarly, in 1989, 8 out of 12 variances were statistically significant. Of the significant variances in the high volume group, 6 out of 8 were greater than the variances in the normal volume group. Aggregating all trading days, the return variances in the high volume group were significantly higher than the normal volume group in both 1989 and 1995.

FINDINGS AND CONCLUSIONS

These findings bring into question the commonly held belief by many technical analysts that high trading volume is a positive indicator of future returns. The full information hypothesis suggests that high stock price returns associated with *high* trading volume should be more stable and exhibit less frequent reversals. The data is not consistent with this hypothesis. There were no significant differences in the frequency of reversals and, to the contrary, the variances in stock returns with high trading volume were significantly greater than with normal volume.

The asymmetric information hypothesis is consistent with the sample data, supporting the notion that high volume is a signal of disagreement in the market, causing greater uncertainty. Although stock price reversals showed no significant differences, the variance in returns were significantly higher when stock prices increased with high volume as opposed to normal volume. This also supports the symmetric information argument that high returns with normal trading volume is a signal of agreement in the market, and should cause greater stability and less variance in stock returns.

Many financial analysts use trading volume activity as a positive screening or filtering tool to select and predict stock returns. The common opinion among practitioners in the field is that high trading volume confirms that high price performance is associated with informed decision-making that is widespread in the market and that this is a good climate for investment. Yet, the findings in this study do not support this belief academics in the field of finance disagree on the meaning of trading volume, as evidenced by the diversity of opinions in the research literature.

The findings in this study are important in two ways. For practicing investment analysts, a warning flag is raised in terms of viewing high trading volume as a positive signal. Second, for academics, the study further supports the notion that high trading volume is a signal of disagreement with respect to the interpretation of new information. Consistent with this view, high stock price returns, coupled with normal volume, implies greater agreement and less uncertainty (or more stability) in the market.

TABLE 2
Reversals and Return Variances of Portfolios with High Returns (+/-) on Day 1 Segmented by Volume in Year 1995

	Normal Volume – Day 1			**High Volume** – Day 1			**NYSE** – all stocks	
Dates	No.	Next Day Reversals	Next Day Variances	No.	Next Day Reversals	Next Day Variances	Reversals	Variances
1/12-13	358	41.62% (-0.12)	0.0012** (1.89)	47	36.17% (-0.76)	0.0043** (3.57)	41.93%	0.00064
2/22-23	343	42.27% (0.44)	0.0012** (2.41)	58	37.93% (-0.67)	0.0027** (2.23)	41.11%	0.00051
3/4-5	258	43.41% (1.04)	0.0013** (2.45)	41	43.90% (0.06)	0.0021** (1.68)	40.23%	0.00051
4/18-19	367	42.23% (1.29)	0.0013** (2.49)	32	50.82% (0.89)	0.0023** (1.71)	38.94%	0.00054
5/10-11	411	41.61% (0.37)	0.0008** (1.49)	61	49.18% (1.20)	0.0023** (2.98)	40.72%	0.00051
6/13-14	268	42.54%** (-0.75)	0.0011** (2.87)	71	42.27% (-0.05)	0.0008** (1.35)	44.81%	0.00040
7/26-27	434	49.77%** (2.42)	0.0014** (2.72)	24	41.67% (-0.79)	0.0008** (2.60)	43.98%	0.00052
8/8-9	334	38.02%* (-1.79)	0.0007** (1.56)	74	44.59% (1.16)	0.0019** (2.50)	42.86%	0.00048
9/5-6	422	44.55%** (2.15)	0.0007** (1.82)	41	24.39%** (-2.60)	0.0017** (2.43)	39.43%	0.00039
10/24-25	247	47.77%* (1.79)	0.0013** (2.54)	52	34.62%* (-1.90)	0.0019** (1.43)	42.15%	0.00052
11/21-22	427	37.24%** (-2.11)	0.0012** (2.34)	16	37.50% (0.02)	0.0014 (1.22)	42.28%	0.00050
12/6-7	450	44.22% (0.78)	0.0007** (1.40)	81	34.57%* (-1.75)	0.0011** (1.45)	42.38%	0.00104
Aggregate	**4,319**	**42.90%** (1.53)	**0.0011**** (1.95)	**598**	**39.80%** (-1.53)	**0.0019**** (1.82)	**41.76%**	**0.00055**

**Statistical significance at the 0.05 level or greater; *Significance at 0.10 level.

TABLE 3
Reversals and Return Variances of Portfolios with High Returns (+/-) on Day 1 Segmented by Volume in Year 1989

	Normal Volume – Day 1			High Volume – Day 1			NYSE – all stocks	
Dates	No.	Next Day Reversals	Next Day Variances	No.	Next Day Reversals	Next Day Variances	Reversals	Variances
1/24-25	227	47.58%** (2.16)	0.0015* (2.62)	2	0.00% (-1.17)	0.0027 (1.85)	40.54%	0.0006
2/2-3	226	45.13% (0.53)	0.0014** (2.61)	14	35.71% (-0.71)	0.0014 (1.02)	43.40%	0.0005
3/8-9	173	40.46% (-0.17)	0.0020** (3.70)	8	62.50% (1.27)	0.0110** (5.48)	41.12%	0.0005
4/12-13	215	45.12% (-0.24)	0.0013** (1.70)	17	58.82% (1.14)	0.0118** (9.26)	45.95%	0.0008
5/17-18	204	43.14% (1.04)	0.0025** (2.41)	12	50.00% (0.48)	0.0018 (1.36)	39.57%	0.0010
6/20-21	223	46.64% (1.32)	0.0014** (2.89)	1	0.00% (-0.93)	0.0000 (n.a.)	42.26%	0.0005
7/26-27	214	36.45%* (1.85)	0.0021* (1.38)	37	18.92%** (-2.22)	0.0008** (2.60)	30.61%	0.0016
8/15-16	183	44.26%** (-4.32)	0.0030** (4.10)	4	50.00% (0.23)	0.0160** (5.29)	59.93%	0.0007
9/27-28	207	42.03% (-0.48)	0.0038** (4.18)	15	53.33% (0.89)	0.0013** (2.94)	43.70%	0.0009
10/10-11	209	40.19% (1.15)	0.0015** (2.11)	34	52.94% (1.52)	0.0052** (3.50)	36.36%	0.0007
11/28-29	234	47.01%* (1.86)	0.0030** (4.27)	26	30.77%* (-1.66)	0.0042** (1.42)	41.00%	0.0007
12/19-20	239	43.51% (0.96)	0.0024** (2.76)	19	42.11% (-0.12)	0.0031** (1.26)	40.46%	0.0009
Aggregate	**2,554**	**43.58%** (1.54)	**0.0017**** (2.14)	**189**	**40.74%** (-0.79)	**0.0044**** (2.60)	**42.07%**	**0.0008**

**Statistical significance at the 0.05 level or greater; *Significance at 0.10 level.

AUTHORS' NOTE

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