

## THE NEED AND IMPORTANCE OF A VOLUME BASED INDEX

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***Abstract:** The importance of volume study has already been highlighted through various researches world-wide. Volume is studied in isolation as confidence proxy; as a liquidity parameter; depth assessment indicator, whereas, volume when studied along with other parameters such as price or returns, reveals interesting conclusions like price direction, momentum, etc. All these have been several times estimated and proven. The empirical results by some of these research initiatives conclude the imperative presence of Volume in market analysis and forecasting.*

*Volumes were and till date are studied in absolute terms for various time intervals. These intervals (normally daily volumes) reveals discontinued pattern of observations. By discontinued pattern of observations we mean the volumes start with zero and cumulate for a day and next day again starts with a zero. The study of such data poses lots of limitations and hindrances in day to day decision making such as relative understanding of volumes patterns, time series analysis and relative analysis of volume with price direction.*

*The aforesaid limitations can be mitigated if volumes studies get reinvented and shaped as a standardized tool like an Index. Volume index would not only help reveal the changes in volumes but also facilitate a long term continued study of market liquidity. The formation of such indices world-wide would also indicate the global fund flow process. Hence, the need of the hour is a volume based index in all the markets of the world to complement the analysis of stock market and facilitate analysts and investors to get a holistic view of the markets.*

### Introduction

Stock market plays an important role as a financial intermediary in an economy. It facilitates the flow of funds from investors to entrepreneurs. Efficiency of the market depends upon various factors such as volume of trading, number of participants (Barnes, 1986) and flow of information. Trading volume indicates the state of the economy (Schneider, 2009) and it is higher in developed markets than in emerging and frontier markets. Thin volume of trading makes the interpretation of stock movement difficult for traders. Beaver (1968) mentioned that trading volume gives rough insight about earnings of a company and its impact on market participants. Trading volume not only measures the liquidity of stock markets but also the impact of information and momentum of the market (Brown *et al.* 2009). It is also influenced by corporate announcements / financial disclosures earlier than the price (Cready & Hurt 2002). Now, though investors generally have same public information, they infer it

differently which leads to trading activity in the stock market (Haris & Raviv 1993). The changes in trading volume reflect changes in the expectation of individual investors (Brown *et al.* 2009). May (2011) has translated the work of Bacheiler (1900) and stated that the relationship between price fluctuation in stock market and investor disagreement and trading volume was a matter of concern even 100 years ago. Almost after 80 years of Bacheiler; Ross (1989) identified the need of a model to study the investors' disagreement and trading volume. Since then, a number of studies have been conducted to study the relationship between price and volume. Amongst all, the most important study was conducted by Wang (1994) where he stated that trading volumes is a dynamic variable reflecting behavioural heterogeneity of the traders and can be used as an important tool to study behaviour of asset price. Volume studies are important in determining the asset returns and have a positive relation with the magnitude of the price change in the equity market (Karpoff 1987). In contrast Bhagat & Bhartiya (1996) identified an asymmetric relation between price and volume. Moreover, Wang (1994) stated that volatility in volume depends upon the information flow in the market. Similarly, Gervais *et al.* (2001) identified that stocks whose trading volume is high have a higher probability of generating positive return in subsequent periods. Volume not only reflects the depth of market but also acts as confidence proxy for the market.

## Literature Review

Investors and technical analysts use volume as an indicator to predict the movement of the stock. Blume *et al.* (1994) stated that volume and price change have positive relationship which helps technical analysts in decision making. There are a number of volume indicators used by technical analysts such as on-balance volume (OBV), money flow index, Accumulation / Distribution Line and Chaikin Money Flow. Thorp (2001) stated that on-balance volume (OBV) indicator was propounded by Joseph Granville in year 1963. The indicator considers today's and previous day's closing price and cumulative volume of today's and previous days. This indicator can be used to study the pattern of volume on a daily basis. However, it does not assist investors to study the pattern of volume on intraday basis. According to National Stock Exchange of India Limited (2010) accumulation/ distribution (AD) indicators considers the high, low and closing price of the shares and volume of the corresponding days to study the pattern. Chaikin Money Flow is the extended version of the accumulation/ distribution indicator, it considers the accumulation/ distribution values for 21 days period. Similarly, Money flow index (MFI) also considers the high, low and close price of the shares and volume of the corresponding period to determine the index. The index assists investors to infer the degree of the demand of the stock (Granville 1976). However, all of the above mentioned indicators assist investors to study the pattern of stock, they are not made to study the pattern of volume of market and also these indicators do not help in analysing the pattern of volume on intraday basis.

According to Bessembinder & Seguin (1993) there are many empirical analyses which suggest positive relationship between price, volume and volatility of tradable asset. In addition to this, Chen *et al.* (2001) examined nine different national markets and concluded that volume consist some information about return of the stock. Blume (1994) also mentioned that past returns and past volumes indicate the expected pattern of stock market. Moreover to this, Kamath *et al.* (1996) stated that changes in price and volume have positive relationship, i.e. if price increases volume would also increase and vice versa. Other than concomitant relationship between trading volume and returns of stock, the dynamic relationship of volume

is also observed in various literatures (Blume *et al.* 1994, Wang 1994, and Chordia & Swaminathan 2000).

Till today, most of the studies have been conducted revolving the price and volume relationship. Therefore, the price/ return indices world-wide have served the purpose for studying the direction of the asset values, leading to study of growth of an economy. As it has already been proven by past studies that price/ return alone cannot be a true reflector of growth unless studied with other variables like volumes. Ross (1989) has also mentioned the need of a standardized tool to study the significance and pattern of volume in stock market. However, still there is no benchmark/ indices which can study the pattern of volume of the market.

