

PERFORMANCE CRITERIA FOR EVALUATING  
ECONOMIC DEVELOPMENT POTENTIAL:  
AN OPERATIONAL APPROACH

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This paper considers the problem of devising relatively objective criteria, based on past performance, for selecting underdeveloped countries with immediate development potential. The question is of practical importance to foreign aid policy, since those countries which are most rapidly adapting their economic and sociopolitical organization in a direction favorable to economic development are also those in which the economic productivity of foreign capital transfers is likely to be highest. Our concern, then, is with criteria for identifying a set of promising countries as potential foreign aid recipients.

In principle, two kinds of approaches can be used to study this question. The first starts from a theoretical model of the development process, estimates it statistically, and then, by analytical methods or sensitivity studies, finds those combinations of values of the relevant parameters which correspond to stagnation, moderate growth, and good growth performance. Each country is then assigned to that group which its parameter combination most closely approximates. This is the essence of the approach used in Chenery and Strout, "Foreign Assistance and Economic Development."<sup>1</sup>

The second approach is more empirical in nature. It determines statistically by an analysis of variance, those linear combinations of country performance characteristics which best discriminate among various groups of countries.<sup>2</sup> The sense in which the derived functions discriminate best among groups is that they represent those linear combinations of characteristics, each of which, seriatim (given

\* The authors are indebted to Frank Adelman, George Dalton, and Jonathan Hughes for valuable comments, and to Donald Morrison for the computer program which was used in these computations. The work was financed by NSF grant GS-1235.

1. *American Economic Review*, LVI (Sept. 1966), 675-733.

2. The technique of discriminant analysis is explained in C. R. Rao, *Advanced Statistical Methods in Biometric Research* (New York: Wiley, 1952), Chaps. 7-9, and in W. W. Cooley and P. R. Lohnes, *Multivariate Procedures for the Behavioral Sciences* (New York: Wiley, 1962), Chaps. 6-7.

the preceding variables), maximizes the remaining distance between the square of the difference between group means and the variance within groups. The discriminant functions obtained in this manner can then be used to classify countries into performance groups with a high degree of reliability, using a relatively small number of performance characteristics. The probability that a given country belongs in a given group can also be estimated from the analysis.

It is the second approach which has been used in this paper. Since the results indicate that over 97 per cent of the discriminable variance between groups can be represented by a function of only four variables, this technique appears to have the merit of operational simplicity.

#### PROCEDURE

In order to obtain a first estimate of the discriminant functions, seventy-three underdeveloped noncommunist countries were first classified into three groups according to past performance. The top group consisted of countries which, from 1950-51 to 1963-64, had achieved an average rate of growth of real per capita GNP of at least 2 per cent and which, in addition, ranked moderately high with respect to no less than five out of the seven following characteristics: change in the degree of industrialization since 1950; the degrees of improvement since 1950 in agricultural productivity, physical overhead capital, effectiveness of financial institutions, the tax system, and the rate of investment; and the rate of additions to the stock of human resources.<sup>3</sup> Excluded from the top group were five countries meeting the above criteria which had not attained a certain minimal level of socio-economic development by 1961.<sup>4</sup>

The lowest group included all those countries which, from 1950-51 to 1963-64 had an average real rate of growth of per capita GNP of less than 1 per cent per year. Many of the countries in this group were stagnant or declining in terms of rate of growth of real per capita GNP.

Except for six countries, which were left unclassified,<sup>5</sup> all other countries were included in the intermediate group. This group there-

3. Brief definitions of these variables are given below.

4. This minimal level was defined in terms of minimal factor score on the factor representing the level of socio-economic development in the factor analysis relating per capita GNP to twenty-three social and political indicators. See Irma Adelman and C. T. Morris, *Society, Politics, and Economic Development: A Quantitative Approach* (Baltimore: The Johns Hopkins Press, 1967), Chap. 4.

5. See Table I for the names of unclassified countries.

fore consisted of both countries in which the rate of growth of per capita GNP, while accompanied by fairly widespread improvement in economic performance, was fairly low (between 1 per cent and 2 per cent per year), and countries showing a relatively high rate of growth of per capita GNP which had only a limited overall impact within the economy. The resultant grouping of countries is given in Table I.

TABLE I  
PRELIMINARY COUNTRY CLASSIFICATION BY DEVELOPMENT POTENTIAL\*

| High Prospect Group  | Intermediate Group | Low Prospect Group | Unclassified |
|----------------------|--------------------|--------------------|--------------|
| Brazil               | Algeria            | Afghanistan        | Burma        |
| China (Taiwan)       | Chile              | Argentina          | Ethiopia     |
| Cyprus               | Colombia           | Bolivia            | Gabon        |
| Greece               | Costa Rica         | Cambodia           | Liberia      |
| Israel               | Ecuador            | Cameroon           | Panama       |
| Jamaica              | El Salvador        | Ceylon             | Tanganyika   |
| Mexico               | Ghana              | Chad               |              |
| Peru                 | Guatemala          | Dahomey            |              |
| Philippines          | Honduras           | Dominican Republic |              |
| South Africa         | India              | Guinea             |              |
| South Korea          | Iran               | Indonesia          |              |
| Thailand             | Iraq               | Laos               |              |
| Trinidad             | Ivory Coast        | Malagasy           |              |
| Turkey               | Jordan             | Malawi             |              |
| United Arab Republic | Kenya              | Morocco            |              |
| Venezuela            | Lebanon            | Nepal              |              |
|                      | Libya              | Niger              |              |
|                      | Nicaragua          | Paraguay           |              |
|                      | Nigeria            | Senegal            |              |
|                      | Pakistan           | Sierra Leone       |              |
|                      | Rhodesia           | Somalia            |              |
|                      | Sudan              | South Vietnam      |              |
|                      | Tunisia            | Surinam            |              |
|                      | Zambia             | Syria              |              |
|                      |                    | Uganda             |              |
|                      |                    | Uruguay            |              |
|                      |                    | Yemen              |              |

\* See the text for explanation.

