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A STOCK MARKET INDEX FOR THE NIGERIAN STOCK EXCHANGE

I. INTRODUCTION*

The purpose of this paper is to devise and compute an appropriate stock market index for the Nigerian Stock Exchange (N.S.E.).[1] Such an index is expected to reflect to some extent, the economic trend in the country and as the stock market develops within the entire financial superstructure such an index should signal some important structural changes in the economy. This exercise is novel in the Nigerian context because as of this date, not much work has been done in this respect. No official index–rough or refined–exists for the public to depict the general trend in the stock market, contrary to what one would find in all other countries with stock exchanges whether developed or underdeveloped.[2]

A stock market index is a technique for recognizing trend using previous high and low points in averages as benchmarks. The theory behind stock market indices consists of a set of precepts which, taken together, provide a framework for evaluating the future of the market from its past performance. A very common use of stock market indices is to measure portfolio performance. Another popular use is to break down a security's risk into its "systematic" or covariance component and also its "unsystematic" component. The former component is related to the general variability of the market whilst the latter component refers to the variability or risk inherent in a particular security. Other uses of stock market indices centre around establishing the degree of efficiency within the capital market. In Nigeria, portfolio management as a major line of business is not very common, hence the main benefit of stock market indices will be to signal changes in the business environment.

An appropriate stock market index can be used as a benchmark for comparison purposes. Stock market indices also act as barometers for monitoring economic upswings and downswings. Indeed, in many countries–the United States, Britain, Germany, France, Singapore and Brazil to mention just a few, the domestic and international investors as well as the government and various individuals rely a great deal on the announcement of such indices periodically before embarking on major financial and/or economic investments. In the United States for instance, the hourly and daily announcement of the Dow Jones Industrial Average (DJIA), the New York Times Industrial Average (NYTIA) and other such indices has far-reaching effects within the business sector and on funds inflow and outflow to and from the country. The relative thinness on the Nigerian Stock Exchange should not be a deterrent to computing a meaningful index since most stock market indices began with a handful of securities and as the market grew, such indices were appropriately adjusted. The DJIA is a very good example in this respect.[1]

In order to compute a realistic index, one must determine the type of distribution that approximates most closely security returns, and one must select an appropriate time series for the computation. In addition, since any stock market index is a portfolio of securities, a brief review of portfolio theory is very relevant. The rest of the paper is therefore divided into three sections. The next section (II), deals with a review of portfolio theory and selection as it relates to this exercise; section (III) deals with the computation of the stock market index; section (IV) compares the index selected with two major economic indicators and the last section (V) summarizes and concludes the paper.

II. PORTFOLIO THEORY AND SELECTION: A REVIEW

A portfolio is a list of securities belonging to an individual or group. It is a distinct entity with measurable characteristics and not just a sum of component parts. Harry Markowitz made the distinct and pioneering contribution to portfolio theory and analysis through his mean-variance hypothesis. Basically, this hypothesis states that investors want to maximize the expected returns on an investment and simultaneously minimize expected risks in that investment. Markowitz suggested that the mean (E) be the surrogate for expected return on a portfolio, and that the variance in expected return (V) be the proxy for risk. These surrogates are based on the assumption of normal distribution of expected returns.[2]

Markowitz's E-V criterion asserts that the diversification of investment reduces risk so long as the correlation between expected returns from two or more investments is less than plus one. This is explained later in the discussion below of the inputs needed for the E-V model.

The inputs for the model comprise of the expected returns, the dispersion in expected returns and the correlation

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[1] The name of the exchange has only been recently changed from the Lagos Stock Exchange to the Nigerian Stock Exchange (N.S.E.) in 1977 on the advice of the Panel on Financial System Review. The NSE has trading floors in Port Harcourt, Kaduna and Lagos. The bulk of trading activity is carried on in Lagos.

[2] It is very possible and most likely however that there are private efforts in this regard, but the author is unaware of any stock index publication for the NSE as of this date.

[1] The DJIA began with only a handful of stocks (11 in all) as far back as 1884. The 11-Stock average was converted to a 20 stock average in 1916. Presently, the average consists of 30 industrials. The three other Dow Jones averages are 20 transportation issues, 15 utilities and the composite of all 65 stocks.

[2] This precludes short sales. Short selling is done by speculators who contract to sell securities they do not own and simultaneously borrow a similar number of these securities to deliver to the purchaser.

between the returns of different securities in a portfolio. The return (E_p) on a portfolio of n securities is given as the linear combination of the returns from the securities. Therefore,

$$E_p = \sum_{i=1}^{n} X_i E_i = X_1 E_1 + X_2 E_2 + \cdots\cdots + X_n E_n \quad (1)$$

where X_i is the relative proportion of security i within the portfolio, E_i is a random variable denoting the return for security i. The proportional sum of all investments must be equal to unity, therefore, the constraint below must be specified:

$$\sum_{i=1}^{n} X_i = 1, 0 \leqslant X_i \leqslant 1 \quad (2)$$

The risk associated with the expected return on the portfolio can be measured as the variance of return or the weighted average of the squared deviations about the expected value. That is,

$$\sigma_p^2 = \sum_{i=1}^{n} P_i [(E_i - \mu)^2] \quad (3)$$

where P_i is the probability of occurrence of the i^{th} outcome where i = 1 . . . n, E_i is the i^{th} outcome (or return) and μ is the expected value of the probability distribution. For simplicity, the portfolio variance can be written as:

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \mathrm{Cov}(E_i, E_j) \quad (4)$$

where $\mathrm{Cov}(E_i, E_j)$ represents the covariability between returns of the i^{th} and j^{th} securities. Since the covariance term is derived from the extent of dispersion as well as the correlation between returns, one can rewrite equation 4 to be:

$$\sigma_p^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} X_i X_j \sigma_i \sigma_j \rho_{i,j} \quad (5)$$

where $-1 \leqslant p \leqslant 1$, and where σ_i and σ_j are the standard deviations of the returns on securities i and j, and $p_{i,j}$ represents the correlation coefficient between any two securities i and j. Following from (5), in a two-security portfolio, the portfolio variance can be expressed as

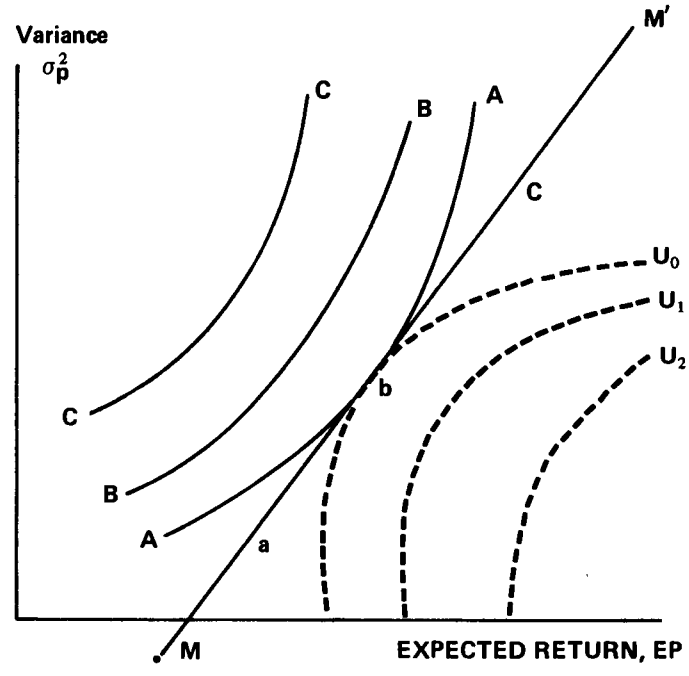
$$\sigma_p^2 = X_1^2 \sigma_1^2 + X_2^2 \sigma_2^2 + 2X_1 X_2 \sigma_1 \sigma_2 \rho_{1,2} \quad [1] \quad (6)$$

It is evident from any of the equations 4 through 6 that diversification reduces the overall risk level when assets that are less than perfectly positively correlated are combined. The lower the correlation, the lower risk level as is obvious from equation 6.

The inputs required for the E-V model could be very cumbersome [n (n + 3)/2 inputs for a portfolio of n securities] especially when the number of securities in the portfolio is very large.[1] Markowitz (and also Sharpe) suggested the use of index-generated inputs whereby each security's return and risk are a function of general market index. This reduces the number of inputs required to 3n + 2. Choosing an appropriate index is the major task of this method. However, this method, assuming an appropriate index, has been found to be quite accurate in many cases for generating inputs for portfolio selection.[2]

Markowitz's model is designed to analyze the expected return, risk and covariance statistics for any group of assets and delineate the efficient frontier which may be expected if the assets are combined into portfolios that are optimal. These optimal portfolios dominate the individual assets in a risk-return space and are highly desirable investments. An efficient set of securities is that set that consists of maximum portfolio return at any given level of risk, or minimum risk at any given level of return. See Figure 1. The slope $\delta\sigma_p^2/\delta E_p$ at any corner portfolio (a, b or c) measures the trade off between risk and return at that point. Points inside the efficient frontier are inefficient. An individual's preference point on a particular efficient frontier would depend on his utility preference. This relates to the final process in the selection of a portfolio.

FIGURE 1
EFFICIENT FRONTIERS IN PORTFOLIO SELECTION



[1] $\sigma_p^2 = (E-E')^2 = [(X_1E_1 + X_2E_2) - (X_1\mu_1 + X_2\mu_2)]^2$
where E' is the expected return.