In this paper, we propose to create a volume index, linked to the broad market price index of a country (India); with base year either matched to the base year of the price index or any other more appropriate year as the case may be. The propose index will help investors to study the pattern of the volume and price of the stock market. It will also help to determine the efficiency of the stock market. The target segment of this research paper is stock exchanges, trading members, investment management firms, researchers who study the behaviour and efficiency of the market. It may also be used by regulatory authorities to get some insight from the index, while designing policies, regulations and even invigilation activities for the stock market.

The pattern of the stock market studies through the price, volume and volatility. Investors and academicians use these three key components to invest in the stock market and study the efficiency of the stock market. There are number of benchmarks and indices based on price and volatility such as S&P 500, Nifty and VIX to assist investors and academicians to study the pattern of the stock market. However, there is no benchmark to study the pattern of volume of the stock market.

### *Index*

A market index is a combination of stocks representing the various industries/ industry or other investment vehicle together. According to Chakrapani *et al.* (2011), index is a statistical method to measure the change in economy or stock market. The market index presents the total value of those represented stocks as against the value of base year. Similarly Securities Exchange Commission (2014) has stated:

*"A market index tracks the performance of a specific "basket" of stocks considered to represent a particular market or sector of the U.S. stock market or the economy."*

In addition to SEC, Shilling (1998) wrote a book title "International Guide to Securities Market Indices" which is well known for the index study. He mentioned in the book that index is a barometer of movement and direction of prices of various financial instruments such as stock, money market instruments, real estate etc. Index is derived from the calculation, which is calculated according to their simple or composite structure against the base value of the underlying determined at the inception of index and the index moves continuously according to movements in the underlying.

### *Market Capitalization Based Index*

Broadly the market indexes are based on prices of the composition of the stocks (Feeney & Hester 1964). The stocks are part of the portfolio; that is why they get some weight according

to the companies' capitalization value. Therefore, the total value of index is a weighted average price of the stocks in the portfolio as compared to base year's weighted average price of those stocks in the portfolio. Such indexes are called price/ total return index (S&P Dow Jones Indices, 2014). While calculating the capitalized value of shares, the product of price of the shares and total number of issued shares or free float shares are considered. Moreover, there are few other types of indexes which cover other key factors of stock market such as liquidity, volatility and interest rates etc. However, there are number of academic papers (see Jun *et al.* 2008) available which suggest that price and return index does not solve the purpose of true benchmarking of the market. As market capitalization indices always overweighs the overvalued stock and underweight the undervalued stock; therefore, few new approaches of constructing index have evolved such as fundamental index (Jun *et al.* 2008) and smart beta index (Lexicon 2014). Despite acknowledging the fact that price and volume have strong relationship, no benchmark is developed till today which can study the pattern and significance of volume in stock market. All above mentioned indexes are basically based on price, dividend and total number of issued shares or number free float shares, no return indexes covers the impact of volume traded of the shares.

### *Volatility Index*

Volatility is one of the key factors of stock market. Investors estimate the volatility of the stock/market to take an investment decision. According to Chiang and Doong (2001) lower stock market return as compared to expected return induces more volatility in the market. The volume and volatility relationship has been studied so long. In earlier literatures, a positive relationship between volume and immediate volatility has been indicated; see Epps & Epps (1976) and Karpoff (1987). Morgan (1976) also found out that variance in stock return is related with the traded volume of the shares. Later, Lamoureux & Lastrapes (1990) also identified the explanatory power of trading volume with respect to variation in daily return. The same informational power and volume and its relation with volatility has been observed in Korean stock market (Pyun *et al.* 2000). Kumar & Singh (2009) mentioned that any unexpected information does have impact on volatility and concomitant volume of the stock.

Academics and researchers study the volatility to conduct empirical analysis on stock market. These requirements of stock market led Chicago Board of Exchange to introduce VIX™ in year 1993 to study the pattern and measure the market expectations (Chicago Board of Exchange 2009). Furthermore, Bardgett (2013) has mentioned that “*The VIX index has been constructed to approximate non-parametrically the expected future realized volatility of the S&P 500 returns over the next 30 days*”. According to Chicago Board of Exchange, people are considering VIX as a barometer of market sentiment. If VIX™ is increasing; it can easily infer that volatility in market is increasing and vice-versa. While calculating the VIX™, volatility in return (price), time to expiration, forward index level, strike prices of index and risk free interests are considered. This shows that the significance of volume in this index is also missing. Therefore, the volatility index (VIX™) does not assist to study the liquidity/ volume in the stock market.

### *Market Liquidity*

The most important factor of economic theory is equilibrium of price through supply and demand. Liquidity is one of the key indicators of stock market see Kaldec & McConnell (1994), Silber (1991), and Brennan & Subrahmanyam (1996). Efficiency of the market depends upon the availability of the liquidity of the stock market. If a market is illiquid, the bid-ask spread would be higher which eventually increase the transaction costs for investors.

The importance of volume has led to development of the following models to study pattern of volume.

Methodology	Description	Studied by
Aggregate Share Volume	Total number of shares traded for the specified period	Gallant <i>et al.</i> (1992), Hiemstra and Jones (1994) and Ying (1966)
Aggregate/ Share Turnover	Number of shares traded during the specified period/ Total number of outstanding shares	James and Edmister (1983) and Lakonishok and Vermaelen (1986)
Individual Share Volume	Price/ Volume or Volatility/ volume	Epps and Epps (1976), James and Edmister (1983) and Andersen (1996)
Relative Individual Dollar Volume	Individual dollar volume normalized by aggregate daily trading volume of market	Tkac (1996)
Total number of trades	Total number of trades in stock market	Conrad, Hameed and Niden (1994)
Number of days	Total number of days in a year	James and Edmister (1983)

All of the above mentioned methodologies consider volume in a different way while analysing its pattern. However, none of the above mentioned methodologies solve the issue of starting point at the time of opening of the market and cumulative traded volume as the time passes in a day.

