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FOREIGN ASSISTANCE AND ECONOMIC DEVELOPMENT

HOLLIS B. CHENERY
AND
ALAN M. STROUT

OFFICE OF PROGRAM COORDINATION A. I. D.

DEPARTMENT OF STATE
AGENCY FOR INTERNATIONAL DEVELOPMENT
Washington, D. C.

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PREFACE

This paper is a revised and expanded version of the seventh in a series of discussion papers issued by the Office of Program Coordination of the Agency for International Development. The discussion papers are intended primarily for circulation within A.I.D. to those persons concerned with the formulation and review of assistance programs. The papers (a) summarize recent theoretical and empirical work on particular subjects which are significant for the programming of foreign assistance, (b) present the results of original research and analysis sponsored by A.I.D., or (c) provide background for discussions of foreign assistance policy. The ideas which are expressed in these papers are those of the individual authors and do not necessarily represent approved A.I.D. policy.

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No. 2. Some Relations between Economic and Military Assistance by Charles Wolf (1962, Unclassified, Not available)

No. 3. Aid to Social Progress and Aid to Economic Development in Latin America by Everett Hagen (1962, Official Use Only, Not available)

No. 4. Aid Strategy and Long-Term Planning in Greece, Turkey and Iran by Hollis B. Chenery (1962, Confidential)

No. 5. Approaches to Development Planning by Hollis B. Chenery (1962, Official Use Only)

No. 6. International Comparisons of Domestic Savings Rates by Cynthia Taft Morris (1963, Unclassified)

No. 7. Foreign Assistance and Economic Development by Hollis B. Chenery and Alan M. Strout (1965, Unclassified)

No. 8. Nondevelopmental Uses of Aid by Joan M. Nelson (1965, Secret)

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FOREIGN ASSISTANCE AND ECONOMIC DEVELOPMENT*

Hollis B. Chenery and Alan M. Strout

In most of the underdeveloped world significant increases in per capita income depend largely on the availability of external resources. A crude measure of this dependence is the net flow of some nine billion dollars per year from advanced to less developed countries, which is equal to a quarter of their gross investment and nearly a third of their imports.1/ Equally important is the provision of skilled manpower and transfer of technical skills.

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*The research on which this article is based was carried out by the Office of Program Coordination of the U.S. Agency for International Development. The analysis and judgments expressed are the sole responsibility of the authors.

The authors are respectively Professor of Economics at Harvard University and Senior Economist, Policy Planning Division, A.I.D. We are indebted to Jaroslav Vanek, Joel Bergsman, Lorene Yap, Paula Tosini, and Carmel Ullman of A.I.D. in carrying out the analysis and to Irma Adelman, Francis Bator, David Cole and Robert Dorfman for helpful comments. A preliminary version of the paper was presented by Chenery to the Boston meeting of the Econometric Society in December 1963.

1/ The OECD countries' component of this flow in 1963 was composed as follows ([13] p. 26.)

(billions of dollars)

Public	Private	Total
6.0	2.5	8.5

The institutional framework for this resource transfer has changed profoundly over the past ten years. Programs of foreign assistance have replaced colonial relations, and donors and recipients now agree that economic and social development is their primary objective. Private investment, which comprises only a quarter of the total resource flow, is increasingly screened for its contribution to the recipient country's development. The effect of these changes is to make the total resource transfer--which can loosely be called "foreign assistance"[1]--virtually a separate factor of production, whose productivity and allocation provide one of the central problems for a modern theory of development.

The possibilities of rapid growth with a high degree of reliance on foreign assistance have been shown in dramatic fashion in the past decade by the experience of Greece, Israel, Taiwan and the Philippines. In each case, a substantial increase in investment financed largely by external resources led to rapid growth of GNP accompanied by a steady decline in the dependence on external financing.

1/ The Development Assistance Committee of the OECD defines "assistance" to include public grants and loans of more than 5 years duration; it also uses a broader definition which includes private investment. The latter is more convenient for our purposes, although obviously only part of the total is "assistance" in the sense of an unrequited transfer of resources.

Not only was the growth rate accelerated by foreign assistance, but the period required for growth to become self-sustaining was probably shortened.

