# DETERMINING THE ACCURACY OF THE NAIROBI STOCK EXCHANGE 20-SHARE INDEX

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# DECLARATION

This research project is my original work and has not been presented for a degree in any other university.

Signed _____ Date: 4/12/2001

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This research project has been submitted for examination with my approval as the University Supervisor.

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# DEDICATION

*To my parents,*
*Odera Ongudu and Florence Odera.*

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# ABSTRACT

The study set out to determine the accuracy of the Nairobi Stock Exchange (NSE) 20-Share index. The need for the study emanated from the apparent weakness of the NSE 20- Share index to effectively report on the market performance as it is calculated using unadjusted share prices and a geometric averaging method that has been statistically proven to have a downward bias in the long run.

In addition, there is need for an alternative performance measure to give a balanced view value movements in the NSE.

The derived indices were four in number: a Composite All-Share index, a 20-Share index (Laspeyres method), a 20- Share index (Paasche method) and a 20-Share index (Fisher's ideal method).

They all used 1996 week 14 as the base period and the base value was set at 3007.39,the value of the NSE 20-Share index in the same period. This figure was selected to provide for uniformity and enable comparison among the indices.

The share prices were adjusted for bonus issues throughout the period under study and the number of shares in issue were used as the weights for all the indices derived.

During the four years under study, the NSE 20-Share index was found to have understated price rises by 12.08%, rendering the index inaccurate and unsuitable for measuring long-term price movements. A more accurate index calculated using the Fisher's Ideal formula was recommended for the Nairobi Stock Exchange, as it proved to able to effectively capture and report on market performance.

# CHAPTER ONE

## INTRODUCTION

### 1.1 BACKGROUND

The Stock Market is one of the most closely observed economic phenomenon in the world. The news media have induced a need for a simple and convenient barometer of changes in the financial markets. A number of stock market indicators have been developed to meet the demand for measures of stock market performance. The stock market indicators are designed to quantify movements in stock market prices. They are used as a standard in evaluating the returns on money invested in the stock market.

Indicators are descriptive data useful in the analysis and forecasting of business conditions. The specific indicator is designed to monitor, signal and confirm cyclical changes especially turning points in the market. Zarnowitz (1992) commenting on the properties of indicators, notes that the co-movement of the indicators is an essential characteristics of the business cycle, no single adequate measure of market activity is available in a consistent form for a long historical period and that the economic statistics are generally prone to error. He concludes that a number of independently complied indicators tend to be more reliable than the evidence from any individual series i.e. we avoid relying on a single indicator.

The measurement of market wide movements is an important activity and is accomplished by the use of index numbers. An Index number effectively summarises hundreds of price movements. However, it is unavoidable that much information is lost. The choice of a stock index is inevitably always a compromise and this explains why several different indices are computed to quantify movements in a single stock market. For example, in the New York Stock Exchange, there is the NYSE composite, the NASDAQ, the DJIA and the S&P 500; in the London Stock Exchange, there is the FT-SE 100, the FTO Index, the FT-SE Eurotrack 100 and the FT-Actuaries All Share Index; in the Tokyo Stock Exchange, there is the TOPIX, Nikkei Stock Average and the Osaka 50 Kabusaki while in the Nairobi Stock Exchange there is the NSE-20 Share Index and the Ammi 27 Share Index.

An indicator useful in monitoring market movements is the market capitalization. Market capitalization measures the total value of an enterprise by aggregating market values of its securities. It is often computed by using the value of equity securities only i.e. the stock market price per share is multiplied by the number of shares that are outstanding. To reflect the size of a company more accurately, the market capitalization measure sometimes includes the value of publicly traded long-term debt or other securities. Market capitalization may fluctuate widely from day to day. It's limitation is that it is based on trading in a small portion of the company's shares, that may not necessarily represent what a purchaser of the entire company would have to pay.

The volume of shares traded might be as important as the change in a market index since substantial price increases and decreases are often accompanied by heavy trading activity. To this extent a positive correlation between purely share price based index and volume based index is hypothesised. The volume of shares traded is the total number of shares traded on the Stock Exchange on a particular day which together with the total value of all shares traded, (that, is turnover) gives a measure of the amount of business activity on the Stock Exchange. A volume driven index is Trading Volume Activity (TVA) ratio as discussed in Foster (1986).

$$TVA = \frac{\text{Number of shares of firm } i \text{ traded in time } t}{\text{Number of shares of firm } i \text{ outstanding in time } t}$$

An indicator must be accurate to be effective. Accuracy is defined as the degree to which bias is absent from an indicator. An accurate indicator is one that neither understates nor overstates the market position. An accurate index number is one that has precision and exactness. Precision indicates the resolving power of a measuring device and is usually given by the number of decimal places reported in the measurements.

The index movement must correspond to actual underlying price movements at the market for it to be accurate. Where there is no correspondence, the cause may be as a result of the effect of bias and those who rely on such indicators are misled. Measurement may be biased if they consistently understate or overstate the market position. Bias may exist either due to the choice of the measurement method or it could be introduced deliberately or through lack of skill by the measurer. To be free from bias, information must be complete to ensure it validly represents underlying conditions and events.

## 1.2 STATEMENT OF THE PROBLEM

Investors have questioned the accuracy of the NSE 20-share index. Their concern with the index gets pronounced under instances where other market indicators such as volume of shares traded and value per transaction are on the increase yet the index is in the decline.

An example of conflict in market indicator is when suppose, in the previous month the index decreased by five per cent each week but the number of shares traded each week consistently increased. This kind of happening sends confusing signals to investors and corporate managers. A weak or indecisive market exists when indicators on being interpreted, are moving in the opposite direction.

This study seeks to establish whether there is no significant difference in performance measurement among market indicators in the Nairobi Stock Exchange namely, the NSE 20-share index, the Market Capitalization and the Trading Volume Activity (TVA). Secondly, the study seeks to compare the NSE 20-share index with an alternative index.

## 1.3 OBJECTIVES OF THE STUDY

The study seeks to: -

1. Compare the NSE 20-share index with other market indicators
2. Compare the existing index with alternative indices.

## 1.4 IMPORTANCE OF THE STUDY

1. The study seeks to enlighten and stimulate interest in investors who use the NSE 20-share index as a benchmark for performance measurement. The findings might encourage a critical evaluation of portfolio performance given that the basic assumption for an investor is to be able to experience a rate of return comparable to the market return.
2. The study is aimed at assisting investment analysts and portfolio managers understand better and be able to analyse the factors considered in designing an index.
3. The study also aims at encouraging managers to explore and develop an alternative indicator series. The idea is to develop an index portfolio and to track the performance of the market in an attempt to outperform the market or to derive similar rates of return as the market portfolio.
4. The study is expected to encourage further research on market performance and the measurement of indicators by demonstrating the feasibility and the practical difficulties that are likely be encountered.

# CHAPTER TWO

## LITERATURE REVIEW

## 2.1 THE HISTORY OF INDICES

Index numbers have a long history (Kendall, 1969). The earliest reference to index numbers appears in a book published in 1707 by the Bishop of Ely, who was concerned with the consequences of the fall in the value of money since the days of King Henry VI some 250 years previously.

The classified definition of index number goes back to Edgeworth (1887) when he was the secretary of a committee of the British Association set up to study methods of measuring variations in the value of money. Laspeyres (1864) and Paasche (1874) had before then contributed enormously to the development of index numbers theory and practice (Allen, 1975).

In 1922, Irving Fisher published the path breaking book '*The Making of Index Numbers: A Study of their variations, tests and reliability*' which generated great interest in the theory of index number. Marshall (1923), Bowley (1926) and Keynes (1929) all developed interest and wrote extensively on index numbers.

In recent years, the development of finance theories in which movements in the market as a whole assume a central role has led to a demand for a measurement of such movements.

## 2.2 THE THEORY OF PRICE INDICES

Index numbers are defined and computed to provide solutions to practical problems. There can be no measurement without theory and much of what is vague and ambiguous in index-numbers practice can be traced to lack of good theoretical basis. This is the reason for the comprehensive development in this research of a theoretical framework.

The Dow theory is probably the oldest formal technical approach to the market. Its principles were formulated by Dow C. and Nelson S. (1902) and popularised by Hamilton W.P. (Winger and Frasca, 1995). The theory is based on the fundamental premises that at all times there are three movements in the stock market. The first movement is the primary trend and is the long term. It is the major bull or bear market.

The second movement, is the secondary reaction. It is a sharp and discernible rally in a primary bear market or a steep reaction in a primary bull market. The third movement is the day-to-day fluctuation of stock prices. All the three movements operate simultaneously and the first movement is the most important while the third is unimportant. The original purpose seemed to be the measurement of change in stock prices but Dow believed that changes in the averages anticipated changes in business activity.

Ross (1992) states that in theory, price indices are designed to measure these movements in the market with a full awareness of their limitations as reliable indicators. Their use is

justified theoretically within the context of simple models for which the indices are exact measures of performance, otherwise the indices themselves are not of particular interest to theory. Importantly it is the desire to give observational content to terms such as 'inflation' that keeps these indices alive. In theory, a particular stock index is the object of concern and is also a consequence of strong assumptions on preferences.

Ross adds that there exists an alternative theoretical rationale for constructing indices since the index is the average holding it is a natural benchmark against which to measure performance. Asking whether an investor has done better or worse than average is equivalent to asking whether an investor has over-or-under-performed relative to the index. The virtue of this interpretation is that the index is not required to include all assets. It is therefore not surprising that the NSE 20-share index includes only 20 of the 50 plus listed securities.

Ross further advanced that indices must satisfy two important criteria for use as benchmarks of performance. Firstly the measurability criterion whereby the index must be attainable. That is, the construction of the index at any moment of time depends only on information available at that time. Secondly, the investment realizability criterion, whereby the movement of the index is the movement of the actual financial asset and the returns on the index are actually realizable by an investor who had formed and held the index. It is this criteria that makes many indices be adjusted to include distribution.

In instances where the gross movement on the index is not the actual gross capital gain or loss on some asset, then the index is attainable but not realizable.

All indices which are formed as portfolios whose weights depend on information that is available at the beginning of each investment period are both attainable and realizable. The use of portfolio as benchmarks for the performance of investors together with the desire to simply summarise stock market performance are the primary source of the interest in indices in the practical world of finance.

## 2.3 STATISTICAL PROPERTIES OF STOCK MARKET INDICES

Stock market indices as aggregate measures are an instrument to meet the information requirement of investors by characterising the development of global markets and specified market segments (descriptive function). In their function as a basis of derivative instruments, stock market indices facilitate the application of certain portfolio strategies such as hedging and arbitrage (operative function). In order to perform these functions, a stock market index should fulfil statistical as well as economic requirements. The statistical requirements for indices in general were summarised by Fisher (1922) and Diewart (1992).

Crucial for stock market indices are (1) invariance to change in scale, (2) symmetric treatment of components, (3) time reversal, that is, the index between any two dates will not be changed if the base period of the index is changed from one date to another, and

(4) indifference to the incorporation of new stocks, that is, *ceteris paribus*, the inclusion or removal of a stock will not change the index compared to its previous value.

