# On Measuring the Pace of Development

## The Problem

The problem which this paper seeks to tackle is: How to measure and quantify the pace of development in an economy like India's, in which modern technology is being infused through planning resulting in a basic change in its productive structure?

## Inadequacy of the Per Capita Real Income Measure

The measure generally used as an index of development is per capita real income. In a situation where relative prices are changing and the composition too is altering, the per capita real income index as conventionally constructed is hardly a theoretically satisfactory measure because of what Mrs. Robinson calls the index number ambiguity. However, in a structurally homogeneous economic system, this index could be meaningful at least for comparison over short periods of time.

But in a developing economy old technology is being replaced deliberately by modern technology, giving rise to a dual technical structure; in this disequilibrating process, the old technology is shrinking in significance, while the modern one is expanding. Real per capita incomes could conceivably be stagnant or even decline during this process and still a basic structural transformation could be taking place which, once completed, could give rise to rising per capita incomes. Thus, the per capita index could fail to reflect the process of structural transformation adequately, particularly during the initial stages when a development process is set in motion.

The development problem, then, is a problem *sui generis* and is different from the growth problem in an economy with a more or less homogeneous technical structure or where the changes in the structure are only of marginal significance. What is important in



the context of the development problem is to set in motion the process of structural transformation; once this is done, it could gather momentum at later stages. During these initial stages, there may not be any startling change in the per capita incomes or in the economic structure. However, once the economy is adapted to the new technological system, the new technical structure would have a pervasive impact on the economy and the process of structural change would be quickened in the later stages.

This *adaptation lag* arises because of a variety of reasons. Entrepreneurial, managerial and other technical skills have to be learnt and absorbed. Imbalances in the production structure, arising as a result of what Dahmen (1) calls incompleted development blocks, have to be corrected. Markets for new goods and services have to be cultivated and created. Potential division of labour and specialisation can be realised only with the expansion of markets at home and abroad. New types of motivation, attitude and behaviour patterns suited to new technology can emerge on the scale required only over time. Various institutional changes have their full impact on the economy only over a period of time. Briefly, once the development process is initiated, the internal and external economies take time to mature and come to fruition.

How, then, to quantify and measure the pace of development during these *significant* initial stages? The significance of these stages for a development process is indeed much greater than can be reflected in the conventional measures of per capita real incomes or structural change.

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(1) Dahmen Erik, *Entrepreneurial Activity in Swedish Industry in the period 1919-1939*, Stockholm, 1950.

"The concept of a development block is intended to emphasise the fact that advances in technology in a certain stage of production or distribution, or in a certain area of the economy, often times cannot be profitably utilised as long as certain other advances in other stages or areas have not been realised. Thus, if progress in one field is not properly timed in relation to progress in another, one may speak of 'structural tensions' within the frame of incompleted development blocks. The disparities with regard to technical or economic organisation may not be of a fundamental nature. The retardation may simply be due to a time lag, meaning that sufficient time has not yet elapsed to make possible completion of the block, though all the prerequisites for such a development are at hand", pp. 425-426 of the Summary in English appended to the book.

## Concept of Development Potential

For measuring and quantifying "development" during these initial stages, we have resorted to the concept of "development potential" and used the index of development potential as the measure (2).

How, then, to define development potential? For this purpose, one has to identify the determinants of development. These determinants may have a varying impact on development; however, they are not substitutes for each other, except marginally. Development is the combined impact of the growth in these factors; all of them should grow if a development process is to be set in motion. On the basis of historical and analytical studies, it appears that one can start with at least the following determinants:

(a) Entrepreneurial/Managerial ability
(b) Capital
(c) Skills
(d) Employment of Labour and
(e) Technical Change.

## Index of Development Potential

A composite index of the growth in the determinants we have called the index of development potential. It may be emphasized that this is not a perfectly satisfactory measure of the pace of development during the initial stages of the process; it is only an approximation as any other measures would be of that we seek to measure. All that is emphasised here is that here is a measurement problem that has not been so far tackled. It is proposed to present in this article a method of doing so.

(2) See SCHUMPETER J. A., *Theoretical Problems of Economic Growth in Essays*, Cambridge, 1951, pp. 227-229. Schumpeter states, "... The thesis that there is no all purpose concept of economic growth or contraction; that this concept must be defined... separately for every purpose; and that the concept, in each case, is defined by the index or other criterion that is chosen by the investigator", p. 228.



