

Construction of Stock Indices for the Newly Formed UAE Stock Market

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Abstract:

This paper addresses the question of establishing an index for the newly established stock market in the United Arab Emirates. The government of the UAE has recently issued a law for the establishment of an official stock market. Different approaches are presented and the existing indices, which are published by different banks and newspapers, were examined for their usefulness in describing the movements in the unofficial stock market and gauging the performance of the whole economy. Different criteria were suggested in the paper for the new index to overcome the problems associated with the existing indices.

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1. Introduction

A stock market, just like any other market, is a place where individuals can exchange economic goods and services, the main goods that are exchanged in the stock market are the financial papers. The stock market role is to allocate capital among public companies and between those companies and other assets. Usually, a high share price is expected with a high demand for a company's products, and a company with a high share price will find it relatively

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easy to raise capital to expand its activities, therefore, it is the role of stock markets to act as an intermediary by transferring funds from the excess units to deficit units in the economy. A stock market, also provides savers with a new outlet of investment for their excess funds, it enables them to select the portfolio which gives them the risk-return combination they like. A stock market provides governments with an alternative means of financing their economic development plans. Of course, this will depend on the ability of the government to use the funds efficiently for the benefit of national economy. Moreover, a stock market can bring foreign capital into a country from foreign portfolio investors wishing to diversify internationally. Stock market plays an important role in setting a fair price for a stock. A transparent stock market, where information about the companies disseminated timely, will result in an efficient stock market, hence share prices will reflect all available information.

The Government of the United Arab Emirates has found that the existing unofficial stock market has not performed the above roles efficiently, therefore it has decided to allow for an official stock exchange. The first main measure taken by the government is to pass law no 4 for the year 2000 concerning the establishment of the Securities and Exchange Commission. The law has given the commission the authority to license the local governments to establish stock market as local government entity. The Government of Dubai took this opportunity and established the first official stock market in the United Arab Emirates⁽¹⁾. As not all shares were listed on this newly formed official stock market, shares in the UAE are traded now on both the official stock market and on the unofficial stock market, the latter comprises of 43 stockbrokers authorized by the UAE Central Bank⁽²⁾. Unfortunately the country, which has no proper stock market, faces the manipulations and mistrust by the investment community. Share prices between stockbrokers differ and a

(1) Dubai Financial Market was officially launched on 26 March 2000.

(2) Economic Bulletin, 1999, United Arab Emirates Central bank, Abu Dhabi, UAE.

segmentation of the market appears. This is exactly the case in the UAE. In the UAE, as in any other country prices of shares traded in the stock market tend to fluctuate during a trading day in accordance with the general mood of the market and with certain specific factors affecting individual stocks. Of course, individual stocks tend to perform differently, for some shares the prices go up and for others the prices go down or remain unchanged on the day. To measure the performance of any stock on a given day we calculate the percentage change in price at the end of the trading day relative to the closing price at the end of the previous day. However, to measure the performance of the whole market, one needs to construct a stock market index. This index not only serves to gauge the performance of the market and business conditions, but also can be used to compare it with other economic variables, such as consumer price index, changes in money supply, industrial production, rate of return on portfolios, etc. Analysts can use stock market index to forecast the price movements in the future. Recent innovation in investment has been to invest in a single index rather individual stocks. It is therefore essential to understand the principles underlying them, as many participants in the stock markets know little about them and their construction. As Reilly (1979) states that a fair statement regarding stock market indicator series is that everybody talks about them, but few people know how they are constructed and what they represent. Therefore, it is the purpose of this study to present how indices are constructed and give a background on the existing indices available in the UAE unofficial stock market.