The initial data inputs consisted of twenty-nine indicators of various broad aspects of economic, social, and political characteristics. The data on these country characteristics had been developed previously by the authors during a broader study of the relationship

between socio-political change and economic development.<sup>6</sup> These twenty-nine indicators combine both statistical and judgmental elements, and, except for the measures of rates of change, apply generally to the period 1957-62. The dynamic indicators are based upon the extent of improvement in performance between 1950 and 1963-64.

The particular form of discriminant analysis chosen scans the initial list of variables and then selects those which add most to the explanation of the variance between group means, given the other variables already included.<sup>7</sup> Variables are added successively to the discriminant analysis until no variables can be found which contribute a reduction of variance between group means significant at the 5 per cent level. In the present case, this process resulted in the selection of only four variables out of the initial list of twenty-nine indicators.

Once the four variables were selected, the computation of the discriminant functions was carried out as indicated in Cooley and Lohnes,<sup>8</sup> to which the interested reader is referred for the mathematical and procedural technique. The important points for our present purposes are that (a) the discriminant functions are chosen in such a way as to maintain the greatest possible separation between the populations being compared;<sup>9</sup> (b) the number of independent discriminant functions that can be developed when the number of variables exceeds the number of groups is one less than the number of groups (i.e., only two independent discriminant functions can be derived for our case); and (c) only the first of these discriminant functions turns out to be statistically significant.<sup>1</sup>

6. Adelman and Morris, *op. cit.*

7. The specific test statistic used is the measure of distance between groups defined by the generalized Mahalanobis  $D^2$  (see Rao, *op. cit.*, pp. 257-58). Variables which gave the largest distance between group means, as measured by  $D^2$  are added successively. Then, given the first variable selected, all other variables are scanned in order to see whether when added to the first variable, they will provide independent information for discrimination among groups. That variable which contributes most independent information (i.e., increases  $D^2$  most) is selected as a second variable for the analysis. The process is repeated, given the first two variables, for a third variable, until no significant improvement in  $D^2$  can be obtained by adding more variables.

8. *Loc. cit.*

9. More specifically, the discriminant functions are the solutions,  $X$ , of the matrix equation  $(B - \lambda W)X = 0$ , where  $B$  and  $W$  are the dispersion matrices between and within populations. This matrix equation is derived by maximizing the ratio of the between sum of squares ( $X' BX$ ) relative to the within sum of squares ( $X' WX$ ) on the discriminant function represented by the eigenvalues  $\lambda$  and their associated eigenvectors  $X$ . For more detail, see Cooley and Lohnes, *op. cit.*, pp. 117-18.

1. Approximate significance tests for large samples are given in Rao, *op. cit.*, pp. 370-78.

## ECONOMIC, SOCIAL AND POLITICAL INDICATORS

A brief description of the twenty-nine economic, social, and political characteristics which comprise the data inputs for the analysis is given below; a complete description of the classification schemes employed may be found in *Society, Politics, and Economic Development*.<sup>2</sup>

## ECONOMIC INDICATORS

1. *Per Capita GNP (1961)*. The score which each country is given with respect to this indicator is the value of its per capita GNP.

2. *Natural Resources*. The grouping of countries into categories by natural resource abundance was based upon information regarding the quantity and variety of fuel and nonfuel mineral resources together with data on the amount of agricultural land available per capita.

3. *Gross Investment Rate (1957-1962)*. Countries were grouped according to the average ratio of gross investment to gross national product.

4. *Level of Modernization of Industry (About 1961)*. This indicator combines three principal elements: the relative importance of *domestically* directed and financed modern power-driven industrial activities; the modernity of machinery and of organization patterns in the modern industrial sector; and the diversity and range of goods produced in the modern industrial sector.

5. *Change in Degree of Industrialization Since 1950*. This index is a composite of three statistical elements: the average rate of change (in constant prices) in industrial output; the increase in the proportion of GNP originating in industry; and the change in the proportion of industrial employment, all over the period 1950-63.

6. *Level of Modernization of Techniques of Agriculture (About 1961)*. This indicator is a composite based upon the extent of use of mechanical power, fertilizer, and other modern techniques in agriculture, and the relative weight of traditional and of modern agriculture.

7. *Degree of Improvement in Agricultural Productivity Since 1950*. This indicator distinguishes among countries by the extent to which they had experienced an increase in output greater than could

2. *Op. cit.* The full list of variables developed for that book consisted of forty-one variables. The variables describing the extent of democracy were deleted from the present study since our previous investigation revealed that they were essentially irrelevant to short-run economic performance.

be accounted for by additional inputs of the same quality as those prevailing in 1950. Indications concerning the extent of increases in the use of chemical fertilizer, mechanical power, the completion of modern irrigation systems, or extensions in the use of other modern agricultural techniques, provided the basis for this classification.

8. *Character of Agricultural Organization (About 1960)*. This index combines indices of land tenure patterns and the size and viability of farming units. Various types of agrarian structure are viewed as located along a scale, one end of which is represented by communally owned agricultural lands on which the marketing of crops is only of incidental importance, and the other end of which is depicted by commercial agriculture in which owner operated farms are sufficiently large to be economically viable. Intermediate on the scale are tenant-operated subsistence farms and large owner-absentee commercial farms or plantations.

9. *Level of Adequacy of Physical Overhead Capital (About 1961)*. Countries were grouped into four categories based upon the adequacy of internal transport systems (including roads, rail and waterways) and power networks, in meeting current requirements for economic development.

10. *Degree of Improvement in Physical Overhead Capital Since 1950*. This is a composite indicator of improvements in transport-systems (road and rail transport). It did not prove possible to broaden the indicator by including estimates of the ratio of change of installed electrical capacity, primarily because, among the lower income countries in the sample, the construction of one or two small electric plants serving a small area often yielded disproportionately high percentage increases in total electric capacity.