## Problem of Measurement

The next problem is: granted that the determinants selected are adequate for the purpose, how to measure them. It is doubtless difficult to measure entrepreneurial/managerial ability or skills. The problem, therefore, is to find out measurable variables which can in some way reflect the growth in the determinants selected.

The table on page 194 indicates the measurable variables which might be used to represent the development determinants indicated earlier.

This selection of measurable variables as a proxy for the determinants is in some respects arbitrary and is guided by the data available in India. Here again better proxy variables could be discovered. However, in a first attempt of this type, we have selected the proxy variables largely on common sense consideration and on the basis of the available data.

A few things about these proxy variables may be noted. Most of the proxy variables are measured in physical terms so as to avoid the problem of valuation. Secondly, as far as possible, only stock changes are sought to be measured; for some variables like capital and intermediate goods and school graduates, however, only flow changes are available. Thirdly, the variables are associated with the introduction of new or modern technology and improvement in the traditional inherited technology. Further, technical changes in agriculture are sought to be measured by advances in irrigated area and fertiliser consumption.

## Composite Index of Development Potential Problem of Weights

The next problem, however, is to combine these variables into a composite index. The simplest way is to attach equal weights and work out the overall average of index number values for each of the years. The rate of growth based on this composite time series will then yield the rate of development potential of the economy. However, since the values in each indicator represent the effect of not only the growth factor, but also other types of factors and disturbances, a more scientific way would be to attempt, if possible, to segregate the growth factor effect in the case of each variable or indicator and then evolve a composite measure through an appro-

MEASURABLE VARIABLES REPRESENTING DETERMINANTS OF DEVELOPMENT

| | | |
|---|---|---|
| I. *Entrepreneurship/Managerial Ability*: | | |
| Number of factory establishments | .. | 1 |
| II. *Capital*: | | |
| A. Infrastructure development: | | |
| (a) Power capacity | .. | 2 |
| (b) Transport capacity | | |
| (i) Railways-Route K-metres | .. | 3 |
| (ii) Wagons loaded | .. | 4 |
| (iii) Road-K-metres | .. | 5 |
| (iv) Trucks registered | .. | 6 |
| (v) Shipping — net registered tonnage | .. | 7 |
| (c) Net area irrigated | .. | 8 |
| (d) Communication | | |
| (i) Number of post offices | .. | 9 |
| (ii) Number of broadcasting licences | .. | 10 |
| B. Output of intermediate and capital goods. | | |
| (i) Intermediate goods | .. | 11 |
| (ii) Capital goods | .. | 12 |
| C. Imports of intermediate and capital goods | .. | 13 |
| D. Number of Indian scheduled banks branches | .. | 14 |
| III. *Skills*: | | |
| (i) Enrolment in primary schools | .. | 15 |
| (ii) Enrolment in secondary schools | .. | 16 |
| (iii) Number of University graduates | .. | 17 |
| (iv) Enrolment in Polytechnics | .. | 18 |
| IV. *Factory Employment*: | | |
| Number of wage and salary earners in factories | .. | 19 |
| V. *Technical Change*: | | |
| (a) Patents registered | .. | 20 |
| (b) Fertilizers consumed | .. | 21 |



priate system of weighting. The technique of factor analysis may be used with advantage for this purpose.

In the following paragraphs, first an attempt is made to explain the technique in a non-mathematical manner and then the results are presented.

## Technique of Factor Analysis

The technique of factor analysis used in this exercise is a well-known one in the field of multivariate analysis. "Factor analysis is a branch of statistical theory concerned with the resolution of a set of descriptive variables in terms of a small number of categories of factors. This resolution is accomplished by the analysis of the inter-correlations of the variables" (3). Essentially, each variable is assumed to be composed of a set of common factors, and a factor unique to the variable. Common factors may be common for the whole set of variables under consideration or to groups of variables of this set. In the case of the problem of constructing an index of pace of development, each of the index numbers — after suitable transformation to a standardized form (4) — is a variable, and there are as many observations as there are years in the series. Each such index series can be seen as composed of a common factor — which is interpreted as the growth factor — plus other common factors and a unique factor. Since the study contemplates development of an index for growth, it is the factor common to all the 21 indicators that is sought to be resolved as against all others which do not interest us at the moment.