#### *Liquidity Index (LIX)*

Keeping the same view of importance of volume, FTSE has launched series of indexes which are based on liquidity of the stocks. To form such indexes, most liquid stocks are considered. After identifying the number of stocks, index would be formed on the basis of free float capitalization rate (FTSE, 2010). Though, the liquid index forms on the basis of most liquid stocks, it doesn't serve the purpose of studying the pattern of volume of stock market. Since, it is once again considered the price and return of those liquid stocks to form the index. It does not solve the purpose of studying pattern of volume in stock market.

## Research Objectives

Lack of an appropriate benchmark to study the pattern and significance of volume in stock market on a continuity basis is the primary motivation behind this study. The objective of conducting research is to identify the benchmark to study the pattern of volume/ value in the financial market. In order to meet its objectives, the study poses the following questions:

1. Does stock market need a standard/ benchmark index based on volume?
2. What would be the methodologies to construct the benchmark volume based index?
3. How the proposed index would be beneficial to the key stake holders of financial markets?

## Research Methodology

The transaction volume and last traded price is collected for a 3 months period from 03 March 2014 to 29 May 2014 of Nifty Stocks at 10 minutes time interval, which helped us to calculate the value (turnover) of that interval. Later, the cumulative traded volume at each interval has been calculated by adding the cumulative traded volume at previous interval and the traded volume at immediate time interval. Once the cumulative traded volume has been ascertained at each interval, the proxy volume has been calculated. To calculate the proxy volume at every time interval, extrapolation methodology has been used. In this method, a serial number has been assigned to each time interval for a day and then multiplied the cumulative traded volume of immediate interval to total number of intervals and then divided by the serial number of respective interval. The calculated value is a proxy volume of that day on that time interval. Further, the proxy turnover of each interval is compared with the total turnover of base date i.e. 01 Jan 1997 and multiplied with 1000.

The proxy volumes are total volumes derived from extrapolating the cumulative volumes arrived upto the specified time interval. Thus, proxy volumes are not hypothetical figures but mirror image of total volumes derived from actual traded volumes upto the time interval. It is estimated by using the following steps:

- Cumulative traded volume has been calculated at each time interval by adding previous cumulative volume at last time interval and trading volume at immediate time interval.

Table 1 Cumulative Traded Volume

Timestamp	Traded Volume (in INR)	Cumulative Traded Volume (INR)
03/03/2014 09:10	1,013,428,572	1,013,428,572
03/03/2014 09:20	1,398,451,381	2,411,879,953
04/03/2014 09:10	1,239,487,687	1,239,487,687
04/03/2014 09:20	1,303,271,988	2,542,759,675

At 9:10 of 3<sup>rd</sup> March 2014, the traded volume was INR 1,013,428,572. Since, it was first trade of the day the cumulative traded volume is also the same. However, in next ten minutes, the total traded volume was INR 1,398,451,381 which subsequently added to the cumulative traded volume at 9:10. Hence, the cumulative traded volume has reached the level of INR

2,411,879,953. Similarly on 4<sup>th</sup> March 2014 at 9:10 AM, the traded volume was INR 1,239,487,687 which considered as cumulative traded volume. Since, it was traded volume of the first interval of the day. Thereafter in next ten minutes traded volume was INR 1,303,271,988 which again added back to the cumulative previous traded volume of the time interval.

- A serial number from 1 to 39 has been assigned to each time interval of daily turnover.

Table 2- Serial Wise Cumulative Traded Volume (In INR)

Sr. No.	Timestamp	Total Volume	Cumulative Traded Volume
1	03/03/2014 09:10	1,013,428,572	1,013,428,572
2	03/03/2014 09:20	1,398,451,381	2,411,879,953
3	03/03/2014 09:30	1,164,199,820	3,576,079,773
4	03/03/2014 09:40	990,528,275	4,566,608,048
-	-	-	-
-	-	-	-
38	03/03/2014 15:20	1,432,799,399	44,373,612,044
39	03/03/2014 15:30	1,534,539,895	45,908,151,940

In the above mentioned table, it is observed that each time interval has got serial number starting from 1 to 39 and as the time interval rises, the serial number increases.

- In next step, to calculate the proxy volume for the day has been calculated by using the following formula at each time interval:

$$(\text{Cumulative Traded Volume} * \text{Total Serial Number}) / \text{Immediate Serial Number}$$

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Table 3- Proxy Volume (In INR)

Sr. No.	Timestamp	Total Volume	Cumulative Traded Volume	Proxy Volume
1	03/03/2014 09:10	1,013,428,572	1,013,428,572	39,523,714,308
2	03/03/2014 09:20	1,398,451,381	2,411,879,953	47,031,659,084
3	03/03/2014 09:30	1,164,199,820	3,576,079,773	46,489,037,049
4	03/03/2014 09:40	990,528,275	4,566,608,048	44,524,428,468
-	-	-	-	-
-	-	-	-	-
38	03/03/2014 15:20	1,432,799,399	44,373,612,044	45,541,338,677
39	03/03/2014 15:30	1,534,539,895	45,908,151,940	45,908,151,940

Note: The total number of serial number would vary according to the number of time interval for the day.

Thereafter, the proxy volumes of each time interval were compared with the total turnover of base date and multiplied by 1000 to ascertain the volume index at each time interval of the day.

