

THE RELATIONSHIP BETWEEN TRADING VOLUME AND STOCK PRICES: AN EMPIRICAL STUDY
ON THE TOP LARGEST LISTED PUBLIC CORPORATIONS IN THE NASDAQ EXCHANGE OF U.S.A

by

Khaled El-Qidreh

A research project submitted in partial fulfillment of the requirements for
the degree of Master of Finance

Saint Mary's University

Copyright Khaled El-Qidreh 2013

Written for MFIN 6692.0 under the direction of
Dr. J. Colin Dodds

Approved: Dr. J. Colin Dodds

Approved: Dr. Francis Boabang

Date: April 01, 2013

ACKNOWLEDGEMENTS

This research study would not have been possible without the support of many people. I wish to express my gratitude to my supervisor, Dr. J. Colin Dodds who was abundantly helpful and offered invaluable assistance, support and guidance. Deepest gratitude is also due to the Department Director, Dr. Francis Boubang without his knowledge and assistance this study would not have been successful. Special thanks also to all members of the Finance Department, Also, I like to thanks Mrs. Michelle Fougere “Manager- Financial Aid & Awards” for her continuous support and effort.

I wish to express my love and gratitude to my beloved family for their understanding and endless love through the duration of my studies. Not forgetting the most special members of my family, my wife Heba El-Helou, my mother Rabeha El-Khedawi , and my sister Yasmine ElQidra , for the endless love and motivation through the duration of my studies.

Abstract

“THE RELATIONSHIP BETWEEN TRADING VOLUME AND STOCK PRICES: AN EMPIRICAL STUDY ON THE TOP LARGEST LISTED PUBLIC CORPORATIONS IN THE NASDAQ EXCHANGE OF U.S.A”

BY KhaledEL-Qidreh

This study focuses on the relationship between stock prices and trading volume. The study is based on the one hundred largest cap companies listed on the NASDAQ starting from June 01, 2010 to Dec 31, 2012. The study shows that trading volume has significant impact on the stock prices. It also shows positive correlation between stock prices and trading volume; and forecasting stock prices in short-term by studying the past trading days. It's important to know that stock prices can be influenced by a variety of factors besides trading volume but investors should consider trading volume when making a trading decision.

April 01, 2013

TABLE OF CONTENTS

ACKNOLEDGEMENTS.....	I
ABSTRACT.....	II
TABLE OF CONTENT.....	III
LIST OF TABLES.....	V
CHAPTER 1 : INTRODUCTION	1
1.1 PURPOSE OF THIS STUDY.....	1
1.2 BACKGROUND.....	2
1.3 ORGANIZATION OF THE RESEARCH.....	5
CHAPTER 2 : LITERATURE REVIEW.....	6
2.1 TRADING VOLUME AND RETURN.....	6
2.2 TRADING VOLUME AND MARKET	8
2.3 TRADING VOLUME AND PRICE CHANGES.....	11
CHAPTER 3 : SAMPELING DATA & METHODOLOGY.....	13
3.1 DATA	13
3.2 THE MODELS & METHODOLOGY	14
3.3 T-TEST & F TEST OF THE MODELS.....	18
3.4 REPORTING THE TEST RESULTS.....	18
CHAPTER 4 : ANALYSIS OF MODELS RESULTS.....	20
4.1 RESULTS OF FIRST MODEL.....	20
4.2 RESULTS OF SECOND MODEL.....	22
4.3 RESULTS OF THIRD MODEL.....	24
CHAPTER 5 : CONCLUSION AND LIMITATIONS.....	26
5.1 CONCLUSION.....	26
5.2 LIMITITION OF THE STUDY.....	28
5.2.1 Signalling... ..	28
5.2.2 Firm Size & Maturity Stage.....	28
5.2.3 Stock Split & Dividend.....	29

5.2.4 Holiday Effect.....29

REFERENCES30

LIST OF TABLES

Table 2-1 Volume & price and market strength/weakness	8
Table 4-1 Statistical Results of Model 1.....	21
Table 4-2 Summary of statistics for 1354 observations.....	22
Table 4-3 Statistical Results of Model 2 (1263 observation).....	23
Table 4-4 Statistical Results of Model 3.....	24

Chapter 1: Introduction

1.1 Purpose of this study

This study tests the relationship between stock prices and trading volume on the NASDAQ, the second-largest stock exchange by market capitalization in the world (Wikipedia, 2012). I am interested in testing the relationship from different angles and in short and long term periods that can help me understand if investors make predictions on stock price movements by observing stock trading volumes. This research will examine whether trading volume is an effective indicator for investors to forecast stock price and returns. The short-term period will study the relationship within one year and the long-term will test the relationship over a year and 10 years period.

In the real world, an investor in the stock market has many and different indicators which can be taken into consideration before he/she takes an investment decision. Investors can't cover all indicators of stock signals which satisfy profitable decisions on each stock trade or transaction. In other words it can never happen that an investor wins 100% of the transactions. Its stock volume is an independent indicator therefore, it is important to analyze the potential stock information from what is available in hand. Obviously trading volume is one of the available data sets that can't be disregarded. Most of the data that are released show stock prices and volume simultaneously and investors watch both while making their trades.