This paper examines the process by which a transition to self-sustaining growth can be achieved and its implications for aid and development policies. To study these questions, the scope of the conventional analysis of growth will be extended to include the net resource transfer as a central policy variable. The growth model which results shows the interrelations among internal development policies and the amounts and uses of external assistance.

The theoretical analysis is designed to permit an evaluation of the experience of the less developed countries which have received significant amounts of external assistance. This evaluation suggests the range of practical possibilities for accelerating growth through foreign assistance as well as the conditions which may frustrate this process. The analysis also suggests international standards of performance which may facilitate the carrying out of foreign assistance programs by both donors and recipients.

I. THE TRANSITION TO SELF-SUSTAINING GROWTH

The central problem of economic development is the transformation of a poor and stagnant economy into one whose normal condition is continuing growth. There is a broad consensus as to the principal changes that must take place in the course of this transformation--an increase in human skills, a rise in the level of investment, adoption of more productive technology, a change in the composition of output, the development of new institutions, etc.--but there is considerable controversy as to the sequence of events comprising this process. In Rostow's view [17], the transition can be usefully broken down into a period in which "preconditions" of growth are established, followed by a relatively short period of "takeoff" in which there is an acceleration in the rate of growth triggered by a combination of critical changes in the economic and social structure. Although the concept of a critical set of changes taking place in a limited transitional period is also basic to the theories of Lewis [17], Ranis and Fei [14] and a number of other economists, none of them gives a great deal of attention to the substantial differences in the transitional process made possible by foreign assistance.

The usual analysis of a country setting out to transform its economy without external assistance assumes that it must provide for all of the requirements of accelerated growth from its own resources or from imports paid for by exports. Success thus requires a simultaneous increase in skills, organizational ability, domestic saving and export production as well as an allocation of the increased resources in such a way as to satisfy the changing demands resulting from rising levels of income. The attempt to increase output can be frustrated by failure in any one of these attempts--a shortage of skills in one case, a lack of savings in another, or inadequate export earnings in a third. When growth is limited in this way by a few bottlenecks, there is likely to be underutilization of other factors such as labor, natural resources, and specific types of productive capacity.

The availability of foreign assistance makes possible a less balanced form of accelerated growth which can make fuller use of domestic resources. Some of the potential bottlenecks--of skills, savings or foreign exchange--can be temporarily relaxed by adding external resources for which current payment is not required. In this way fuller

use can be made of other resources, and the overall growth of output may be substantially higher than would be permitted by the rate of increase of the most restrictive domestic factor.

This alternative sequence recognizes the existence of a set of requisites for continued growth, but it makes the timing of their appearance much more flexible. The full set of requirements for sustained growth need only become available from domestic sources as the inflow of foreign resources is reduced. During the course of the transitional period, however, the additional resources produced through more rapid growth must be allocated to making good the deficiencies which are temporarily being supplied from outside assistance.1/

Two basic questions may be raised as to the feasibility of such a sequence of events. The first is the extent to which foreign resources can substitute for missing local factors and actually permit an increase in total output. The second is whether countries which have achieved an initial success through external assistance will take the further steps needed to reduce their dependence on it

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1/ In criticizing the notion of "prerequisites" to industrialization, Gerschenkron [7, p.355] suggests other possibilities of substitution for the missing requirements which stimulate their subsequent development.

in the future. The simple model proposed in the next two sections states the conditions for successful performance in quantitative terms which can be used in assessing the available evidence. Several less restrictive forms of the basic model are analyzed in section C to test the efficiency of alternative growth paths.

A. The Limits to Growth

The local resources that can be augmented through foreign assistance fall into three general categories:

(i) the supply of skills and organizational ability;

(ii) the supply of investable resources;

(iii) the supply of imported commodities and services.

Aggregate growth models for less developed countries usually concentrate on the savings-investment limitation. In analyzing Israel's development alternatives, Chenery and Bruno [6] extended the Harrod-Domar type of model to include both a skill limitation and a balance of payments limitation. A simplified version of this model will be used here to analyze the effects of external assistance on the development process.