II. Construction of Stock Index

Lorie and Hamilton (1973) have suggested that three important issues must be considered when a stock market index is constructed. They are the following:

- 1 - Selecting stocks for inclusion
- 2 - Determining the relative importance or weight of each included stock
- 3 - Combining or averaging stocks

Kok (1995) also emphasized the above three issues of sampling, weighting, and averaging. The explanation of these three issues is as follows:

II.1 Sampling

Stock markets around the world have taken different approaches to the inclusion of stocks in the index. Some have based their stock market indices on all the stocks listed in the stock exchange. Others have chosen only a sample of stocks. Of course, to choose a sample requires these stocks to represent the movements of the whole market, that is to say, confidence must be established that the index infers movements in excluded stocks on the basis of movements in included stocks. Selection of a sample is usually influenced by two factors, market capitalization of these few stocks must constitute a large proportion of the value of the stocks of all listed companies, and the tendency of all stocks to move together.

Examples of indices, which use all stocks listed in a stock exchange, are the New York Stock Exchange Index, American Stock Exchange Index, Singapore All-Share Index, and Kuala Lumpur Emas Index. Whereas stock exchanges that base their indices on a sample of stocks are, the New York Stock Exchange which uses the Dow-Jones Index which is based on 30 stocks and Standard & Poor's 500 Index which is based on 500 stocks, the index is a standard by which investors measure the performance of large capitalization U.S. stock market. The 500 stocks of this index are selected for being a representative sample of leading companies in leading industries. Many money managers index their portfolios to match the S&P 500, so the return on their investments keeps pace with the performance of the index.. The London Stock Exchange uses the FT-SE 100, which is based on 100 stocks. Tokyo Stock Exchange uses the Nikkei, which is based on 225 stocks. The Hong Kong Stock Exchange uses the Hang Seng Index, which is based on 33 stocks. The Paris Stock Exchange uses CAC-40 index, which uses 40 stocks. Dax Index for the German Stock Market uses 30 shares, whereas Faz Index of the Frankfort Stock Market uses 100

shares to form its index. Most of Arab Stock markets such as Egyptian Stock Market, Bahrain Stock Market, Kuwait Stock Market, Amman Stock Market and Muscat Financial Market use indices, which are, based on a sample of shares.

The oldest and the most well known of the above indices is the Dow Jones Index which was originally set up in 1896 with only 12 shares by Charles Dow founder of the well known Wall Street Journal. In 1916 the number of shares in the index increased to 20, and by 1928 the number of shares in the index increased to 30 and since then the number of shares included did not change, but the component shares have been changing to include shares which are widely held and active in trading.

II.2 Weighting

Shares traded in the stock market usually have different importance or weights, therefore when combining shares to form an index their relative importance should be taken in consideration.

The ways in which weights can be assigned are categorized into three:

(1) weighting by the market value of a share,

(2) weighting by the price of the share,

and (3) weighting each share equally regardless of its price or market value.

Each method mentioned serves an objective, the first serves to measure the performance of a portfolio of shares in which the investment in a share is proportional to the market value of that share, the second method serve the objective of measuring a portfolio in which the investment in a share is proportional to the price of that share. The third method is used to measure the performance of a portfolio in which equal amount of money is invested in each share.

To construct indices according to the above three methods, a general mathematical model will be developed and then a mathematical model for each method will be presented.

Let us denote the share prices for the base period for the n shares included in the index as

$$P_{b1}, P_{b2}, P_{b3}, \dots, P_{bn}$$

let their corresponding market prices in the current period be

$$P_{c1}, P_{c2}, P_{c3}, \dots, P_{cn}$$

If the holding period return for a share is calculated as

$$R_j = \frac{P_{cj} - P_{bj}}{P_{bj}}$$

Then for n shares their returns are $R_1, R_2, R_3, \dots, R_n$.

With an index of 100 for the base period, the value of the index in the current period may be expressed in terms of returns as

$$I_c = 100x \left[1 + \frac{\sum_{j=1}^n w_j R_j}{\sum_{j=1}^n w_j} \right]$$

where the weights $w_1, w_2, w_3, \dots, w_n$ for the returns of the component shares are dependent on the weighting method used as described above.

To illustrate the three methods, we use an example. In table 1, 4 shares have been chosen to be included in the index. A, B, C, and D. The number of share outstanding and all relevant information are given in the table.