The importance of observing trade volume has been addressed by Pring (1991)

“Knowing the principle that volume goes with the price trend is a useful confirmation of the price action, but studying volume is even more helpful because volume often leads prices”
(Pring, 1991- p.271).

In another part of his research Pring mentions

“Most indicators of market movement are statistical deviation from price data since volume indicators are totally independent of price, they offer a more objective view of the quality of the price trend”(Pring, 1991- p.202).

It is important to know that Pring’s focus was on high traded stock volume where the stock price can be manipulated. Observed traded volume complements the information provided by the price (Blume, et al). Daily traders and most speculators trader on volume data which move with price simultaneously to help them to take better positions.

1.2 Background

Technical analyses is used to evaluate securities prices based on the assumption that market-related data, such as historical charts of price, volume and open interest, can help to forecast the future (usually short-term) stock price movement direction. A paper published about the role of volume stated that

“Technical analysis of market data has long been a pervasive activity in both security and futures markets. Technical analysts believe that price and volume data provide indicators of future price movements, and that by examining these data, information may be extracted on the fundamentals driving returns” (Blume, et al, 1994, p.153).

It is important to understand the Efficient-Market Hypothesis (EMH) which asserts that financial markets are "informationally efficient" which means the current price captures all information and adjusts very quickly, and then such activity is pointless. Scholars have argued that in the real world, market types are either semi-strong or weak-form. If the process by which prices adjust to information is not immediate, then market statistics may include information which is not yet incorporated into the current stock market price. As a result, stock volume could be informative about the process of stock movements and returns over a period of time.

Based on the market supply-demand theory, stock price and trading volume should move in the same direction. However, investors can't identify whether there is an excess supply or demand with any given amount of trading volume. Volume traded is a price match transaction between buyers and sellers. Earlier researchers found significant evidence that proved the relationship between trading volume and absolute price changes. For example,

“For a stock price pattern to be a valid “signal” many technicians require that trading volume “confirm” it—that is, trading volume should rise to reinforce the trend” (Fogler, 1973,p. 123).

With information technology innovation and rapid program development such as “Algo trading” and other technical analysis programs, technical analysis can provide many profitable opportunities for traders. Technicians believe that stock prices move in trends and patterns and those securities prices don't move as a random walk. Weak-Form Efficient Market Hypothesis implies that the stock prices adjusts to market related data such as trading volume, past prices and bid-ask spreads.

Trading volume remains a puzzle in the rational standard finance world (Statman, 1999). It is difficult to define why any trading takes place among traders in the real market or exchange. If both buyer and seller of a security aim to gain profit and have the same information set, then why would an investor buy and other sell? It has been explained that investors trade among themselves because they are different (Wang, 1994) and how they analyze a given information set will differ. Investor reaction of any information is different and their returns to risk preferences are different too. Thus the behavior of trading volume is closely linked to the underlying heterogeneity among investors, though there are occasions when it appears that investors are driven by other factors. Investors can agree on qualitative opinions good or bad,

buy or sell, but each is different with the decision to proceed and on the price range which reflects the opportunity. It been explained as “behavior trading” that differ one to other investor. By examining the dynamic relation between volume and prices, we can study how the nature of investor heterogeneity determines the behavior of stock prices. As Karpoff stated

“it is not clear what, if any, information is reflected by volume data” (Karpoff, 1986)

and another paper argued

“volume might play a greater role than a simple descriptive measure of the trading process on the stock exchange” (Blume, et al, 1994).

They explained that volume is a possible quality indicator for investors’ informational patterns. Based on the trading volume being an indicator of future stock prices, then investors take their decisions. These decisions will definitely affect the volume and future prices and will affect the trend direction of the stock and the market.

Investors have different investment objectives and it is important to understand that large institutional investors are the main investors in the NASDAQ based on value and ownership percentages. Although the stock price and volume information are available for all investors, each will act in different ways as responses to any new information or price movement. It is possible that they make different decisions to maximize their wealth or minimize their losses. We can pose the questions, how does trading volume influence price changes and can an investor be sure about his next transaction is correct after doing the analysis of trading volume? Lacking statistical tests on the relationship between price movements and stock trading volume, no one can provide a definite answer or equation identifying the relationship. The volume remains a black box which affects stock markets.

1.3 Organization of The Research

The organization of this research is as follows. A literature review is discussed in Chapter 2 and Chapter 3 discusses the data selection and study methodology. The results are analyzed in Chapter 4. Finally, Chapter 5 provides a conclusion and the limitations of this research.

Chapter 2: Literature Review

2.1 Trading Volume and Return

An interesting study done by Chen, et al (2001) tried to define how trading volume increases the stock forecasting ability in terms of stock return and volatility. Their empirical test data included the market price index and trading volume from the following largest exchanges, New York, Tokyo, London, Paris, Toronto, Milan, Zurich, Amsterdam and Hong Kong. They found evidence of a positive relationship between trading volume and price change persisting. When trading volume changes, then the stock price moves. However, the study couldn't define the relationship between stock return and trading volume. Changes in trading volume could have positive or negative stock returns. Remarkably, in most cases, returns cause a change in volumes to be greater than the volume affecting returns.