The basic assumption underlying this model is that at any moment in time there is little possibility of

substitution among the scarce factors: skills, capital goods, and imported commodities. Over longer periods, investment can be devoted to augmenting skills through training and increasing the supply of currently imported commodities, either through raising exports or import substitution. These changes require other inputs besides capital, however, and can only take place at a limited time rate.

Assuming that minimum quantities of skills, capital goods, and imported commodities are required to achieve a specified level of GNP gives three separate restrictions on the growth process, any one of which may be controlling at a given moment in time. This type of production function leads to the description of the transitional process in terms of three phases, each associated with a single limiting factor. The Harrod-Domar growth path will be identified as "savings-limited growth", or Phase II in our terminology. The relation among the three phases over time will be taken up after they have been analyzed separately.

Our model is also designed to illuminate the alternative development policies available to governments.[1/]

1/ The factors stressed in this model are based on more detailed analyses of development policies and external assistance in Israel [6], Greece [1], Pakistan [10], Colombia [20], Turkey [21], and other countries.

The effects of government actions are reflected in the values taken by the variables subject to significant policy control, denoted here by Greek letters.[1] The more important variables used are as follows:

Endogenous (Uncontrolled) Variables

V_t	Gross national product in year t
I_t	Gross investment
S_t	Gross domestic savings
E_t	Exports of goods and services
M_t	Imports of goods and services
F_t	Net inflow of foreign capital (foreign assistance)

Principal Policy Variables

ϕ_t	Ratio of foreign capital inflow to GNP $(\frac{F_t}{V_t})$
α'	Marginal savings rate[2] $(\frac{\Delta S}{\Delta V})$
k	Marginal capital-output ratio $(\frac{I}{\Delta V})$
μ'	Marginal ratio of imports to GNP[2] $(\frac{\Delta M}{\Delta V})$
ϵ	Rate of growth of exports
i	Rate of growth of investment

1/ Since government actions only affect the variables in an aggregate model indirectly--as savings rates are altered by changes in tax structure--it is not possible to make a sharp distinction between controlled and uncontrolled variables. Our six policy variables indicate the principal focus of development policy as it affects aid requirements, but each of them requires a less aggregated formulation to guide government policy.

2/ The average values of these parameters in year t are indicated by α_t and μ_t .

The Skill Limit - The limit to growth that is inherent in the available human skills can be defined by asking the question: how rapidly could the national product be increased if investment resources (domestic and foreign) and imported commodities were freely available at constant prices? The relevant skills are those of the labor force on the one hand and the managerial abilities of government and private entrepreneurs on the other. In the case of Israel the skill limit was stated in terms of the maximum annual increase that could be achieved in labor productivity [6], p.877. However, for most underdeveloped countries the managerial aspect is probably more significant and the model should contain some limit to the possible increase in entrepreneurial activity.

While it is not possible to sum up the effectiveness of management in a simple ratio like the productivity of labor, the management function which is of most concern to the early part of the growth process is the ability of the society as a whole to increase productive capacity. The measure of this capability to be used here is the rate of increase in investment that can be carried out at an acceptable minimum level of productivity. The training of skilled labor is one of the requirements for an increase

in productive investment, but other aspects of skill acquisition are neglected in this formulation.[1]

While it is not currently possible to determine the skill limit on *a priori* grounds, the rates of increase in investment that have been achieved without large reductions in productivity can be measured with reasonable accuracy. Table A-1 (Annex A) gives such measurements for 31 less developed countries over the past decade or so. There are several cases of growth in investment of the order of 20% per annum for a five year period, but none much greater than 10% for a period as long as ten years. The upper bound for this aspect of the skill limit would appear to be 10-15% annual growth save in exceptional cases. This limit will be called $\bar{i}$.

The following equations (1) to (7) describe the growth of GNP and the need for external assistance under the assumptions that the ability to increase investment exceeds the initial ability to raise savings. Assuming for the time being a constant marginal capital-output ratio (k)[2]

1/ This definition of the skill limit is closely related to the notion of absorptive capacity which is commonly used to specify the ability of a country to utilize external resources.