Stock market indices can be classified using three separate criteria:

(a) The stocks selected for inclusion (sampling)

(b) The weighting system (market value weighted, price weighted or equally weighted)

(c) The averaging procedure (arithmetic or geometric)

### 2.3.1 Sampling

An index can be based on a sample of stocks or upon all of them. It is necessary to consider which factors are important in computing an index that is intended to represent a total population. The size, breadth and source of the sample used are all important in constructing an index (Reilly and Brown, 1997). A small sample of the total population will provide valid indications of the behaviour of total population if the sample is properly selected. In fact, at some point, the cost of taking a larger sample will almost certainly outweigh any benefits of increased size. The sample should be representative of the total population, otherwise it's size will be meaningless. The sample can be obtained by completely random selection or by a non-random selection technique that is designed to incorporate the characteristics desired. The source of the sample becomes important if there are any differences between alternative segments of the population, in which case samples from each segments are required. The adequacy of indexes based on samples is caused by two factors. Firstly, the fact that stocks of relatively few companies constitute a large proportion of the value of the stocks of all companies and the tendency of all stocks

to move together. Secondly, the usefulness of indices based on samples is influenced by the degree to which one can confidently infer movements in excluded stocks on the basis of movements in included stocks (Lorie and Hamilton, 1978).

There are four hypotheses concerning the inclusion of a share in the index and changes in its price and volume.

The price pressure hypothesis argues that the price effect (when the inclusion of a share to the index leads to a demand of that share resulting into a rise in both price and volume) is temporary because with time, investors (in search of shares with superior returns) will substitute between shares, eventually resulting in equilibrium price of the share being restored. Pruitt and Wei (1989) found that when a share is added to the S&P500 index an additional 2% of its share capital is bought by institutional investors. Woolridge and Ghosh (1986) found a permanent price effect and a temporary rise in volume and concluded that the price pressure hypothesis is true. They found an initial rise in volume of 25%, which is largely sustained during the subsequent years. Harris and Gurel (1986) also accepted the price pressure hypothesis as they found that when a share is included in the S&P500 index, its volume initially rises by 89% and there is a permanent rise in volume by 26%. Dhillon and Johnson (1991) found that volume rises by 45% in the first 40 days after inclusion, and is still 8% higher a year later. Lamoureux and Wansley (1987) found a temporary rise in both returns and volume and argued that this was consistent with the price pressure hypothesis.

The imperfect substitute hypothesis requires that at least some of the price effect is permanent. This is because other assets are not perfect substitutes for the share included in the index. Shleifer (1986) accepted the imperfect substitute hypothesis because his results showed the price rise to be permanent. The liquidity hypothesis argues that including a share in the index increases its liquidity and this leads to a permanent rise in prices. Woolridge and Ghosh (1986) also concluded that the liquidity hypothesis was true, although their results more clearly supported the imperfect substitutes hypothesis which they did not consider.

Lastly, the information hypothesis implies that the decision to include a share in the index conveys information to the market about the firm's future prospects. Jain (1987) discovered price rises of 3% for shares that were included in the S&P indices, and price falls of 1% for shares that were excluded from the index. This suggested that the abnormal price changes on the announcement day is due to information effects. A similar result was obtained by Arnott and Vincent (1986) who also studied the S&P500 index.

### 2.3.2 Weighting

The share price included in an index must be combined in order to determine the value of the index. For that purpose it is necessary each time the index is computed to determine the relative importance of each included stock (Lorie and Hamilton, 1978).

The simplest approach is to construct an index using the share prices directly without applying any weights. In such a price-weighted index, the index number movements are influenced by the differential prices of the components. A high priced security will

therefore carry more weight than a low priced security. This becomes a limitation since movements in the share prices of companies with high share prices are likely to dominate, as they tend to change by large absolute amounts. The price-weighted index will considerably overstate the overall market portfolio change as a result of over weighting the movement of the high priced stocks. The advantages of the price-weighted index is that it reflects changes in the average price of the stocks used to construct the index.

Another possibility is that the price of each share in the index is given an equal weight. An equally weighted index is based on the assumption that equal shilling amounts are invested in each security, that is price relatives. The advantage to this approach is that companies with high share prices do not have a disproportionate effect on the index. Equal weight is achieved by considering the proportionate change in the share price relative to some base date. While companies with high share prices do not have a disproportionate effect on the index, this method does not reflect the difference in size between the companies (Sutcliffe, 1997).

A weighted index gives greater importance to the price of same share and hence less importance to the price of other shares. Weighting schemes usually award great weight to the share prices of companies that constitute a big proportion of the value of the shares held by shareholders, and less weight to companies that account for only a small proportion of shareholders portfolios. Such weights are generally market capitalization,

that is, the number of shares issued by the company multiplied by the share price at some specified time.

### 2.3.3 Averaging

A group of common stocks must be aggregated to produce a single number in order to create a descriptive measure, that is the value of the index. This is either done by the arithmetic average or the geometric average (Sutcliffe, 1997).

The arithmetic average is simply the sum of the numbers (market weighted, price weighted or equally weighted) divided by *n* the number of shares in the index. Thus the arithmetic average (*AW*) of three numbers is:

$$AW = (W_1X_1 + W_2 X_2 + W_3X_3) / 3 \qquad (1)$$

Where *X*, are the numbers

*W*, are the weights.

$$AW_t^0 = \sum_{i=1}^{n} W_i R_i \qquad (2)$$

The arithmetic weighted stock market index at time *t* with a base of time *o* is given by;

Where $R_i = P_{it}/P_{io}$

$\Sigma W_i = 1$

The geometric average of a set of numbers is the *nth* root of their product. Thus, the geometric equally weighted average (*GU*) of three numbers is:

$$GU = (X_1 X_2 X_3)^{\frac{1}{3}} \quad (3)$$

The geometric equally weighted stock market index at time $t$, with a base of time $o$, is given by:

$$GU_t^0 = (Z_t / Z_0)^{\frac{1}{n}} \quad (4)$$

Where $Z_j = P_{1j} \text{ X } P_{2j} \text{ X } P_{3j} \text{ X } \ldots\ldots\ldots\ldots \text{ X } P_{nj}$

j = $o$ and $t$

Although it is relatively easy to change the base date and replace one share with another using the geometric index, the main disadvantage of the index is that unless all share prices in the index rise (or fall) by exactly the same proportion, a geometric index will understate a rise and overstate the absolute size of a fall in share prices. The larger the diversity of movement in individual share price the greater the degree of under or overstatement.

Consequently, an index constructed using geometric averaging such as the NSE 20-share index will always grow more slowly or decline more rapidly than an indicator constructed using the arithmetic average. (Sources: Sutcliffe, 1997; Fabozzi & Jankus, 1985; Lorie & Hamilton, 1971).

## 2.4 COMPUTATION OF STOCK MARKET INDICES

### 2.4.1 Choice of a base date.

All market weighted and equally weighted indices have a base date. This is the time when the value of the index is usually set to unity, a hundred or a thousand. For price-weighted indices, a base date is of little importance as the index is expressed in units of currency rather than as a ratio with respect to the base date. The base date should not be too distant from the present. The further away we move the base date, the less we know about the economic conditions prevailing at that time (Simiyu, 1991). While selecting the base date, a decision has to be made as to whether the base shall remain fixed or not, That is whether it will be a fixed base or a chain base index.

In a fixed base method, the year to which all other prices are related is constant for all times while in the chain base method, the prices of a year are linked with those of the preceding year.

### 2.4.2 Choice of Formula

There exist a large number of formulae that have been designed for constructing index numbers. Often the choice of the formula depends not only on the data available but also on the purpose of the index (Lorie and Hamilton, 1978). For example a price-weighted index is an appropriate benchmark for an investor who apportions his or her wealth among stocks in ratios that correspond to their current prices. It is preferably the right basis of comparing how a portfolio 'outperforms the market'. The equally weighted index is an appropriate benchmark for an investor who apportions his or her wealth in

equal shilling amounts among all stocks selected while the market value – weighted index is appropriate for indicating changes in the aggregate value of stocks represented by the index.

The London Stock Exchange Financial Times – Stock Exchange 100 Share Index (commonly known as the FT–SE 100) is an arithmetic weighted index where the weights are market capitalization. This index is computed using the average of the best bid and ask price quotations. The Paasche formula is used. In Japan, the Tokyo Stock Price (TOPIX) is an arithmetic market value weighted index of all shares quoted in the First Section (The Blue Chip Section) of the Tokyo Stock Exchange. It is computed every minute using the Paasche formula.

In Germany, the *Deutscher Akienindex* (DAX) index of the Frankfurt Stock Exchange is an arithmetic market-weighted index computed every minute using the Laspeyres formula. The Frankfurter *Allgemeine Zeitung* (FAZ) Index, based on the Frankfurt Stock Exchange is also a Laspeyres computed index using market capitalization weights.

The Nairobi Stock Exchange NSE 20-Share Index is a geometric equally weighted index with market capitalization as weights. The last price of the day of each share is used but in cases where no trade occurs, the arithmetic average of the ask and bid prices is used. The index is only computed once a day using the Fisher ideal formula. Simiyu (1991) computed a 23-share index made of the most actively traded stocks. The index was computed using the Laspeyres formula and was weighted by the number of shares outstanding using the geometric means of the bid and ask spread.

No particular formula can be regarded as the best under all circumstances. On the basis of the users' knowledge of the characteristics of different formulae, the user can choose technical methods adapted to the data available and appropriate to the purpose of the index *ad lib*. Some of these formulas include the Paasche formula, the Laspeyres formula, the Marshall-Edgeworth index, the Fisher ideal-index *ad inf.* (Allen, 1975; Diewart, 1992).

## 2.5 ADJUSTMENT PROCEDURES FOR CHANGES IN CAPITALIZATION

Index constructors necessarily make adjustments for any changes in capitalization that changes the current price of a stock in the index. Adjustments made for changes in the price of the stock are more in the nature of bringing up to date the weighting factor of each stock, rather than preventing price distortions in the index.

### 2.5.1 Bonus Issues

Bonus issues are common in the Nairobi Stock Exchange. Bonus issues are 'free' shares given to shareholders through a given ratio by a company, for example, 1:2 bonus means that a shareholder on record at a particular date would get a free share for every two held. Bonus issues might have dilution effects on share prices but when the stock sells ex-bonus, the price goes down considerably. Bonus issue adjustments are undertaken as follows. The ratio of new shares (after the issue) to the old shares is determined. For instance, in the case of 1 for 2 the ratio will be 3/2. Multiply the ex-bonus price with this

ratio. For example, a share selling at shs 40.50 after bonus issue of 1 for 2 will have an adjusted price of shs 40.50 x 3/2 = shs 60.75. This is the price to be used in computing the new index. The weighting factor will also be changed to equal the number of shares outstanding after the bonus has become effective.

### 2.5.2 Rights Issue

Stock rights are issued by corporations to acquire a specified number of shares of capital stock under prescribed conditions within a stated period of time. The value attached to these rights depends upon the proportionate increase in the shares outstanding and the difference between the market price and the price at which the new stock is offered. These rights are bought and sold until the stock sells ex-rights, at which point their value is deducted from the market price of the stock. Stock rights adjustments are undertaken by maintaining the same weighting factor at all times to the shares outstanding but the base value for the index will have to be increased. The old weighting factor of the stock is increased by the number of shares actually sold to form a new weighting factor. The old group value can then be increased by an amount equal to the value of the stock sold. A proportionate increase will have been made in the old base value of the group to offset any change in the index because of the changes in the group value. The introduction of the new weighting factor for the stocks and the corresponding change in the group base value will have been made when computing the first index that involves the ex-rights price of a stock. (This method is used by Standard and Poor's Corporation).