The relationship between stock return and trading volume can be analyzed from a stock liquidity view. Evidence shows a high correlation between trading volume and a stock's liquidity with large volume showing higher liquidity. Both trading volume and liquidity are important factors in stock exchange markets. The Liquidity Hypothesis, see Amihud and Mendelson (1986) shows that stocks that traded with low volume are less liquid and require a higher expected returns. The idea here is when investors are motivated to trade with low volume stocks, then they may drive the prices. An interesting paper on aggregate market spreads, depths, and trading activity for U.S. equities was conducted by Chordia, et al (2001) they found strong evidence that daily changes in market averages of liquidity and trading activity are very volatile and negatively serially dependent. They concluded that recent market volatility and stock market returns affect trading activity and liquidity.

Datar, et al (1998) found that stocks with low trading volume generate a higher return than those with high trading volumes. Lee and Swaminathan (2000) agree that there is a relation between trading volume and past price momentum in predicting cross-sectional returns with the samples consisting of all firms listed on the NYSE and AMEX for the period from January 1965 until December 1995. They stated:

“...Firms with high (low) past turnover ratios exhibit many glamour (value) characteristics, earn lower (higher) returns, and have consistently more negative (positive) earnings surprises over the next eight quarters. Past trading volumes also predicts both the magnitude and persistence of price momentum. Specially, price momentum effects reverse over the next five years, and high (low) volume winners (losers) experience faster reversals.” (p.2017).

On the other hand, a study that tests stocks listed on the NYSE from August 1963 and December 1996, by Gervais, et al (2001) found that

“stocks that experienced unusually high (low) trading volume outperform the stocks which had normal trading volume. Moreover, this effect appears to grow over time, especially for the high-volume stocks.” (p.877).

Campbell, et al (1993) examined the connection between the serial correlation of daily stock returns and stock trading volume. Their study presented a model in which the risk-averse [market makers] accommodate buying or selling pressure from ‘non informational’ and ‘liquidity’ investors. They also stated that

“a stock price decline on a high-volume day is more likely than a stock price decline on a low-volume day to be associated with an increase in the expected stock return” (p. 905).

2.2 Trading Volume and Market

Meyers (1989) specified that volume is observed as a measure of market strength and weakness. Historically, the relationship between market price and volume is demonstrated in the following Table 2.1.

Table 2.1

Volume & price and market strength/ weakness

Price Volume Implication

Rising	Up	Bullish
Rising	Down	Bearish
Declining	Up	Bearish
Declining	Down	Bullish

When the stock price is increasing and the trading volume is larger, that motivates investors to buy the stocks at the higher price. That is the demand is greater than the supply side in the market. Because the price continues to rise, then the market will turn to be bullish. If stock prices are decreasing and the trading volume is rising, that will motivate investors to sell their stocks at the lower price. That is the price will be falling and the Market will turn to bearish. The stock can decline while volume is low, then buyers will support the prices as sellers have low pressure now, and that could be the sign where the bullish trend will begin.

On the other hand, the declining trading volumes displays that the investors aversely trade the stocks at the recent price, causing a change on the price moving direction. Under the

perspective of small trading volume, if the price is declining, it will be going up and lead to bullish sentiment. If it is rising, it will be going down and lead to the reverse.

Meyers (1989) concludes that stock movement follows rules. When volume is rising while stock price is increasing or declining, the price will continue the recent trend. On the other hand, falling of volume could be a guide to the running out in the recent trend direction and a turn in the stock trend may occur. His study concludes that both buyers and sellers have power to drive the stock trend in markets.

Other studies defined trading volume as that which is from private or public information sources and which is available to the market and (or) other investors. Beaver (1968) studied the relationship among trading volume, price change and information revelation through joint distributions of volume and price movements, assuming they were connected to public information. He summarized that trading volume is the mirror image of all different investors' analysis of public information, while stock price movement indicates the market outlook toward the piece of information. Some investors lack stock trading knowledge or any investment valuation, and as a result, their wrong understanding of existing information is reflected in their trading behaviors, and thus trading volumes.

It is good to understand the volume impact from a Technical Analysis point of view. The level of stock volume is usually compared to that of a current period in order to determine whether it is lower or higher. Pring (1991) developed a set of rules based on the observations:

- a. The volume curve has an almost consistent tendency to peak out ahead of price during both bull or bear phases;*
- b. In most instances, fairly reliable indications of potential trend reversal can be obtained when the volume momentum crosses price;*
- c. When the price index is above its zero reference line and is falling, but volume is rising, the expanding activity represents distribution and should be interpreted as a very bearish factor once the rally has terminated;*

- d. A reversal in volume at a market bottom should be confirmed by reversal in price momentum as well;*
- e. Extremely high reading in the volume indicator are usually followed by strong bull markets;*
- f. When volume crosses below zero, it is normally, but not always, a negative sign; and*
- g. During the initial stages of a bull move, volume momentum is always above price.” (p. 273)*

Moreover, Lamoureux and Lastrapes (1990) found that trading volume in markets generates information related to forecasting future price volatility. Following their steps, Suominen (2001) concluded that trading volume includes private information, and knowledgeable investor (or) traders use volume change to recognize this type of information and then proceed to their buy or sell transactions. His model assumes that investors can access some information more easily than others and a number of investors can observe market information more efficiently than others. As a result, informed investors such as speculators and liquidity traders depend on historical trading volume to

“correctly update their estimates of the state of the economy, which is the firm’s activity or, equivalently, the probability of private information” (p.554).