2/ A constant marginal capital-output ratio is of course only a rough approximation, but there is little evidence of a consistent rise or fall in capital required per unit of output in the recent experience of the underdeveloped countries. The analysis assumes that there is a minimum amount of investment needed to increase output, but the assumption of a constant ratio over time is purely a matter of convenience.

and a constant growth of investment (i)[1] gives:

$$(1) \qquad k = \frac{I_{t-1}}{V_t - V_{t-1}}$$

$$(2) \qquad i = \frac{I_t - I_{t-1}}{I_{t-1}}$$

If investment grows at its maximum rate ($\bar{i}$), the amount of investment in any year is given by:

$$(3) \qquad I_t = I_o(1 + \bar{i})^t$$

The upper limit to GNP at time t is therefore:

$$(4) \qquad V_t = V_o + \frac{1}{k} \sum_{T=0}^{T=t-1} I_T$$

If investment can be increased more rapidly than savings, foreign assistance will be needed to support this maximum increase in GNP. The maximum savings that can be obtained from a given set of government policies are indicated by:

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[1] An alternative formulation of the investment policy variable would express the increase in investment as a ratio to the increase in GNP:

$$\psi' = \frac{I_t - I_{t-1}}{V_t - V_{t-1}} = ki.$$

If the marginal capital-output ratio remains constant, a steady rate of growth of investment implies a constant ratio of the increase in investment to the increase in GNP. The incremental investment ratio ψ' may be used as an alternative--and sometimes more convenient--measure of the skill limit.

$$(5) \quad \bar{S}_t = S_o + \alpha' (V_t - V_o)$$

The effects of tax and other policies affecting savings are summed up in the incremental savings ratio, α', which is one of the main policy variables.

The minimum net inflow of foreign capital is determined by the difference between investment and savings:[1]

$$(6) \quad F_t = I_t - \bar{S}_t$$

Since $\sum_{0}^{t-1} I_t = \frac{I_o}{\bar{i}} \left[(1 + \bar{i})^t - 1\right]$ therefore,

from (4), $I_o(1 + \bar{i})^t = k\bar{i}(V_t - V_o) + I_o$. The latter plus (3) and (5) can be substituted into (6), giving F_t as a function of V_t:

$$(7) \quad F_t = F_o + (k\bar{i} - \alpha')(V_t - V_o)$$

where $F_o = I_o - S_o$

This formulation can be interpreted in terms of Harrod's original idea [9] of different growth rates corresponding to the growth of population and skills (the "natural" rate) and the growth of savings (the "warranted" rate). When the skill-determined rate is higher, foreign

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1/ As explained below, when the trade limit is more restrictive than the savings limit, domestic savings fall short of the maximum given by (5); equations (5) and (7) are then replaced by (16) and (15) below. The model may be said to be in phase IA or IB according to which limit (savings or trade respectively) is more restrictive.

assistance can fill the gap between investment and savings, thus permitting the savings-determined rate to be exceeded.

The Savings Limit - A country which continues to increase its level of per capita income will eventually reach a point at which management skills are no longer the primary limitation to the rate of growth. While external assistance may have been provided largely on a grant basis in the earlier phase, it will normally be shifted to long-term loans when a country's prospects for future growth become more promising.1/ Furthermore, foreign lenders are not likely to be willing to finance more than a given proportion of a country's total investment on a continuing basis, which is likely to be less than 40% apart from exceptional circumstances.2/ Under these circumstances the rate of investment will be determined primarily by the country's willingness and ability to mobilize current savings to finance current investment and prospective future savings to service its mounting external debt.

1/ For example, the great bulk of foreign assistance to Africa south of the Sahara is in the form of grants; assistance to most of Asia and all of Latin America is mainly in the form of loans. Average terms for all free world assistance in 1963 were 3.2%. [13]

2/ Of the 31 countries analyzed in table A-2, only Israel, the U.A.R., Tunisia, Chile, Bolivia, Jordan, Liberia, Mauritius and Korea have recently received a higher inflow of external resources.

A procedure commonly adopted to reach a political judgment on desirable levels of investment and savings is to establish a target rate of growth in GNP after debate over the fiscal and other implications of alternative possibilities. In a very high proportion of developing countries the target rate chosen is between 5% and 7%. Lower targets reflect a realistic estimate of the skill limitation (as in the early plans of Pakistan and Nigeria). Higher targets have only turned out to be feasible in a few exceptionally well organized countries like Israel and Yugoslavia.