As shown in table 1, the index is constructed by four shares A, B, C and D with the number of shares being 500, 250, 100 and 50 respectively. Suppose their prices increased from 20, 18, 15 and 6 respectively, in the base period to 22, 19.45, 16.20 and 6.90, respectively, in the current period. With an index of 100 in the base period, then the construction of the indices according to the three methods outlined above are as follows:

1. for the index which depends on the market value in its

construction the procedure is to sum the returns weighted by the market value and divide the sum by the total market value in the base period, that is

$$I_c = 100 \left[1 + \frac{1527.5}{16300} \right] = 109.37$$

or using share prices and quantities with the following formula:

$$I_c = 100 \left[\frac{\sum_{j=1}^n P_{cj} Q_{bj}}{\sum_{j=1}^n P_{bj} Q_{bj}} \right]$$

Which is the ratio of the total market value of the component shares in the current period to the total market value of these shares in the base period, that is

$$I_c = 100 \left[\frac{\sum_{j=1}^n P_{cj} Q_{bj}}{\sum_{j=1}^n P_{bj} Q_{bj}} \right] = 100 \left[\frac{17827.50}{16300.00} \right] = 109.37$$

2. For the index which depends on the value of the price-weighted index in its construction the procedure is to sum the increase in the prices for all the shares and divide the sum by the sum of the prices in the base period, that is

$$I_c = 100 \left[1 + \frac{5.55}{59} \right] = 109.41$$

or using only prices with the following formula:

$$I_c = 100 \left[\frac{\sum_{j=1}^n P_{cj}}{\sum_{j=1}^n P_{bj}} \right]$$

Which is the ratio of the sum of the prices of the component

shares in the current period to the sum of the prices of these shares in the base period, that is

$$I_c = 100 \left[\frac{64.55}{59} \right] = 109.41$$

3. For the index, which gives equal weights to its component shares, the procedure is to sum the return values of the component shares and divide the sum by the number of shares in the index, that is

$$I_c = 100 \left[1 + \frac{0.41}{4} \right] = 110.25$$

As can be observed from the calculations, the three indices have different values because of the different weighting methods used to construct them.

Table 1
**Construction of indices using market value,
price weighting and equal weighting**

Share	No of Shares	Price Per Share			Weighting System			Return Weighted by		
		Base	Current	Return	Market Value	Price	Equal Weight	Market Value	Price	Equal Weight
A	500	20.00	22.00	0.10	10000	20.00	1	1000	2	0.10
B	250	18.00	19.45	0.08	4500	18.00	1	362.5	1.45	0.08
C	100	15.00	16.20	0.08	1500	15.00	1	120	1.20	0.08
D	50	6.00	6.90	0.15	300	6.00	1	45	0.90	0.15
Total					16300	59.00	4	1527.5	5.55	0.41

Table 1 shows that the index constructed using market value usually attaches greater importance to large companies, which tend to behave differently from small companies.⁽³⁾ The latter tend to be more volatile while the former tend to move with the general

(3) Companies with higher market capitalization have greater influence on the market and hence the index.

economic condition in the economy. Another advantage of using this method is that it adjusts itself automatically for stock split and bonus issue⁽⁴⁾. However, indices, which are not weighted by market value, do not adjust automatically. For example, when a stock in the index splits, adjustment is made by changing the divisor used in the calculation of the average. This can be illustrated by the following simple example: suppose the index includes only two shares A and B, their prices in day T are 10 Dirhams and 20 Dirhams respectively. The divisor in this case is 2 and the average is calculated as $(10 + 20)/2 = 15$. In day T + 1 Company B announces a stock split on the basis of 2:1. If the closing prices on day T + 1 for stock A and B are 13 Dirhams and 11 Dirhams respectively, then we can say that the stock market has increased. If adjustment for stock split is not made when calculating the index, then its value will become $(13 + 11)/2 = 12$, this suggests that the stock market has declined by 20 %. In fact, in day T + 1, the stock market average has increased to 17.5 calculated as $[(13 + (11 \times 2))/2]$, an increase of 16.67%. Of course, if adjustment has not been taken into consideration, the calculation will produce a downward bias, because the stock split reduces the relative importance of that stock. To overcome this bias, the divisor is adjusted whenever a stock split happens. In our example, we get the new value of the divisor (D) in the day of split by solving the following equation: $(13 + 11) / D = 17.5$, which gives a value of 1.37 and this will be used until a new stock split is announced, where a new divisor is calculated.