Each given variable is considered as a linear combination of common factors plus the unique factor. It follows, therefore, that unless major the part of the total contribution comes from the factor of growth — common to all variables of the set — it will be necessary to search for other factors which may be common only to some groups of the variables and the index of growth based on such a set of variables may not in fact be a useful one. Factor analysis also indicates how much of the total variation is explained by this common

(3) Holzinger, K. J. and Harman, H. H., *Factor analysis*, p. 3.

(4) Standardized form of a variable X is obtained as follows:

If $X_1, X_2, \ldots X_n$ are the values for n years, $\overline{X}$ is the mean value and S is the standard deviation of the series,

then $x_i = \frac{X_i - \overline{X}}{S}$ is the standard form of the value Xi of the series (i=1, 2, ...n).

factor in the case of each variable as also for all variables taken together. In fact, this measure of contribution helps us to assign weights (5) to each variable in order to construct a composite index of growth.

Because of these various features, factor analysis has been widely used as a statistical tool in segregating the contribution made by various common factors to the different variables, separately and in a combined way. It, however, needs to be stressed that the fact that a large part of the measure of contribution is explained by a common factor for a variable or a set of variables should not by itself lead to the inference that it has been possible to discover a fundamental or basic set of variables which can explain a certain phenomenon represented by a factor or a set of phenomena by a set of factors. In our case, just because the combined index of growth explains about 90 per cent of the variation, it cannot be said that the 21 indicators adopted for the purpose of measuring the pace of growth necessarily form in any sense a complete or an almost complete set. The justification or the rationale for adopting certain variables has to be found independently of the results of the factor analysis, and the process of selection of variables is, indeed, to some extent, a subjective one in this particular case, based on the availability of non-monetary indicators representing different sectors of the economy. Once the set of variables is fixed, factor analysis "does give a simple interpretation of a given body of data and thus affords a fundamental description of the particular set of variables analysed".

Another point which deserves to be noted is that the meaning which is to be attached to a particular factor does not follow from the factor analysis itself but is a matter of interpretation. Thus, in the present exercise, the first factor which is common to all selected variables is interpreted as the factor of growth or pace of development. Since price element is not involved in any of these variables, and since all of them are indicative of development of one or the other facets of the economy, it is reasonable to assume that the factor common to all variables is the one representing "growth" or pace of development.

(5) These weights are determined on the basis of the intercorrelations among all possible pairs of the different variables. There is of course no *a priori* basis to assume that these necessarily reflect the economic importance of each variable in the building up development potential. It seems, however, that this weighting pattern could be deemed more objective as compared to simple averaging where each series carries an equal weight.



*To summarize*:

Factor analysis enables one to do the following:

(i) Resolve a set of variables in terms of a small number of categories or factors.

(ii) Measure the contribution of each factor in the making up of a variable.

(iii) Combine the different variables of the whole set into a composite measure. This is made possible by a system of weights which can be assigned to each of the variables of the whole set.

(iv) Measure the total variation explained by the composite measure.

However, it should also be noted that:

(i) Factor analysis cannot by itself discover a basic or fundamental set of variables representing completely or almost completely a given factor.

(ii) Factor analysis cannot provide interpretation of what a particular factor represents. Interpretation has to be based on the knowledge of the forces at work in the problem under study through one's experience of the applied field under investigation.

## Construction of the Index of Development Potential: Three Variants

Analysis of data thrown up by the 21 selected indicators is attempted in three ways. The absolute data are first converted into an index series, the starting year of 1954-55 having the value 100 in each case. In a couple of cases where final year (1963-64) data are still not available, these have been estimated on the basis of immediate past trends. In the alternative, it would have been necessary either to give up one year, which itself cannot be considered very recent, or these indicators would have had to be discarded, although they are considered important ones to be included in the whole set of 21 indicators.

In the first method, each group is assumed to have equal weighting (viz. 20 each, for 5 groups). The various indicators under each group have equal weight. Thus, where only one indicator represents

a group (Group I & IV), the weight is 20; where only two indicators represent a group (Group V), each indicator carries a weight 10, and so on. In Group II, a similar process of distribution of weights has been carried out for indicators under each of the four sub-groups, each sub-group carrying an equal weight of 5. The rate of growth on this basis comes to 8.5 per cent.