## 2.6 LIMITATIONS OF STOCK MARKET INDICES

### 2.6.1 Long-term downward bias

In reality share prices tend to rise in the long run and they do so by differing amounts. The geometric index e.g. the NSE 20-share index will understate any price rise and overstate any fall (Sutcliffe, 1997). Therefore it can be out-performed by simply investing an equal amount in each share in the index and holding this investment throughout the period (Cootner, 1966). The downward bias represents a serious understatement and renders geometric indices unsuitable for measuring long-term price movements.

### 2.6.2 Base date

The base date is usually either the start or end of the time period under consideration. But where base dates are other than the start or the end period, Sutcliffe (1997) demonstrated that: -

(a) The returns on a geometric index are independent of a base date. This means that the rates of returns on a geometric index calculated using different base dates are equal. The geometric mean, therefore, measurers the rate of growth of the initial portfolio during the performance evaluation period.

(b) Relative to the market portfolio, the geometric index understates price rises and overstates price falls. This implies that the larger the diversity of movement in the individual share prices, the greater the degree of under or overstatement.

(c) The arithmetic index only measures the percentage return on the market portfolio when the base date is the start of the period for which the return is being computed and will correctly measure the rate of return on a portfolio held unchanged throughout the period. Over long periods of time, an arithmetic index will out perform most of its components due to the characteristics of stock prices since there is a lower, but no upper, limit to price changes.

(d) Depending on the base date chosen, the percentage change in the arithmetic index can be larger or smaller than that of the geometric index. This is because in computing the arithmetic mean, the amount invested is assumed to be maintained (through additions or withdrawals) at its initial value. The geometric mean on the other hand varies in size because of the assumption that all proceeds are reinvested (Modigliani & Pogue, 1974).

Thus a geometric index is biased in a consistent direction while the direction of bias in an arithmetic index varies. An arithmetic index with a base year other than the start of the period can over or understate the return on a portfolio, while a geometric index will always understate this return. Marks and Stuart (1971) investigated this problem for the Financial Times Ordinary (FTO) index, which is an equally weighted geometric index. They took the share prices used in the computation of the FTO and calculated the values of the corresponding equally weighted arithmetic index. With the end of 1960 as the base date for these two indices, by the end of 1970, the FTO index had risen by 11.6% while the arithmetic equivalent index was 41.2% higher than at its base date. Therefore, while the value of an equally weighted portfolio of the 30 shares in the index had risen by

41.2% over ten years, the FTO measured less than a third of this rise. This represents a serious understatement and renders the geometric indices unsuitable for measuring long-term price movements.

### 2.6.3 Selection Bias

When an index is a composite and covers all shares traded on the Exchange (for instance NYSE Composite, AMVI, Topix and Nasdaq Composite), then there is no problem. However, the use of a sample is usually necessary to enable the rapid and repeated calculation of the index. If the coverage of the index is less than complete, the shares selected for inclusion will represent a biased sample for the market as a whole. There are two reasons for this. Firstly, since many indices are designed to contain only large leading companies, they are based on a biased sample because many relatively small companies are also traded on the stock market. Recent research has found that the performance of small firms tends to differ systematically from that of large companies (Dimson, 1988). Secondly, the identity of the shares in the index changes over time. Companies that have grown at a slow rate tend to be removed from the index, while companies that have shown rapid growth are added. Rose (1971) reports that companies dropped from the FTO index subsequently underperformed the market, while companies added to the index went on to outperform the market.

### 2.6.4 Averaging Bias

Explicit averaging, by using closing values for each calendar month, will introduce (or increase) positive serial correlation into changes in the index and will also lower the

variance and mean of the index. This will occur when the published values of the market index are in fact averages of a number of values of the index computed at different times, that is, explicitly averaged. Board and Sutcliffe (1985) demonstrated that using averaged data can considerately alter the portfolios in the efficient set and that biases introduced are non-trivial. Market indices are usually calculated using the most recent transaction price of each share. Some shares do not trade continuously and prices used do not recur at the same moment. This means implicitly, that the prices used are non-synchronized and the index computed will measure an average of the 'true' value. This is known as implicit averaging.

Brealey (1970) attempted to measure the magnitude of the serial correlation introduced into the UK market indices by non-synchronous trading. He concluded that, after removing the positive first order serial correlation introduced by averaging, some positive correlation remained, that is, the positive serial correlation was not entirely due to non-synchronicity of prices used to compute the FTO index. Atchison, Butler and Simonds (1987) used transaction data on 280 shares quoted on the NYSE to investigate the magnitude of non-synchronous trading bias and found that it only accounted for about 15% of the positive correlation in the index. Mackinlay and Ramaswamy (1988) argued that, as the length of the differencing interval is increased, so the effect of 'stale' prices should diminish. They studied the S&P500 and found that while an increase in the differencing interval from 15 minutes to one hour led to a reduction in positive autocorrelation, further increases in the differencing interval did not remove the

remaining autocorrelation. They concluded there must be some cause for this residual autocorrelation other than stale prices.

## 2.7 CONCLUDING REMARKS

Modern portfolio theory requires knowledge of the relationship of prices of individual stocks to movements in the market in order to allocate funds rationally among stocks. For these purposes, it is essential that there is a summary measure of behaviour of 'the market'. Such measurements are desired for a number of reasons, for example a standard against which to compare the performance of Investment Managers. Since the share price is often treated as a measure of the markets expectations of the cashflows from the company concerned, market risk is estimated by relating the returns on an individual share to the returns of the market as a whole. This requires an analyst to estimate the return in the market. The fluctuation in the market index have been used as a surrogate for returns on the market and it then becomes crucial that the market index is accurate. As a result, a market index provides a leading indicator of national economic importance. Therefore understanding the construction, computation and purposes of indices is necessary in designing and implementing an investment strategy and can make a crucial difference in interpreting the results of research.

Even though an optimal index number may not exist, differences among indices are not likely to be great. However, the more accurate indices are those that suffer less from the effect of downward, selection and averaging biases and can consistently be relied upon as good measure for behaviour of market performance (Cootner, 1966).

# CHAPTER THREE

# RESEARCH DESIGN

## 3.1 POPULATION

The population for the study constituted all the companies whose ordinary shares were quoted on the Nairobi Stock Exchange (NSE) as at 31st December 1999. As for that date, 54 companies were quoted but only 51 were actively trading as two were suspended, namely Regent and Kenstock Loans while Ol Pejeta was voluntarily winded up.

## 3.2 SAMPLING PLAN

The sampling plan that Simiyu (1991) used to construct his Alternative Index was adopted for this study as it was found appropriate. The companies on the NSE were classified into the following sectors; Agricultural, Commercial and Services, Finance and Investment, Industrial and Allied.

This is the classification adopted by the NSE and it was found appropriate for the purpose of this study. To qualify for selection, ordinary shares of the company must have been quoted on May 1996 and remained continuously quoted over the period under consideration.

The sampling plan for each sector adopted by the NSE was found appropriate for the purpose of this study as it accounts for approximately 80% of all value movements.

## 3.3 DATA COLLECTION

The data required for each company was collected from the NSE for a period of four years from 1st May 1996 to 31st December 1999. The period was chosen as interest in market trend is in the recent past. For each company, the following secondary data was collected from the NSE: -

Share prices, NSE 20-share index, volume of shares traded, value of shares traded, number of shares in issue, number of transactions and market capitalization for the period.

## 3.4 DATA ANALYSIS

The analysis was tied to each objective to enable accurate conclusions. Inferential statistics was used to analyse the data. To improve accuracy and reduce the computational burden the application of SPSS computer package was used to calculate all statistical tests.

**Test for Long-term downward bias:**

The two leading firms by value of trading in 1999,Kenya Power and Barclays Bank were selected to compute an unweighted geometric index (refer to formula 3 and 4 in page 15) and an unweighted arithmetic index (refer to formula 1 and 2 in page 14). The percentage change of these indices were then compared to determine which index overstates a price fall and which one understates a price rise and by what percent.

**Test for Averaging Bias:**

The first-order autocorrelation was calculated to determine the existence of a positive Serial correlation on the NSE 20-Share index. The first-order autocorrelation coefficient ($r_1$) is expressed mathematically as:

$$r_1 = \frac{\sum_{t=1}^{n-1}(Y_t - \overline{Y})\,(Y_{t-1} - \overline{Y})}{\sum_{t=1}^{n}(Y_t - \overline{Y})^2} \qquad (5)$$

Where $r_1$ = First order autocorrelation coefficient

$\overline{Y}$ = Mean of the values of the series

Y = Observation at time period t

$Y_{t-1}$ = Observation one time period earlier, or at time period t-1

**Test for selection bias:**

The existence of the size effect on the NSE 20-share index was examined. The percentage of the total market capitalization that is represented by the constituent companies of the index was examined. The nature of all the stocks that were suspended, de-listed or added during the period was also examined.

**Bonus issues:**

Bonus issues are very common in the NSE. 13 Companies out of the 20 in the sample had bonus issues during the period. Bonus issues were incorporated by changing the weighting factor to equal the number of shares in issue after the bonus had become effective. The new weighting factors were introduced when computing the first index

after the stock was sold ex-bonus. Prices were adjusted by multiplying the ex-bonus price with the ratio of the new shares (after the issue) to the old shares.

**Construction of the Alternative indices:**

**Composite and 20-share indices (Laspeyres formula)**

The conventional arithmetic weighted indices were used with weights as market capitalization. The Laspeyres formula was used to calculate a composite index and a 20-share index. The Laspeyres price index is a base-weighted index. The Laspeyres formula is expressed mathematically as:

$$I = \frac{p_1 q_0}{p_0 q_0}(100) \qquad (6)$$

Where I= the Index Number

$p_1$ = market price in current period

$p_0$ = price in the base period

$q_0$ = No. of shares in issue in the base period.

Thus $p = \frac{\text{Total market value in period } t \times \text{(index value in base period)}}{\text{Total market value in base period}}$

The market value ($p_1q_o$) in the period t was calculated for all the companies in the NSE and then a summation for the total market value in period t was derived.

The market value ($p_0q_0$) in the base period was calculated for all the companies and then a summation for the total market value in the base period was obtained. The index value in the base period used was 3007.39. This was the NSE 20-share index in the beginning of the period under study. The Composite Index took into consideration all the 50

companies trading in the NSE whereas the Alternative 20-share index considered only the 20 companies that are constituent in the 20 share portfolio of the NSE index.

**Justification:**

The Laspeyres formula is a base weighted index that is equally weighted in the base period. The use of base period weights is the most commonly applied method since the index need not be revised.

**Disadvantage:**

The Laspeyres method does not take into consideration changes in the market values.

**Alternative 20-share index (Paasche formula):**

The Paasche formula was also used to compute a 20-share index. The Paasche price index is a current weighted index. The Paasche formula is expressed as:

$$I = \frac{p_1 q_1}{p_0 q_1}(100) \qquad (7)$$

Though similar to the Laspeyres, the major difference is that the Paasche method captures quantity measures for the current period rather than for the base period. To compute the Paasche index, the current period share price was multiplied by the current period number of shares in issue for each company in the 20-share portfolio. The sum obtained for each company was then used to aggregate a total sum for the portfolio. The base period share prices were then multiplied by the current number of shares in issue. Again the summation for all the firms were used as the total sum.