11. *Level of Effectiveness of the Tax System (1961)*. This indicator is a composite based upon: the proportion of total domestic government revenue to GNP; the ratio of direct tax revenues to total government revenues with, however, special treatment of countries in which a single foreign sector provided almost all direct tax revenues; and the breadth of the tax base and the efficiency of tax collections.

12. *Degree of Improvement in the Tax Systems Since 1950*. This index is a composite variable based upon the change in the ratio of domestic revenue to GNP, the average rate of increase in real domestic government revenues, and the change in the ratio of direct tax to total government revenues.

13. *Level of Effectiveness of Financial Institutions (About 1961)*. This variable is a broad composite which combines both the

success of financial institutions in attracting private savings and the extent to which they provide medium and long-run credit to the major sectors of the economy.

14. *Degree of Improvement in Financial Institutions Since 1950.* Countries were classified on the basis of statistical measures of the extent of increase since 1950 in both the volume of private savings flowing through the banking system and the volume of medium and long term lending by the banking system to the private sector. Among the statistical indicators used were the percentage point change in the ratio of time and demand deposits to GNP for 1950-51 to 1962-63 and the approximate increase in the real value of private domestic liabilities to the banking system over the same period.

15. *Rate of Improvement in Human Resources (1961).* This indicator is based upon the Harbison-Myers composite index of the level of human resource development and is a weighted average of secondary and higher level school enrollment ratios as a percentage of the relevant age group. We interpret this index to refer to the rate of improvement in human resources since it measures the rate of additions to the stock of education (about 1961) rather than the related total stock of education.

#### SOCIO-CULTURAL INDICATORS

16. *Size of Traditional Agricultural Sector (About 1960).* This classification indicates the proportion of the population of less developed countries engaged in traditional subsistence agriculture in which production is largely for self-contained indigenous communities, and marketing of surpluses is of incidental importance. Both modern commercial agriculture and indigenous cash-crop agriculture are excluded.

17. *Extent of Dualism (About 1960).* This index stratifies countries by the presence and extent of socio-economic and technical dualism. At one pole are the largely agrarian societies having extremely small exchange sectors; at the other pole are countries with continuous interaction between modern and nonmodern elements. Intermediate are societies in which a foreign financed and directed modern sector is superimposed upon a predominantly agrarian society and countries in which the growth of an indigenous small-scale cash-crop sector using conventional techniques has evolved at the expense of a traditional subsistence sector.

18. *Extent of Urbanization (1961).* The categories of this

index are defined in terms of the proportion of the population living in urban areas containing over 20,000 people.

19. *Character of Basic Social Organization (About 1960).* This classification is based upon the predominant character of a less developed country's basic social unit. Countries are grouped into three principal categories with countries in which the predominant form of social organization is the immediate family group at the top, and countries in which strong tribal allegiances are widespread, at the bottom.

20. *Extent of Literacy (About 1958).* This classification groups countries by the percentage of population (aged fifteen and over) which is literate.

21. *Extent of Mass Communication (About 1960).* This classification is designed to indicate the prevalence of media of mass communication in less developed countries. It is based upon a composite measure of newspaper circulation and of radios in use, in which the former is given the greater weight.

22. *Importance of the Indigenous Middle Class (About 1960).* This classification is based upon the relative size and political importance of indigenous people in middle class occupations in less developed countries. Middle class occupations are interpreted to include entrepreneurs, and managerial, technical, administrative, commercial and banking employees.

23. *Extent of Social Mobility (About 1960).* This classification is based upon a composite measure of several aspects of social mobility, including the extent of racial or cultural barriers to mobility, the extent of educational opportunity, and access to membership in the middle class.

24. *Crude Fertility Rate (1955-59).* This index is based upon estimates of crude fertility rates.

25. *Degree of Modernization of Outlook (About 1960).* This classification is a composite measure of the degree of modernization of outlook of educated urban groups and of the extent to which programs of political and economic modernization have gained the support of both rural and urban populations.

#### POLITICAL INDICATORS

26. *Extent of National Integration (1957-62).* This classification groups countries according to both cultural and political aspects of national integration. Statistical information concerning the proportion of population speaking a common language is combined

with two qualitative aspects of integration: the degree of integration of local political structures with national political institutions and the prevalence among the population of a sense of national identity.

27. *Degree of Administrative Efficiency (1957-62)*. This classification is based upon several aspects of efficiency of administration in less developed countries: the degree of permanence and training of administrators, the extent to which corruption interferes with government functioning, the extent to which bureaucratic inefficiency and incompetence hamper government functioning, and the extent to which instability of policy at higher levels of administration promotes inefficiency. Inasmuch as the quality of administrative efficiency changed noticeably over the 1957-62 period, greater weight has been given to more recent years.

28. *Extent of Political Stability (1950-63)*. This classification groups countries according to the stability of their political systems over the period 1957-63. The degree of stability is judged by the frequency of changes in form of government, the frequency and violence of coups, the extent of political subversion and domestic violence, and the effectiveness of internal security.

29. *Degree of Commitment of Leadership to Promoting Economic Development (1957-62)*. Three broad categories of leadership commitment were distinguished on the basis of the following judgments: (1) whether the heads of agencies involved in direct or indirect central guidance of the economy typically make concerted efforts to promote the country's economic growth; (2) whether or not this planning effort includes serious attempts to alter the institutional arrangements which clearly block the achievement of planning goals; and (3) whether or not there is a national plan and a planning group functioning within the government which is charged full-time with executing the plan.