It is important to understand that trading volume is embedded in investors behavior and estimates for a stock and those investors both institutional and individuals change over time. Also it includes a variety of traders with different strategies for profitable positions.

2.3 Trading Volume and Price change

Many academic researchers tried in the past to study the relationship between stock price and volume traded. It starts in the 1950’s, when Osborne found a positive correlation between changes in stock price and volume traded (Karpoff, 1987). A group of researchers also tried to prove the hypothesis of non-correlation between volume and price change. However, their studies were unsuccessful.

With an investigation of stocks listed on the S&P 500 composite index from their daily closing price and daily trading volume point view, Ying (1966) found a strong correlation between these two factors. He used and absorbed a model test between the recent price change and five-day trading volumes. Also he categorized each stock's daily price and volume traded data into five different classes subject to its mean price and variability among the study period.

Ying concluded his research with the following points:

- (1) A small volume is usually accompanied by a fall in price.*
- (2) A large volume is usually accompanied by a rise in price.*
- (3) A large increase in volume is usually accompanied by either a large rise in price or large fall in price.*
- (4) A large volume is usually followed by rise in price.*
- (5) if the volume has been decreasing consecutively for a period of five trading days, then there will be a tendency for the price to fall over the next four trading days.*
- (6) if the volume has been increasing consecutively for a period of five trading days, then there will be a tendency for the price to rise over the next four trading days." (p. 676).*

In 1970, Crouch (1970) found a positive correlation between absolute change in daily price level and trading volume by analyzing both individual stocks and the market index. Several researchers followed Ying and Crouch who to determine there was a positive relationship between trading volume and price change. These empirical studies open a view for market applicants that trading volume can be very valuable source when examining stock historical price patterns, and forecasting future price changes.

According to Pring (1991), a stock price was effected by larger volume in a normal market phenomenon. He found that an investor who was motivated to purchase (buy) stock for a certain price was not willing to close the position for a lower price or losses. This is an idea which all investor agree with, simply gain profits from each trade. The psychological factor that investors will be driven to buy such stock when price is increasing and every day more traders

are motivated to buy more in such stock which drive the expansion of trading volume is the referred to as herd behavior. Pring found argued that

“a rally that develops on constructing volume is suspect and warns of a potential trend reversal in price.” (p. 271).

After reviewing most research in this area, I can conclude that most studies agree regarding the positive correlation between trading volume and stock price changes.

In conclusion, a correlation exists between stock price and trading volume. This can be defined as follows:

- 1) the negative correlation between stock return and trading volume (Liquidity or turnover ratio).
- 2) Trading volume can be used in forecasting the market (bullish or bearish), that is to say, trading volume is the signal of future price changes.
- 3) The trading volume and the responding price move in the same direction, with large volumes seeing by an appreciation in stock price and small volume is usually accompanied by falling prices.

Chapter 3: Sampling Data and Methodology

3.1 Data

In order to study the relationship between stock prices and trading volume, data were collected from the NASDAQ, for the period from June 01, 2010 to Dec 31, 2012 and tested under several models.

The data collected were for all the largest 100 listed companies that make up the 100 NASDAQ Index. These companies represent most of the NASDAQ exchange trading volume and are listed in different industries such as Technology, Finance, Health care, Services and others. The NASDAQ exchange has more than 2500 listed securities where those 100 companies capture most of trading volume over the year. The rationale of using such a sample is that owners of these companies vary between institutional, large private investors and others. In other words, the price of stock can move based on the trading of a large percentage of buyers and sellers.

There were many challenges for data collection such as choosing a moment in time that was unaffected by major external economic factors. Looking for the last 10 years of the market, I found the market went through one major recession started at the end of 2007 to 2009, then recovered for the next two years from 2009 to 2010. Usually, most stocks and market will follow the same trends in recession and recovery periods, which could affect our study. In a recession most investors dump their portfolio of stocks, which leads the market index to drop heavily over a short period of time. On the other hand, the market will recover with buy trends for most stocks where most investors try to buy back their portfolios. This type of behavior means stock prices and markets move with a beta closer to one, and it usually takes place with high trading volumes.

The second challenge was the stocks listed industry variance, as I like to study stocks from different industries that are more representative of the market. The 100 NASDAQ index includes most active stocks with different industries that have a large weight in the NASDAQ index. That will lead my study to be more neutral.

The challenge was selecting stocks listed in the NASDAQ for the same period. The data that were chosen has the same traded history and all stocks were listed for the last 2 years which make the data as balanced as possible. Also most of the stocks traded daily in the market had a daily average which compared to the market value.

The data for the 100 stocks in the study start from June 2010 to Dec 2012 and were collected from two sources, Bloomberg and Yahoo finance. The daily stock quotes and the historical trading volumes were based off the closing price and were downloaded from Yahoo finance (<http://finance.yahoo.com>).

3.2 The Models and Methodology

In order to examine the relation between stock prices and trading volumes I will examine the variables from three perspectives. The first is whether the change in stock price depends on a change of trading volume; the second is whether previous trading volumes has any affect on the stock and can be used to forecast stock price; and the third is whether both variables are correlated.