**Justification:**

The Paasche method is helpful as it combines the effect of changes in share prices and the number of shares in issue. Thus it is a better indicator of general changes in the NSE than the Laspeyres method.

**Disadvantages:**

The main disadvantage of the Paasche method is the need to tabulate the number of shares in issue for each period examined. Frequently, quantity information for each period is either expensive to gather, time consuming and generally unavailable. Since the quantity measure used for one index period is usually different from the measure used for another period, it is impossible to attribute the difference between the two index values to price changes only. This makes it difficult to compare indices from different periods.

**Alternative 20-share index (Fisher's Ideal formula):**

The Fisher's Ideal method is the geometric mean of the Laspeyres and Paasche indices. It is expressed as:

$$I = \sqrt{\frac{p_1 q_0}{p_0 q_0} * \frac{p_1 q_1}{p_0 q_1}} \qquad (8)$$

**Justification:**

It takes into account both current year as well as base year prices and quantities. The Ideal index also satisfies both the time reversal and factor reversal tests.

**Time Reversal Test:**

This test expresses the idea that the formula for calculating an index should be such that it will give the same ratio between one point of comparison and the other, no matter which of the two is taken as the base. That is, if an index number for 1997 with 1996 as the base year at 100 is 200%, the same index for 1996 with 1997 as the base year at 100 should be 50%. Symbolically:

$$I_{0,1} * I_{1,0} = 1 \qquad (9)$$

Where I= the Index Number

**Factor Reversal Test:**

This test requires that the product between a price index and the corresponding quantity index be equal to the value index. Thus,

$$V = \frac{\sum p_1 q_1}{\sum p_0 q_0} \qquad (10)$$

Where V = the Value Index

That is, the two results (a price index multiplied by a quantity index) should give a true value ratio.

Subsequently, the Fisher's Ideal index should be free from bias as it geometrically crosses the Laspeyres and Paasche formulae (which embody opposing market values and weight bases) to cancel any bias, upward and downward respectively, revealed by the time reversal and factor reversal tests.

It is however erroneous to assume that the criteria mentioned above provides an absolute benchmark by which one can measure the relative merits of index numbers. All such tests should be considered only as supplementary to practical considerations that arise in the construction of an index. When practical advantages are in conflict with theoretical considerations, it is prudent to give the practical needs more attention.

# CHAPTER FOUR

## FINDINGS AND INTERPRETATION

## 4.1 INTRODUCTION

The study set out to determine the accuracy of the NSE 20-Share index. It was hoped that any inaccuracy would be identified and measured. It was also hoped that an Alternative index would be derived and recommended to measure more accurately the performance of the NSE.

## 4.2 LONG-TERM DOWNWARD BIAS

| | Share Prices | | | |
|---|---|---|---|---|
| | Time 0 | Time 1 | Time 2 | Time 3 |
| | 199913 | 199919 | 199926 | 199929 |
| Kenya Power | 110.32 | 115.71 | 110.2 | 110.44 |
| Barclays Bank | 110.94 | 109.05 | 78 | 114 |

Table 1: Value of indices based on Arithmetic and Geometric averages of share prices.

| | Time 0 | Time 1 | Time 2 | Time 3 |
|---|---|---|---|---|
| $GU^0$ | 1 | 1.015 | 0.838 | 1.014 |
| $GU^1$ | 0.985 | 1 | 0.825 | 0.999 |
| $GU^2$ | 1.193 | 1.212 | 1 | 1.21 |
| $AW^0$ | 1 | 1.016 | 0.851 | 1.015 |
| $AW^1$ | 0.985 | 1 | 0.834 | 0.999 |
| $AW^2$ | 1.212 | 1.224 | 1 | 1.232 |

Table 2: Percentage change in the indices.

| | Time 0 to 1 | Time 1 to 2 | Time 2 to 3 |
|---|---|---|---|
| $GU^0$ | 1.50% | -17.50% | 21% |
| $GU^1$ | 1.50% | -17.50% | 21% |
| $GU^2$ | 1.50% | -17.50% | 21% |
| $AW^0$ | 1.60% | -16.20% | 19.30% |
| $AW^1$ | 1.50% | -16.66% | 19.80% |
| $AW^2$ | 3.20% | -18.30% | 23.20% |
| Portfolio | 1.60% | -16.20% | 19.30% |

Table 1 and 2 illustrates that in the NSE:

I. The returns on a geometric index are independent of the base date.

II. Relative to the market portfolio, a geometric index understates price rises and overstates price falls.

III. The arithmetic index only measures the percentage return on the market portfolio when the base date is the start of the period for which the return is being computed.

IV. Depending on the base date chosen, the percentage change in the index can be larger or smaller than that of a geometric index.

## 4.3 TEST FOR AVERAGING BIAS

The study set out to investigate the magnitude of the non-synchronous trading bias in the NSE by testing for positive first-order serial correlation in the value of the NSE 20-share index. Serial correlation is the term used to describe the situation when each observation is statistically dependent on the previous one. For example, after years of low prices, the next year's price is more likely to be low again. Positive serial correlation means that successive observation tend to resemble previous observations. When a variable is measured over time, it is frequently correlated with itself, when 'lagged' one or more periods. This correlation between time series residuals (known as serial correlation) is measured by the autocorrelation coefficient. The correlation between successive residuals is called first-order autocorrelation.

**Table 3: Computation of the first- order Autocorrelation.**

| 1999 Week(t) | NSE Index $(Y_t)$ | Y Lagged one Period $(Y_{t-1})$ | $(Y_t - \overline{Y})$ | $(Y_{t-1} - \overline{Y})$ | $(Y_t - \overline{Y})^2$ | $(Y_t - \overline{Y})(Y_{t-1} - \overline{Y})$ |
|---|---|---|---|---|---|---|
| 1 | 3119.89 | ----- | 452.14 | --- | 204430.5796 | ----- |
| 2 | 3058.99 | 3119.89 | 391.24 | 452.14 | 153068.7376 | 176895.2536 |
| 3 | 3014.37 | 3058.99 | 346.62 | 391.24 | 120145.4244 | 135611.6088 |
| 4 | 2983.48 | 3014.37 | 315.73 | 346.62 | 99685.4329 | 109438.3326 |
| 5 | 2967.36 | 2983.48 | 299.61 | 315.73 | 89766.1521 | 94595.8653 |
| 6 | 2932.33 | 2967.36 | 264.58 | 299.61 | 70002.5764 | 79270.8138 |
| 7 | 2930.56 | 2932.33 | 262.81 | 264.58 | 69069.0961 | 69534.2698 |
| 8 | 2988.88 | 2930.56 | 321.13 | 262.81 | 103124.4769 | 84396.1753 |
| 9 | 2963.83 | 2988.88 | 296.08 | 321.13 | 87663.3664 | 95080.1704 |
| 10 | 2891.47 | 2963.83 | 223.72 | 296.08 | 50050.6384 | 66239.0176 |
| 11 | 2834.99 | 2891.47 | 167.24 | 223.72 | 27969.2176 | 37414.9328 |
| 12 | 2853.24 | 2834.99 | 185.49 | 167.24 | 34406.5401 | 31021.3476 |
| 13 | 2806.95 | 2853.24 | 139.2 | 185.49 | 19376.64 | 25820.208 |
| 14 | 2806.23 | 2806.95 | 138.48 | 139.2 | 19176.7104 | 19276.416 |
| 15 | 2786.45 | 2806.23 | 118.7 | 138.48 | 14089.69 | 16437.576 |
| 16 | 2778.47 | 2786.45 | 110.72 | 118.7 | 12258.9184 | 13142.464 |
| 17 | 2767.89 | 2778.47 | 100.14 | 110.72 | 10028.0196 | 11087.5008 |
| 18 | 2759.11 | 2767.89 | 91.36 | 100.14 | 8346.6496 | 9148.7904 |
| 19 | 2750.54 | 2759.11 | 82.79 | 91.36 | 6854.1841 | 7563.6944 |
| 20 | 2745.42 | 2750.54 | 77.67 | 82.79 | 6032.6289 | 6430.2993 |
| 21 | 2762.85 | 2745.42 | 95.1 | 77.67 | 9044.01 | 7386.417 |
| 22 | 2778.41 | 2762.85 | 110.66 | 95.1 | 12245.6356 | 10523.766 |
| 23 | 2771.65 | 2778.41 | 103.9 | 110.66 | 10795.21 | 11497.574 |
| 24 | 2773.97 | 2771.65 | 106.22 | 103.9 | 11282.6884 | 11036.258 |
| 25 | 2760.39 | 2773.97 | 92.64 | 106.22 | 8582.1696 | 9840.2208 |
| 26 | 2765.57 | 2760.39 | 97.82 | 92.64 | 9568.7524 | 9062.0448 |
| 27 | 2765.57 | 2765.57 | 97.82 | 97.82 | 9568.7524 | 9568.7524 |
| 28 | 2776.71 | 2765.57 | 108.96 | 97.82 | 11872.2816 | 10658.4672 |
| 29 | 2774.49 | 2776.71 | 106.74 | 108.96 | 11393.4276 | 11630.3904 |
| 30 | 2758.98 | 2774.49 | 91.23 | 106.74 | 8322.9129 | 9737.8902 |
| 31 | 2744.55 | 2758.98 | 76.8 | 91.23 | 5898.24 | 7006.464 |
| 32 | 2750.87 | 2744.55 | 83.12 | 76.8 | 6908.9344 | 6383.616 |
| 33 | 2753.88 | 2750.87 | 86.13 | 83.12 | 7418.3769 | 7159.1256 |
| 34 | 2588.75 | 2753.88 | -79 | 86.13 | 6241 | -6804.27 |
| 35 | 2561.27 | 2588.75 | -106.48 | -79 | 11337.9904 | 8411.92 |
| 36 | 2477.33 | 2561.27 | -190.42 | -106.48 | 36259.7764 | 20275.9216 |
| 37 | 2436.9 | 2477.33 | -230.85 | -190.42 | 53291.7225 | 43958.457 |
| 38 | 2413.38 | 2436.9 | -254.37 | -230.85 | 64704.0969 | 58721.3145 |
| 39 | 2397.5 | 2413.38 | -270.25 | -254.37 | 73035.0625 | 68743.4925 |
| 40 | 2423.64 | 2397.5 | -244.11 | -270.25 | 59589.6921 | 65970.7275 |
| 41 | 2370.57 | 2423.64 | -297.18 | -244.11 | 88315.9524 | 72544.6098 |
| 42 | 2370.1 | 2370.57 | -297.65 | -297.18 | 88595.5225 | 88455.627 |
| 43 | 2352.09 | 2370.1 | -315.66 | -297.65 | 99641.2356 | 93956.199 |
| 44 | 2309.33 | 2352.09 | -358.42 | -315.66 | 128464.8964 | 113138.8572 |
| 45 | 2283.04 | 2309.33 | -384.71 | -358.42 | 148001.7841 | 137887.7582 |
| 46 | 2283.79 | 2283.04 | -383.96 | -384.71 | 147425.2816 | 147713.2516 |
| 47 | 2296.73 | 2283.79 | -371.02 | -383.96 | 137655.8404 | 142456.8392 |
| 48 | 2293.08 | 2296.73 | -374.67 | -371.02 | 140377.6089 | 139010.0634 |
| 49 | 2297.22 | 2293.08 | -370.53 | -374.67 | 137292.4809 | 138826.4751 |
| 50 | 2298.08 | 2297.22 | -369.67 | -370.53 | 136655.9089 | 136973.8251 |
| 51 | 2296.62 | 2298.08 | -371.13 | -369.67 | 137737.4769 | 137195.6271 |
| 52 | 2295.36 | 2296.62 | -372.39 | -371.13 | 138674.3121 | 138205.1007 |
| | **138723.12** | | | | **3161744.713** | **2955537.519** |

$\overline{Y} = 138723.12/52 = 2667.76$

In Table 3 above, the first-order correlation coefficient $r_1$ (the correlation between $Y_t$ and $Y_{t-1}$ known as the autocorrelation for lag 1) was found to be 0.935. This means that successive residuals for the weekly variable exhibit positive serial correlation. Put differently, the presence of positive serial correlation confirms the existence of non-synchronous trading bias and thus averaging bias in the NSE 20-share index.