### RESULTS

The results of the analysis are striking. They indicate that a single discriminant function, of only four variables, accounts for 97 per cent of the discriminable variance between groups.<sup>3</sup> The variables selected by the discriminant analysis were two broad indices of dynamic economic performance: (the degree of improvement in financial institutions,  $F$ , and the degree of improvement in physical

3. This is, of course, only a partial indicator of the quality of the results obtained. In addition, as discussed below, the separation among groups is good as indicated by the fact that the group means in the discriminant space are relatively far apart; and the groups are relatively distinct from each other as is evident from the modest extent of overlap between groups.

overhead capital,  $K$ ); one broad indicator of social development (the degree of modernization of outlook,  $M$ ); and one broad index of the political climate (the extent of leadership commitment to economic development,  $L$ ). Specifically, the first discriminant function is:

$$D_1 = .71F + 26K + .52M + .37L.$$

The importance in  $D_1$  of the variable representing the degree of improvement in financial institutions ( $F$ ) is perhaps not surprising. It will be recalled that this indicator is an overall measure of the success of the economy in increasing the flow of domestic savings through financial institutions and the extent to which these financial organizations provide medium and long term credit for investment in the major sectors of the economy. The degree of improvement in financial institutions, therefore, describes one fundamental aspect of successful economic performance in a developing country — the loosening of the savings-investment constraint through domestic efforts. It is interesting to note that this general indicator of the effectiveness of institutions for saving and lending was chosen by the discriminant analysis in preference to the more specialized index offered by the rate of investment itself. This is in part due to the fact that our variable  $F$  reflects a widespread pattern of dynamic improvements: as evident from Table II,  $F$  is well correlated with changes in the degree of industrialization, improvements in agricultural productivity, improvements in tax institutions, and to a lesser extent, improvements in human resources.

Physical overhead capital ( $K$ ), our second economic variable in  $D_1$ , is crucial to the development of low-income countries. Power supplies are necessary to support a modern industrial sector, and transportation is an essential element of a market economy on both the consumption and the production sides. Furthermore, investment in both transport and power tends to result in pecuniary external economics, which may greatly facilitate direct investment in other fields. For all these reasons an economy's development potential can be expected to be related to differences in the rate of improvement of physical overhead capital.

The inclusion of the indicator of the degree of modernization of outlook ( $M$ ) in the discriminant function is also very much in line with one's a priori expectations, since the presence of attitudes favorable to change and innovation plays a crucial role in successful economic development.<sup>4</sup> Indeed, many social scientists would

4. In practical applications of this technique it might, nevertheless be desirable to replace this variable with another, less judgmental, indicator.

TABLE II  
SAMPLE CORRELATIONS OF INCLUDED VARIABLES  
(FULL SAMPLE OF 73 COUNTRIES)

|   | Rate of<br>Improvement<br>of Financial<br>Institutions<br>(F) | Modern-<br>ization<br>of<br>Outlook<br>(M) | Leader-<br>ship<br>Commit-<br>ment<br>(L) | Improve-<br>ment<br>in<br>Physical<br>Overhead<br>Capital<br>(K) |
|---|---|--|---|--|
| Level of GNP per capita                           | .369  | .685                                       | .339                                      | .108   |
| Abundance of Natural Resources                    | .195  | .317                                       | .153                                      | .278   |
| Level of Modernization of Industry                | .540  | .788                                       | .280                                      | .270   |
| Level of Agricultural Productivity                | .409  | .784                                       | .280                                      | .002   |
| Character of Agricultural Organization            | .434  | .748                                       | .398                                      | .148   |
| Level of Effectiveness of Tax System              | .462  | .669                                       | .464                                      | .220   |
| Level of Effectiveness of                         |   |  |   |  |
| Financial Institutions                            | .574  | .751                                       | .478                                      | .337   |
| Adequacy of Physical Overhead Capital             | .500  | .802                                       | .392                                      | .128   |
| Gross Investment Rate                             | .407  | .639                                       | .392                                      | .231   |
| Change in Degree of Industrialization             | .724  | .444                                       | .247                                      | .312   |
| Improvement in Agricultural Productivity          | .638  | .371                                       | .379                                      | .387   |
| Improvement in Effectiveness of                   |   |  |   |  |
| Tax System  | .600  | .281                                       | .360                                      | .246   |
| Improvement in Effectiveness of                   |   |  |   |  |
| Financial Institutions                            | 1.000   | .456                                       | .196                                      | .320   |
| Improvement in Physical                           |   |  |   |  |
| Overhead Capital                                  | .320  | .148                                       | .153                                      | 1.000  |
| Improvement in Human Resources                    | .562  | .641                                       | .250                                      | .169   |
| Size of Traditional Agricultural Sector           | -.525   | -.807                                      | -.218                                     | -.100  |
| Degree of Dualism                                 | .575  | .815                                       | .257                                      | .253   |
| Degree of Urbanization                            | .429  | .694                                       | .227                                      | .187   |
| Degree of Modernization of Outlook                | .456  | 1.000                                      | .402                                      | .148   |
| Importance of Indigenous Middle Class             | .549  | .694                                       | .259                                      | .185   |
| Extent of Social Mobility                         | .418  | .719                                       | .229                                      | .160   |
| Extent of Literacy                                | .402  | .688                                       | .107                                      | .075   |
| Extent of Mass Communication                      | .466  | .715                                       | .140                                      | .127   |
| Basic Social Organization                         | .411  | .644                                       | .075                                      | -.041  |
| Crude Fertility Rate                              | -.298   | -.513                                      | -.137                                     | -.077  |
| Extent of National Integration                    | .360  | .577                                       | .156                                      | .061   |
| Degree of Administrative Efficiency               | .252  | .667                                       | .484                                      | .194   |
| Degree of Political Stability                     | .039  | .311                                       | .527                                      | .136   |
| Extent of Leadership Commitment<br>to Development | .196  | .402                                       | 1.000                                     | .153   |

agree with W. E. Moore that an essential aspect of the transition of a less developed society into a developed one is the "transformation of the contents of the minds of the elite who direct and of the

This could be done by deleting this variable from the permissible list, and, thereby, forcing the analysis to select another variable (or variables) instead.

men who run" the society and polity.<sup>5</sup> A number of authors have attempted to define this transformation. One school of thought sees a fundamental spiritual characteristic of advanced societies in their emphasis upon individual rationality of thought and behavior based upon the belief that man can control his environment. Another approach underlines the individual's sense of participation in the socio-cultural and political life of the nation.