Table 4- Volume Index (VOX™)

Sr. No.	Timestamp	Cumulative Traded Volume (INR)	Proxy Volume (INR)	Volume Index (VOX™)
1	03/03/2014 09:10	1,013,428,572	39,523,714,308	4041.28
2	03/03/2014 09:20	2,411,879,953	47,031,659,084	4808.96
3	03/03/2014 09:30	3,576,079,773	46,489,037,049	4753.48
4	03/03/2014 09:40	4,566,608,048	44,524,428,468	4552.60
-	-	-	-	-
-	-	-	-	-
38	03/03/2014 15:20	44,373,612,044	45,541,338,677	4656.58
39	03/03/2014 15:30	45,908,151,940	45,908,151,940	4694.09

Base Year: 01 Jan 1997- Total Traded Value- INR 9.78 Billion

*Base Year*

A year from which the data is available related with price and volume of Nifty is considered as base year for the purpose of construction of volume based index. Therefore, here base date 01 Jan 1997 has been taken for calculating the index.

*Formula*

$$VOX^{TM} = (\text{Proxy Transaction Value for the Day} / \text{Base year's day transaction value}) * 1000$$

Similarly, the daily total turnover value has been collected for the period of 01 Jan 1997 to 01 June 2014. Further, the daily turnover is compared with the total turnover value of base date i.e. 01 Jan 1997 and multiplied by 1000 to ascertain the closing index value of each day.  
 (Proxy Transaction Value for the Day/ Base year's day transaction value) \* 1000

- $I_n$  = Number of time intervals i.e. respective serial number
- Traded Volume = Price of shares \* number of shares traded
- $V_n$  = Volume of respective intervals
- $N$  = Total number of time intervals in a day
- $B$  = Base year
- $PV_n$  = Proxy volume of respective intervals

$$PV_n = \frac{\sum V_n * N}{I_n}$$

$$VOX^{TM} = PV_n * 1000 / B$$

**Research and Findings**

The roots of this research dates back to a century old need of volume studies. Researchers and analysts have always given importance to the study of volume as a leading, lagging and sometimes as a coincident indicator for forecasting price direction or returns. In last so many decades the importance of volume was never undermined but the methodology to study volume was never standardized.

Our research aims to standardize the methodology to study the volumes (depth of the market) through an index named as Volume Index (VOX<sup>TM</sup>). Even though volume was always an important parameter of study, the creation of index for volumes has been held back due to the unique one sided step up pattern for intraday followed by a zero base opening figure. This aforesaid pattern brings a very wide gap between the previous close volume and next day opening. This unique nature of the variable (volume) has always posed a challenge to researchers and analysts in creating a volume based index. Keeping in view, this imperative need of volume studies in current market dynamics, we have attempted to adopt a unique methodology of creating an index through a unique concept of proxy volumes. This methodology has attempted to resolve the old complexities of volume data. It is well known that as the time rises in a trading day the total trading volume rises. As it is mentioned above that volume has a unique characteristic of one-sided step up, it is difficult to compare the volume at each time interval in a day.

*Empirical Analysis and Findings*

1. Critical analysis of volume (cumulative traded volume) vis-à-vis volume index is done by taking two days sample data. The empirical findings clearly reflect the volume following a step up pattern with time during the trading day. It can be seen in Table 5 column 3, the cumulative traded volume starts from INR 2.71 billion and goes up to the INR 50.14 billion at the closing time of the market. The same reflection is observed on the second day where the cumulative traded volume starts from INR 1.97 Billion and closes at INR 46.94 Billion (refer Figure 1). The same pattern of volume is repeatedly visible on every trading day (refer Figure 2) reflecting the data for one month.

Looking at the VOX<sup>TM</sup> for the same period reflects a smoothing movement from a value 5407 to 5126 for day one and 3932 to 4799 on day two. It can be inferred from the index movement of day one that the momentum of volume change during the day has declined which was otherwise not visible in absolute volume data. The variation in absolute volume reflected in column 4 of Table 5 indicates a change of 80.50% in first ten minutes, which gets even out in the index to a change of 20.33%. The same effect is visible in the subsequent ten minutes time interval. Another important observation is the variation of previous day closing volumes and next day opening volumes in column 4 Table 5 which is -96.07%, the same gets evened out in the index to -23.29%. Thus the index serves the purpose of reading the volume change during intraday as well as inter-day on continued basis reducing the noise observed in absolute volume data.

Table 5 Sample of Cumulative Traded Volume and VOX for Two Days

Timestamp	Time	Cumulative Traded Volume (In INR Billions)	Change in Volume (%)	Volume Index (VOX <sup>TM</sup> )	Change in VOX (%)
02/05/14	09:20:00	2.71	-	5,407	-
02/05/14	09:30:00	4.90	80.50%	6,507	20.33%
02/05/14	09:40:00	6.67	36.26%	6,650	2.19%
02/05/14	09:50:00	8.56	28.33%	6,827	2.66%
02/05/14	15:10:00	47.17	3.90%	5,083	1.09%
02/05/14	15:20:00	48.50	2.82%	5,089	0.11%
02/05/14	15:30:00	50.14	3.38%	5,126	0.73%
05/05/14	09:20:00	1.97	-96.07%	3,932	-23.29%
05/05/14	09:30:00	3.65	85.05%	4,851	23.36%
05/05/14	09:40:00	4.74	29.85%	4,724	-2.61%
05/05/14	09:50:00	6.12	29.03%	4,876	3.23%
05/05/14	15:10:00	44.20	3.54%	4,763	0.75%

Timestamp	Time	Cumulative Traded Volume (In INR Billions)	Change in Volume (%)	Volume Index (VOX™)	Change in VOX (%)
05/05/14	15:20:00	45.53	2.99%	4,776	0.28%
05/05/14	15:30:00	46.94	3.11%	4,799	0.47%