## 4.4 SELECTION BIAS

The NSE index was found to represent 71.61% of the overall market capitalization at the end of 1999 (see Appendix 1). In the Agricultural sector, George Williamson, Kakuzi and Sasini represented 8.22% of the subsector total of 9.83%. In the Commercial and Services sector, Kenya Airways, Lonrho, Nation and Uchumi represented 9.77% of the subsector total of 11.84%. In the Finance and Investment sector, Barclays, Diamond Trust, KCB and Standard Bank represented 20.14% of the subsector total of 38.08%. In the Industrial and Allied sector, Bamburi, BAT, BOC, E.A.Packaging, E.A.Breweries, Kenya National Mills, Kenya Power and Total represented 32.98% of the subsector total of 40.23%.

Thus, in both the Agricultural sector and the Commercial and Services sector, the size effect was evident as the top four leading companies were selected in the two sectors. However, in the Finance and Investment sector, the top three leading companies were selected, but the fifth ranked company Diamond Trust was selected in favour of the fourth ranked NIC Bank.It was only in the Industrial and Allied sector that there was evidence of small companies being selected. E.A.Packaging with only 0.07% and Kenya

National Mills with 0.60% of the subsector market capitalization were selected. Left out was Firestone with 4.17% and E.A. Portland with 0.95%. The 1990's witnessed the listing of a number of companies, spurned mainly by the privatisation of government held corporations and the relaxing of foreign exchange controls. However, during the period under study, only Kenya Airways was listed in 1996 as a result of privatisation.

The NSE does not to have a clear portfolio selection and revision policy. There was no precise criterion to determine why a particular stock was dropped or why a new one was added to the portfolio. During the period under study, Kenya Airways replaced CMC Holding in the portfolio in 1996. There was no explanation on record and this represented a serious drawback. On the other hand, three companies were delisted from the NSE during the same period. These were Kenya Finance Bank, African Tours and Hotels and Kingfisher Properties.

## 4.5 THE PERFORMANCE OF THE NSE 20-SHARE INDEX

The unweighted averages method was used to compute a 20-share index geometric and a corresponding arithmetic index. With week 14 of 1996 as the base date for these two indices and the NSE 20-share value of 3007.39 as the base value, by week 19 of 1999, the geometric index had risen 6.29% while the arithmetic equivalent index was 19.37% higher than at it's base date. Therefore, while the value of the arithmetic 20-share index had risen 19.37% over the four years, the geometric equivalent had measured less than a third of this rise. This represents a serious understatement and renders the geometric

index (such as the NSE 20-Share index) unsuitable for measuring long-term price movements.

## 4.6 THE COMPARISON BETWEEN NSE 20-SHARE INDEX, MARKET CAPITALIZATION INDEX AND THE TVA INDEX

Table 4: The correlation between NSE index Market capitalization index, Trading volume Activity index.

**Correlations**

| | | NSE | MCAP | TVA |
|---|---|---|---|---|
| NSE | Pearson Correlation | 1.000 | .147* | .149* |
| | Sig. (2-tailed) | . | .038 | .037 |
| | N | 198 | 198 | 198 |
| MCAP | Pearson Correlation | .147* | 1.000 | -.037 |
| | Sig. (2-tailed) | .038 | . | .606 |
| | N | 198 | 198 | 198 |
| TVA | Pearson Correlation | .149* | -.037 | 1.000 |
| | Sig. (2-tailed) | .037 | .606 | . |
| | N | 198 | 198 | 198 |

*. Correlation is significant at the 0.05 level (2-tailed).

Table 4 above illustrates that the correlation between **NSE** index and Market Capitalization (**MCAP**) on the one hand and **NSE** index and the Trading Volume Activity (**TVA**) on the other are both positive and significant at the 0.05 level. However, the **MCAP** and **TVA** are negatively correlated though insignificantly.This suggests that less trading activity leads to higher levels of market capitalization.

Though known to be related to the NSE index, the correlations display a weak relationship suggesting that the index is more influenced by other market variables such as change in share prices.

The results are consistent with the fact that the NSE 20-share index is primarily a price index while the Market Capitalization and the Trading Volume Activity measure other factors more effectively namely, change in capitalization and change in trading activity respectively.

Table 5: Regression Analysis of the NSE index, Market Capitalization and Trading Volume Activity.

**Variables Entered/Removed** [b]

| Model | Variables Entered | Variables Removed | Method |
|---|---|---|---|
| 1 | TVA, MCAP [a] | . | Enter |

a. All requested variables entered.

b. Dependent Variable: NSE

Table 6: The model summary of the regression analysis

**Model Summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .213[a] | .045 | .036 | 311.8741 |

a. Predictors: (Constant), TVA, MCAP

Multiple regression was used to express the relationship among the independent variables (Table 5 and 6). The multiple regression coefficient (R square or $R^2$), tells us how well the independent variables explain the dependent variable. The $R^2$ for the equation is 0.045 suggesting that only around 4.6% of the variance in the index is explained by the two independent variables, the Trading Volume Activity (**TVA**) and the Market Capitalization (**MCAP**). This implies that an overwhelming 95.4%is not explained by the two variables in the equation.

Table 7: The coefficients of the regression analysis

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 2538.817 | 194.388 | | 13.061 | .000 |
| | MCAP | .113 | .051 | .153 | 2.187 | .030 |
| | TVA | 3.39E-02 | .015 | .154 | 2.203 | .029 |

a. Dependent Variable: NSE

The Beta values illustrated in Table 7 allow us to examine the effects of each of the independent variables on the dependent variable. Although the **MCAP** provides the largest unstandardized coefficient, the Beta for both the **MCAP** and the **TVA** are almost equivalent at 0.153 and 0.154 respectively, suggesting that they both have almost a relatively similar impact on the index. Thus the beta for the **MCAP** implies that for each one unit change in the **MCAP**, there is a standard error change in the index of 0.051 with the effects of the **TVA** partialled out.

## 4.7 THE ALTERNATIVE INDICES

The indices derived were four in number and they were calculated weekly from1996 to 1999(Appendix 2). The base period was week 14 of 1996 with the index value chosen as 3007.39. This was the figure of the NSE 20-share index at week 14 and it selected for the purpose of standardizing the indices for ease of comparison. Missing values were largely due to public holidays or when there was no trading at the NSE.

A Composite index was derived using the Laspeyres method with weights as the number of shares in issue. All the 50 companies active during the period were represented in the

All-Share index thereby eliminating the effect of bias associated with using a sample index.

Three 20-Share indices were also computed using the Laspeyres, the Paasche and the Fisher's ideal formulae with weights also as the number of shares in issue.

In a weak form efficient market such as the NSE, the number of shares in issue infrequently change, remaining constant for weeks on end. As a result, during the initial week 14 to week 38 of 1996, the three 20-share indices were all equivalent in that they reported the same values. This equivalence can be attributed to the constant number of shares in issue for all the firms in the 20-share portfolio during this period. As such, the total current market value (p1q1) was equivalent to the total current price base quantity value ($p_1q_0$) for all the firms. Also the total base market value ($p_0q_0$) and the base price current quantity value ($p_0q_1$) were found to be the same during the period.

Thus caution must be taken when using weights, as they might not necessarily reflect the true value movements in the market.

## The Recommended Index:

It is the researcher's opinion that a Composite index for the NSE is neither necessary nor economical as the stocks included in the 20-Share index accounted for 91.9% of the value of trading in 1999.The NSE also exhibited thinness of the market as proven by the Trading Volume Activity that only a small fraction of the shares in issue are traded for any one stock at any given time. As a result, a Composite index would have to be carefully interpreted since small changes in the active stocks tend to be considerably magnified in the index.

On the other hand, the Laspeyres method does not consider changes in the market value while the Paasche method requires time consuming and an expensive process of gathering quantity information for each period. Also the quantity measures (weights) used for each period are usually different from the weights for another index period. It becomes impossible to attribute the difference between the two indices to price changes only. This makes it difficult to compare indices from different periods.

The researcher recommends the use of the NSE 20-Share index (Fisher's ideal method) as it is the most representative, consistent, bias-free and accurate measure of value movements and market performance of the Nairobi Stock Exchange.

## 4.8 THE COMPARISON BETWEEN NSE 20-SHARE INDEX AND THE ALTERNATIVE INDICES

Table 8: The descriptive statistics of the NSE index and the alternative indices

**Descriptive Statistics**

| | N | Mean | Std. Deviation | Minimum | Maximum |
|---|---|---|---|---|---|
| NSE | 198 | 3016.770 | 317.5959 | 2283.04 | 3550.27 |
| COMP | 198 | 2904.423 | 222.1500 | 2397.02 | 3376.70 |
| LASP | 198 | 2969.111 | 190.4431 | 2493.78 | 3371.31 |
| PAAS | 198 | 3101.810 | 234.2275 | 2634.91 | 3661.26 |
| FISH | 198 | 3034.218 | 205.3810 | 2599.58 | 3487.34 |

**Table 9: Friedman Test of Mean Ranks**

**Ranks**

| | Mean Rank |
|---|---|
| NSE | 3.43 |
| COMP | 2.10 |
| LASP | 2.41 |
| PAAS | 3.88 |
| FISH | 3.17 |

**Table 10: Test Statistics results**

**Test Statistics[a]**

| | |
|---|---|
| N | 198 |
| Chi-Square | 175.780 |
| df | 4 |
| Asymp. Sig. | .000 |

a. Friedman Test

The Friedman rank test shown in Table 9 was used to rank each index and then calculate the mean rank for each index. Differences were observed in the mean ranks, clearly indicating the differences between the indices.

The null hypothesis tested was that the NSE 20-Share index was equivalent to the Alternative Indices. In Table 10, the calculated Chi-square value at 175.780 was greater than the critical value 18.46 at 4d.f. The observed frequency (NSE 20-Share index) was significantly different from the expected frequencies (the Alternative Indices). In other words, since the probability of obtaining this by chance is nil (which means $p<0.00005$), we can conclude that the NSE 20-Share Index and the Alternative Index are not equal

# CHAPTER FIVE

## SUMMARY AND CONCLUSION

## 5.1 SUMMARY AND CONCLUSION

The results obtained are hardly surprising given the thinness of the market of the Nairobi Stock Exchange. As such, any price index for this market must be very carefully interpreted since small changes in the few active stocks tend to be considerably magnified in the index. It is common fact that price changes in the NSE for most companies are relatively small from one point to the next. This in effect means that index changes for the most part will also not be significant.