The second method consists in subjecting this set of 21 indicators to factor analysis with a view to segregating the factor of growth from other factors — common or unique — and obtaining weights for each indicator which are to be applied to the data for a given year. The data are not in terms of index, but appear in standardized form amenable to factor analysis. The value of the indicator in the standardized form when multiplied by the values of the weight gives for a given year "factor score" for that year in respect of the indicator. The sum total of all such factor scores for each year gives the figures for working out the growth rate. These "scores" are expressed as index, beginning with 100 for the starting year 1954-55. As can be seen from Table 4, the annual growth at compound rate works out to 7.3 per cent, as against the figure of 8.5 per cent obtained through arithmetic average of index numbers.

In the third method, the data are classified into five groups: (i) Entrepreneurship, (ii) Capital, (iii) Skills, (iv) Factory employment, and (v) Technical change. Each of the 21 indicators is assigned uniquely to one of these five groups. For each group, simple arithmetic average of indices, for each year, is worked out to give the index for each group. These indices at group level are then subjected to factor analysis and the annual growth rate is worked out in the same manner as described earlier for the 21 indicators. This method also gives a figure of 7.3 per cent for the annual growth rate.

An important point emerging from the analysis is that the weights as represented by the "factor loading", a term which is used to denote the square root of the proportion of total variance explained by this growth factor in the case of each variable, are more or less equal and range between 0.9654 to 0.9988, except in two cases. For the indicator "shipping - net registered tonnage" the weight is only 0.06, indicating a relatively minor contribution that this variable has made to the factor of growth. The second variable whose contribution gets less weightage (0.87) is the indicator "imports of intermediate and capital goods". The weightage is, all the same, considerable and cannot be ignored.



The results are presented in a set of tables at the end of the article. Table 1 gives the various series and the growth rate calculated on the basis of simple arithmetic average. Table 2 gives the means and the standard deviations for each variable as also basic matrix of correlations from which factor loadings (or weights of each variable) emerge. The figures of factor loadings and proportion of variance explained are given in Table 3. The calculations for the composite index appear in Table 4. Tables 5 to 7 give similar data for group indicators. Table 8 gives the three index series obtained through the three methods referred to earlier. The annual growth rates in their case have also been shown therein.

## Concluding Observations

In this paper a method to measure the pace of development in the Indian economy has been presented. For this purpose, the main determinants of development potential have first been identified and appropriate series of data to measure changes in these have been located. The data have been subjected to factor analysis — a statistical tool which helps to resolve a large number of series into a small set which could be considered as consisting of one or more common factors and special factors. An index of development potential is then constructed on the basis of this analysis. This seeks to measure real changes in development potential particularly during the initial stages of a planned process of development.

The growth rate in this index has been more than 7 per cent per annum during 1954-55 to 1963-64 or has been double the rate of growth of real national income. This appears to suggest that provided *the momentum of the development process is maintained, the growth rate in national income could accelerate, after the adaptation lags indicated earlier are completed.*

Though the growth rate in real national income has been only 3.5 per cent per annum, the index of development potential does reflect the fact that the process of structural transformation has been taking place at a fairly rapid rate. It is this process which is of significance for development.