In this first approximation, we shall characterize the savings-limited phase by a constant growth rate which reflects both the willingness of the country to mobilize domestic savings and the willingness of foreign countries to provide assistance. In determining the need for external assistance, the assumption of a constant growth of GNP replaces the assumed constant growth of investment that characterized the previous phase. Models with variable growth rates are discussed in section I.C.

With these additional assumptions the savings-limited phase of growth can be described as follows. The need for foreign assistance is measured by the difference between investment and maximum domestic savings (6) as before.

GNP in year t is determined by constant growth at the target rate $\bar{r}$, starting from the level of GNP in the year m, when the savings-limited phase is assumed to begin:

$$(8) \quad V_t = V_m(1 + \bar{r})^{t-m}$$

The investment level required for this rate of growth is determined from (1) as:

$$(9) \quad I_t = k\bar{r}V_t$$

The rate of growth can be stated as a function of the amount of aid provided by substituting (9) in (6) and solving for $\bar{r}$:

$$(10) \quad \bar{r} = \frac{\alpha_t + \phi_t}{k}$$

$$\text{where} \quad \alpha_t = \frac{\bar{S}_t}{V_t}$$

$$\text{and} \quad \phi_t = \frac{F_t}{V_t}$$

Equation (10) differs from the Harrod-Domar model of savings-limited growth in two respects: the addition of foreign investment and the assumption that the marginal savings rate in underdeveloped countries can be raised above the average rate.[1] Without the second assumption, external assistance will have no enduring effect on the

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1/ This model is essentially the same as that used by Rosenstein-Rodan [15,16] to determine aid requirements.

rate of growth, which will fall back to its former level as soon as aid is withdrawn.

The expression for the ratio of the aid required to GNP (Φ_t) is of some interest, since it determines whether the country will approach self-sustaining growth with its present policies. It is derived by substituting (5) into (10):

$$(11) \quad \Phi_t = \frac{F_t}{V_t} = (\bar{kr} - \alpha') + (\alpha' - \alpha_o)\frac{V_o}{V_t}$$

The assistance ratio Φ_t will decline and eventually reach zero if the marginal savings rate α' is greater than the required investment rate $\bar{kr}$ since the magnitude of the second term declines steadily as V_t increases. If $\alpha' < \bar{kr}$, a constantly rising level of aid will be needed to sustain the target growth rate.

Savings-limited growth will persist so long as the required external assistance is forthcoming unless: (i) the skill limit--including the needed increase in labor skills--becomes more restrictive; or (ii) the falling level of external assistance implied by equation (11) fails to provide for the minimum import requirements. In the latter case, the trade limit will become the dominant factor.

The Trade Limit - The trade limit arises largely from the limited flexibility in the productive structure of less developed countries.[1] Many manufactured goods are not produced at all; their imports can only be replaced by domestic production through substantial investment over a considerable period of time. Exports are mainly primary products, for which income and price elasticities are generally low. Development of new export products requires investment as well as quality improvements and expanded sales efforts, all of which take time.

The trade limit need not become a bottleneck to growth if countries would follow policies designed to anticipate the changes in their productive structure required to meet the changing pattern of domestic demand and external markets. However, the experience of many developing countries in trying to avoid structural disequilibria suggests that these required changes are at least as difficult to bring about as the required increase in savings. The trade limit therefore seems to have as much practical significance as the skill limit or the savings limit.

A model of trade-limited growth may be formulated as follows. As before, we assume that foreign assistance is forthcoming in sufficient quantity to maintain a constant

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1/ The nature of the trade limit is explored further in Chenery and Bruno [6] and McKinnon [12].

rate of growth, but in this case the amount of foreign capital needed is determined by the balance of payments gap. Assuming that this phase of growth starts in year j, the GNP in year t is:

$$(12) \quad V_t = V_j(1 + \bar{r})^{t-j}$$

The import level required to sustain this level of GNP is given by:

$$(13) \quad \bar{M}_t = M_j + \mu' (V_t - V_j)$$

where the minimum marginal import ratio μ' may be determined as the average of the incremental ratios for different components of demand. 1/ It is assumed to be an instrument variable since the government has a choice--within limits--as to how far to push import substitution.