The existence of a number of indices on the NSE will facilitate the application of different measures and indicators, which together should give a clearer picture of value movements and market performance. It is important to note that price indices move in closely related swings. But in order to identify the movement and nature of stock prices, there is need to prefer the more accurate indicator, as it is able to effectively capture and report on market performance.

## 5.2 LIMITATIONS OF THE STUDY

Currently there are only two active Stock Indices on the Nairobi Stock Exchange, the NSE 20- Share Index and the Ammi 27-Share Index. Alico Asset Management Ltd., the company that calculates the Ammi 27-share index could not release the data, construction

and computation method due to restrictive company policy. As such, only the NSE 20-Share index was available for comparison.

## 5.3 SUGGESTIONS FOR FURTHER RESEARCH

I. Further research can be conducted to test the reliability of the NSE 20-Share index covering a longer period of time.

II. Further research can also be carried out using other market indicators for Comparison for example, the Average Value per Transaction.

III. Other market weights, for example the number of shares transacted can also be used to examine how accurately they report on value movements.

# APPENDIX 1

## NSE Market Capitalization as at 30th December 1999

| Company | No. of Issued Shares | Price Dec 31' 99 | Market Cap.(Kshs.) | % of total Cap. |
|---|---|---|---|---|
| **Agricultural** | | | | |
| Brooke Bond* | 48875000 | 104 | 5083000000 | 4.76% |
| Eagaads | 6431400 | 26 | 167216400 | 0.16% |
| George Williamson* | 8756320 | 93 | 814337760 | 0.76% |
| Kakuzi* | 19599999 | 87 | 1705199913 | 1.60% |
| Kapchorua | 3912000 | 150 | 586800000 | 0.55% |
| Limuru Tea | 200000 | 650 | 130000000 | 0.12% |
| Rea Vipingo | 60000000 | 4.8 | 288000000 | 0.27% |
| Sasini Tea* | 38009250 | 45 | 1710416250 | 1.60% |
| Theta Group | 1927900 | 5.1 | 9832290 | 0.01% |
| **SECTOR SUBTOTAL** | **1877118690** | | | **9.83%** |
| **Commercial & Services** | | | | |
| A.Baumann &Co. | 3840066 | 14.7 | 56448970.2 | 0.05% |
| C.M.C Holding | 24279560 | 30 | 728386800 | 0.68% |
| Car & General | 22279616 | 10 | 222796160 | 0.21% |
| Express Kenya | 4800000 | 19 | 91200000 | 0.09% |
| Hutchings Bemier | 360000 | 20.25 | 7290000 | 0.01% |
| Kenya Airways* | 461615484 | 7.85 | 3623681549 | 3.39% |
| Lonhro Motors* | 63761073 | 13.3 | 848022270.9 | 0.79% |
| Marshalls | 14393106 | 23.5 | 338237991 | 0.32% |
| Nation Media* | 35652630 | 100 | 3565263000 | 3.34% |
| Pearl Drycleaners | 1597715 | 3 | 4793145 | 0.00% |
| Standard Newspapers | 12811859 | 9.85 | 126196811.2 | 0.12% |
| TPS Serena | 38679000 | 16.05 | 620797950 | 0.58% |
| Uchumi Supermarkets* | 60000000 | 40 | 2400000000 | 2.25% |
| **SECTOR SUBTOTAL** | **744070109** | | | **11.84%** |
| **Finance & Investment** | | | | |
| Barclays Bank* | 154305000 | 103 | 15893415000 | 14.89% |
| City Trust | 4166046 | 22 | 91653012 | 0.09% |
| CFC Bank | 100000000 | 14.25 | 1425000000 | 1.34% |
| Diamond TrustBank* | 79500000 | 26 | 2067000000 | 1.94% |
| HFCK | 115000000 | 10.55 | 1213250000 | 1.14% |
| I.C.D.C. Investments | 37677905 | 50 | 1883895250 | 1.76% |
| Jubilee Insurance | 36000000 | 25.75 | 927000000 | 0.87% |
| Kenya Commercial Bank* | 112200000 | 31.5 | 3534300000 | 3.31% |
| National Bank of Kenya | 200000000 | 5 | 1000000000 | 0.94% |
| NIC Bank | 82414551 | 27 | 2225192877 | 2.08% |
| Pan Africa Insurance | 16000000 | 27 | 432000000 | 0.40% |
| Standard Chartered Bank* | 164828976 | 56.5 | 9312837144 | 8.72% |
| Regent Undervalued Assets Ltd. | 1104622 | 580 | 640680760 | 0.60% |
| **SECTOR SUBTOTAL** | **1103197100** | | | **38.08%** |

| | | | | |
|---|---|---|---|---|
| **Industrial &Allied** | | | | |
| Athi River Mining | 75000000 | 5.75 | 431250000 | 0.40% |
| Bamburi Cement* | 362940725 | 26.25 | 9527194031 | 8.93% |
| British American Tobacco* | 75000000 | 77.5 | 5812500000 | 5.45% |
| B.O.C. Gases* | 19525446 | 64.5 | 1259391267 | 1.18% |
| Carbacid Investments | 9438963 | 67 | 632410521 | 0.59% |
| Crown Berger | 21570000 | 10 | 215700000 | 0.20% |
| Dunlop Kenya | 10000000 | 10 | 100000000 | 0.09% |
| EA Cables | 20250000 | 13 | 263250000 | 0.25% |
| EA Packaging* | 7679980 | 10.3 | 79103794 | 0.07% |
| EA Portland | 90000000 | 11.25 | 1012500000 | 0.95% |
| Firestone | 278342400 | 16 | 4453478400 | 4.17% |
| EA Breweries* | 93235665 | 70 | 6526496550 | 6.14% |
| Kenya National Mills* | 67235665 | 9.5 | 638738817.5 | 0.60% |
| Kenya Oil Co. | 7199800 | 67 | 482386600 | 0.45% |
| Kenya Orchards | 400000 | 5 | 2000000 | 0.00% |
| Kenya Power & Lighting* | 79128000 | 95.5 | 7556724000 | 7.08% |
| Total Kenya* | 56000000 | 48.25 | 2702000000 | 2.53% |
| Unga Group | 46858758 | 26 | 1218327708 | 1.14% |
| **SECTOR SUBTOTAL** | **1320171989** | | | **40.23%** |

*denotes the companies included in the NSE 20-Share Index.