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# STATISTICAL APPENDIX

## INDEX OF THE PACE OF DEVELOPMENT

TABLE I

| Indicators | 1954-55 | 1955-56 | 1956-57 | 1957-58 | 1958-59 | 1959-60 | 1960-61 | 1961-62 | 1962-63 | 1963-64 | Weight |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. Entrepreneurship/Managerial Ability: | | | | | | | | | | | |
| Number of factory establishments . | 100.0 | 105.2 | 107.7 | 109.7 | 114.2 | 121.8 | 123.2 | 129.6 | 138.4 | 139.1* | 20.0 |
| II. Capital . . . . . | 100.0 | 107.4 | 122.4 | 134.9 | 130.0 | 144.4 | 162.5 | 171.5 | 184.6 | 200.2 | |
| A. Infrastructure development . . | 100.0 | 106.9 | 112.7 | 120.3 | 128.1 | 139.4 | 153.8 | 166.3 | 180.6 | 197.6 | |
| (a) Power capacity . . . . | 100.0 | 106.3 | 115.6 | 125.0 | 134.4 | 150.0 | 175.0 | 193.7 | 215.7 | 237.5 | 1.25 |
| (b) Transport capacity . . . . | 100.0 | 106.2 | 109.2 | 114.9 | 121.0 | 124.7 | 134.6 | 133.5 | 131.8 | 135.6 | |
| (i) Railway-Route K.metres | 100.0 | 100.1 | 100.2 | 100.6 | 101.1 | 101.5 | 102.1 | 102.3 | 102.8 | 103.1 | 0.25 |
| (ii) Wagons loaded . . . | 100.0 | 108.8 | 116.2 | 122.9 | 122.6 | 130.3 | 135.4 | 136.9 | 147.4 | 142.7 | 0.25 |
| (iii) Road-K. metres . . . | 100.0 | 100.0 | 97.5 | 103.0 | 106.4 | 111.7 | 115.0 | 111.7 | 111.6 | 113.3 | 0.25 |
| (iv) Trucks registered . . | 100.0 | 114.1 | 118.2 | 127.4 | 141.4 | 150.1 | 160.6 | 181.1 | 206.4 | 214.8 | 0.25 |
| (v) Shipping — net registered tonnage . . . . . | 100.0 | 108.0 | 113.8 | 120.8 | 133.5 | 129.7 | 159.8 | 135.5 | 91.0 | 103.9 | 0.25 |
| (c) Net area irrigated . . . . | 100.0 | 103.0 | 102.0 | 104.8 | 105.9 | 108.6 | 111.3 | 112.3 | 117.6 | 118.3 | 1.25 |
| (d) Communication . . . . | 100.0 | 112.0 | 124.0 | 136.4 | 151.2 | 174.4 | 194.5 | 225.8 | 257.1 | 298.6 | |
| (i) No. of post offices . . | 100.0 | 110.5 | 118.2 | 124.3 | 130.5 | 142.0 | 154.3 | 165.1 | 175.7 | 185.4 | 0.625 |
| (ii) No. of broadcasting licences . . . . . | 100.0 | 113.6 | 129.7 | 148.5 | 172.0 | 206.8 | 234.7 | 286.5 | 338.5 | 411.9 | 0.625 |
| B. Output of intermediate & capital goods . . . . . | 100.0 | 115.7 | 135.5 | 148.0 | 146.2 | 158.2 | 186.4 | 199.8 | 225.6 | 249.9 | |
| (i) Intermediate goods . . | 100.0 | 112.6 | 124.7 | 132.2 | 134.4 | 143.9 | 153.1 | 160.0 | 173.7 | 186.9 | 2.5 |
| (ii) Capital goods . . . . | 100.0 | 118.7 | 146.2 | 163.7 | 157.9 | 172.4 | 219.7 | 239.6 | 277.5 | 312.9 | 2.5 |
| C. Imports of intermediate & capital goods . . . . . | 100.0 | 103.4 | 134.4 | 152.5 | 113.8 | 136.8 | 158.7 | 159.9 | 164.3 | 170.9 | 5.0 |
| D. Number of Indian scheduled bank branches . . . . . | 100.0 | 103.4 | 106.9 | 118.8 | 132.0 | 143.0 | 151.2 | 160.0 | 167.7 | 182.2 | 5.0 |
| III. Skills . . . . . | 100.0 | 112.3 | 125.4 | 141.5 | 164.2 | 178.9 | 196.7 | 218.7 | 230.2 | 248.0 | |
| (i) Enrolments in primary schools | 100.0 | 103.3 | 107.8 | 111.6 | 109.8 | 116.8 | 120.0 | 132.8 | 141.0 | 149.6 | 5.0 |
| (ii) Enrolments in secondary schools . . . . . | 100.0 | 123.7 | 139.0 | 154.1 | 208.1 | 227.0 | 262.9 | 298.4 | 328.9 | 358.0 | 5.0 |
| (iii) Number of University graduates . . . . . | 100.0 | 96.4 | 113.5 | 128.4 | 136.7 | 148.5 | 171.9 | 183.2 | 187.0* | 198.4* | 5.0 |
| (iv) Enrolments in Polytechnics . . | 100.0 | 125.9 | 141.3 | 171.8 | 202.3 | 223.4 | 232.1 | 260.5 | 264.1 | 285.8 | 5.0 |
| IV. Factory Employment . . . . . | 100.0 | 102.5 | 112.0 | 114.6 | 112.4 | 119.7 | 123.9 | 129.0 | 135.3 | 144.0 | |
| Number of wages (and salary) earners in factories . . . . . | 100.0 | 102.5 | 112.0 | 114.6 | 112.4 | 119.7 | 123.9 | 129.0 | 135.3 | 144.0 | 20.0 |
| V. Technical change: . . . . . | 100.0 | 112.1 | 131.2 | 147.4 | 170.6 | 186.7 | 210.5 | 236.4 | 282.0 | 343.2 | |
| (a) Patents registered . . . . . | 100.0 | 114.2 | 128.8 | 145.6 | 167.6 | 185.3 | 203.6 | 225.0 | 251.2 | 278.0 | 10.0 |
| (b) Fertilisers consumed . . . . | 100.0 | 110.0 | 133.6 | 149.1 | 173.6 | 188.1 | 217.4 | 247.9 | 312.8 | 408.5 | 10.0 |
| INDEX OF PACE OF DEVELOPMENT . . . . . | 100.0 | 107.9 | 119.7 | 129.6 | 138.3 | 150.3 | 163.4 | 177.0 | 194.1 | 214.9 | 100.0 |
| Simple average of 21 indicators . . | 100.0 | 108.7 | 119.4 | 130.0 | 138.6 | 150.4 | 166.0 | 178.6 | 192.8 | 211.7 | |