$\sigma_p^2 = [(X_1E_1 - X_1\mu_1) + (X_2E_2 - X_2\mu_2)]^2$
$= (X_1E_1 - X_1\mu_1)^2 + (X_2E_2 - X_2\mu_2)^2 + 2(X_1E_1 - X_1\mu_1)(X_2E_2 - X_2\mu_2)$
$= \sigma^2_{X_1E_1} + \sigma^2_{X_2E_2} + 2X_1X_2\mathrm{Cov}(E_1E_2)$

[1] For an n-asset portfolio, the total inputs required are n expected returns, n variances or standard deviations and $(n^2 - n)/2$ covariances which add up to n(n + 3)/2.

[2] For a detailed analysis of portfolio selection using the E-V method see H. Markowitz *Portfolio Selection*, op. cit., Chapter 4. Other major models of portfolio selection are (1) the single index model (See William F. Sharpe, "A Simplified Model for Portfolio Analysis," *Management Science*, March 1963), and (2) the Multi-Index Model (see for example K. J. Cohen & J. A. Pogue, "An Empirical Evaluation of Alternative Portfolio Selection Models," *Journal of Business*, April 1967).

Utility theory is a fundamental part of portfolio theory. It refers to investors' preference toward uncertain future outcome. An individual's utility function (U), can be defined as $U = U(W)$ or $U = Ep - \alpha\sigma_p^2$, where W refers to wealth and α refers to the risk aversion coefficient, where $\alpha > 0$. In finance, unless otherwise specified, the general assumption is that over the relevant range, U(W) is an increasing function at all levels of investment such that $\delta U/\delta U(W) > 0$. From the assumption of the E-V model since $\delta u/\delta E_p > 0$ and $\delta u/\delta \sigma_p^2 < 0$, therefore,

$$\frac{\delta\sigma_p^2}{\delta E_p} = \frac{-du/dE_p}{du/d\sigma_p^2} < 0 \quad [1] \qquad \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Figure 1 shows U_0, U_1 and U_2 as the utility preference curves for different risk-return combinations. The point of tagency between the efficient frontier and the utility curve indicates the optimal portfolio. The line MM' is the borrowing-lending line along which the investor moves. An optimal portfolio selection occurs at the point b in Figure 1.

The purpose of this review is that if one selects an average lending-borrowing rate, and plots the efficient frontier from the available securities on the stock exchange, an optimal portfolio, referred to as the market portfolio which all investors will desire can be selected. This market portfolio is the 'ideal'[2] one and it is useful only as a theoretical construct against which any index computed can be compared. The indices computed are compared with this 'ideal' market portfolio in order to establish to some extent, the degree of closeness of the indices with the market portfolio. A close association would suggest that the selected index is representative of the market.

III. COMPUTATION OF A STOCK MARKET INDEX

Sources and Nature of Data

The data used are the prices and dividends declared monthly of all equity-listed stocks in the Nigerian Stock Exchange (NSE) from January 1965 through December 1974. Statistical adjustments were made in order to incorporate the effects of dividends, stock splits and bonus issues to reflect the market value of each stock. All the data used were obtained directly from the then Lagos Stock Exchange.

The daily or weekly returns and prices were found to be insensitive to market fluctuations because trading on the NSE on a daily or weekly basis is not that active. Some stocks are not traded for months. Monthly data however reflect some sensitivity to market activities while at the same time are unaffected by temporary disturbances commonly observable from daily or hourly data in stock markets where such data are available.

Month-end prices are used rather than average monthly prices because it is believed that the average for each month in this instance is more susceptible to rapid fluctuations that are not necessarily due to changes in market activities. Usually at the end of the month, erratic changes in prices during the month tended to adjust to a reasonable level. Hence month-end prices are perceived to be realistic for this study.

Following the selection of the appropriate data series (monthly as opposed to daily or weekly or quarterly etc.), one must do two things: (1) determine the distribution that approximates most closely security returns and (2) select which securities to include in the index.

Distribution of Stock Prices and Returns

On examining the distribution of monthly returns and prices for the given period, it was found that the return relatives rather than the price relatives reflected a fairly symmetric distribution for the period 1972 through 1974.[1] The reason for this is due to the fact that the actual returns reflect the dynamic nature of the market more than price ratios. The return relatives reflect the trend in the market much better especially for the period from 1972 onwards when more stocks were listed on the exchange and the picture became a little clearer. Using the third moment about the mean to measure the degree of skewness (the extent of asymmetry of departure from symmetry of a distribution) the moment coefficient of skewness (α_3) was found to vary between -0.0060019 and 0.093357. These values were found to be statistically not different from zero at the 90% significant level. For perfectly normal distribution, the moment coefficient of skewness (α_3) is zero. It could be concluded that the distribution is fairly symmetric.

To examine to what extent the distribution approximates a normal distribution, the moment coefficient of Kurtosis was calculated. For a normal distribution this is $\alpha_4 - 3 = 0$. For our data, the values ranged between 2.41002 and 4.000121 during the period. The values for α_4 were found to be statistically close to 3 at the 80% significant level. It could be concluded that both in terms of the degree of skewness and the measure of Kurtosis, the data set approximates a normal distribution.[2] Therefore, Markowitz Mean-Variance criterion can be applied for analyzing the securities, particularly because of its theoretical plausibility and its analytic usefulness.

Selection of Securities for the Indices

There are mainly three categories of securities listed on the NSE. These are (1) the Nigerian Government Development Stocks, (2) Industrial Loan and Preference Stocks, and (3) Equity Stocks. The first category as the name indicates are government stocks (17 stocks) whose prices are determined solely by the government. The quotations on these

[1] The analysis here is strictly for the risk averter who typically has diminishing marginal utility for wealth or security returns. Most investors are in this category.

[2] 'ideal' within the given number of securities, at a given borrowing-lending rate and in a given period. The composition of the market index would of course vary from time to time.

[1] The Pennsylvania State University's Fortran IV STPAC program was used for this section. The return relative is defined as $(P_t + D_t)/P_{t-1}$ and the price relative is defined as P_t/P_{t-1} where all prices (p) are adjusted for stock splits.

[2] In the real world, all so-called normal distributions are really approximations to the normal, and in this instance, the approximation is realistic.

stocks have remained fixed at ₦200 for each stock issued up till January 1978.[1] The second category comprises of only seven loan and preference stocks. The third category comprises of 36 equity listed stocks. It is for this third category that indices will be computed because the sample of companies cuts across the entire population and these securities are more susceptible to changes in the level of economic activity than those in Categories 1 and 2.

It would not be meaningful to include the Nigerian Government Development Stocks because as stated earlier the prices of these stocks were artificially pegged during the period of analysis, irrespective of the changes in the demand and supply conditions in the market. Since the purpose of a security index is to measure changes in market conditions, the inclusion of such stocks in any index prior to January 1978 will distort the overall picture. The other category—industrial loan and preference stocks—consists of only a handful of stocks which are relatively difficult to adjust for (with respect to dividends declared, splits, bonus issues) in order to make them reflect changes in market conditions rather than changes in capital structure.

It is considered that at this stage of the development of the capital market, a composite index consisting of equity stocks, government stocks, loan and preference stocks would be practically meaningless for reasons stated earlier, and because the prices of the loan and preference securities are difficult to adjust to make them reflect changes in market forces only. This is why indices are computed only for the equity stocks on the exchange. As the level and nature of activity on the exchange alter to reflect heavier trading in all types of securities, it would become useful to compute indices for each category of stocks and the composite of all stocks.

From the listed equity securities on the NSE, only fifteen had the relevant data on prices, dividends, stock splits, bonus issues or scrips (if any) for at least January 1972 through December 1974. This is because all the others were not listed before then or were rather inactive. It therefore follows that in the period before January 1972, fewer than fifteen stocks could be included in the indices computed. Stocks included in the indices are the stocks of fairly big and small companies with net assets ranging from ₦1.5 million to ₦40.00 million or more. The stocks are traded fairly often on the NSE and are representative of the market. The list of these stocks is given on Table 1.

TABLE 1

EQUITY SECURITIES SELECTED FOR STOCK MARKET INDICES

Security Number	Stock
	Investment Stock of:
11	John Holt Investment Co.
	Financial Stock of:
2	Barclays Bank of Nigeria Limited
3	Nigerian Industrial Dev. Bank "A"
4	Nigerian Industrial Dev. Bank "B"
5	United Bank for Africa
*	Standard Bank Nigeria Ltd.
	Manufacturing Stock of:
6	Dunlop Nigeria Industries, Ltd.
7	Guiness (Nigeria) Ltd.
8	Nigerian Cement Co.
9	Nigerian Tobacco Co.
10	Tate and Lyle (Nigeria) Ltd.
*	Nigerian Textile Mills
	Commercial Stock of:
*	Lennards (Lagos) Ltd.
*	UTC Trading Co.
	Service Stock of:
11	Daily Times of Nigeria

*Did not fall on the efficient frontier

The Base Period

For index computation, base period serves as a benchmark for comparison purposes. Although statistical theory requires that the period chosen should be 'normal' with respect to the variables in the index, it would be a mere coincidence if all stocks were aligned uniformly in any one month chosen as the base. The period January 1965 was selected as the base because this marks a 'normal' period in the economy as well as a period where the exchange has had time to adjust to stock trading after being in business for four years.