In developing our index of *M*, we had to devise a very broad characterization of less developed countries, for which we were forced to rely heavily upon judgmental information and interviews with regional experts. Two qualitative elements were combined in the index: the extent to which the outlook of educated urban groups was modernized and the extent to which programs of political, social, and economic modernization (such as health programs and institution building) had gained support among the urban and the rural populations. With respect to the former element, a judgment of "significant" modernization required that the adoption of Western or modern styles of living had gone considerably farther than external forms and dress, and that at least some important modern institutions of social and political participation (for example, voluntary associations) had been created.

It is clear from the simple correlations of our indicator of the modernization of outlook (Table II above) that it captures a wide array of socio-economic characteristics. It is highly correlated with the level of modernization of industry, the level of agricultural productivity, the character of agricultural organization, the level of effectiveness of financial institutions, the adequacy of physical overhead capital, the size of the traditional agricultural sector (negatively), the extent of dualism, the importance of the middle class, the degree of social mobility, and the extent of mass communication. It is also apparent from Table III (which gives the group means of variables in the discriminant function) that *M* is an important discriminant primarily between the lowest and the intermediate groups: the mean value of this variable in the intermediate group is more than twice its value in the lowest group; the change between the intermediate and the high group is only 50 per cent.

The last important variable appearing in the discriminant function is *L*, the extent of leadership commitment to economic de-

5. "Theory, Ideology, Non-Economic Values, and Politico-Economic Development," in *Tradition, Values and Socio-Economic Development*, ed. Ralph Braibanti and J. J. Spengler (Durham, N.C.: Duke University Press, 1961), p. 5.

TABLE III  
MEANS OF VARIABLES IN DISCRIMINANT FUNCTION

|   | High Potential Group | Intermediate Potential Group | Low Potential Group |
|---|----------------------|------------------------------|---------------------|
| Improvement in Effectiveness of Financial Institutions ( <i>F</i> ) | 78.9                 | 54.6                         | 21.7                |
| Improvement in Physical Overhead Capital ( <i>K</i> )               | 65.6                 | 52.5                         | 35.9                |
| Degree of Modernization of Outlook ( <i>M</i> )                     | 78.9                 | 50.4                         | 22.7                |
| Leadership Commitment to Development ( <i>L</i> )                   | 64.4                 | 36.2                         | 30.7                |

velopment. As indicated above, the ranking of countries in terms of this variable was based upon various attributes of leadership actions in the economic field: in particular, the extent of concerted effort by official and semi-official national agencies to promote economic growth; the extent of purposeful attempts by the leadership to remedy various institutional barriers to development and the existence of national plans and government agencies for plan formulation and implementation. Interestingly enough, the indicator *L* discriminates primarily between the intermediate and high potential groups; the mean value of *L* is only about 20 per cent higher for the intermediate nations than it is for the low potential countries, as contrasted with almost a factor of two differences in the mean value of leadership commitment between the intermediate and high potential groups (see Table III). The striking importance of leadership commitment as a discriminant between the middle and the high performance groups is consistent with the results obtained by the authors in a larger study of economic and noneconomic determinants of the short-run economic performance of underdeveloped countries.<sup>6</sup> In this study, it was found that, once the major socio-structural bottlenecks to development have been overcome, the only important noneconomic determinant of an economy's rate of progress towards self-sustained growth is the extent of leadership commitment to development.

In general, the stepwise discriminant analysis encompasses to a remarkable extent the full range of characteristics of low income countries which would be expected to affect a country's development

6. Adelman and Morris, *op. cit.*

prospects. For example, Davis, Hughes, and McDougall<sup>7</sup> found that a combination of a government responsive to the community's social overhead needs, a dynamic financial system, developing transport, and a physically mobile and socially adaptive population accounts virtually completely for the "outline" of American development. Similarly, there is a correspondence between the variables selected by the stepwise discriminant analysis and those which turn out to be important in a larger cross-sectional analysis of interactions among economic, social and political forces in the process of development.<sup>8</sup>

But which of the above four variables is the most important in discriminating among static and dynamic economies? To answer this question discriminant function  $D_1$  must be normalized so that its variance in each of the groups is unity. The normalized form of  $D_1$ , is

$$D_1' = 127F + 65K + 108M + 72L$$

which indicates that, in terms of overall contribution to the discriminating power of the function, the order of importance of the variables is: (1) the rate of improvement of financial institutions, (2) the extent of modernization of outlook, (3) leadership commitment to development, and (4) the improvement in physical overhead capital.

The extent of usefulness of a given discriminant function depends, however, not only upon the reasonableness of the variables selected and upon the percentage of discriminable variance for which this function accounts, but also upon the extent of separation among groups to which its use gives rise. With respect to this last criterion, the group means in the discriminant space are relatively far apart. The mean discriminant score of the high potential group is 135, for the intermediate group 92, and for the low potential group 49. The groups are also relatively distinct from each other. The extent of overlap into the high group by the intermediate group is 25 per cent;<sup>9</sup> similarly, only about one-sixth of the intermediate countries have characteristics close to those of the high group; finally, the overlap of low countries into the intermediate group is about 13 per cent.

7. L. E. Davis, J. R. T. Hughes, and D. M. McDougall *American Economic History* (Rev. ed.; Homewood, Ill.: Irwin, 1965) pp. 4-9.

8. Adelman and Morris, *op. cit.*

9. This figure should be interpreted to mean that approximately 25 per cent of the countries in the high group are just as close or closer, in terms of their discriminant scores, to the countries in the intermediate group as they are to those in the higher group.