# APPENDIX 2

**The NSE 20-Share Index and the Alternative Indices from 1996-1999.**

| YEAR WEEK | NSE INDEX | MCAP INDEX | TVA INDEX | COMP INDEX | 20-SHARE LASPE INDEX | 20-SHARE PAAS INDEX | 20-SHARE FISH INDEX |
|---|---|---|---|---|---|---|---|
| 199614 | 3007.39 | 3007.39 | 3007.39 | 3007.39 | 3007.39 | 3007.39 | 3007.39 |
| 199615 | 2963.07 | 2993.41 | 1355.64 | 2994.88 | 3007.72 | 3007.72 | 3007.72 |
| 199616 | 2907.12 | 2956.68 | 703.65 | 2935.01 | 2963.83 | 2963.83 | 2963.83 |
| 199617 | 3027.17 | 3069.44 | 1475.68 | 3034.60 | 3070.61 | 3070.61 | 3070.61 |
| 199618 | 3024.56 | 3088.62 | 1515.12 | 3055.86 | 3077.23 | 3077.23 | 3077.23 |
| 199619 | 3004.45 | 3000.39 | 659.18 | 2971.16 | 2968.92 | 2968.92 | 2968.92 |
| 199620 | 3025.69 | 3037.04 | 1531.83 | 3000.98 | 2994.60 | 2994.60 | 2994.60 |
| 199621 | 3030.28 | 3008.59 | 809.88 | 2977.20 | 2977.68 | 2977.68 | 2977.68 |
| 199622 | 3031.02 | 3003.16 | 2347.75 | 2971.39 | 2971.61 | 2971.61 | 2971.61 |
| 199623 | 3061.74 | 2987.89 | 1149.21 | 2959.85 | 2957.99 | 2957.99 | 2957.99 |
| 199624 | 3100.51 | 3020.50 | 5938.18 | 2990.12 | 2974.76 | 2974.76 | 2974.76 |
| 199625 | 3115.21 | 3032.41 | 1600.16 | 3016.71 | 2988.61 | 2988.61 | 2988.61 |
| 199626 | 3144.33 | 3042.90 | 1300.06 | 3019.58 | 2990.79 | 2990.79 | 2990.79 |
| 199627 | 3161.80 | 3033.46 | 1097.56 | 3011.35 | 2989.77 | 2989.77 | 2989.77 |
| 199628 | 3154.68 | 3046.07 | 1828.99 | 3033.63 | 3004.76 | 3004.76 | 3004.76 |
| 199629 | 3149.07 | 3012.29 | 906.15 | 2998.49 | 2961.45 | 2961.45 | 2961.45 |
| 199630 | 3134.99 | 2987.76 | 1383.71 | 2980.97 | 2957.50 | 2957.50 | 2957.50 |
| 199631 | 3154.70 | 3022.34 | 1248.02 | 2986.26 | 2946.59 | 2946.59 | 2946.59 |
| 199632 | 3120.15 | 3028.21 | 3145.88 | 2990.46 | 2955.28 | 2955.28 | 2955.28 |
| 199633 | 3138.64 | 3043.64 | 2341.85 | 2971.55 | 2939.58 | 2939.58 | 2939.58 |
| 199634 | 3069.29 | 2955.82 | 1568.70 | 2889.20 | 2856.48 | 2856.48 | 2856.48 |
| 199635 | 3073.88 | 2964.19 | 2855.29 | 2889.27 | 2867.69 | 2867.69 | 2867.69 |
| 199636 | 3060.88 | 2968.87 | 1238.14 | 2909.30 | 2890.60 | 2890.60 | 2890.60 |
| 199637 | 3049.84 | 2920.36 | 890.10 | 2854.01 | 2809.89 | 2809.89 | 2809.89 |
| 199638 | 3047.55 | 2934.94 | 1990.94 | 2807.44 | 2779.43 | 2679.43 | 2728.97 |
| 199639 | 3072.76 | 2977.91 | 2000.78 | 2829.00 | 2782.54 | 2683.63 | 2732.64 |
| 199640 | 3044.14 | 2943.12 | 6044.22 | 2800.42 | 2765.10 | 2665.51 | 2714.85 |
| 199641 | 3035.33 | 2911.41 | 1316.14 | 2759.73 | 2731.92 | 2634.91 | 2682.98 |
| 199642 | 3039.89 | 2953.35 | 956.40 | 2798.04 | 2785.44 | 2684.07 | 2734.29 |
| 199643 | 3042.74 | 2957.14 | 766.54 | 2800.01 | 2790.89 | 2688.64 | 2739.29 |
| 199644 | 3046.55 | 2921.45 | 9075.22 | 2778.91 | 2766.82 | 2666.16 | 2716.03 |
| 199645 | 3044.46 | 2930.85 | 2095.57 | 2788.92 | 2754.65 | 2654.28 | 2704.00 |
| 199646 | 3042.06 | 2948.93 | 633.02 | 2791.09 | 2785.64 | 2682.21 | 2733.44 |
| 199647 | 3056.40 | 2967.39 | 1582.12 | 2804.23 | 2782.24 | 2672.15 | 2726.64 |
| 199648 | 3055.12 | 2999.25 | 2178.48 | 2839.17 | 2814.83 | 2703.15 | 2758.42 |
| 199649 | 3111.56 | 2980.19 | 4470.83 | 2822.17 | 2807.19 | 2696.22 | 2751.14 |
| 199650 | 3114.11 | 3027.24 | 4438.49 | 2860.97 | 2877.78 | 2762.80 | 2819.70 |
| 199651 | 3114.11 | 3040.95 | 1364.09 | 2884.67 | 2918.17 | 2801.83 | 2859.41 |
| 199652 | 3114.11 | 3014.63 | 999.11 | 2852.28 | 2876.74 | 2763.63 | 2819.62 |
| 199653 | 3124.14 | 3023.98 | 558.99 | 2860.01 | 2888.74 | 2775.15 | 2831.37 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 199701 | 3233.75 | 3150.60 | 1283.91 | 2927.39 | 2954.52 | 2865.12 | 2909.48 |
| 199702 | 3550.27 | 3240.59 | 1344.81 | 3009.65 | 3028.20 | 2935.61 | 2981.55 |
| 199703 | 3535 | 3611.70 | 3479.63 | 3314.38 | 3348.28 | 3308.48 | 3328.32 |
| 199704 | 3476.67 | 3578.82 | 1383.61 | 3299.41 | 3310.04 | 3262.70 | 3286.28 |
| 199705 | 3456.92 | 3472.91 | 2103.47 | 3223.49 | 3226.45 | 3176.10 | 3201.18 |
| 199706 | 3492.24 | 3494.92 | 2227.38 | 3224.70 | 3238.29 | 3194.60 | 3216.37 |
| 199707 | 3536.17 | 3557.76 | 2441.55 | 3252.84 | 3266.14 | 3238.89 | 3252.49 |
| 199708 | 3473.99 | 3645.00 | 3053.05 | 3314.03 | 3330.06 | 3288.51 | 3309.22 |
| 199709 | 3461.21 | 3735.78 | 4529.27 | 3315.67 | 3320.04 | 3329.55 | 3324.79 |
| 199710 | 3392.25 | 3718.41 | 3076.35 | 3289.45 | 3266.06 | 3286.42 | 3276.23 |
| 199711 | 3380.42 | 3660.81 | 2067.27 | 3246.27 | 3204.86 | 3213.63 | 3209.25 |
| 199712 | 3354.72 | 3669.79 | 2051.92 | 3246.22 | 3217.29 | 3235.04 | 3226.15 |
| 199713 | 3345.14 | 3560.14 | 593.47 | 3153.29 | 3129.62 | 3157.00 | 3143.28 |
| 199714 | 3298.95 | 3545.60 | 1639.39 | 3131.62 | 3114.71 | 3142.18 | 3128.41 |
| 199715 | 3265.32 | 3531.50 | 2379.22 | 3122.89 | 3113.43 | 3143.25 | 3128.31 |
| 199716 | 3294.61 | 3515.07 | 2782.65 | 3108.69 | 3090.86 | 3122.81 | 3106.80 |
| 199717 | 3303.89 | 3826.49 | 1269.08 | 3122.84 | 3099.56 | 3286.84 | 3191.82 |
| 199718 | 3379.54 | 3871.40 | 738.80 | 3162.15 | 3157.43 | 3343.67 | 3249.21 |
| 199719 | 3380.57 | 3981.49 | 3223.25 | 3238.62 | 3223.98 | 3418.42 | 3319.78 |
| 199720 | 3401.12 | 4018.39 | 2710.71 | 3266.79 | 3218.69 | 3409.90 | 3312.92 |
| 199721 | 3460.55 | 4043.69 | 2492.12 | 3270.65 | 3246.06 | 3455.38 | 3349.09 |
| 199722 | 3445.5 | 4066.21 | 1263.19 | 3280.05 | 3259.35 | 3479.44 | 3367.60 |
| 199723 | 3417.11 | 4019.65 | 2419.76 | 3241.49 | 3220.15 | 3442.24 | 3329.34 |
| 199724 | 3462.42 | 4011.09 | 1494.36 | 3243.49 | 3233.61 | 3423.00 | 3326.96 |
| 199725 | 3527.73 | 4113.95 | 2915.21 | 3327.03 | 3309.86 | 3502.89 | 3405.01 |
| 199726 | 3508.68 | 4169.10 | 1911.02 | 3376.70 | 3371.31 | 3559.14 | 3463.95 |
| 199727 | 3502.76 | 4143.98 | 5831.00 | 3347.50 | 3319.32 | 3514.32 | 3415.43 |
| 199728 | 3466.54 | 4146.68 | 2532.25 | 3311.18 | 3261.08 | 3482.53 | 3369.99 |
| 199729 | 3455.58 | 4094.94 | 1686.60 | 3283.07 | 3251.60 | 3454.34 | 3351.44 |
| 199730 | 3466.92 | 4092.77 | 1796.76 | 3283.75 | 3226.55 | 3432.52 | 3327.94 |
| 199731 | 3423.87 | 4071.84 | 6600.17 | 3255.37 | 3195.05 | 3408.42 | 3300.01 |
| 199732 | 3425.22 | 3951.94 | 2841.08 | 3155.45 | 3094.18 | 3293.76 | 3192.41 |
| 199733 | 3411.9 | 3987.34 | 2283.21 | 3176.57 | 3155.05 | 3356.85 | 3254.39 |
| 199734 | 3403.22 | 4004.37 | 2970.70 | 3183.81 | 3166.81 | 3367.68 | 3265.70 |
| 199735 | 3420.46 | 3885.91 | 1504.05 | 3044.85 | 3172.52 | 3394.84 | 3281.80 |
| 199736 | 3495.85 | 4033.15 | 1859.65 | 3179.95 | 3174.59 | 3398.27 | 3284.53 |
| 199737 | 3474.36 | 4027.00 | 2303.04 | 3152.64 | 3199.69 | 3417.39 | 3306.75 |
| 199738 | 3435.12 | 4000.56 | 2000.16 | 3123.11 | 3161.07 | 3364.72 | 3261.30 |
| 199739 | 3416.61 | 3946.78 | 1613.69 | 3090.30 | 3129.05 | 3330.32 | 3228.12 |
| 199740 | 3425.8 | 3891.14 | 1453.11 | 3048.49 | 3091.59 | 3303.94 | 3196.00 |
| 199741 | 3321.49 | 3847.10 | 4255.25 | 3010.43 | 3051.39 | 3244.84 | 3146.63 |
| 199742 | 3298.63 | 3732.02 | 1073.59 | 2939.96 | 2986.68 | 3153.30 | 3068.86 |
| 199743 | 3314.85 | 3696.76 | 1016.75 | 2915.26 | 2973.06 | 3122.75 | 3046.99 |
| 199744 | 3275.19 | 3776.69 | 889.67 | 2959.68 | 3016.89 | 3199.98 | 3107.09 |
| 199745 | 3208.79 | 3743.04 | 994.18 | 2949.61 | 3014.57 | 3185.77 | 3098.99 |
| 199746 | 3088.93 | 3808.30 | 1594.19 | 2877.95 | 2940.84 | 3075.57 | 3007.45 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 199747 | 3046.6 | 3646.69 | 1517.66 | 2802.38 | 2825.32 | 2948.90 | 2886.45 |
| 199748 | 3068.72 | 3680.75 | 1405.84 | 2828.80 | 2862.77 | 2990.13 | 2925.76 |
| 199749 | 3063.05 | 3716.99 | 1003.11 | 2816.41 | 2867.78 | 3037.38 | 2951.36 |
| 199750 | 3088.69 | 3704.53 | 800.77 | 2838.82 | 2893.34 | 3055.00 | 2973.07 |
| 199751 | 3117.47 | 3704.69 | 1553.37 | 2865.59 | 2829.86 | 3004.70 | 2915.97 |
| 199752 | 3117.47 | 3785.93 | 636.15 | 2874.70 | 2922.61 | 3084.69 | 3002.56 |
| 199753 | 3117.47 | 3808.90 | 1007.17 | 2879.77 | 2928.56 | 3101.87 | 3013.97 |
| 199801 | 3118.78 | 3873.21 | 918.61 | 2919.16 | 2976.47 | 3160.40 | 3067.06 |
| 199802 | 3273.16 | 4189.25 | 761.94 | 3142.26 | 3190.89 | 3407.90 | 3297.61 |
| 199803 | 3335.18 | 4278.90 | 2001.33 | 3216.33 | 3212.12 | 3435.46 | 3321.91 |
| 199804 | 3338.09 | 4287.97 | 1195.03 | 3188.27 | 3170.75 | 3396.25 | 3281.56 |
| 199805 | 3333.49 | 4169.45 | 1115.03 | 3110.88 | 3100.15 | 3311.55 | 3204.10 |
| 199806 | 3377.34 | 4184.66 | 1699.94 | 3110.59 | 3125.43 | 3335.22 | 3228.62 |
| 199807 | 3369.65 | 4214.77 | 4684.02 | 3122.50 | 3149.20 | 3359.48 | 3252.64 |