* Estimated. Growth rate: 8.5% per annum.

MEANS, STANDARD DEVIATIONS AND CORRELATION CO-EFFICIENTS

TABLE 2

| Indicators | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Means . . . . . | 118.9 | 155.3 | 101.4 | 126.3 | 107.0 | 151.4 | 119.6 | 108.4 | 140.6 | 214.2 | 142.2 | 190.9 | 139.5 | 136.5 | 119.3 | 220.0 | 146.4 | 200.7 | 119.3 | 179.9 | 204.1 |
| Standard Deviations . | 13.06 | 45.48 | 1.09 | 14.32 | 6.11 | 37.18 | 19.45 | 6.05 | 27.30 | 98.30 | 25.60 | 65.75 | 24.72 | 27.40 | 15.77 | 85.82 | 35.38 | 60.37 | 13.26 | 56.54 | 91.96 |
| Correlations | | | | | | | | | | | | | | | | | | | | | |
| 1 . . . . . | 1.000 | .986 | .987 | .965 | .863 | .994 | .006 | .991 | .993 | .977 | .983 | .973 | .839 | .984 | .972 | .991 | .972 | .970 | .974 | .992 | .951 |
| 2 . . . . . | .986 | 1.000 | .987 | .934 | .845 | .993 | —.013 | .988 | .992 | .994 | .980 | .991 | .850 | .982 | .988 | .988 | .976 | .949 | .982 | .992 | .977 |
| 3 . . . . . | .987 | .987 | 1.000 | .952 | .914 | .984 | .099 | .987 | .991 | .972 | .974 | .969 | .833 | .996 | .955 | .996 | .990 | .974 | .963 | .992 | .947 |
| 4 . . . . . | .965 | .934 | .952 | 1.000 | .869 | .949 | .156 | .954 | .967 | .908 | .971 | .940 | .902 | .951 | .912 | .955 | .960 | .971 | .051 | .958 | .878 |
| 5 . . . . . | .863 | .845 | .914 | .869 | 1.000 | .835 | .399 | .866 | .871 | .812 | .843 | .805 | .721 | .915 | .768 | .890 | .909 | .914 | .812 | .874 | .769 |
| 6 . . . . . | .994 | .993 | .984 | .949 | .835 | 1.000 | —.038 | .992 | .992 | .989 | .984 | .984 | .830 | .982 | .985 | .990 | .968 | .959 | .977 | .994 | .971 |
| 7 . . . . . | .006 | —.013 | .099 | .156 | .399 | —.038 | 1.000 | —.011 | .068 | —.080 | —.058 | —.020 | —.156 | .114 | —.127 | —.087 | .171 | .210 | .005 | .051 | —.123 |
| 8 . . . . . | .991 | .988 | .987 | .954 | .866 | .992 | —.011 | 1.000 | .988 | .979 | .978 | .979 | .836 | .980 | .972 | .985 | .965 | .954 | .968 | .988 | .959 |
| 9 . . . . . | .993 | .992 | .991 | .967 | .871 | .992 | .068 | .988 | 1.000 | .981 | .992 | .987 | .873 | .990 | .975 | .995 | .986 | .976 | .986 | .997 | .958 |
| 10 . . . . . | .977 | .994 | .972 | .908 | .812 | .989 | —.080 | .979 | .981 | 1.000 | .974 | .986 | .822 | .973 | .992 | .976 | .955 | .933 | .980 | .986 | .992 |
| 11 . . . . . | .983 | .980 | .974 | .971 | .843 | .984 | —.058 | .978 | .992 | .974 | 1.000 | .987 | .892 | .979 | .971 | .981 | .973 | .972 | .993 | .992 | .963 |