II.3 Averaging Share Prices

In the previous section we have described how indices are constructed using the three different methodologies. This section will present the concept of averaging share prices. It is important to note that indices are not quite the same as averages. The difference lies in

(4) If a company decides to make a stock split or give bonus issue and the aggregate market value did not change, then the relative importance of such stock remains the same and the index is not affected.

the fact that the index is constructed by setting the value of the average equal to a predetermined value, say 1000 (or 100) at some point or period in time in order to facilitate comparisons of the value of the index at some subsequent (or previous) points in time.

Most stock market indices use either the arithmetic mean or the geometric mean for their description measurements of their prices. The well-known indices, Dow Jones Industrial Average, the Nikkei Average, and the Hang Seng indices are based on the arithmetic mean of prices, while the well-known Value Line Index is based on the geometric mean.⁽⁵⁾

The computation of the arithmetic mean is the sum of individual prices of the component shares divided by the number of the component shares, that is

$$\text{Arithmetic mean} = \frac{\sum_{j=1}^n P_j}{n}$$

While the geometric mean is the nth root of the product of the prices of the component shares, that is

$$\text{Geometric mean} = \sqrt[n]{p_1 \cdot p_2 \cdot \dots \cdot p_n}$$

Table 2 gives an example of the difference between arithmetic and geometric means using price weighting of component shares. Whereas table 3 gives an example of the difference between the two methods using market value weighting of the component shares, where it is assumed that the number of shares outstanding for the component shares A, B, C and D in the base period are 500, 1000, 2000 and 5000 shares respectively. The value of the index for the base period is set to 100 regardless of the weighting system used. The indices are also plotted and shown in Figures 1 and 2.

(5) Lorie and Hamilton, 1973, *The Stock Market: Theories and Evidence*, Irwin Inc.

Table 2
Share Price Indices Based on Arithmetic Mean
and Geometric Mean Using Price Weighting System

Share	Base	Share prices at different periods				
		T1	T2	T3	T4	T5
A	10.00	10.50	10.75	10.25	10.15	10.30
B	15.00	15.10	15.15	15.25	15.25	15.25
C	12.00	12.15	12.30	12.45	12.75	12.75
D	25.00	24.75	24.50	25.00	25.15	25.15
Average						
Arithmetic	15.50	15.63	15.68	15.74	15.83	15.86
Geometric	14.56	14.78	14.88	14.85	14.93	14.98
Index						
Arithmetic	100.00	100.81	101.13	101.53	102.10	102.34
Geometric	100.00	101.46	102.19	101.97	102.48	102.86

Figure 1
Share Price Indices Based on Price Weights

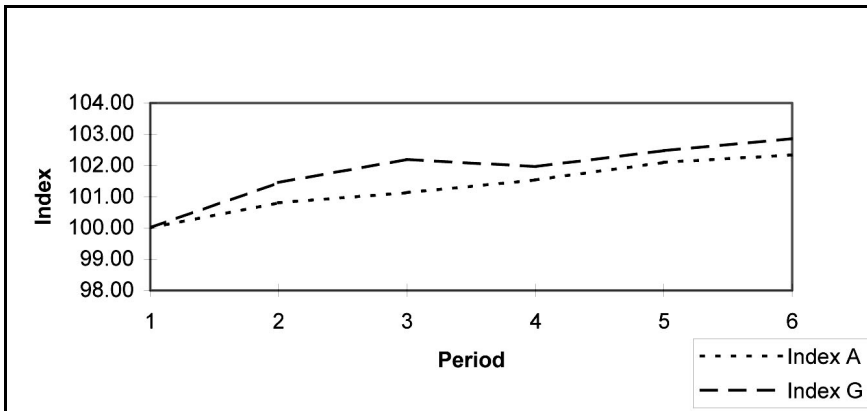
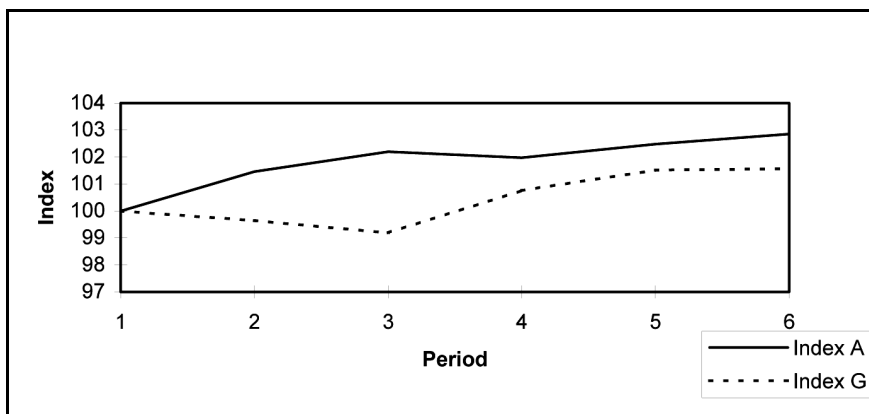