Markowitz Algorithm

Since the stock market is relatively young, it would be interesting to compare any index finally computed with an 'ideal' market index (that is, an 'ideal' set from the given stocks in the market). Markowitz algorithm is used for this purpose. In the algorithm for the efficient frontier, only a maximum of eleven stocks were selected out of the fifteen. The risk-return values for the period January 1974 through December 1974 are shown in Table 2 for those stocks selected. It is evident from Table 2 that the stock numbered 2

TABLE 2

MARKOWITZ MEAN-VARIANCE EFFICIENT FRONTIER RISK-RETURN VALUES

Security Number	Expected Return (Mean)	Variance
1	0.9937	0.00337
2	1.0297	0.00167
3	1.0121	0.01760
4	1.0137	0.19670
5	1.0232	0.00663
6	1.0079	0.00619
7	1.0034	0.01243
8	1.0159	0.00350
9	1.0009	0.00269
10	1.0037	0.00530
11	0.9924	0.00529

Number of securities considered = 11
Number of observations per security = 35

[1] From 1959 till 1978, government stocks were bought and sold at par irrespective of the maturity or yield of such stocks.

has the highest return as well as the lowest variance. This stock was therefore selected as the first corner portfolio.[1] This happens to be Barclays Bank[2] stock. This is not very surprising as it is the second oldest and biggest bank in the country out of the existing commercial banks today. Also, banking business is relatively very lucrative.

Table 3 gives the return variance values for the corner portfolios on the efficient frontier. The table confirms what is expected of an efficient frontier that no portfolio on this frontier has higher variance at any given level of return or higher return at any given level of risk. All points within the efficient frontier are inefficient. A plot of the values of the portfolios is given in Figure 2. This clearly depicts the risk-return trade-off thus verifying that more return is required to compensate for more risk-taking. The efficient frontier here is used in subsequent section for comparison purposes.

TABLE 3

CORNER PORTFOLIOS ON THE EFFICIENT FRONTIER FROM THE FIFTEEN STOCKS

Code Number of Companies in Corner Portfolio	Expected Portfolio Return	Expected Portfolio Variance	Reward to Variability
2	1.0297	0.00160	0.6063
2, 5	1.0290	0.00140	0.6499
2, 4, 5	1.0287	0.00131	0.6602
2, 4, 5, 8	1.0249	0.00070	0.7458
2, 4, 5, 6	1.0244	0.00060	0.7505
2, 4, 5, 6, 8, 9	1.0224	0.00050	0.7608
2, 3, 4, 5, 6, 8, 9	1.0205	0.00042	0.7539
1, 2, 3, 4, 5, 6, 8, 9	1.0202	0.00041	0.7500
1, 2, 3, 4, 5, 6, 7, 8, 9	0.0167	0.00030	0.6759
1, 2, 3, 4, 5, 6, 7, 8, 10	1.0166	0.00029	0.6731
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1.0139	0.00020	0.5574

Selecting an Index for the Stock Market

As an overview, nine very popular indices which are used as measures of market performance and under different portfolio policies will be briefly recalled here. It is from these different indices that an appropriate index is selected. These nine indices are listed below:

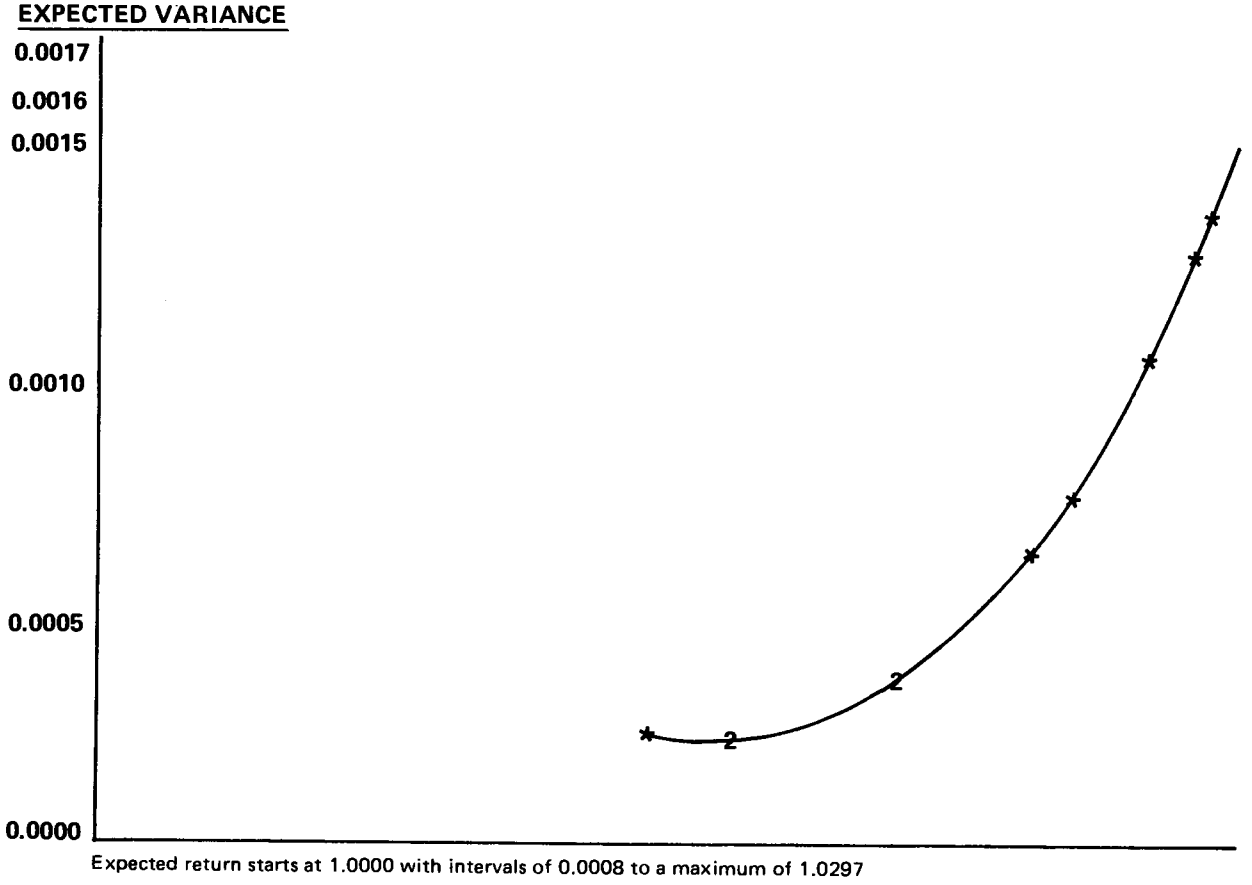
I. *Buy-and-hold Policy*
   A. Average Price Level Indices
      1. Dow Jones Average (DJIA)–'unweighted' arithmetic mean.

[1] In Finance, it is common to refer to a one-asset or one-security portfolio, especially in discussing the efficient frontier. See for example J. C. Francis *Investments Analysis and Management*, McGraw-Hill Co., New York 1972, page 403.

[2] Now the Union Bank of Nigeria Ltd.

FIGURE 2

MARKOWITZ EFFICIENT FRONTIER: MARKET PORTFOLIO



2. American Stock Exchange Index (AMEX)–unweighted arithmetic mean.
3. New York Times Industrial Average (NYTIA)–unweighted arithmetic mean.

B. Aggregate Market Value Indices
1. Standard and Poor Indices–unweighted arithmetic mean.
2. New York Stock Exchange Indices–weighted arithmetic mean.
3. Moody's Composite Average–weighted arithmetic mean.

II. *Portfolio Reallocation Policy*

A. Periodic Portfolio Reallocation
1. Average Investment Performance Index
2. United Press International Market Indicator.

B. Continuous Portfolio Reallocation
1. Value Line Average.[1]

Each of the indices above is in a sense a portfolio, ranging from 30-stock portfolio of DJIA to a multi-stock portfolio consisting of almost all the universe on an exchange. There are differences in the computation of these indices because different measures of central tendency are used. Hence the distribution of each unit of money invested varies among the different indices.

Indices in Category II will not be computed because a portfolio reallocation policy would not provide a consistent performance since these indices would not represent the Nigerian structure where no deliberate reallocation policy exists as such. I am more concerned with indices that are computed on the assumption of buy-and-hold policy because this approximates the investment behavior of most Nigerians presently, due to the high capitalization rate on financial investments. This category consists of (1) aggregate market value indices whose mean prices or index numbers are weighted by the number of shares outstanding, and (2) average price level indices whose mean values are unweighted.

The major difference between these two categories is that the aggregate market value implies that people purchase stocks in proportion to their market value relative to the aggregate market value of all stocks in the sample, whilst the average price-level-indices assume people purchase stocks on the basis of price per share of stocks comprising the index. The effect on aggregate market value of weighting is that companies with high aggregate market value will dominate companies with smaller aggregate market value and the index may reflect only blue-chip companies. On the other hand non-weighted indices may not be desirable for wealthy or institutional investors who might not wish to invest in securities with small value of outstanding shares because large lumpy purchase or sale of such securities may drastically affect the prices of such securities and perhaps to the detriment of such institutional investors.

The non-weighted type of index is computed for five reasons:

1. An aggregate market value index would be dominated by the few issues of highly capitalized companies, and the index would tend to vary as these 'blue-chips' vary. The index desired is a representative average, not necessarily a blue-chip average.

2. Many investors in the equity shares listed on the NSE are the relatively small investors who are not likely to invest say 15 times in Company A as in B simply because A has 15 times more shares outstanding. On the average, investors are more likely to distribute their funds almost equiproportionally between different securities. The implication of this is that if Messrs A, B and C each invests ₦3,000 in Companies X, Y and Z, the pattern of investment may be such that A, B, and C invest ₦1,100, ₦1,000 and ₦900 respectively in Company X; ₦1,200, ₦600 and ₦1,200 respectively in Company Y; and ₦700, ₦1,400 and ₦900 respectively in Company Z. This gives an average of ₦3,000 investment by each person in each company. In a young stock market, the investment pattern is likely to be stochastic rather than as a result of rational investment planning. The unweighted type of index is therefore practical under such circumstances.