For the first issue, the study tests the trading volume impact on the stock prices. The Straight-Line Probabilistic Model (SLPM) is used to estimate whether the effect of volume on price is significant and that will help in drawing a conclusion whether or not the change in volume impacts the stock price. As I am interested in studying the high and low volume effects on stock prices, the model's function will consider the change rate of stock prices as the dependent variable (Y) and the change rate of trading volume as the independent variable (X). By comparing the effect of the rate of change I will conclude the volume impact of stock.

That is $R_p = f(R_v)$, which explains the rate of change in price as a function of rate of change in volume and defined as follows:

$$R_p = \frac{P_{t+1} - P_t}{P_t} = \frac{\Delta P}{P_t} \text{-----3.1}$$

$$R_v = \frac{V_{t+1} - V_t}{V_t} = \frac{\Delta V}{V_t} \text{-----3.2}$$

R_p will estimate the rate of change on prices, and R_v will be the rate of change for volume. Expressed as a linear function, we have the following regression relationship:

$$R_p = \beta_0 + \beta_1 * R_v + \varepsilon \text{-----3.3}$$

where, ε = Random error term

A test of the relationship is given as (Null Hypothesis):

$$H_0: \beta_1 = 0 , \text{ the Null , } \quad H_1: \beta_1 \neq 0 , \text{ the Alternative.}$$

If the Null Hypothesis is true, that will allow us to conclude that there is no correlation between trading volume and stock prices. If it not, then that supports the alternative hypothesis, where trading volume has an effect of stock prices.

For the second issue, whether previous trading volumes help us to forecast future stock prices I will be using the General Linear Model (GLM). The GLM is structured in order to find such a relationship and to draw a conclusion where previous trading volumes predict the current price of stock or the current volume can forecast the future stock price. The model assumes a relationship exists between trading volume and stock prices where the stock price is the dependent variable on trading volumes of previous day. It will examine the change within a window of five previous days from a certain date where stock prices change significantly.

That is $P_t = f(V_{t-1}, V_{t-2}, V_{t-3}, V_{t-4}, V_{t-5})$. Articulated as multivariate linear relationship and we can obtain the following:

$$P_t = \beta_0 + \beta_1 \cdot V_{t-1} + \beta_2 \cdot V_{t-2} + \beta_3 \cdot V_{t-3} + \beta_4 \cdot V_{t-4} + \beta_5 \cdot V_{t-5} + \varepsilon \text{ -----3.4}$$

The model show the lag (5) of trading volume as an explanatory variable of stock price on a certain day; ε = Random error term, which captures the effect of all other variables.

A test of the relationship is given as (Null Hypothesis):

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0, \text{ the Null}$$

$H_1: \beta_i \neq 0$, the Alternative. Where at least one of the explanatory parameters “ β_i ” differs from 0

If the data supports the null, then trading volume with lag (5) can't be said to predict stock prices. I will use the model together with a set of data in order to see the effect. The first data set will be the daily closing stock prices and volume which will help to study the data for the short term. The second set of data will be the weekly closing prices and weekly trading volume which will be used to study if the trading volume can help us to forecast the stock prices from the long term perspective.

For the third issue, my study will look to see if there is a type of relationship between the rate of change in stock price and rate of change in trading volume. I will study the correlation between both variables stock price and trading volume and the move direction for both.

Let ΔP represent the change of stock prices ; and ΔV is the change of trading volumes.

$$\Delta P = P_{t+1} - P_t$$

$$\Delta V = V_{t+1} - V_t$$

where P_t and P_{t+1} are the stock price on t date and the day after and V_t and V_{t+1} will represent trading volume on t date and the date t+1.

In order to capture the relation between the two variables and how one performs compared to other, my formula will be the following:

$$F(\Delta P, \Delta V) = \frac{\Delta P}{P_t} \times \frac{\Delta V}{V_t} \text{-----} 3.5$$

The above equation will determine the correlation between both variables, whether both have a positive correlation. If $F(\Delta P, \Delta V) > 0$, this means stock prices and trading volume move

in the same direction or if F value < 0 then both have negative correlation and move in the opposite direction. From the data set I will study all observations when there is significant change in trading volume and the effect on stock prices. The significant change in trading volume as an explanatory variable should represent a 50% increase or decrease on the previous trading volume.

3.3 Test of significance using t-test and F-test for the models

To test the significance of all the models, I will use the T-test statistic for the first model where trading volume can be used to forecast of stock price.

Test statistic:
$$T = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

For the second General Linear multivariate Model, the statistic performed using an F-test.

Test statistic: $F = \text{Mean Square for Model} / \text{mean Square for errors}$

3.4 Reporting Test Results

In this study the set level of significance will be at $\alpha = 0.05$, in order to develop the statistical hypothesis-testing technique. As Sincich stated,

“the rejection region for the t-test and F-test above is fixed. No matter how large or how small the observed value of the test statistic, H_0 will be rejected if the value test statistic (t or F) falls into the rejection region” (Sincich, 1996).

In other words, this fixed significance level serves as a measure of reliability of the inference where the P-value will observe the level of significance of the model's results. Where

the study hypothesis Null will be rejected (Null= H_0) if p-value < 0.05 or 5%; on the other hand, Null (H_0) will not be rejected if the p-value > 0.05 , the p-value will become a judgment tool compared with alpha.