| 199808 | 3362.23 | 4175.84 | 2280.54 | 3134.73 | 3145.64 | 3295.35 | 3219.63 |
| 199809 | 3329.74 | 4226.69 | 1862.40 | 3119.95 | 3113.73 | 3311.07 | 3210.88 |
| 199810 | 3277.59 | 4222.13 | 948.42 | 3114.01 | 3107.13 | 3323.88 | 3213.68 |
| 199811 | 3289.38 | 4408.66 | 1072.98 | 2988.28 | 2952.64 | 3191.02 | 3069.52 |
| 199812 | 3224.64 | 4332.76 | 1262.43 | 2937.89 | 2910.41 | 3144.22 | 3025.06 |
| 199813 | 3185.61 | 4281.18 | 2554.68 | 2915.78 | 2896.26 | 3123.88 | 3007.92 |
| 199814 | 3057.19 | 4167.99 | 755.77 | 2857.18 | 2839.44 | 3035.39 | 2935.78 |
| 199815 | 3038.38 | 4096.75 | 499.69 | 2824.67 | 2810.51 | 2987.04 | 2897.43 |
| 199816 | 3034.65 | 4026.06 | 1808.01 | 2765.94 | 2772.84 | 2951.34 | 2860.70 |
| 199817 | 3015.01 | 4233.79 | 676.42 | 2749.40 | 2765.81 | 2963.65 | 2863.02 |
| 199818 | 2967.23 | 4164.76 | 638.69 | 2711.96 | 2708.73 | 2890.02 | 2797.90 |
| 199819 | 2971.55 | 4204.95 | 659.53 | 2729.33 | 2739.83 | 2929.41 | 2833.04 |
| 199820 | 3009.69 | 4233.34 | 1915.02 | 2745.84 | 2766.75 | 2966.17 | 2864.72 |
| 199821 | 3016.44 | 4032.85 | 1090.19 | 2778.06 | 2851.62 | 3121.36 | 2983.44 |
| 199822 | 2999.21 | 3980.58 | 1786.96 | 2789.91 | 2873.67 | 3076.83 | 2973.52 |
| 199823 | 2990.02 | 4094.09 | 1343.42 | 2836.14 | 2944.85 | 3183.44 | 3061.82 |
| 199824 | 2960.34 | 4037.51 | 1304.25 | 2806.62 | 2907.92 | 3127.16 | 3015.55 |
| 199825 | 2885.61 | 3991.27 | 1495.27 | 2793.27 | 2865.24 | 3079.56 | 2970.46 |
| 199826 | 2926.07 | 3983.07 | 1053.93 | 2792.99 | 2876.45 | 3087.01 | 2979.87 |
| 199827 | 2900.08 | 3953.48 | 1818.99 | 2771.30 | 2867.03 | 3069.52 | 2966.55 |
| 199828 | 2765.13 | 3896.76 | 2081.11 | 2755.16 | 2844.23 | 3028.98 | 2935.15 |
| 199829 | 2796.73 | 3889.05 | 1091.58 | 2733.46 | 2832.73 | 3025.66 | 2927.61 |
| 199830 | 2805.79 | 3866.11 | 1388.27 | 2731.04 | 2823.79 | 3002.99 | 2912.01 |
| 199831 | 2774.34 | 3864.82 | 3130.00 | 2737.71 | 2832.56 | 3007.31 | 2918.63 |
| 199832 | 2761.73 | 3872.46 | 666.36 | 2742.55 | 2853.59 | 3026.97 | 2939.00 |
| 199833 | 2776.88 | 3854.27 | 1584.39 | 2731.76 | 2849.54 | 3016.05 | 2931.61 |
| 199834 | 2766.59 | 3881.52 | 1672.97 | 2744.37 | 2866.37 | 3041.81 | 2952.79 |
| 199835 | 2733.68 | 3823.69 | 1100.94 | 2717.72 | 2853.99 | 3018.94 | 2935.31 |
| 199836 | 2642.69 | 3806.46 | 4886.33 | 2717.49 | 2848.75 | 2999.74 | 2923.27 |
| 199837 | 2568.86 | 3819.49 | 11611.82 | 2713.04 | 2852.53 | 3023.24 | 2936.64 |
| 199838 | 2533.84 | 3764.89 | 824.35 | 2672.02 | 2807.75 | 2974.92 | 2890.13 |
| 199839 | 2580.11 | 3722.62 | 1683.76 | 2659.51 | 2788.61 | 2949.99 | 2868.16 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 199840 | 2595.36 | 3677.05 | 1266.68 | 2636.94 | 2771.29 | 2922.84 | 2846.06 |
| 199841 | 2660.34 | 3690.56 | 631.71 | 2625.36 | 2767.09 | 2931.00 | 2847.86 |
| 199842 | 2732.3 | 3677.20 | 942.29 | 2624.66 | 2764.74 | 2924.19 | 2843.34 |
| 199843 | 2894.19 | 3691.43 | 648.32 | 2636.66 | 2780.44 | 2939.85 | 2859.03 |
| 199844 | 2962.06 | 3647.68 | 740.42 | 2618.56 | 2765.52 | 2923.44 | 2843.38 |
| 199845 | 2962.06 | 3529.30 | 2297.65 | 2593.46 | 2748.47 | 2865.16 | 2806.21 |
| 199846 | 2962.06 | 3555.86 | 982.56 | 2571.03 | 2715.70 | 2843.87 | 2779.05 |
| 199847 | 2962.06 | 3578.57 | 1695.17 | 2572.55 | 2724.90 | 2865.28 | 2794.21 |
| 199848 | 2962.06 | 3565.71 | 1234.95 | 2555.81 | 2708.77 | 2847.19 | 2777.12 |
| 199849 | 2962.06 | 3608.02 | 1358.35 | 2587.58 | 2750.44 | 2892.70 | 2820.67 |
| 199850 | 2962.06 | 3746.86 | 814.89 | 2684.20 | 2868.83 | 3011.13 | 2939.12 |
| 199851 | 2962.06 | 4039.79 | 6056.45 | 2877.79 | 3092.97 | 3277.34 | 3183.82 |
| 199852 | 2962.06 | 4106.81 | 988.53 | 2969.76 | 3182.81 | 3367.12 | 3273.67 |
| 199853 | 2962.06 | 3680.44 | 272.64 | 2809.95 | 2977.82 | 2971.72 | 2974.77 |
| 199901 | 3119.89 | 4467.27 | 1608.17 | 3089.25 | 3271.41 | 3578.63 | 3421.57 |
| 199902 | 3058.99 | 4616.41 | 2157.26 | 3170.07 | 3321.67 | 3661.26 | 3487.34 |
| 199903 | 3014.37 | 4435.31 | 818.27 | 3071.96 | 3236.17 | 3547.22 | 3388.13 |
| 199904 | 2983.48 | 4345.84 | 1584.74 | 2998.78 | 3149.63 | 3454.48 | 3298.54 |
| 199905 | 2967.36 | 4381.47 | 1126.11 | 3015.29 | 3172.70 | 3474.27 | 3320.06 |
| 199906 | 2932.33 | 4346.84 | 1246.83 | 3002.92 | 3161.54 | 3443.80 | 3299.65 |
| 199907 | 2930.56 | 4309.12 | 1209.76 | 3014.25 | 3190.67 | 3456.65 | 3321.00 |
| 199908 | 2988.88 | 4211.56 | 1313.99 | 2972.54 | 3154.50 | 3408.07 | 3278.83 |
| 199909 | 2963.83 | 4207.11 | 1099.57 | 2970.58 | 3154.51 | 3418.51 | 3283.86 |
| 199910 | 2891.47 | 4144.13 | 1489.66 | 2952.92 | 3134.22 | 3375.88 | 3252.81 |
| 199911 | 2834.99 | 4006.00 | 2051.43 | 2849.49 | 3018.05 | 3265.58 | 3139.38 |
| 199912 | 2853.24 | 3989.90 | 1338.68 | 2848.22 | 3039.06 | 3273.87 | 3154.28 |
| 199913 | 2806.95 | 3949.11 | 1191.87 | 2842.43 | 3015.57 | 3242.87 | 3127.16 |
| 199914 | 2806.23 | 3952.01 | 731.82 | 2846.44 | 3016.12 | 3243.31 | 3127.65 |
| 199915 | 2786.45 | 3991.06 | 1245.68 | 2872.62 | 3034.81 | 3271.30 | 3150.84 |
| 199916 | 2778.47 | 3922.83 | 3113.98 | 2846.93 | 3041.44 | 3273.82 | 3155.49 |
| 199917 | 2767.89 | 3839.96 | 2082.73 | 2800.44 | 2996.59 | 3213.98 | 3103.38 |
| 199918 | 2759.11 | 3815.27 | 989.46 | 2795.16 | 2989.00 | 3192.29 | 3088.97 |
| 199919 | 2750.54 | 3780.39 | 4191.09 | 2774.66 | 2955.98 | 3162.46 | 3057.48 |
| 199920 | 2745.42 | 3787.14 | 2956.82 | 2792.60 | 2958.90 | 3156.12 | 3055.92 |
| 199921 | 2762.85 | 3804.86 | 1968.66 | 2800.89 | 2984.91 | 3188.65 | 3085.10 |
| 199922 | 2778.41 | 3785.88 | 1247.31 | 2782.77 | 2957.92 | 3150.82 | 3052.85 |
| 199923 | 2771.65 | 3906.01 | 1603.48 | 2835.96 | 3009.30 | 3233.10 | 3119.19 |
| 199924 | 2773.97 | 3857.02 | 4649.72 | 2812.20 | 2983.95 | 3194.54 | 3087.45 |
| 199925 | 2760.39 | 3849.65 | 1286.21 | 2810.42 | 2988.70 | 3195.69 | 3090.46 |
| 199926 | 2765.57 | 3863.27 | 2085.69 | 2810.69 | 2996.37 | 3205.37 | 3099.11 |
| 199927 | 2765.57 | 3956.47 | 745.39 | 2848.79 | 3038.59 | 3268.35 | 3151.38 |
| 199928 | 2776.71 | 4008.65 | 1118.80 | 2889.07 | 3089.10 | 3311.26 | 3198.25 |
| 199929 | 2774.49 | 3976.62 | 1501.73 | 2860.06 | 3058.82 | 3283.70 | 3169.27 |
| 199930 | 2758.98 | 3986.36 | 720.65 | 2863.89 | 3063.41 | 3297.98 | 3178.53 |
| 199931 | 2744.55 | 3982.30 | 740.99 | 2864.61 | 3069.22 | 3298.96 | 3182.02 |
| 199932 | 2750.87 | 3953.86 | 1935.62 | 2851.59 | 3061.77 | 3287.88 | 3172.81 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 199933 | 2753.88 | 3853.34 | 1049.39 | 2794.17 | 2988.60 | 3207.05 | 3095.90 |
| 199934 | 2588.75 | 3795.95 | 2142.83 | 2764.71 | 2963.19 | 3166.68 | 3063.24 |
| 199935 | 2561.27 | 3661.76 | 1739.84 | 2657.50 | 2844.96 | 3065.78 | 2953.31 |
| 199936 | 2477.33 | 3658.30 | 1481.52 | 2653.95 | 2841.63 | 3063.57 | 2950.51 |
| 199937 | 2436.9 | 3594.36 | 1421.71 | 2629.57 | 2803.06 | 3012.32 | 2905.81 |
| 199938 | 2413.38 | 3534.52 | 900.24 | 2606.19 | 2781.70 | 2979.08 | 2878.70 |
| 199939 | 2397.5 | 3537.64 | 579.90 | 2614.31 | 2792.40 | 2985.42 | 2887.30 |
| 199940 | 2423.64 | 3576.72 | 484.79 | 2638.87 | 2812.13 | 2996.36 | 2902.79 |
| 199941 | 2370.57 | 3582.55 | 1269.53 | 2661.21 | 2811.01 | 2984.18 | 2896.30 |
| 199942 | 2370.1 | 3599.62 | 1976.70 | 2678.39 | 2813.52 | 2979.99 | 2895.55 |
| 199943 | 2352.09 | 3515.61 | 382.11 | 2621.66 | 2791.29 | 2940.67 | 2865.01 |
| 199944 | 2309.33 | 3325.99 | 526.58 | 2426.71 | 2557.50 | 2731.89 | 2643.26 |
| 199945 | 2283.04 | 3300.01 | 623.48 | 2404.78 | 2539.01 | 2713.53 | 2624.82 |
| 199946 | 2283.79 | 3318.91 | 626.90 | 2403.05 | 2532.14 | 2710.44 | 2619.78 |
| 199947 | 2296.73 | 3340.10 | 864.52 | 2449.14 | 2579.25 | 2754.50 | 2665.44 |
| 199948 | 2293.08 | 3324.00 | 901.89 | 2409.91 | 2527.70 | 2716.22 | 2620.26 |
| 199949 | 2297.22 | 3365.37 | 799.58 | 2435.73 | 2528.17 | 2726.78 | 2625.60 |
| 199950 | 2298.08 | 3372.17 | 941.55 | 2429.18 | 2500.33 | 2713.51 | 2604.74 |
| 199951 | 2296.62 | 3347.86 | 3863.86 | 2416.28 | 2493.78 | 2709.87 | 2599.58 |
| 199952 | 2295.36 | 3331.97 | 3345.74 | 2397.02 | 2502.19 | 2716.25 | 2607.02 |

**NOTE:**

**MCAP** index denotes Market Capitalization Index

**TVA** index denotes Trading Volume Activity Index

**COMP** index denotes All-Share (Composite) Index

**LASPE** index denotes 20-Share (Laspeyres) Index

**PAAS** index denotes 20-Share (Paasche) Index

**FISH** index denotes 20-Share (Fishers-Ideal) Index

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