3. The aggregate market type of index may cause the relative importance of any component in the index to change when there are stock splits, or stock dividends. This change may not correspond to any change in the intrinsic value of that security. This is a major disadvantage of weighting on the basis of shares outstanding.

4. There are inconsistencies in the figures published on outstanding shares of various companies. The scanty data that exist for some companies give only the yearly outstanding shares for a few years, hence it was not possible to compute an index that incorporates value of oustanding shares month by month.

5. The indices computed use adjusted prices, incorporate stock splits, dividends, scrips or bonus issues. *SINCE PRICES ARE DIRECTLY RELATED TO OUTSTANDING SECURITIES, THE OVERALL MARKET VALUE OF A STOCK AND THEREFORE ITS PRICE, REFLECT MOST OF WHAT THE INVESTOR NEEDS TO KNOW.* Price changes month by month therefore reflect stock value.

This is not to say that the unweighted indices are perfect indices. In fact, there is no all-purpose stock market average, and the predictive ability of any index of bulls and bears on the market depends on the extent to which it portrays the population it purports to describe. Since ownership in equity shares on the NSE is relatively broad and since the 'small' investors are less likely to be concerned with total outstanding shares of the companies they invest in, I selected the unweighted type of index as approximating investors behaviour in general and the market also for the given period.

Three indices under the category of the unweighted type of index were computed. Their formulae are given below:

I. NSE Index A (Formula identical with New York Times Industrial Average). The formula is:

[1]The discussion of one or more of these indices can be found in the following references:
(a) Kalman J. Cohen and Bruce P. Fitch, "The Average Investment Performance Index", *Management Science*, Vol. 12, February 1966, pp. B-195-B-215.
(b) K. V. Smith, "Stock Price and Economic Indexes for Generating Efficient Portfolios", *The Journal of Business*, July 1969.

$$I_{A,t} = \frac{\sum_{i=1}^{n} \sum_{t=1}^{T} (n_t)(P_{i,t})}{\sum_{i=1}^{n} (P_{i,t})/I_{t-1}} \quad \ldots\ldots\ldots\ldots (8)$$

where $I_{A,t}$ = Index type A in period t
n_t = The number of securities in the index in period t. n has a maximum of 15
P_{it} = The month end closing price for security i in period t
T = Total number of time periods.

This index is formed in the base period as if you have only one share in each stock. The number of shares changes and the prices change over time as adjustments are made for stock splits, bonus issues[1] and stock and cash dividends.

II. NSE-Market Index B (Formulation is identical with the Dow Jones Industrial Average). The formula is:

$$I_{B,t} = \frac{\sum_{i=1}^{n} \sum_{t=1}^{T} (n_t)(P_{i,t})}{\sum_{i=2}^{n} (P_{i,t})/I_{B,\,t-m}} \quad \ldots\ldots\ldots (9)$$

where I,n,P and T are as previously defined.
$P_{i,t}$ = old price adjusting for split or bonus issues
$I_{B;t-m}$ = old value of the index in period t-m where m is the number of previous periods.

This NSE-Market Index is slightly similar to the previous index A, except that it adjusts the divisor for stock splits and bonus issues.

This NSE-Market Index is not really an average in the sense that its computation involves a lot more than merely adding all the 15 prices and dividing by 15. The divisor changes as stocks are split. For example, if four stocks are priced at 50K, ₦1.00, ₦1.50 and ₦2.00, the average is ₦1.25. If the fourth stock is split 2-for-1 so that its new price is ₦1.00 the post split average would be ₦1.00 if there was no divisor adjustment. The maintenance of the index on a continuous basis would require that the average remains ₦1.25 because there has been no change in real market forces. This would imply a reduction of the divisor from 4 to 3.20 to keep the index on a consistent trend that should be affected by changes in the market only, and not in the capital structure of any of the companies included.

III. NSE Index C (formula approximately that of AMEX Average). The formula is:

$$I_C = \frac{\sum_{i=1}^{n} (P_{i,t} - P_{i,t-1})}{n_t} + PLI_{t-1} \quad \ldots\ldots (10)$$

where I, P and n are as previously defined.

PLI = Price level index. Here a base average has to be assumed for the index. This was $I_{o,1}$ = 100 for January 1965.

Table 2 gives the values for the three indices during 1965 through 1974. The 15 securities shown on Table 1 are used for this purpose. For periods earlier than 1972, there were less than 15 securities in the indices computed since some of the stocks were not registered on the exchange before 1972. From the values given in Table 4 it is obvious that the NSE-Market and the NSE-A are fairly similar. It is only the divisor adjusting procedure of the NSE-Market that differentiates it from NSE-A.

NSE-A Index C moved from a base of 100 in January 1965 to a level of 72.75 in December 1974. The highest for this index was in November 1972 when it reached a high of 143.42. For the NSE-A and NSE-Market, the indices both moved from the same level of 100.00 to 194.60 and 223.11 respectively during the same period. The highest for the NSE-A and the NSE-Market also occurred in November, 1972 at the levels 197.43 and 235.17 respectively. The highs for all the three indices occurred in 1972 when the indigenization Decree was promulgated and many shares were transferred into the hands of many Nigerians. Also the period represented a boom for the economy due to the huge receipts from the oil sector which is still the major contributor to GNP. The final implementation of the indigenization decree is expected to create further major structural changes in the activity on the NSE and subsequently on the stock market index.

The indices computed are compared with their market portfolio counterpart. The market portfolio concept was discussed in Section II. One could see from Figures 3, 4 and 5 that the NSE-Market Index approximates the market more closely than the other two in terms of value of the indices and trend pattern.

NSE-Market Index (equivalent to DJIA formulation) can be criticized for putting statistical premium on unsplit equities whilst split equities are constantly adjusted for. The argument that this might create an upward bias in the index has been investigated by Carter and Cohen[1] who found that the DJIA formulation exhibits no consistent bias through occurrence of splits or method of adjusting for the split.

The NSE-C Index is eliminated as a possible index for the NSE because this index (AMEX equivalent), appears to be more of an arithmetic average than an index and it approximates our market portfolio less than the NSE-Market. It also considers the arithmetic mean of absolute price change and equal weight is given to absolute rather than relative price changes. For instance, the NSE-C Index would regard a price change of 5 kobo on a security of ₦2.00 as being as important as a price change of 5 kobo on a security of 50 kobo. Since the NSE consists of both low priced (50 kobo) and high priced securities (100 kobo or over) such an index would over-emphasize the importance of low priced stocks.

[1]Bonus issues are stocks issued to existing shareholders instead of, or in addition to cash dividends.

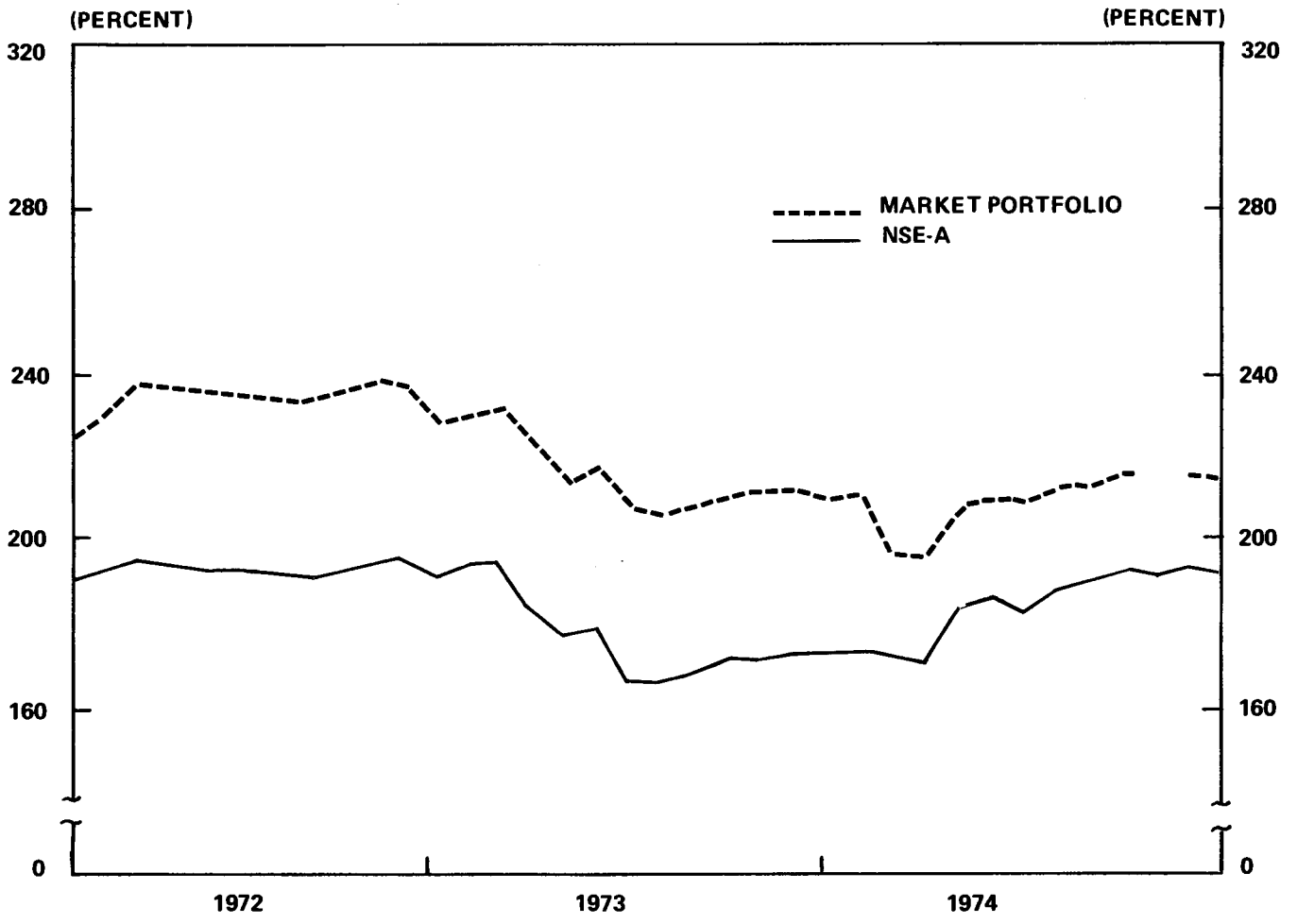
[1]E. Carter and K. Cohen, "Bias in the D.J.I.A. Caused by Stock Splits," *Financial Analysts Journal*. November/December 1966, pp. 90-94.