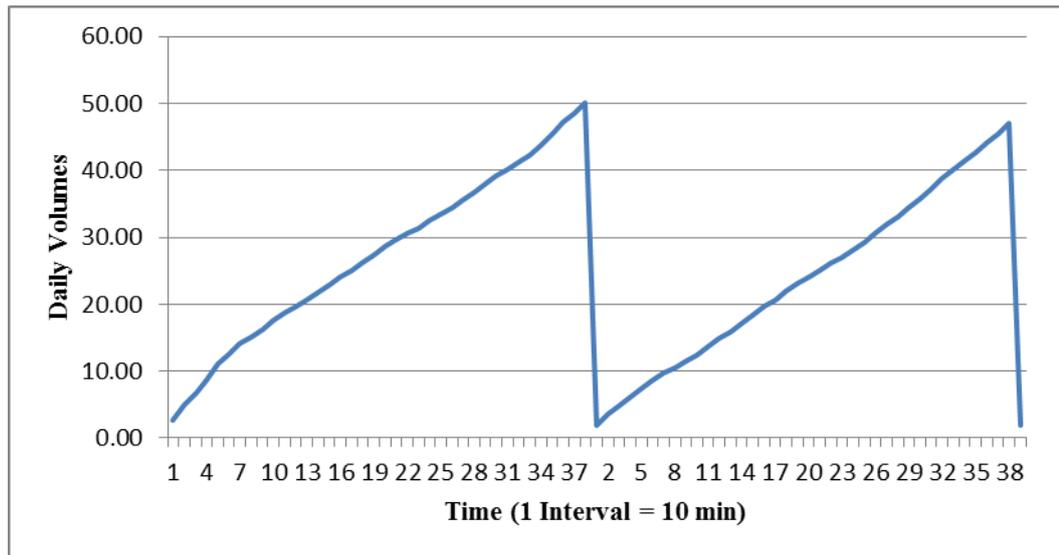


Figure 1- Cumulative Traded Volume for Two Days (In INR Billion)

2. An observation of one month data on cumulative traded volume (refer figure 2) reveals a spike pattern leading to a drop to “0” value on a daily basis. This pattern is formed on account of the reading methodology of volume with absolute data with span of one day only. As a traditional practice to study absolute volume, this spiked pattern has been a constraint to study volume momentum on intraday and inter-day. Researchers and analysts do volume analysis on a daily basis starting from value zero, thus leading to discontinued study. The volume index (VOX™) on the contrary reflects a continued value linked to the actual volumes but normalized to the base value (volumes on the base date, in this case 01 January 1997). The index values can be observed for the similar period in Figure 3 highlighting, a continued and normalized volume studies.

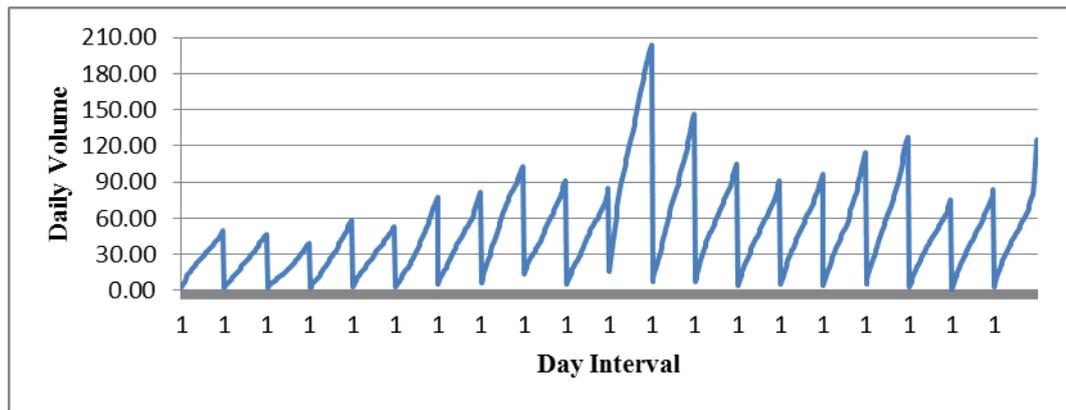


Figure 2 - Cumulative Traded Volumes for a Month (In INR Billion)

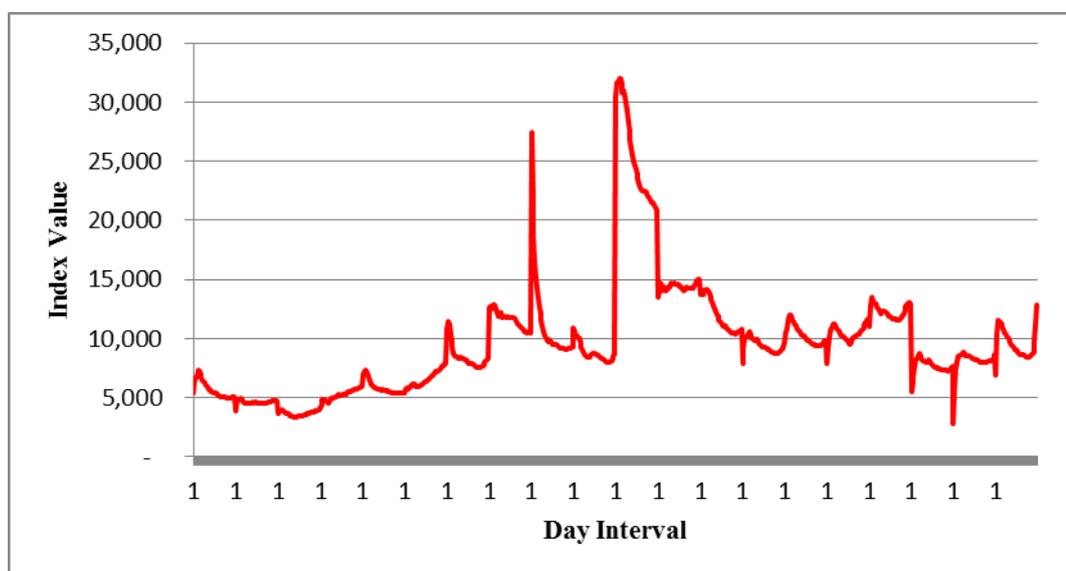


Figure 3- Volume Index (VOX™)

3. By superimposing the Volume Index (VOX™) on the absolute volume data (refer Figure 4) a comparison can be drawn on various facets of volume studies. The volume index is observed to follow a continuous pattern starting from 6507 (in the selected time frame) going up to 13683 without touching zero value as visible in absolute volume data. It can also be observed that volume index is reflecting a smoothing effect of actual volume movement. The index can be used to study the momentum of volumes even on short intervals during the day. The most important of all these observations is statistically tested perfectly positive correlation of absolute volume and volume index (VOX™) (refer Figure 5).