Table 3
Share Price Indices Based on Arithmetic Mean and Geometric Mean using Market Value Weighting System

Share	Base	Share market value at different periods				
		T1	T2	T3	T4	T5
A	5000	5250	5375	5125	5075	5150
B	15000	15100	15150	15250	15250	15250
C	24000	24300	24600	24900	25500	25500
D	125000	123750	122500	125000	125750	125750
Average						
Arithmetic	42250	42100	41906	42568	42893	42912
Geometric	21779	22096	22256	22208	22319	22401.72
Index						
Arithmetic	100.00	99.64	99.19	100.75	101.52	101.57
Geometric	100.00	101.46	102.19	101.97	102.48	102.86

Figure 2
Share Price Indices Based on Value Weights



III. UAE Unofficial Stock Market Indices

At present there are several share price indices, which are published by different institutions, banks and major newspapers in the country. Examples of the indices that are published by banks are the National Bank of Abu Dhabi share price index, the Emirates Bank International share price index (Emnex) and the Union National Bank share price index. An example of an index that is published by newspapers is the Al Khaleej newspaper index.⁽⁶⁾ All indices published include different sectors of the economy, banks, insurance, services, real estates and industrial sectors. A description of each index is given below.

1. Emirates Bank International Index (EMNEX)

EMNEX was started on 1/1/1996 at 1000 with 29 companies included, later it increased to 36 companies. It is a value-weighted index. Each company in the index is weighted in accordance with the market value of publicly held share. The largest weight is given to Etisalat, which has around 34 percent of the total capitalization of the market. All prices in the index are adjusted for bonus issues, right issues and stock splits.

2. Union National Bank Index

Union National Bank has created "The UNB Market Index", along with its sub indices in January 1998. It consists of 43 actively traded companies in the UAE unofficial stock market. Each company in the index is weighted in accordance with the market value of publicly held share (free float). In other words, the index reflects the market capitalisation of shares that are actually traded in the market, rather than the total capitalisation. The importance of this adjustment is substantiated by the fact that the adjusted market capitalisation (free market capitalisation) forms only 48% of the non-adjusted

(6) Al Khaleej newspaper is published in Arabic and it is the most widely read newspaper in the country.

market value. All prices in the index are adjusted for bonus issues, right issues and stock splits.