TABLE 4

THREE STOCK MARKET INDICES FOR THE NIGERIAN STOCK EXCHANGE, JANUARY 1965–DECEMBER 1974

Year	Period	NSE Index-A	NSE-Market	NSE Index-C	Year	Period	NSE Index-A	NSE-Market	NSE Index-C
1965	1	100.00	100.00	100.00	1970	61	138.57	137.73	99.60
	2	104.33	104.33	100.40		62	137.80	136.98	100.05
	3	104.33	104.33	100.40		63	140.73	139.89	111.41
	4	105.47	105.47	101.53		64	141.77	140.00	115.43
	5	104.80	104.80	100.87		65	144.15	143.26	116.40
	6	105.60	105.60	101.67		66	137.13	137.52	144.22
	7	105.27	105.27	101.33		67	156.45	149.12	111.01
	8	105.53	105.53	101.60		68	164.05	153.21	112.91
	9	105.07	105.07	101.13		69	168.35	156.18	113.95
	10	104.40	104.40	100.47		70	169.77	156.74	114.33
	11	103.40	103.40	99.47		71	171.62	157.38	114.50
	12	103.13	103.13	99.20		72	185.17	172.70	116.71
1966	13	115.93	115.93	112.00	1971	73	189.15	175.83	119.22
	14	111.67	111.67	107.73		74	190.78	177.67	110.00
	15	116.00	116.00	112.07		75	191.75	176.31	109.23
	16	117.20	117.20	113.27		76	193.11	206.07	130.00
	17	115.33	115.33	111.40		77	194.50	209.68	109.21
	18	115.67	115.67	111.73		78	191.01	207.75	107.12
	19	115.13	115.13	111.20		79	190.00	207.03	107.33
	20	115.47	115.47	111.53		80	192.21	222.30	110.00
	21	115.00	115.00	111.07		81	189.51	217.46	109.22
	22	113.33	113.00	109.40		82	189.43	217.62	109.22
	23	114.73	114.73	110.80		83	188.01	203.10	101.41
	24	113.13	113.13	109.20		84	195.00	220.08	102.60
1967	25	113.80	113.80	109.87	1972	85	190.01	199.90	100.00
	26	114.60	114.60	110.67		86	194.44	225.60	104.75
	27	116.33	116.33	112.40		87	196.04	234.40	110.00
	28	115.87	115.87	111.93		88	195.00	231.11	109.00
	29	112.73	112.73	108.80		89	193.41	229.20	108.00
	30	113.60	113.60	109.67		90	193.42	229.04	107.75
	31	113.60	113.60	109.67		91	193.56	229.01	107.75
	32	108.27	108.27	104.33		92	192.01	229.07	107.58
	33	109.13	109.13	105.20		93	193.00	230.12	108.75
	34	108.13	108.13	104.20		94	195.51	234.15	111.75
	35	111.47	111.47	107.53		95	197.43	235.17	143.42
	36	109.80	109.80	105.87		96	192.80	224.18	122.33
1968	37	107.53	107.53	103.60	1973	97	195.50	225.10	102.92
	38	110.67	110.67	106.73		98	196.33	226.04	103.75
	39	112.72	112.33	106.93		99	218.05	218.05	92.42
	40	118.00	117.53	112.07		100	178.17	209.06	85.58
	41	121.05	120.57	115.07		101	180.08	211.01	87.50
	42	121.58	121.04	115.53		102	167.92	200.17	75.33
	43	122.07	121.45	115.93		103	167.58	200.16	75.00
	44	123.10	122.39	116.87		104	169.17	201.15	76.58
	45	106.43	105.51	100.20		105	173.25	205.14	80.67
	46	121.13	120.37	114.87		106	173.67	206.12	81.08
	47	107.72	106.72	101.40		107	175.42	207.00	82.83
	48	107.97	106.92	101.60		108	174.00	207.00	81.42
1969	49	108.20	107.19	101.87	1974	109	175.42	209.14	82.83
	50	108.53	107.46	102.13		110	173.25	205.07	80.67
	51	106.68	105.57	100.27		111	172.58	205.80	80.00
	52	106.48	105.37	100.07		112	185.83	229.12	93.95
	53	106.88	105.78	100.47		113	187.67	221.11	73.33
	54	106.33	105.37	100.07		114	185.08	218.14	70.75
	55	107.83	106.72	101.40		115	191.66	222.03	71.58
	56	108.62	107.46	102.13		116	192.66	222.04	72.42
	57	108.95	107.80	102.47		117	195.03	224.04	72.75
	58	109.52	108.34	103.00		118	193.99	222.08	72.50
	59	87.18	85.72	80.67		119	195.94	227.14	76.42
	60	127.58	126.58	90.15		120	194.60	223.11	72.75

FIGURE 3
THE NSE-A INDEX AND THE MARKET PORTFOLIO COUNTERPART (1972-74)



The NSE-Market Index was selected over the NSE-A Index (N.Y.T.I.A. equivalent) because it is believed that the NSE-Market Index (NEM) would summarize future activities on the exchange better than the NSE-A Index would due to the constant divisor-adjustment for splits and dividends, built into the NSE-Market, and the fact that this index moves more closely with the market portfolio than the other indices computed.

Currently on the NSE, daily and weekly price fluctuations are relatively unimportant. This feature of the market appears to some extent to fit into a Dow type of theory that regards daily and secondary fluctuations as relatively unimportant and that it is the primary fluctuations [long upward (bull market) or long downward (bear market) swings] that are important. This index is designed to reflect the "primary" fluctuations in the market.

A major criticism of the DJIA and therefore of the NSE-Market is the underestimation of the importance of growth stocks over a long-term period if the divisor is constantly adjusted for, when stocks are split or bonuses issued. This criticism does not appear vital with respect to the ability of the index to portray economic activity because many of the stocks in the index are the stocks of "growth" or expanding firms in various industries in the country. Moreover stocks splits or bonus issues are relatively infrequent for many of the listed companies. See Appendix I for the stock splits and bonus issues during the ten year period. For all intent and purposes therefore, the DJIA type of index which is referred to here as the NSE-Market (NEM) index is very appropriate for depicting stock market trend on the Nigerian Stock Exchange. The NSE-Market can be used as a benchmark for comparison purpose.

It can be seen from Table 4 that the NSE-Market rose from 100.00 in January 1965 to as high as 223.11 in December 1974 showing in general, the relative changes within this sector. The upward trend of the stock market index is indeed a reflection of the general trend in the country when the boom in the oil sector impinged on all other sectors. The peak of activity on the NSE was in the latter part of 1972. The general movement of the NEM coincides with the general economic trend as is later shown in the next section. This nearly parallel pattern indicates that the stock market, as young as it is, is not insensitive to general market trend.

FIGURE 4
THE NSE-MARKET INDEX AND THE PORTFOLIO COUNTERPART (1972-1974)