## GROUP MEMBERSHIP PROBABILITIES

One of the most useful operational aspects of the discriminant analysis is that it makes possible an estimation of the probability that a given country belongs in a given development potential group on the basis of its classification with respect to only a very small number of indicators. This probability can be used to assess the development potential of previously unclassified countries, as well as to revise the original estimate of a nation's development prospects. The group membership probabilities of the individual countries included in the present analysis are given in Table IV. In general, they bear out our original country classification. There are, nevertheless, a few notable exceptions. Thus, of the countries initially included in the high group, the analysis suggests that Thailand, Peru, and South Korea are more akin to members of the intermediate group than they are to the high group. Similarly, in the intermediate group, Rhodesia and India seem to approximate the high group more closely than they do the intermediate group; and Iraq, Algeria, Libya, and Zambia appear to be more nearly akin to the low group. Finally, in the low group, Ceylon, Argentina, and Syria seem closer to the intermediate group than to the low prospect group. As for the unclassified countries, Gabon, Ethiopia, Liberia, and Tanganyika belong to the low group, despite their high growth rates. The analysis suggests that the performance of these countries might best be characterized as growth without development.<sup>1</sup> Panama belongs in the intermediate class, while Burma is marginal between the intermediate and low groups.

The discriminant analysis thus produces new information, in that it enables one to classify unassigned countries and in that it calls attention to potential misclassifications. Some of these cases of apparent misclassification can actually be supported by a closer look at the economic and political conditions in those countries. For example, in the high group, the extremely good performance of Thailand, Peru, and South Korea is, for the most part, a product of only the last few years of the period covered by our dynamic indicators, and their levels of socio-economic development are still rather low. The suggestion that India, despite its low growth of per capita GNP, may belong in the high rather than the intermediate grouping by development potential, receives some support from the

1. Indeed this is the title of a book recently published on one of the four countries. R. W. Clower, G. Dalton, M. Harwitz and A. A. Walters: *Growth Without Development: An Economic Survey of Liberia* (Evanston Ill.: Northwestern University Press, 1966).

TABLE IV  
GROUP MEMBERSHIP PROBABILITIES OF INDIVIDUAL COUNTRIES  
(USING DISCRIMINANT FUNCTION  $D_1$ )

| Country                   | Discriminant Score | Probability of Membership in |                    |                     |
|---------------------------|--------------------|------------------------------|--------------------|---------------------|
|                           |                    | High Potential Group         | Intermediate Group | Low Potential Group |
| <i>High Potential</i>     |                    |                              |                    |                     |
| Brazil                    | 127                | .62                          | .38                | 0                   |
| Cyprus                    | 115                | .56                          | .42                | .01                 |
| Greece                    | 156                | .92                          | .08                | 0                   |
| Israel                    | 173                | .97                          | .03                | 0                   |
| Jamaica                   | 117                | .53                          | .46                | 0                   |
| Mexico                    | 125                | .60                          | .40                | 0                   |
| Peru                      | 98                 | .18                          | .75                | 0                   |
| Philippines               | 131                | .70                          | .31                | 0                   |
| South Africa              | 164                | .95                          | .05                | 0                   |
| South Korea               | 104                | .25                          | .71                | .04                 |
| Taiwan                    | 157                | .92                          | .07                | 0                   |
| Thailand                  | 101                | .21                          | .73                | .05                 |
| Trinidad                  | 157                | .93                          | .07                | 0                   |
| Turkey                    | 148                | .87                          | .13                | 0                   |
| United Arab Republic      | 123                | .56                          | .44                | 0                   |
| Venezuela                 | 164                | .95                          | .05                | 0                   |
| <i>Intermediate Group</i> |                    |                              |                    |                     |
| Algeria                   | 50                 | 0                            | .17                | .83                 |
| Chile                     | 106                | .28                          | .69                | .03                 |
| Colombia                  | 102                | .21                          | .73                | .05                 |
| Costa Rica                | 86                 | .07                          | .71                | .21                 |
| Ecuador                   | 74                 | .02                          | .52                | .46                 |
| El Salvador               | 76                 | .03                          | .56                | .40                 |
| Ghana                     | 80                 | .04                          | .65                | .31                 |
| Guatemala                 | 89                 | .09                          | .74                | .17                 |
| Honduras                  | 84                 | .06                          | .69                | .25                 |
| India                     | 157                | .93                          | .07                | 0                   |
| Iran                      | 102                | .23                          | .72                | .04                 |
| Iraq                      | 64                 | 0                            | .35                | .65                 |
| Ivory Coast               | 109                | .32                          | .66                | .02                 |
| Jordan                    | 90                 | .09                          | .75                | .16                 |
| Kenya                     | 74                 | .02                          | .54                | .44                 |
| Lebanon                   | 88                 | .08                          | .74                | .18                 |
| Libya                     | 64                 | 0                            | .35                | .65                 |
| Nicaragua                 | 113                | .38                          | .60                | .01                 |
| Nigeria                   | 115                | .42                          | .57                | .01                 |
| Pakistan                  | 114                | .41                          | .58                | .01                 |
| Rhodesia                  | 133                | .72                          | .28                | 0                   |
| Sudan                     | 99                 | .18                          | .75                | .07                 |
| Tunisia                   | 91                 | .11                          | .76                | .14                 |
| Zambia                    | 46                 | 0                            | .13                | .86                 |