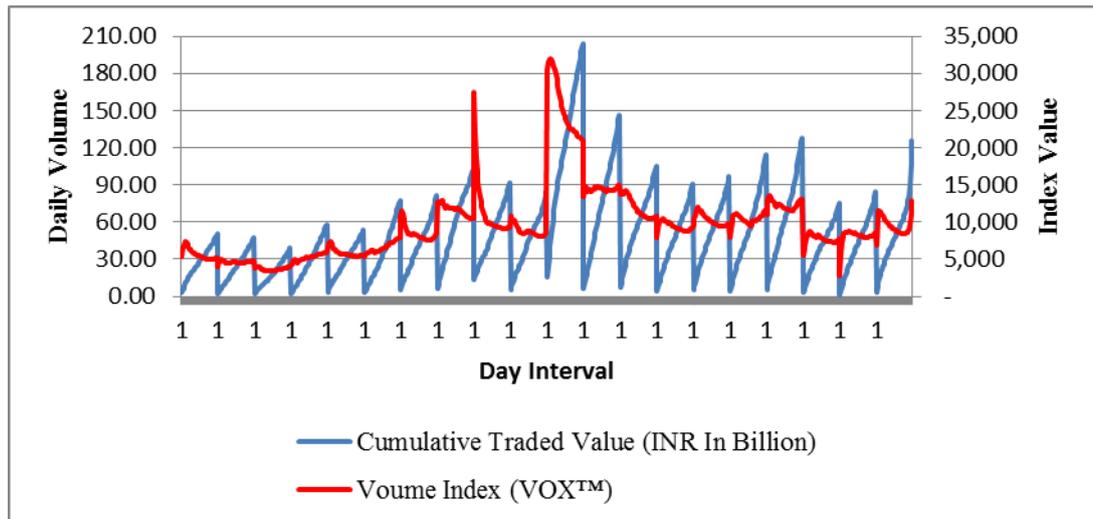


Figure 4 – Volume Index Superimposed on Absolute Volume

4. Last 17 years comparison of absolute volume and volume index (VOX™) confirms volume index as true reflector of volumes supported by statistical analysis of correlation turning perfectly positively correlated ( $r = +1$ ). The same can be observed in Figure 5. The index with its base value of 1000 (Base year 1997) turns 13683 in month ending May 2014. Thus indicating market depth increase by 13.68 times in the span of 17 years (refer Table 6). These indications can be further used researchers, analysts and policy makers to draw meaning conclusions for the market.

Table 6- Volume Index Perfectly Replicating the Absolute Volume Change

Date	Traded Value (in INR Billions)	Change in Turnover (Times)	Volume Index (VOX™)	Change in VOX (Times)
01-Jan-97	9.78	-	1000.00	-
29-May-14	133.85	13.68	13,683.33	13.68

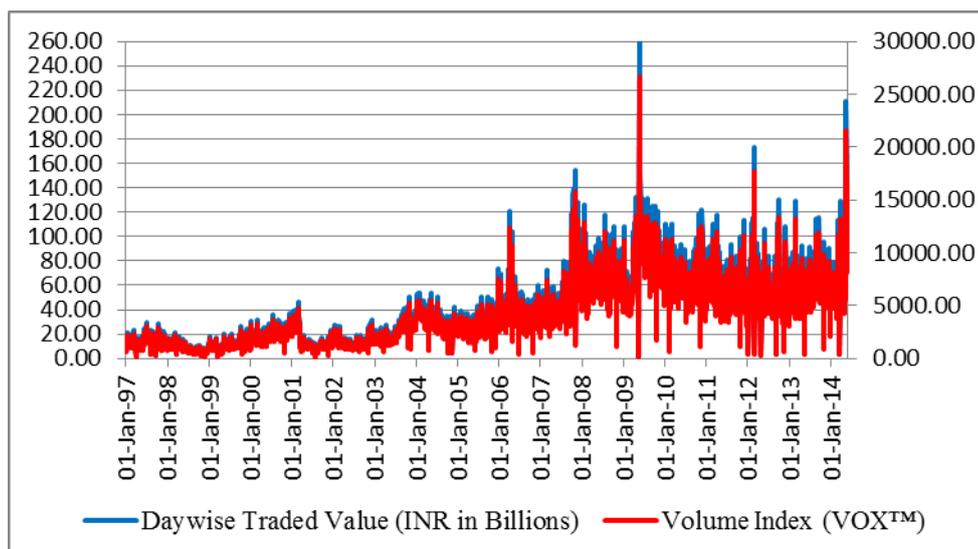


Figure 5- Volume Index Perfectly Replicating the Absolute Volume Change

5. There are various literatures that support the argument of volumes follows the asymmetric pattern (Kyle 1985 and Admati and Piederer, 1988). Henry and McKenzie (2006) also found the relationship between volume and volatility is asymmetric. The same is observed in intraday as well as in inter-day pattern of volumes movement in our research.

A sharp movement is observed at the opening time of the market in all days. Later, the same index moves smoothly except in day 3 (refer figure- 6, 7, 8, 9, 10 and 11).