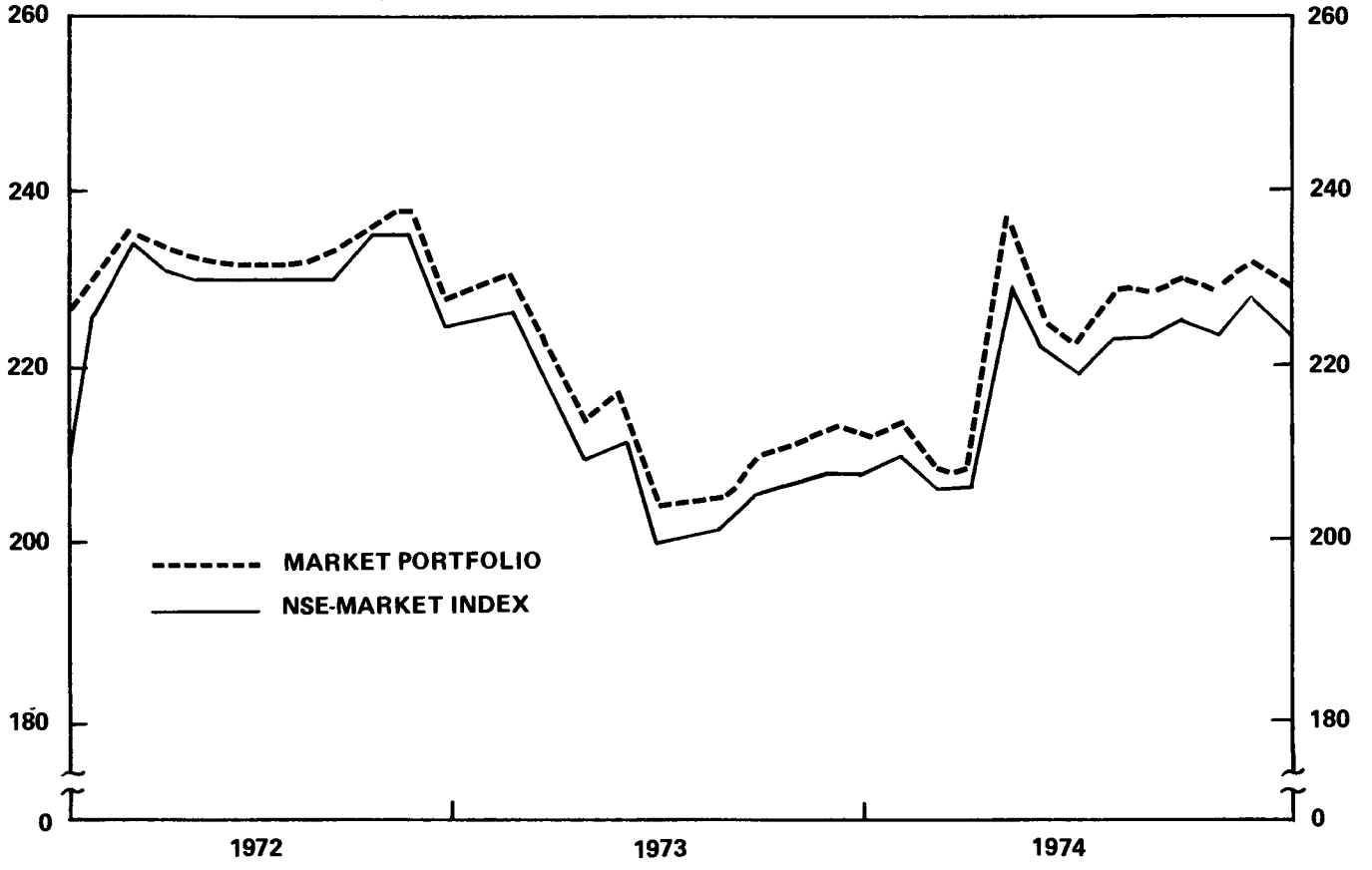
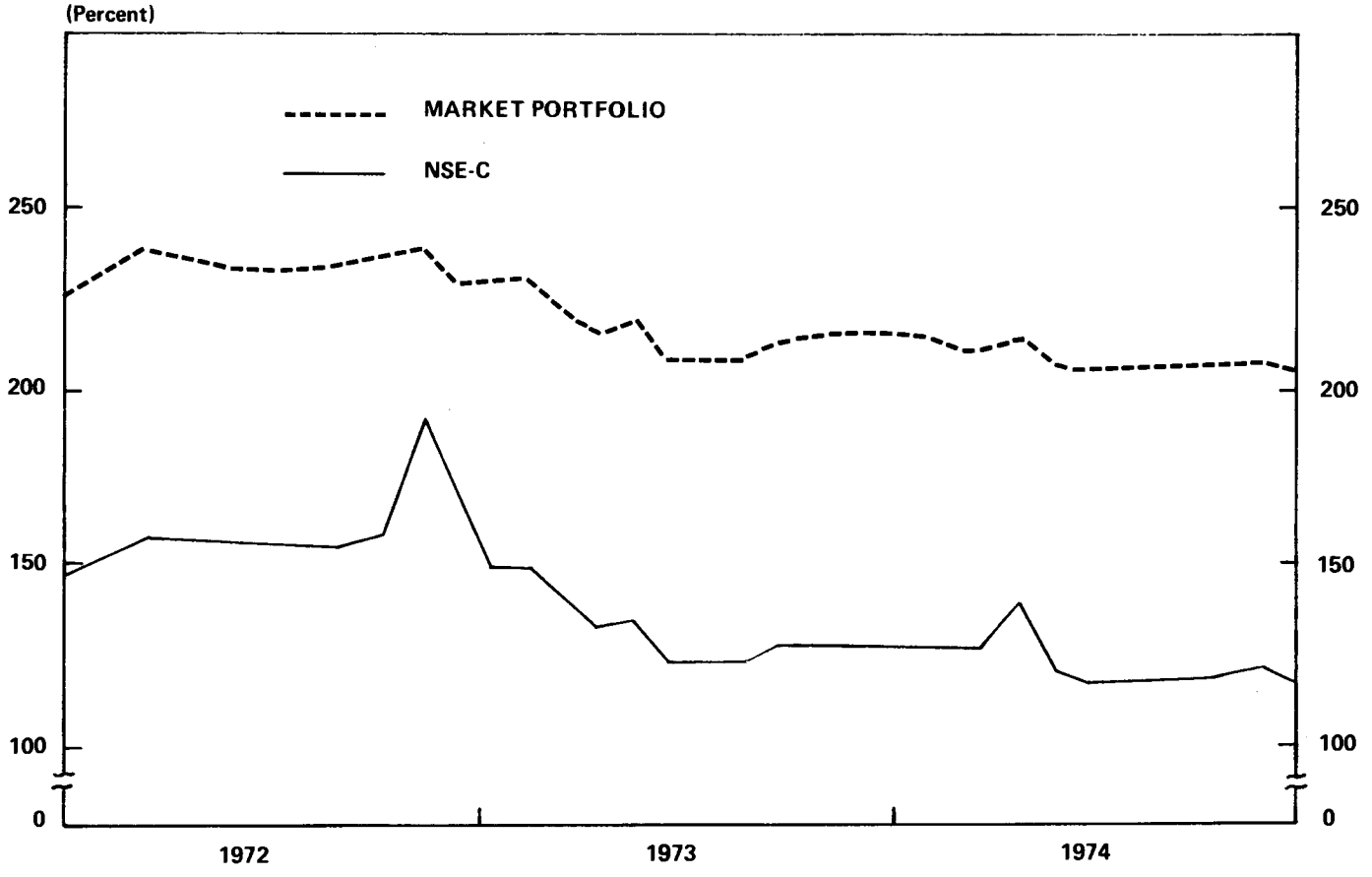


FIGURE 5
THE NSE-C INDEX AND THE MARKET PORTFOLIO COUNTERPART (1972-74)

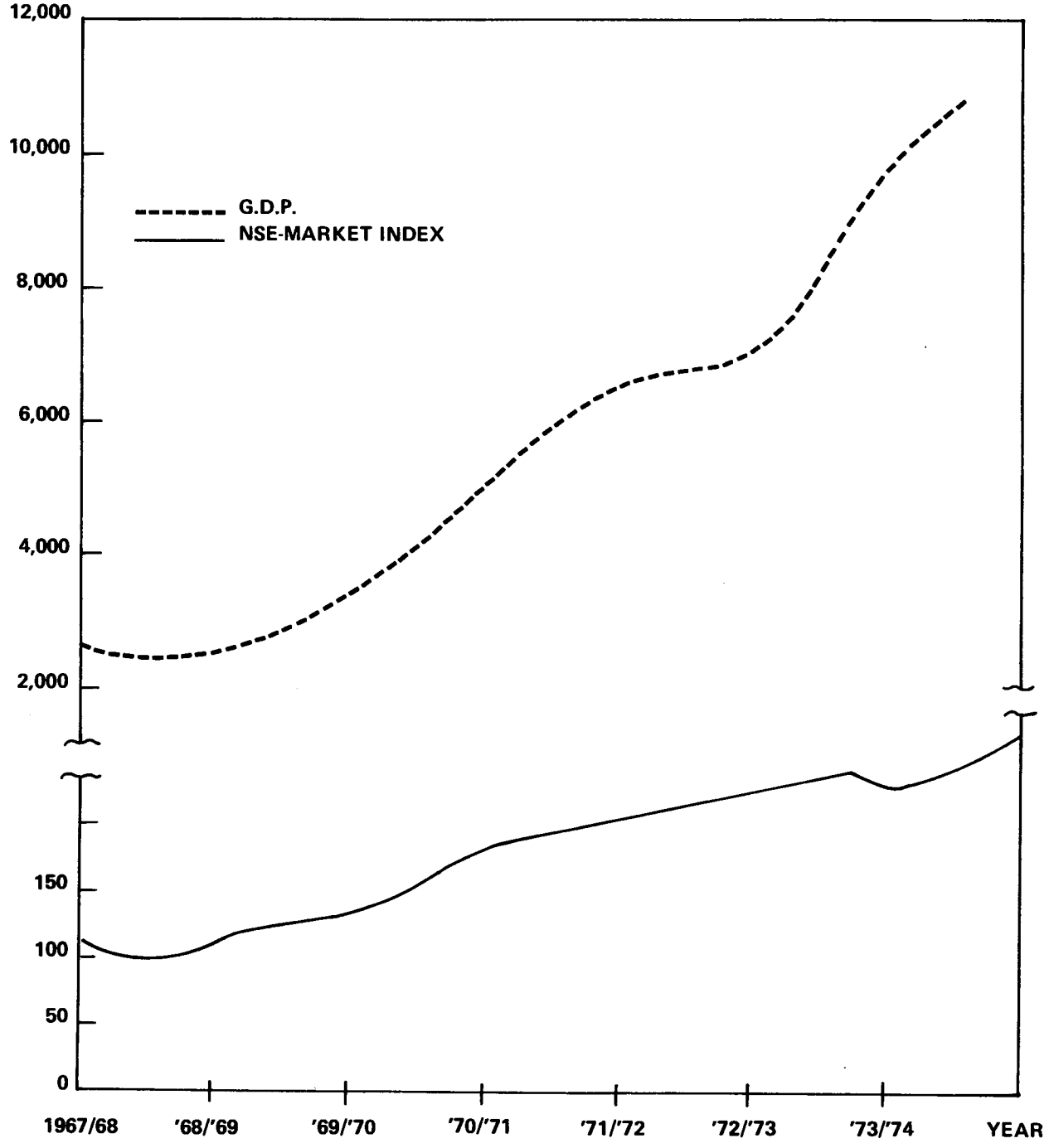


IV. THE NSE-MARKET INDEX AND TWO MAJOR ECONOMIC INDICATORS

In this section, the NSE-Market Index is compared with two major economic indicators in order to determine whether the index is responsive to the aggregate level of activity. If the index moves up in slumps or falls in booms, then perhaps such an index can not be relied upon as an appropriate economic signal.