The index is calculated as follows:

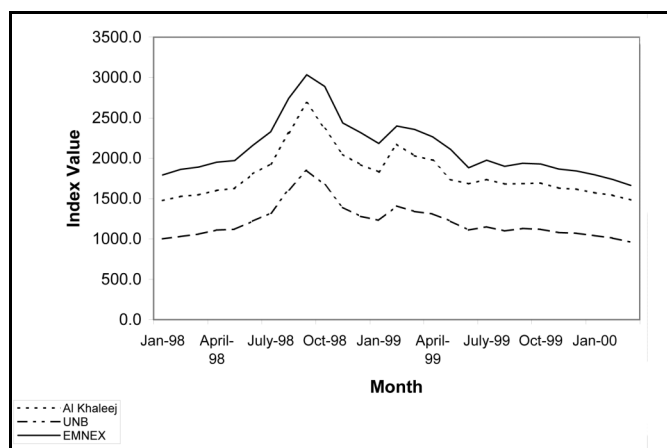
$$\frac{\text{Free Float Market Capitalisation}}{\text{Base Value Free Float Market Capitalisation}} \times 100$$

3. Al Khaleej Newspaper Index

Al Khaleej Newspaper developed its own Index on 1/1/1996 at 1000 as a base covering 36 common stocks traded on the UAE unofficial stock market with total market capitalization of around 64 billion Dirhams. It is similar in concept to the EMNEX Index in that it is an index of market value.

To compare the three indices, monthly closing levels for the period January 1998 to March 2000 are plotted in figure 3. We note that the three indices moved together and behaved in much the same way. This similarity could be attributed to the low number of companies available for inclusion in the index and most indices include them all. Also, not all companies in the index are frequently traded and this adds to the stability of the indices.

Figure 3
Comparative Movements of the Three Indices
of the UAE Stock Market



To illustrate statistically the degree of this relationship between the various indices, the correlation coefficient between each pair of indices is calculated using daily share price indices for the period January 1998 to March 2000, using the following formula:

$$r_{xy} = \frac{\sum x_i y_i}{\sqrt{\sum x_i^2} \sqrt{\sum y_i^2}}$$

where $x_i = X_i - \bar{X}$, $y_i = Y_i - \bar{Y}$, , and $\bar{X}, \bar{Y}$ are the mean values of the variables.⁽⁷⁾

This measures the degree in which two series move together. The range of the correlation coefficient is -1 (for perfectly negative correlation) and +1 (for perfectly positive correlation) while a value of 0.0 (zero) would indicate no correlation.

Using daily share price indices Table (4) shows the correlation coefficients between the three main indices. All the correlations are above 0.97, indicating that the three indices move together very closely.

Table 4
Correlation coefficient between the three indices
on the UAE stock market

Index	Al Khaleej	Union National Bank	Emnax
Al Khaleej	1.00	0.989036	0.976821
Union National Bank	0.989036	1.00	0.98551
Emnax	0.976821	0.98551	1.00

IV. Conclusion and Recommendations

In this study, we discussed methodologies used on how stock market indices are constructed, and examined various indices, which are currently published by national banks and local newspaper in the unofficial UAE stock market. We have found that most indices

(7) See Koutsoyiannis (1984) for a detailed theory of Correlation.

published use almost the same number of companies, therefore a strong relationship was found between them. Visual presentation and a test of correlation have demonstrated that they are highly correlated. This implies that the investment community in the UAE market can use only one of these indices to gauge the performance of the unofficial market, hence the performance of their own portfolios of shares and in their future prediction of share prices.

A fair understanding of the index construction will undoubtedly help the authorities in the newly formed stock market in the construction of an index. Therefore the authorities in this market, should set some criteria for selecting the component shares for the construction of the new index, we recommend the following:

- 1 - To include shares which their major business activities contribute substantially to the UAE economy.
- 2 - Avoid shares, which are not traded frequently (e.g. three to six months inactive trading).
- 3 - To include shares which represent all sectors of the economy, so that it does not over-represent or under-represent a certain sector.
- 4 - Avoid shares which have low volume of trading in a certain period of time(e.g. shares with a trading volume of less than 50,000 shares per month will be excluded).
- 5 - A weighting system should be used and must be clear to all market participants.
- 6 - Avoid the inclusion of the newly listed companies to avoid the distortion of the index through price volatility. At least a year must be allowed before their inclusion in order for their prices to stabilise.

The introduction of the new official market by the UAE government must not be taken by the authorities as a panacea for solving the problems of transfer of saving, investment and growth. Its contribution to the national economy may be limited, however, its contribution will be in the fair dealings of securities and in the liberalization of the capital market.

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