In figure 8, a sharp rise is observed at starting time, the index moves up from 3720 to 4010, and then it started moving down and reached at lowest level of the day at 3378. From the lowest level, it again started rising and closed at 4017. Index varied 15.91% in intraday from high to low. The same pattern of abrupt movement is also observed in five days inter-day graph (refer figure 12). The five days variation at high and low level was 36%. Index from 5142 to 4990 from day 1 to day 2, further it went down with 14.60% to 4262 in day 3. In day 4, it showed a sharp rise of 56% and reached the level of 6658 and further it went down to 5534 and registered 17% negative growth. The same asymmetric movement is also observed in intraday graphs.

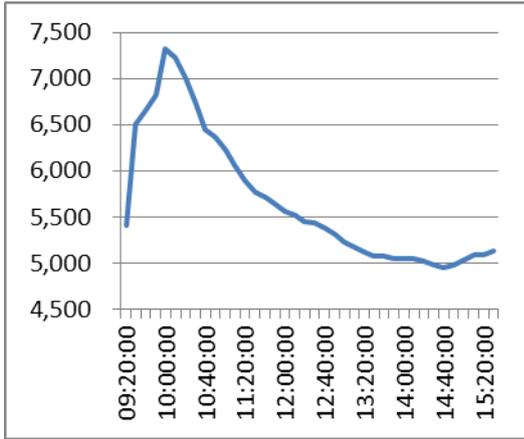


Figure 6- Volume Index (Day-1)

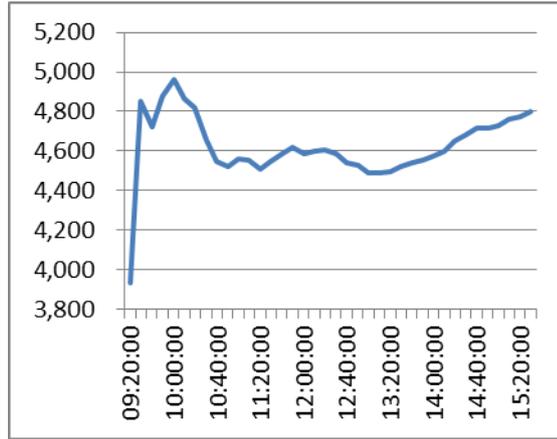


Figure 7- Volume Index (Day-2)

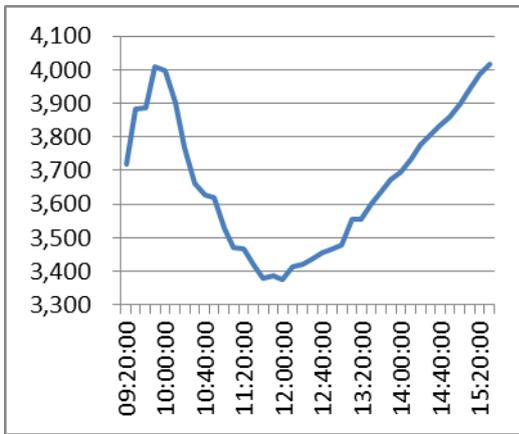


Figure 8- Volume Index (Day-3)

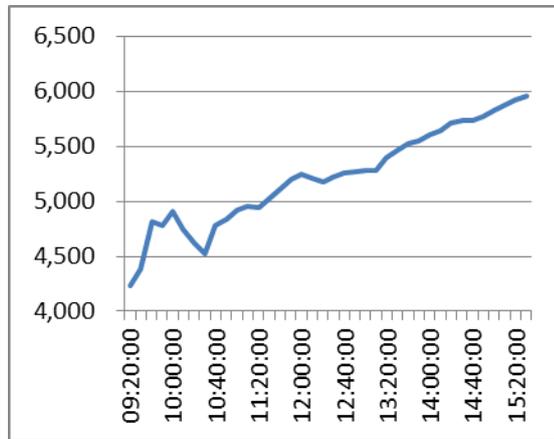


Figure 9- Volume Index (Day-4)

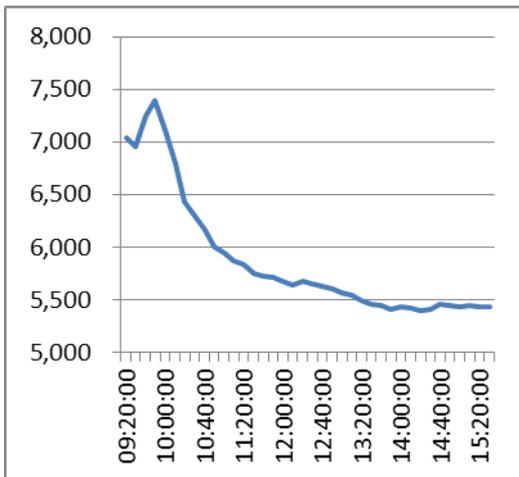


Figure 10- Volume Index (Day-5)

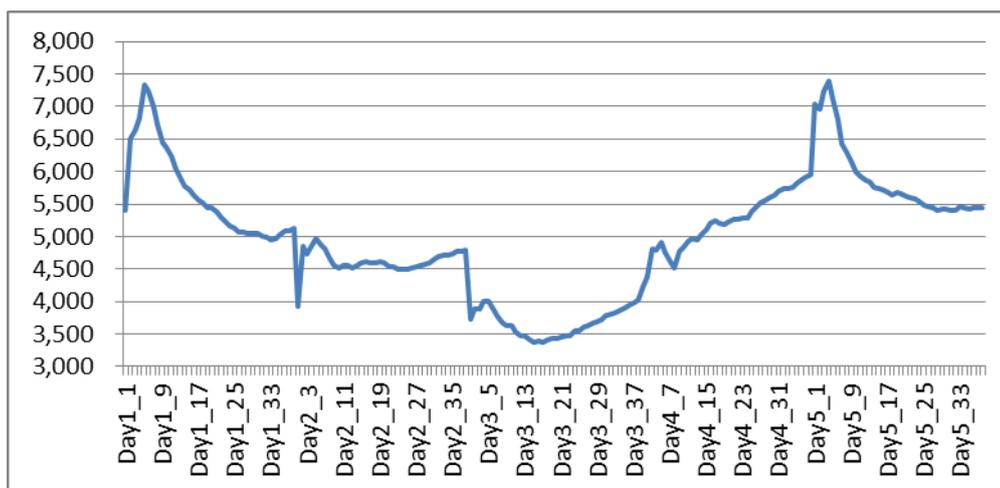


Figure 11- Volume Index (All five days at intraday level)