In general equilibrium analysis, everything depends on every other thing. This principle applies also to the interdependence between real goods market and financial markets. Among other things, the prices in financial markets are logical indicators of economic stability or instability, financial and real. It is a well known fact that in many countries with developed capital markets, the upswings and downswings are first reflected on the stock exchanges. Stock market prices are used as one of the leading indicators of changes in business conditions by the National Bureau of Economic Research (NBER) and other financial analysts. Robinson and Wrightsman rightly stated that "financial movements are the effects of fluctuations in general economic activity . . . The markets for the raising of business capital are early reflectors of variations in the demand for (business capital expenditure) funds . . . If the promise of future profits and business prospect looks bright, stock market trading often leads to rising

FIGURE 6
NSE-MARKET AND THE GDP: 1967/68–1973/74



stock prices well in advance of an actual upturn in economic activity."[1] On this basis, the trend of the NEM was examined.

Average annual values of the NSE-Market Index were computed so as to compare the trend in two major economic indicators—the GDP and the level of gross fixed capital formation for the years 1967/68 through 1973/74. The GDP figures used are based on the market prices for the selected years since the stock prices are also market-determined prices.

Figures 6 and 7 clearly depict the trend of NSE-Market with the GDP and fixed capital formation. The similarity in trend is more visible with the GDP than with fixed capital formation (gross). The percentage changes in GDP and the index were computed to see how marked the trend is and this is shown in Figure 8. It is seen from this figure that while the major upswings and downswings can not be expected to be identical, the movements in pattern of the GDP and the index are rather symmetrical.

Changes in the stock market have therefore been proved here to relate to GDP changes. The major point to note is that the trend in the market index does not run counter to the major economic indicators, and this is important.

V. SUMMARY AND CONCLUSION

A stock market index capable of depicting activity on the market and reflecting to some extent the activity in the economy, was computed for the equity-listed stocks on the NSE. An appropriate formula for the index was selected on

[1] It is along the foregoing reasoning that the index is compared with our gross capital formation and the level and changes in the GDP. See Robinson, R. I. and Wrightsman, D. *Financial Markets and Allocation of Wealth.* New York, McGraw-Hill Book Co. 1974, p. 368.

FIGURE 7
NSE-MARKET INDEX AND GROSS FIXED CAPITAL FORMATION

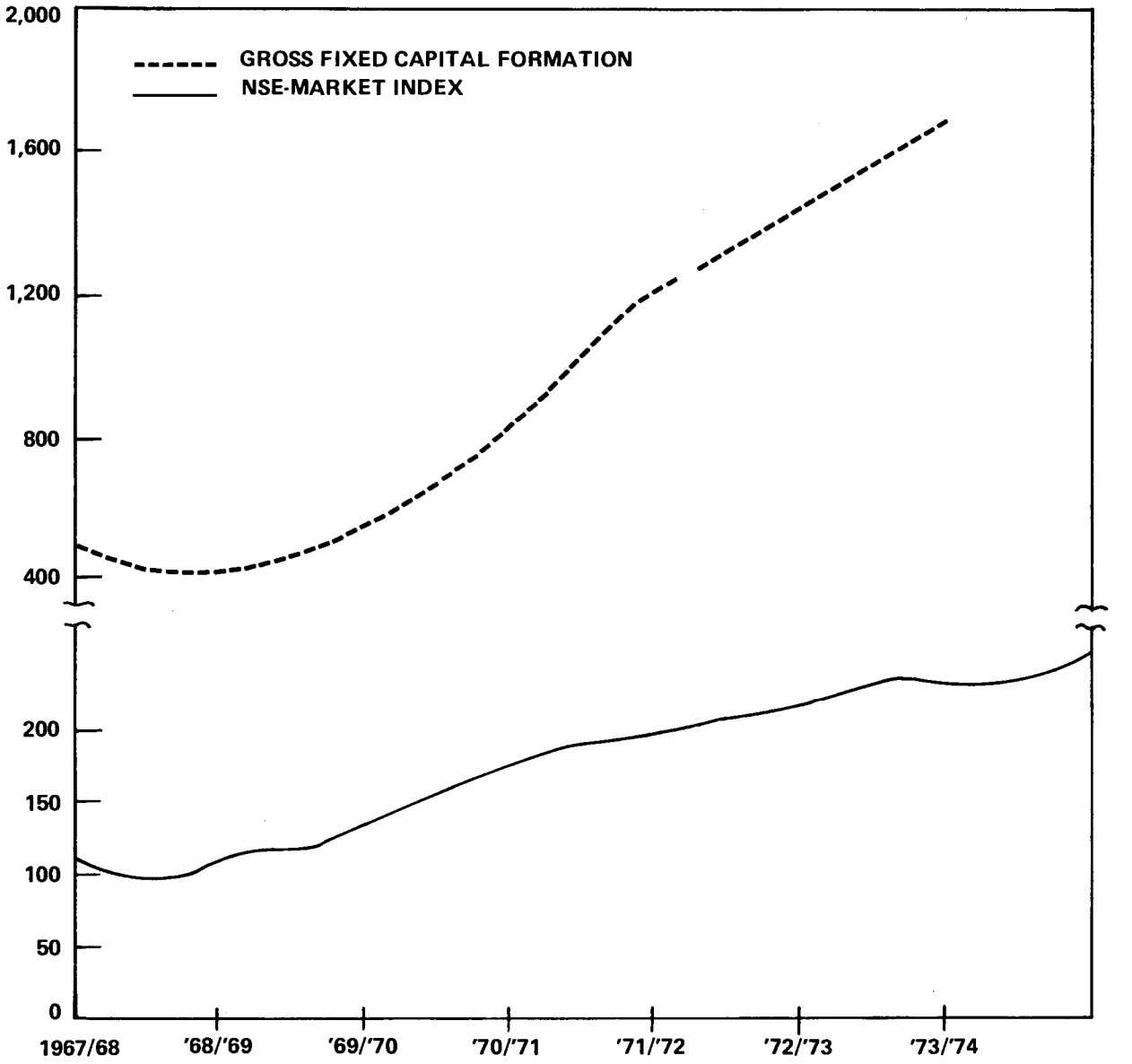
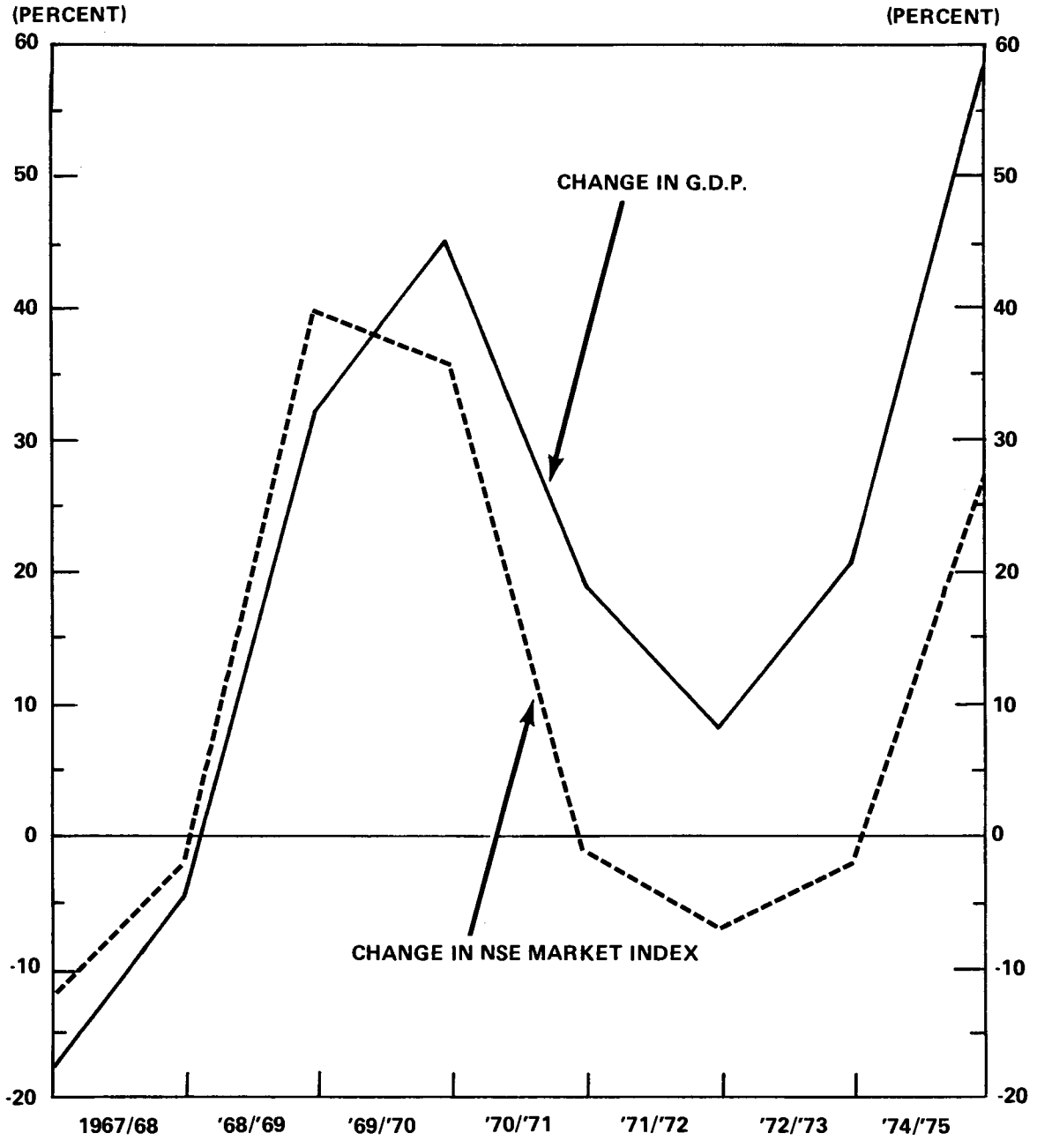