Chapter 4: Analysis of Models Results

The objective of this study is to find the correlation between stock prices and trading volume and determine the impact of trading volume on stock prices. Also the study will test the relation of index closing and trading volume to figure any kind of relationship. To test such a relationship, we examine the data set (for the large cap stocks which listed in NASDAQ for last 2 years) from three different perspectives:

- (1) Whether significant change in trading volume has an impact on the change in stock price.

Our estimate will study closing volume and closing prices as a window event.

- (2) Whether the trading volume can be used as a tool to predict the stock prices in long and short term. Measured through the extent to which trading volume can affect stock prices.

- (3) Whether stock prices and the corresponding trading volume have any type of relationship.

Positive correlation if they move in same direction or negative correlation if they move in opposite directions.

4.1 Results of first Model – Does trading volume has significant effect on stock prices?

Table 4-1 illustrates the result of the first model (Model 1). The t-statistic is used to measure the statistical significance of the relationship between rate of change in stock prices (R_p) and rate of change in trading volume (R_v) for the model ($R_p = \beta_0 + \beta_1 * R_v + \varepsilon$) applied at a significance level of 5%. My sample size found 1893 observations, $N=1893$, the critical t-value of 95% is 1.96. If the t-value is greater than +1.96 or less than -1.96, the result is significant. In other words, the t-value fails.

In all, 82 percent of the stocks have a p-value less than 0.05, that is, their null hypotheses are rejected. In other words, after testing all the largest 100 cap in NASDAQ over a 2 year period and looking for the effect of significant change of their trading volume and the impact on the stock prices, the study found 82 percent of prices have been effected by their significance in trading volume. To define the significant change in trading volume in this study, the current closing trading volume (V_t) is different than previous trading volume (V_{t-1}) by more than 50 percent.

As the following Table 4-1 shows, there is a significant impact from the independent variable (X = rate of change on trading volume) on the dependant variable (Y =rate of change of stock price). In other words, out of my total observations of 1893, the test found 1553 events that support the statement “a significant change in trading volume affected the stock prices”.

Table 4-1 Summary of the statistics for 1893 observations (events)

	t>0	t<0	Total # of stocks	Percentage
p<0.05	1086	467	1553	82%
p>0.05	268	72	340	18%
Total # of stocks	1354	539	1893	-

The highest p-value, 0.966368521 is performed by Amazon.com, Inc (AMZN) one of the most famous retail websites. The lowest p-value, 5.35622E-08, is performed by KRFT, which is the stock of Kraft Foods Group Inc, which operates a food and beverage businesses.

Furthermore, the sign of a t-value represents the direction of the relationship between R_v and R_p . Among all 1893 stock observations, 1354 observations have a positive t-value, which states when trading volume increase significantly (by more than 50% of previous closing) that

will effects stock prices to move forward; simply, more than 71% of the observations support a positive relationship where stock prices and trading volume move in same direction. All other 539 observations with negative t-values, support the negative relationship between stock prices and trading volume, they move in opposite directions. One can conclude that more than 71% of observations support a positive correlation between stock prices and trading volume. On the other hand, 28.4% support the negative relationship between both variables.

I was interested to analyze the 70% of observations that show stock prices and trading volume moving in the same direction and to pose the question; does a significant increase of trading volume have the same effect of a significant decrease in trading volume related to stock prices? The study found evidence supporting an increase in trading volume has more effect on stock price. Out of 1354 observations the table below concludes, 88% of the observations support an increase in trading volume will lead to an increase in stock prices:

Table 4-2 Summary of the statistics for 1354 observations (Positive Correlation.)

	Total # of stocks	Percentage
Increase	1192	88.04%
Decrease	162	11.96%
	1354	

4.2 Results of Second Model – Can trading volume be used to predict stock prices?

The study used an F-test to interpret the statistical significance of the forecasting ability of trading volumes with respect to stock prices. In other words, the study will test if previous trading volumes can used to predict the current and future stock prices. In this study, the significance level employed the second multiple model (General Linear Model).

$P_t = f(V_{t-1}, V_{t-2}, V_{t-3}, V_{t-4}, V_{t-5}) = \beta_0 + \beta_1 \cdot V_{t-1} + \beta_2 \cdot V_{t-2} + \beta_3 \cdot V_{t-3} + \beta_4 \cdot V_{t-4} + \beta_5 \cdot V_{t-5} + \epsilon$ is 0.05 with 1263 samples (events where a five day lag was used), $N=1263$ and five volumes are treated as explanatory variables. So while performing the F-test, $F_{0.05(5,\infty)}$ is 2.21.

If the calculated F-value is greater than 2.21, then the result is significant and H_0 should be rejected. Compared with $\alpha = 5\%$, significance F is more direct to reach the conclusion. If Significance $F > 0.05$, H_0 will not be rejected, which supports the hypothesis that trading volume cannot be used to predict stock prices with confidence. If estimated F-value where less than 0.05 ($F < 0.05$), then H_0 will be rejected, that will support that trading volumes can be used to predict stock prices with more than 95% confidence.

I was interested to study how trading volume can predict the future stock price from two different periods – the long and short term. First, I used the daily data set for all stocks and volumes and ran the multiple regressions to determine the effect for short term. Table 4-3 shows the results of the regression and test statistic summary for the General Linear Model.