| 12 . . . . . | .973 | .991 | .969 | .940 | .805 | .984 | —.020 | .979 | .987 | .986 | .987 | 1.000 | .892 | .965 | .988 | .972 | .965 | .938 | .991 | .983 | .977 |
| 13 . . . . . | .839 | .850 | .833 | .902 | .721 | .830 | —.156 | .836 | .873 | .822 | .892 | .892 | 1.000 | .830 | .853 | .826 | .880 | .842 | .909 | .849 | .803 |
| 14 . . . . . | .984 | .982 | .996 | .951 | .915 | .982 | .114 | .980 | .990 | .973 | .979 | .965 | .830 | 1.000 | .955 | .995 | 988 | .985 | .968 | .995 | .951 |
| 15 . . . . . | .972 | .988 | .955 | .912 | .768 | .985 | —.127 | .972 | .975 | .992 | .971 | .988 | .853 | .955 | 1.000 | .962 | .945 | .920 | .983 | .975 | .981 |
| 16 . . . . . | .991 | .988 | .996 | .955 | .890 | .990 | —.087 | .985 | .995 | .976 | .981 | .972 | .826 | .995 | .962 | 1.000 | .986 | .981 | .969 | .996 | .953 |
| 17 . . . . . | .972 | .976 | .990 | .960 | .909 | .968 | .171 | .965 | .986 | .955 | .973 | .965 | .880 | .988 | .945 | .986 | 1.000 | .980 | .967 | .984 | .925 |
| 18 . . . . . | .970 | .949 | .974 | .971 | .914 | .959 | .210 | .954 | .976 | .933 | .972 | .938 | .842 | .985 | .920 | .981 | .980 | 1.000 | .950 | .979 | .905 |
| 19 . . . . . | .974 | .982 | .963 | .951 | .812 | .977 | .005 | .968 | .986 | .980 | .993 | .991 | .909 | .968 | .983 | .969 | .967 | .950 | 1.000 | .984 | .971 |
| 20 . . . . . | .992 | .992 | .992 | .958 | .874 | .994 | .051 | .988 | .997 | .986 | .992 | .983 | .849 | .995 | .975 | .996 | .984 | .979 | .984 | 1.000 | .969 |
| 21 . . . . . | .951 | .977 | .947 | .878 | .769 | .971 | —.123 | .959 | .958 | .992 | .963 | .977 | .803 | .951 | .981 | .953 | .925 | .905 | .971 | .969 | 1.000 |

FACTOR CO-EFFICIENTS — TABLE 3

| Indicators | Factor loading | Proportion of variance explained in the growth factor |
|---|---|---|
| 1 | .9920 | .9841 |
| 2 | .9929 | .9859 |
| 3 | .9924 | .9849 |
| 4 | .9656 | .9324 |
| 5 | .8762 | .7677 |
| 6 | .9918 | .9837 |
| 7 | .0605 | .0037 |
| 8 | .9895 | .9791 |
| 9 | .9988 | .9976 |
| 10 | .9831 | .9665 |
| 11 | .9933 | .9866 |
| 12 | .9876 | .9754 |
| 13 | .8745 | .7648 |
| 14 | .9924 | .9849 |
| 15 | .9762 | .9530 |
| 16 | .9937 | .9874 |
| 17 | .9877 | .9756 |
| 18 | .9766 | .9537 |
| 19 | .9877 | .9756 |
| 20 | .9982 | .9964 |
| 21 | .9634 | .9281 |
| Total | | .9022 |