FIGURE 8
ANNUAL PERCENTAGE CHANGES IN GDP AND NSE-MARKET INDEX (1967/68-1974/75)



the basis of the type of distribution that approximates security returns on the NSE and under an assumption of a buy-and-hold portfolio policy by many investors. Portfolio theory and selection was briefly reviewed for the purpose of estimating a market portfolio which was compared to the indices computed. The index that approximated closest to the market portfolio was selected as the NSE-Market Index.

The results from comparing two major economic indicators with the NSE-Market Index were encouraging considering the fact that the stock market is still young and relatively thin.

Updating

The index could be updated in a fairly easy fashion by merely using a desk calculator. Moreover, as the effects of the indigenization process impact on the activity on the stock market substantially, different stocks could be added to the existing group comprising the index. From time to time, stock market index compilers can substitute one stock for another either because a company is merged or acquired, or else has become too inactive and ceases to represent a substantial segment of its industrial classification.[1]

The Possibility of Other Indices

There can be some other indices as the population of stocks whose prices over a long period can be monitored,

[1] In 1970 for example, 9 railroad stocks were deleted from the former Dow Jones Railroad Average. They were later replaced by other transportation issues.

rises. One could have (1) NSE Financial Index for stocks depicting strictly the financial sector (2) NSE Commercial Index (3) NSE Service Stock Index and (4) a Composite of all listed stocks. Other indices could be computed using slightly different but appropriate formulae. Such indices and formula must be based on the distribution of returns on the market and other relevant features of the market. The stock market as it develops can accommodate a few more indices. It is very common to find on many stock exchanges different indices with different values. At the end of June 1970 in the United States for instance, the American Stock Market closed at 683.53 or 213.03 or 79.89 or 41.60 or 20.06 or 298.98 depending on which average one used–DJIA, Dow Jones composite Average, Standard and Poor's Industrial Index, the NYSE Industrial Index, the AMEX Price Level Index or the OTC Industrial Average respectively.

As remarked earlier, there is no all-purpose index, and there is no magic ratio that can measure every structural change on the market. The merit of any index is to be judged against its reflection of what it purports to represent. From all indications, the NSE market index is very appropriate and its computation on a continuous basis should provide a useful benchmark for comparison purposes with respect to changes in economic activity.

As the market becomes more active, broad, resilient and deep,[1] weekly and daily indices can be computed and used by the investing public and the government to monitor booms, slumps and stability of economic activity.

The stock market is a vital sector of the economy as it makes it possible for businesses to raise new or additional long-term funds through an organized exchange market. This market encourages an efficient means of mobilizing funds and using such funds optimally. The suppliers and users of funds try to divert their resources only into those areas where optimal returns are to be expected and therefore promote to some extent optimal allocation of resources. While it is true that this market is relatively young, it is inter-related with various other sectors of the economy and one should not undermine its actual and potential importance. Stock prices are a useful barometer of business activity hence the need for stock market indices. It is believed that this paper has laid the ground work for the computation of stock market indices.

by **DR. 'TOYIN PHILLIPS (Mrs.)**
Research Department

[1]The breadth of the market is measured in terms of the volume of orders and the variety of investor groups. The larger the volume and the number of investors, the broader the market. A market has depth if there are both buy and sell orders below and above the last market price. When new orders pour in to take advantage of a price break, then the market is not thin but resilient.

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APPENDIX I: BONUS ISSUES AND STOCK SPLITS OF EQUITY-LISTED STOCKS IN THE NSE–1965-1974

BONUS ISSUES–1965-1974

John Holt Investment Co.	March, 1968, 1 for 4; 1970, 1 for 1; March, 1975, 1 for 4; 12758.
Barclays Bank	January, 1975, 1 for 5.
Standard Bank	December, 1971, 1 for 4; June, 1975, 1 for 5.
United Bank for Africa	July, 1974, 1 for 3; July, 1975, 1 for 4.
Associated Industries	November, 1973, 1 for 4; November, 1974, 1 for 5.
Nigerian Bottling Co., Ltd.	December, 1974, 1 for 4.
Nigeria Textiles Mills	March, 1973, 1 for 4.
Nigeria Tobacco Co., Ltd.	July, 1970, 1 for 4.
Wiggings Teape (W.A.)	February, 1975, 1 for 1.
R. T. Briscoe (Nigeria)	August, 1975, 1 for 1.

STOCK SPLITS–1965-1974

Daily Times	–₦2 Ordinary Shares were sub-divided into 4 Ordinary Shares of 50k each in July, 1970.
Dunlop	–₦2 Ordinary Shares were sub-divided into 4 Ordinary Shares of 50k each in April, 1974.

Source: The Nigeria Stock Exchange.

"THE POLITICAL ECONOMY OF INTERNATIONAL COCOA AGREEMENT" BY C. E. NEMEDIA[1]

A COMMENT BY O. O. AKANJI (Mrs.)

I congratulate the writer on the effort put into writing the paper, especially for making a scholarly contribution to the Political problem of the most erratic world commodity trade –cocoa. However, I have a few remarks on the analysis of the paper.

Firstly the paper fails to do sufficient justice to the policy implications of the analysis for both the producing and consuming countries. The most obvious policy implication of the analysis is the need to utilize the bulk of cocoa supply in the main producing countries themselves. It can validly be asserted that the low level of consumption of cocoa by the producing countries has given rise to the agreement which does not effectively reflect the realities of the cocoa market. This in turn is explained by the undue influence of consuming countries in drafting the Agreement. An organization like the cocoa Producers Alliance should by now be in a position to manage or organize adequate storage facilities such that sales by producers can be more effectively controlled.

Secondly, the commodity agreement itself was not fully discussed in the paper. The paper discussed the objectives of the agreement which are long-term objectives and very general. But it is pertinent to know that the regulations attached to the international cocoa agreement (ICA), tend to be very complex. Apart from the general objectives, the main contents of the Agreement can be summed up in two statements:

(i) If an agreement is truly to stabilize prices on an international commodity market, someone somewhere must manage a stock of the commodity so as to even out irregularities in the quantity supplied.

(ii) Nearly every commodity agreement has eventually broken down because it finds itself attempting to stabilize market prices at a level which is either substantially below or substantially above the longrun equilibrium.

Thirdly, the statement of the author on the fiscal role of commodity boards is not totally correct, it may be correct for Ghana, but in Nigeria a commodity board is no more a revenue collector as it used to be before 1976.

The re-organization of the old marketing boards in 1976 made it open to all producers to sell to anybody, and the old system of paying well below the world market price has been abolished.

Table 1 shows the price ratios between the Nigeria producer prices, Ghana producer prices and the world prices. To some extent the Nigeria ratio reflects the re-organization in the marketing and pricing system of the boards. However, lack of information on marketing expenses by the cocoa board makes it impossible to determine their exact trading position.

Fourthly, the paper did not discuss what might have led to the inoperation of international cocoa agreement over its 6 years span of life. There were two main developments contributing to the inoperation. The first of these is the steady growth of demand from the consuming countries. Despite the steady rise in prices in the last few years, demand has risen steadily and this in fact tends to confirm the generally inelastic demand for cocoa at the world level. Secondly, the supply of cocoa has not grown as fast as demand. Besides the Ivory Coast, production of cocoa has more or less stabilised in the other producing countries. The resultant effect of the excess demand in the cocoa market has been the inability to make up the necessary buffer stock of the ICA.

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TABLE 1

RATIO OF PRODUCER PRICE TO WORLD PRICE IN NIGERIA AND GHANA

Year	Nigeria Producer Price in £ Sterling MT	Ghana Producer Price in £ Sterling MT	World Price F.O.B. in £ Sterling MT	Ratio Nigeria/Ghana	
1973	201.19	135.65	585.35	0.3	0.2
1974	313.35	181.00	990.14	0.3	0.2
1975	443.39	226.29	722.74	0.6	0.2
1976	547.30	327.13	1,399.44	0.4	0.3
1977	637.39	486.05	2,943.87	0.2	0.2
1978	849.46	551.97	2,005.58	0.4	0.3
1979	849.46	551.97	1,998.18	0.4	0.3

Source: Gill and Dufus; cocoa market report.

N/B £ Sterling had to be used as there are currency differentials between Ghana and Nigeria.

[1] C. E. Nemedia, Economic and Financial Review. Vol. 16 No. 1 June 1978, pp. 18-25.