Table 4-3 Summary of the statistics for 1263 observations on F-test

	Significance $F < 0.05$ $F > 2.21$	Significance $F > 0.05$ $F < 2.21$	Total
Amount	863	400	1263
Percentage	68.31%	31.69%	100%

From the above Table (4-3), over 68.31% of stocks studied in this study shows evidence with more than 95% confidence level, that the daily previous trading volume can be used to predict the stock prices. In other words, trading volumes have significant effect on their prices. For the 863 stocks, the Null hypothesis are rejected ($H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$), at least one of the parameters, ($\beta_i, i=1,2,3,4,5$) differs from zero in General Linear Model.

The highest F-value, 24.25689523 performed by Apple Inc (AAPL) one of the largest communication and media device companies. The lowest F-value is 0.03100856 performed by AMGN, which is the stock of Amgen Inc, a biotechnology medicine company.

4.3 Results of Third Model – Does trading volume correlate with stock prices?

This study summarizes our sample stock results, which are presented in Table 4-4. This study focused on understanding the relation between a change in trading volume and stock prices and whether or not it had a positive or negative correlation.

Table 4-4 Summary of test of $F(\Delta P, \Delta V) = \frac{\Delta P}{P_t} \times \frac{\Delta V}{V_t}$

	F (ΔP,ΔV) > 0 Same direction	F (ΔP,ΔV) < 0 Opposite direction	Same Direction Percentage %
Lowest %	265	255	50.89%
Highest %	374	146	72.01%
Total	30326	21674	58.32%

The results show that all those stocks’ percentages of “move in same direction” are around 58%. In other words, 58% of our events show that a change in trading volume is correlated positively with stock prices. If trading volume increase then stock price increase and if trading volume decrease stock price will. The total percentage is not significant when it was above 50%. After testing the trading volume and sock prices for the largest listed stocks in NASDAQ for last 2 years, the study concludes 58% of the events show a positive relationship between trading volume and stock prices, rising trading volume and stock prices simultaneously or falling volume and price simultaneously. The highest percentage above is 72.01% and performed by Costco (COST), a well-known wholesale retailer. This means 7.2 times out of 10, both trading volume and stock price moves in same direction.

These conclusions, which are shown in Table 4-4, explain a total of 58% of the time that trading volume and stock price move in same direction. It means on average of all 100 largest cap stocks, 5.8 times out of 10 both variables (volume and price) move in same direction either up or down. However, since it is not more significant than 50%, no investor can use it as trading strategy with safety to predict movements of both trading volume and stock price. The rationale behind this conclusion is that no investor can be sure about the next transaction and whether or not it will enlarge his or her wealth. In other words, if an investor likes to use it for his investment, then every 5.8 times out of 10 they will see gains and every 4.2 times of 10 they will fail.

CHAPTER 5: CONCLUSION AND LIMITATIONS

5.1 Conclusion

In this study, I was trying to understand the relationship between trading volume and stock prices. When we open any financial report or stock market closing report, we always recognize the stock open and close prices next to the trading volume. The study attempted to find answers with regards the relationship between both variables for the following three questions:

- (1) Does significant change in trading volume impacts the change in stock price?
- (2) Can trading volume be used as tool to predict the stock prices in long and short-term?
- (3) Do stock prices and the corresponding trading volume have any type of relationship or certain behavior?

The performance was measured by testing a sample of 100 largest Cap listed in NASDAQ during the period beginning on June 1st, 2010 and ending on Dec 31st, 2012.

First, based on Model 1 test results that show trading volumes have significant impact on stock prices in more than 82% of cases. The study tried to find what the effect of both variables when they move in same direction. Results show that 88% of the observations support an increase in trading volume will lead to an increase in stock prices. The rationale of such results can define the following factors:

- a- Most stocks that were used in the study sample were owned by large institutes or investors, where they used almost the same valuation methods with different time periods for the analysis. This result is consistent with what is described as “Herding”

behavior. Typical of the type of investor who depends on fundamental analysis which leads to correct stock price, while analyzing company's financial statements to measure the stock prices. Any news with a positive sign will lead to a positive signal and buy flow from such investors and on the other hand negative signals lead to sell flow of the stock.

- b- While most of stock ownership belongs to institutions and large investors who follow certain patterns for when to buy or sell, when those investors are motivated to buy stock as it should be worth more in future, they will buy it as a large percentage in beginning. They do this to reduce over a period of time the pattern that will benefit owners based of the average cost and current stock price. Meaning that if an investor likes to buy 2% of the company, he will break his order into series of smaller orders starting with large quantities and end up will low quantity over a period of time. On the other side, with a negative signal those investors will dump their portfolio to the new calculated value which will lead to fall in stock price within short period some time a day.

Second, the statistical tests for Model 2 of the 863 stocks show evidence that there is a significant effect for the last five days trading volume on stock prices, where the previous volumes play an effective indicator in predicting stock price. Therefore, the investors can forecast the stock price in the next transaction based on the previous volumes information.

Last, the question whether the stock prices and trading volume are correlated was addressed. The study shows no significance level of correlation between trading volume and

stock prices. It shows that both variables are correlated with 58% in total. This is a low level of significance, where it is 72% when both variables are highest.

5.2 Limitations of this study

5.2.1 Signaling

The major limitation belongs to the economics of information. The objective of this is to beat the ignorance about some relevant information or the situation of asymmetric information taking decisions intended to provide incentives and to induce the revelation of private information.