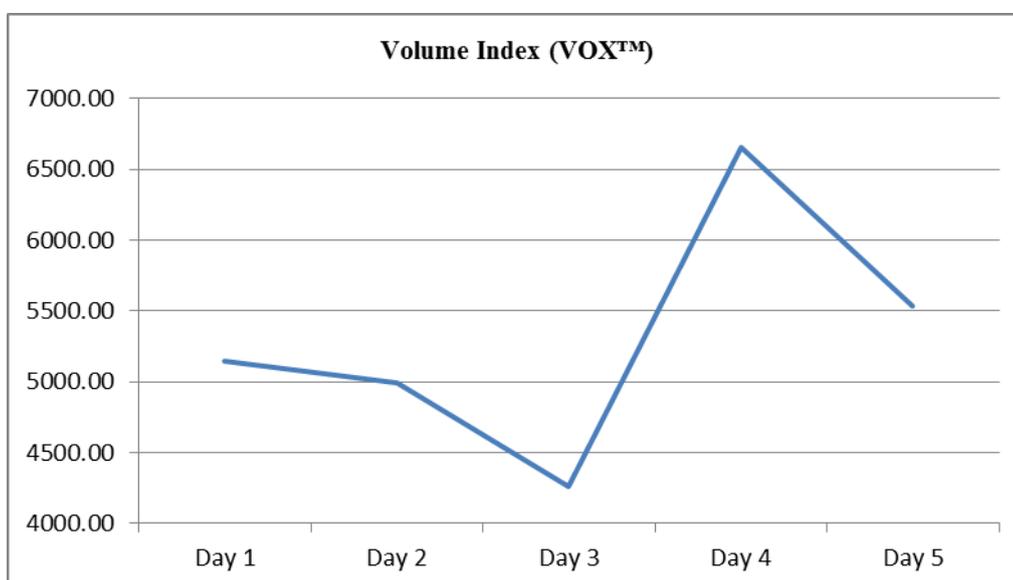


Figure 12- Volume Index (Inter Day for five days)

6. Though the volume index represents proxy volumes during the entire day, the unique methodology adopted in this index converges the proxy volumes towards actual volumes with time and gets equated to exact volumes on the closing time. Thus, the volume index turns a true reflector of volume at the market closing hours.

## Limitations

- The variability in the indices is higher due to two reasons (1) Call Auction (2) Magnified effect of extrapolation of proxy volumes.
- The volume index designed here reflects the changes in volume only for large cap stocks represented by broad based market index (NIFTY). It does not reflect volume changes across other market segments such as mid cap, small cap, and sector specific.
- The index does not distinguishes traded volumes in regular market vis-à-vis negotiated trade done for executing corporate actions or strategic decisions such as

mergers, acquisitions, take over, spin-offs, bonus, splits, reverse splits, rights block trades and offer for sale (OFS), etc.

- The index does not reflect a true picture of market wide participation i.e. it does not distinguishes concentrated trades coming from institutions or cartels with trades coming from retail segment.
- The index has also limitation of not reflecting the market depth during call auction process at the beginning of the market known as pre-opening session in India and post trading session of the market.

## **Potential Uses of VOX™**

Volume index (VOX™) will be helpful for the overall market in taking appropriate decisions and would open a plethora of uses for the regulators, exchanges, brokers, consultants, analyst, traders and investors.

Volume index (VOX™) would also act as a guiding tool for regulators and watchdogs to frame or modify rules, regulation and policies pertaining to capital market to make the market more efficient. Researchers and academicians can read the growth of the stock markets and compare the efficiency of the financial markets of different countries.

Volume index (VOX™) would act as a depth indicator facilitating investment decisions for global investors, large size fund and even sovereign funds. Breadth and depth studies form an integral part of market analysis. It would be instrumental in studying, the most intricate financial process i.e. fund shifting process across asset classes and fund shifting process across currencies. It can be further used to estimate and mitigate liquidity risk.

## **Conclusion**

The concept of volume index has been tested with Indian market data. However, volume studies are omnipresent and universal, thus leading to a universally acceptable tool for all markets across the world.

With all the ardent care taken in creating this volume index (VOX™), we have identified this as a beginning of new horizons for dynamic indices. Our study would leave a noose for researchers world-wide to think beyond the small hurdle that was holding us back for more than a century. The limitations discussed above lead a scope for designing new variants of VOX™ on mid cap, small cap and sectors etc. We hope the world would find volume index as an important tool not only to study volumes but indirectly to facilitate the study of market direction and other important relationship like valuations and volatility. Our research aims laying down foundation for more innovative indexes in complex market scenarios anticipated in decades ahead.

*Our end is our beginning*

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## List of Abbreviations

OBV	: On-balance volume
A/D	: Accumulation/Distribution
MFI	: Money Flow Index
S&P 500	: Standard & Poor 500 Index
Nifty	: NSE(National Stock Exchange) Fifty Index
VIX	: Volatility Index
LIX	: Liquidity Index
VOX™	: Volume Index
OFS	: Offer for Sale

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