TABLE IV—continued

| Country                    | Discriminant Score | Probability of Membership in |                    |                     |
|----------------------------|--------------------|------------------------------|--------------------|---------------------|
|                            |                    | High Potential Group         | Intermediate Group | Low Potential Group |
| <i>Low Potential Group</i> |                    |                              |                    |                     |
| Afghanistan                | 64                 | 0                            | .35                | .64                 |
| Argentina                  | 89                 | .09                          | .74                | .16                 |
| Bolivia                    | 72                 | .02                          | .49                | .49                 |
| Cambodia                   | 53                 | 0                            | .20                | .80                 |
| Cameroon                   | 65                 | 0                            | .37                | .62                 |
| Ceylon                     | 90                 | .09                          | .74                | .17                 |
| Chad                       | 23                 | 0                            | .03                | .97                 |
| Dahomey                    | 40                 | 0                            | .09                | .91                 |
| Dominican Republic         | 68                 | .01                          | .42                | .57                 |
| Guinea                     | 19                 | 0                            | .04                | .96                 |
| Indonesia                  | 23                 | 0                            | .06                | .94                 |
| Laos                       | 18                 | 0                            | .03                | .97                 |
| Malagasy                   | 48                 | 0                            | .14                | .86                 |
| Malawi                     | 12                 | 0                            | .02                | .98                 |
| Morocco                    | 56                 | 0                            | .23                | .77                 |
| Nepal                      | 14                 | 0                            | .02                | .98                 |
| Niger                      | 27                 | 0                            | .04                | .96                 |
| Paraguay                   | 60                 | 0                            | .28                | .71                 |
| Senegal                    | 44                 | 0                            | .11                | .89                 |
| Sierra Leone               | 15                 | 0                            | .09                | .91                 |
| Somalia                    | 46                 | 0                            | .14                | .87                 |
| South Vietnam              | 50                 | 0                            | .17                | .83                 |
| Surinam                    | 54                 | 0                            | .21                | .79                 |
| Syria                      | 79                 | .04                          | .62                | .34                 |
| Uganda                     | 48                 | 0                            | .15                | .85                 |
| Uruguay                    | 60                 | 0                            | .29                | .71                 |
| Yemen                      | 14                 | 0                            | .02                | .98                 |
| <i>Unclassified Group</i>  |                    |                              |                    |                     |
| Burma                      | 68                 | .01                          | .43                | .55                 |
| Ethiopia                   | 26                 | 0                            | .04                | .96                 |
| Gabon                      | 44                 | 0                            | .11                | .88                 |
| Liberia                    | 29                 | 0                            | .05                | .95                 |
| Panama                     | 78                 | .03                          | .61                | .35                 |
| Tanganyika                 | 65                 | 0                            | .37                | .62                 |

relatively widespread, albeit modest, pattern of concurrent economic improvements which have occurred in that country from 1950 to 1963-64. The four countries classified in the intermediate group which appear more akin to the low group (Iraq, Algeria, Libya and Zambia), all experienced fairly high average rates of economic growth with, however, only very limited impact upon a quite sub-

stantial traditional agricultural sector. Finally, Ceylon, Argentina, and Syria are countries in which economic performance has been extremely poor in recent years by most criteria; they nevertheless have all had periods of successful widespread growth in the past which suggest that their current economic potential may be greater than is immediately apparent. There is thus some evidence that group membership probabilities derived from the first discriminant function point to genuine cases in which initial classifications with respect to development potential may have been mistaken.

A dubious classification is, of course, not automatically incorrect, since the original judgment which went into the classification includes a consideration of a broader range of information than just the variables included in the discriminant analysis. It is, however, a useful warning signal and suggests the desirability of further and better analysis of the apparently misclassified countries. If, upon re-examination, the original classification is believed to be accurate, the analysis could well be stopped at this point. The discriminant functions derived above would be used together with more recent country information on the four relevant variables to classify the seventy-three underdeveloped countries according to potential performance in the next few years.

However, since our confidence in our initial country classification was not especially high, we decided to repeat the analysis, omitting those countries which our first discriminant study indicated might be misclassified and allocating to their respective groups those countries which had originally been left unassigned. The results of this second discriminant analysis were then used to reclassify the countries left out in the second analysis. A third discriminant analysis was then made. No revisions were required in the third analysis, as no misclassifications were indicated on the second.

The discriminant function finally obtained by this process also included only four variables. The first three variables are the same as before but, in the new discriminant function, the rate of improvement of agricultural productivity,  $A$ , was substituted for  $K$ , the rate of improvement in physical overhead capital.

The resulting discriminant function is:

$$D_2 = .56 F + .79 M + .48 L + .54 A,$$

which in normalized form becomes

$$D_2' = 95. F + 139. M + 88 L + 70 A.$$

The order of importance of the included variables now is: the extent of modernization of outlook, the rate of improvement of

financial institutions, the extent of leadership commitment to development, and the degree of improvement in agricultural productivity.

The discriminant function  $D_2'$  also accounts for over 97 per cent of the overall variance. The separation between groups is considerably better, however, and the dispersion within the groups is substantially reduced. The new group means are 174 for the high,

TABLE V  
GROUP MEMBERSHIP PROBABILITIES OF INDIVIDUAL COUNTRIES  
(USING DISCRIMINANT FUNCTION  $D_2$ )