Signaling is one main part in the economics of information. Signaling can be a major player in affecting stock prices and drive high or low trading volumes. The reaction of the firm to signaling varies and usually compares with expected values. Signals can be positive which would lead to an appreciation of stock prices with higher volumes. But on other hand, it can be negative where stock prices decrease with different trading volumes.

The study does not take into account the effect of such signaling on the selected sample. For example, IPO signal, or profit announcement can affect the stock prices and volumes. There are many signals that can be considered which will show differ evidence and results.

5.2.2 Firm size and maturity

The second limitation of the study is that it does not consider the firm size and stock price. When firms have low stock prices then volume effects could be more significant. It is the same when a firm is in a mature stage and usually it can be more reasonable and better evaluated

by owners. Using the firm dividend policy or historical financial statement, investors can expect the future growth and prices. That leads to less volatility and firm stock will not be of interest to technical traders (Day Trader) who are looking for more fluctuation in prices. When a day trader ignores those stocks then effect of trading volume will be lower.

5.2.3 Stock Split and Dividend

All models in this study do not consider split or dividend affects on the stock prices and trading volume. When stock splits take place, theoretically it should not affect the firm value and stock prices. But usually stock price appreciate from the split as the new price allows more traders to buy a quantity of the stock. If a small investor would like to buy Google for the price of \$800 this could use the whole of planned investment amount. But if the stock split 1:10, then the new price will be 80 and that can motivate more small investors to take advantage of a lower stock price which would lead for greater trading volume. From the dividend perspective, the study does not consider the increase or decrease of dividend payout. Many stocks used in this study increased their payout dividend and that usually will increase the stock price and will lead to the trading volume effect on the announcement date.

5.2.4 Holiday Effect

The study does not consider Monday's effects or January effects for the selected period, which is a major factor in the NASDAQ exchange. Where most stocks appreciate in January of each year as gains from the Christmas sales will affect last quarter of the company financial statement. Also, the Monday effect, where the study does not take into consideration the Monday fluctuation where stock prices will reflect the compound news on holidays.

References

- Amihud, Y. and H. Mendelson. 1986 . "Asset pricing and the Bid-Ask Spread". *Journal of Financial Economics*. Vol. 17.223-249.
- Beaver, W., 1968. "The information content of annual earning announcements", *Journal of Accounting Research*.
- Blume, L., D. Easley, and M. O'Hara. 1994 ."Market Statistics and Technical Analysis: The Role of Volume". *The Journal of Finance*.. Vol. 49.153-181
- Campbell, J. Y., Grossman S. J. and Wang J., 1993. "Trading Volume and Serial Correlation in Stock Returns", *The Journal of Finance*, 108,905-939.
- Chen, G., Lee, C. and Rui, O., 2001. "Stock Returns and Volatility on China's Markets". *McGraw-Hill, Inc.* New York.
- Chordia, T., Subrahmanyam, A. and Roll, R., 2001 "Market Liquidity and Trading Activity", *The Journal of Finance*, Apr. 2, Vol 56.
- Crouch, R., 1970. "The Volume of Transactions and Price Changes on the New York Stock Exchange", *Shakespeare Quarterly*, v21 nn4.
- Datar T., Naik, N. and Radcliffe, R. 1998. "Liquidity and stock returns: An alternative test", *Journal of Finance Markets*. V1 , n2.
- Darrat, Ali F. and Maosen Zhong., "On Testing the Random-Walk Hypothesis: a Model-comparison Approach". *The Financial Review*. August 2000. Vol 35, Iss.3.105-124.
- Fogler, H., 1973. "Analyzing the stock market: quantitative approach". *Snippet view*.
- Gervais, S., Kaniel, R. and Mingelgrin, D., 2001. "The High-Volume Return Premium". *The Journal of Finance*. Vol 56, No.3. 877-919.
- Karpoff, J. 1986. "The Relation between Price Changes and Trading Volume: A Survey". *Journal of Financial and Quantitative Analysis*. Vol. 22, No.1.
- Lamoureux, C. and W. Lastrapes. "Heteroskedasticity in in Stock Return Data: Volume versus GARCH effects". *Journal of Finance*. 1990. Vol. 45. 221-229.

- Lee, C. and Swaminathan, B., 2000. "Price Momentum and Trading Volume ", *Journal of Finance*,
5. Oct. 2000, 2017-2069.
- Meyers, T., 1989. "The technical analysis course: a winning program for stock futures trades investors" , *Probus Pub Co*, Chicago.
- Pring, M. 1991. "Technical Analysis Explained: The Successful Investor's Guide to Spotting Investment trends and Turning Points". *McGraw-Hill, Inc.* New York.
- Statman, M., 1999. "Behavioral Finance: Past Battles and Future Engagements". *Financial Analysts Journal*, V55.
- Sincich, T., 1996. "Business statistics by example", *Upper Saddle River*, NJ.
- Suominen, M., 2001. "Trading Volume and Information Revelation in Stock Markets". *Journal of Financial and Quantitative Analysis*, Vol 36, No.4. 545-567.
- Wang, H. 1994. "Structure of the Contradiction in Japanese-American Relations in the 1990s". *Chinese Economy*, v27.
- Ying, C. 1966. "Stock Market Prices and Volumes of Sales". *Econometrica*. Vol. 34, No.3. 676-685.