COMBINED INDEX — TABLE 4

| Years | Factor scores | Index |
|---|---|---|
| 1954-55 | 35.8321 | 100.0 |
| 1955-56 | 38.9664 | 108.7 |
| 1956-57 | 42.2286 | 117.9 |
| 1957-58 | 44.5333 | 124.3 |
| 1958-59 | 46.3908 | 129.5 |
| 1959-60 | 49.8675 | 139.2 |
| 1960-61 | 52.8281 | 147.4 |
| 1961-62 | 57.7778 | 161.2 |
| 1962-63 | 63.8879 | 178.3 |
| 1963-64 | 67.6873 | 188.9 |
| Compound Rate of Growth | | 7.3% |



TABLE 5

MEANS, STANDARD DEVIATIONS AND CORRELATION CO-EFFICIENTS

| Groups | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Means | 118.9 | 145.8 | 171.6 | 119.3 | 192.0 |
| Standard deviations | 13.06 | 31.46 | 48.90 | 13.26 | 73.69 |
| Correlations | | | | | |
| 1 | 1.000 | .980 | .988 | .974 | .974 |
| 2 | .980 | 1.000 | .984 | .995 | .980 |
| 3 | .988 | .984 | 1.000 | .973 | .971 |
| 4 | .974 | .995 | .973 | 1.000 | .983 |
| 5 | .974 | .980 | .971 | .983 | 1.000 |

FACTOR CO-EFFICIENTS — TABLE 6

| Groups | Factor loading | Proportion of variance explained in the growth factor |
|---|---|---|
| 1 | .9912 | .9824 |
| 2 | .9956 | .9912 |
| 3 | .9910 | .9821 |
| 4 | .9929 | .9858 |
| 5 | .9893 | .9788 |
| Total | | .9840 |

COMBINED INDEX — TABLE 7

| Years | Factor scores | Index |
|---|---|---|
| 1954-55 | 35.8726 | 100.0 |
| 1955-56 | 38.6557 | 107.5 |
| 1956-57 | 41.9763 | 117.0 |
| 1957-58 | 44.8170 | 124.9 |
| 1958-59 | 45.8855 | 127.9 |
| 1959-60 | 50.2852 | 140.2 |
| 1960-61 | 54.0676 | 150.7 |
| 1961-62 | 57.7164 | 160.9 |
| 1962-63 | 63.1698 | 176.1 |
| 1963-64 | 67.6539 | 188.6 |
| Compound rate of Growth | 7.3% | |

TABLE 8

INDICES OF THE PACE OF DEVELOPMENT

| Years | | Factor scores based on 21 indicators | Index | Factor scores based on 5 group determinants | Index | Index of pace of development * |
|---|---|---|---|---|---|---|
| 1954-55 . . . | . . | 35.8321 | 100.0 | 35.8726 | 100.0 | 100.0 |
| 1955-56 . . . | . . | 38.9664 | 108.7 | 38.5557 | 107.5 | 107.9 |
| 1956-57 . . . | . . | 42.2286 | 117.9 | 41.9763 | 117.0 | 119.7 |
| 1957-58 . . . | . . | 44.5333 | 124.3 | 44.8170 | 124.9 | 129.6 |
| 1958-59 . . . | . . . | 46.3908 | 129.5 | 45.8855 | 127.9 | 138.3 |
| 1959-60 . . . | . . | 49.8675 | 139.2 | 50.2852 | 140.2 | 150.3 |
| 1960-61 . . . | . . | 52.8281 | 147.4 | 54.0676 | 150.7 | 163.4 |
| 1961-62 . . . | . . | 57.7778 | 161.2 | 57.7164 | 160.9 | 177.0 |
| 1962-63 . . . | . . | 63.8879 | 178.3 | 63.1698 | 176.1 | 194.1 |
| 1963-64 . . . | . . | 67.6873 | 188.9 | 67.6539 | 188.6 | 214.9 |
| Annual rate of growth (per cent) | . . | | 7.3 | | 7.3 | 8.5 |

* Based on simple average.

V. V. D and V. V. B.