| Country                             | Discriminant Score | Probability of Membership in |                              |                     |
|-------------------------------------|--------------------|------------------------------|------------------------------|---------------------|
|                                     |                    | High Potential Group         | Intermediate Potential Group | Low Potential Group |
| <i>High Potential Group</i>         |                    |                              |                              |                     |
| Brazil                              | 160                | .61                          | .38                          | 0                   |
| Greece                              | 210                | 1.00                         | 0                            | 0                   |
| Israel                              | 227                | 1.00                         | 0                            | 0                   |
| India                               | 193                | 1.00                         | 0                            | 0                   |
| Jamaica                             | 176                | .98                          | .02                          | 0                   |
| Mexico                              | 192                | 1.00                         | 0                            | 0                   |
| Philippines                         | 181                | 1.00                         | 0                            | 0                   |
| South Africa                        | 215                | 1.00                         | 0                            | 0                   |
| Taiwan                              | 201                | 1.00                         | 0                            | 0                   |
| Trinidad                            | 193                | 1.00                         | 0                            | 0                   |
| Turkey                              | 173                | .97                          | .03                          | 0                   |
| United Arab Republic                | 168                | .90                          | .10                          | 0                   |
| Venezuela                           | 198                | 1.00                         | 0                            | 0                   |
| <i>Intermediate Potential Group</i> |                    |                              |                              |                     |
| Argentina                           | 119                | 0                            | .99                          | 0                   |
| Bolivia                             | 97                 | 0                            | .99                          | .31                 |
| Ceylon                              | 122                | 0                            | .99                          | 0                   |
| Chile                               | 140                | 0                            | .98                          | 0                   |
| Colombia                            | 137                | 0                            | .99                          | 0                   |
| Costa Rica                          | 142                | .03                          | .97                          | 0                   |
| Cyprus                              | 132                | 0                            | .99                          | 0                   |
| El Salvador                         | 114                | 0                            | .98                          | .02                 |
| Ghana                               | 125                | 0                            | 1.00                         | 0                   |
| Guatemala                           | 108                | 0                            | .96                          | .04                 |
| Honduras                            | 100                | 0                            | .81                          | .19                 |
| Iran                                | 105                | 0                            | .91                          | .09                 |
| Ivory Coast                         | 130                | 0                            | 1.00                         | 0                   |
| Jordan                              | 118                | 0                            | .99                          | .01                 |
| Kenya                               | 97                 | 0                            | .68                          | .32                 |
| Lebanon                             | 137                | .01                          | .99                          | 0                   |
| Nicaragua                           | 143                | .03                          | .96                          | 0                   |
| Nigeria                             | 137                | 0                            | .99                          | 0                   |

TABLE V—continued

| Country                    | Discriminant Score | Probability of Membership in |                    |                     |
|----------------------------|--------------------|------------------------------|--------------------|---------------------|
|                            |                    | High Potential Group         | Intermediate Group | Low Potential Group |
| Pakistan                   | 153                | .24                          | .76                | 0                   |
| Panama                     | 105                | 0                            | .92                | .08                 |
| Peru                       | 133                | .01                          | .99                | 0                   |
| Rhodesia                   | 140                | .02                          | .98                | 0                   |
| Sudan                      | 134                | .01                          | .99                | 0                   |
| South Korea                | 108                | 0                            | .95                | .05                 |
| Syria                      | 103                | 0                            | .87                | .12                 |
| Thailand                   | 114                | 0                            | .98                | .02                 |
| Tunisia                    | 125                | 0                            | 1.00               | 0                   |
| <i>Low Potential Group</i> |                    |                              |                    |                     |
| Afghanistan                | 62                 | 0                            | 0                  | 1.00                |
| Algeria                    | 70                 | 0                            | 0                  | 1.00                |
| Burma                      | 75                 | 0                            | .01                | .99                 |
| Cambodia                   | 79                 | 0                            | .04                | .96                 |
| Cameroon                   | 77                 | 0                            | .03                | .97                 |
| Chad                       | 47                 | 0                            | 0                  | 1.00                |
| Dahomey                    | 52                 | 0                            | 0                  | 1.00                |
| Dominican Republic         | 78                 | 0                            | .03                | .97                 |
| Ecuador                    | 84                 | 0                            | .11                | .89                 |
| Ethiopia                   | 43                 | 0                            | 0                  | 1.00                |
| Gabon                      | 67                 | 0                            | 0                  | 1.00                |
| Guinea                     | 38                 | 0                            | 0                  | 1.00                |
| Indonesia                  | 57                 | 0                            | 0                  | 1.00                |
| Iraq                       | 54                 | 0                            | 0                  | 1.00                |
| Laos                       | 22                 | 0                            | 0                  | 1.00                |
| Liberia                    | 34                 | 0                            | 0                  | 1.00                |
| Libya                      | 54                 | 0                            | 0                  | 1.00                |
| Malagasy                   | 58                 | 0                            | 0                  | 1.00                |
| Malawi                     | 32                 | 0                            | 0                  | 1.00                |
| Morocco                    | 59                 | 0                            | 0                  | 1.00                |
| Nepal                      | 30                 | 0                            | 0                  | 1.00                |
| Niger                      | 52                 | 0                            | 0                  | 1.00                |
| Paraguay                   | 71                 | 0                            | 0                  | 1.00                |
| Senegal                    | 67                 | 0                            | 0                  | 1.00                |
| Sierra Leone               | 52                 | 0                            | 0                  | 1.00                |
| Somalia                    | 57                 | 0                            | 0                  | 1.00                |
| South Vietnam              | 54                 | 0                            | 0                  | 1.00                |
| Surinam                    | 89                 | 0                            | .25                | .75                 |
| Tanganyika                 | 84                 | 0                            | .11                | .89                 |
| Uganda                     | 62                 | 0                            | 0                  | 1.00                |
| Uruguay                    | 87                 | 0                            | .20                | .80                 |
| Yemen                      | 17                 | 0                            | 0                  | 1.00                |
| Zambia                     | 74                 | 0                            | 0                  | .98                 |

113 for the intermediate, and 53 for the low, a significantly greater separation than before. The extent of overlap between groups is now almost completely eliminated, as can be seen from the new group membership probabilities for each country (see Table V).

#### CONCLUSION

This method of analysis clearly has a strong potential as an operational guide for forecasting development prospects of underdeveloped countries. With the help of a discriminant function, such as  $D_2$ , and the most recent data on the variables appearing in it, one can compute an individual discriminant score for each country. This discriminant score can then be used to calculate the group membership probabilities for each nation, as was done for Tables IV and V, thereby assessing its development potential. The discriminant score therefore constitutes a single figure of merit which can meaningfully be used to assess the cumulative contributions of both domestic reform and external assistance to the raising of a country's development capacity.

While there has been no controlled statistical test of the predictive reliability of this method, it is suggestive that the cross-sectional discriminant analysis produces an outcome which is generally in agreement with results achieved by economic historians and others studying economic development over time. There is a close correspondence between the variables selected by our stepwise discriminant analysis and those which are generally considered to be important determinants of the process of economic development.

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