The country's earnings of foreign exchange depend on how fast exports of goods and services can be increased by various means. These are reflected in the instrument variable, ϵ, in the following equation:

$$(14) \quad E_t = E_j(1 + \epsilon)^{t-j}$$

1/ Where an input-output model is available, as in Israel, the UAR, Pakistan, India and a few other developing countries, it can be used to determine the import requirements with varying assumptions about the composition of demand and import-substitution on a sector basis. This procedure was followed in [6]. The possibility of varying the degree of import substitution is considered in section I.C.

The need for foreign assistance is determined in this phase by the difference between minimum import requirements and export earnings:

$$(15) \quad F_t = \bar{M}_t - E_t$$
$$= M_j + \mu' (V_t - V_j) - E_j(1+\epsilon)^{t-j}$$

In the other two phases, the foreign capital inflow was assumed to be greater than the minimum trade gap determined by (15), which would permit either a rise in foreign exchange reserves, an excess of imports over the minimum requirement or some relaxation in the effort to increase exports. In the trade-limited phase, however, it is potential savings which are excess to investment needs. Investment is determined by (9); the savings needed are given by the difference between investment and foreign capital inflow:

$$(16) \quad S_t = I_t - F_t = k\bar{r}V_t - F_t$$

The larger potential savings determined by (5) may be reduced to this level in various ways, such as lower taxes or higher consumption. Alternatively, reserves may be drawn down to reduce F or investment may take less productive forms because of the import shortage or use up the available savings in the creation of excess capacity with less increase in GNP.

If the marginal import ratio is equal to the average ratio, the need for external capital will only be eliminated if exports rise more rapidly than GNP. The conditions under which the trade gap will be eliminated under other assumptions are stated in equation (24) below.

B. Phases of the Transition

Three possible growth paths, each corresponding to a separate limitation, have now been described, but their duration and relation to each other remain to be established. The sequence in which one phase follows another is not necessarily the same in all countries, since the limiting factor at a particular time depends both on the country's historical development and the success of different types of government policy. Despite the possibilities for variation, however, there is a considerable likelihood that if growth is accelerated from a low initial income level the phases will succeed each other in the order in which they have been presented: (I) Skill-limited Growth; (II) Savings-limited Growth; (III) Trade-limited Growth. Formulae for the length of each phase and the total aid required will be developed on the assumption of this sequence.

The discussion of the phases of the transition will be illustrated by the case of Pakistan, one of the

best examples to date of progress being made by a very poor country receiving substantial foreign assistance. In 1956, when substantial aid was initiated, Pakistan had a rate of gross investment of 7-8% of GNP and a domestic savings rate of 4-5%. From 1956-1962 investment grew at 13% per year and the marginal savings rate was over 20%. By 1962, which is the starting point for our projections of alternative growth paths, investment had reached 12% of GNP and savings 8-9%. The inflow of foreign capital--primarily public assistance--increased from 2% to 3-4% of GNP. These and the other aggregate variables in the model are shown in Table 1 and plotted in Figure 1.[1/]

The alternative projections of future growth possibilities for Pakistan will also illustrate the method of analysis that is applied to each of 50 countries in the following sections.[2/] The parameters in the model are estimated first from historical experience and then on two other sets of assumptions--generally more optimistic--about future development policies. In Table 1 and Figure 1 we show the

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1/ The most recent revision of the Pakistan national accounts gives higher initial values of savings, a 1964/65 savings-to-GNP ratio of .09, and a 1964/65 investment-to-GNP ratio of .15 in 1959/60 prices. [8, pp.7, 63; GNP measured at market prices.] These ratios are close to those derived from the 1964-65 "upper limit" projections in Table 1, but they imply a foreign resource ratio of .06 (1959/60 prices) instead of the ratio of .043 implicit in Table 1.

2/ As explained in section II, the parameter estimates and starting point for the projections are based on normalized values of the variables rather than the actual magnitudes in 1962.

FIGURE 1

ILLUSTRATIVE GROWTH PATHS: PAKISTAN, PAST AND PROJECTED

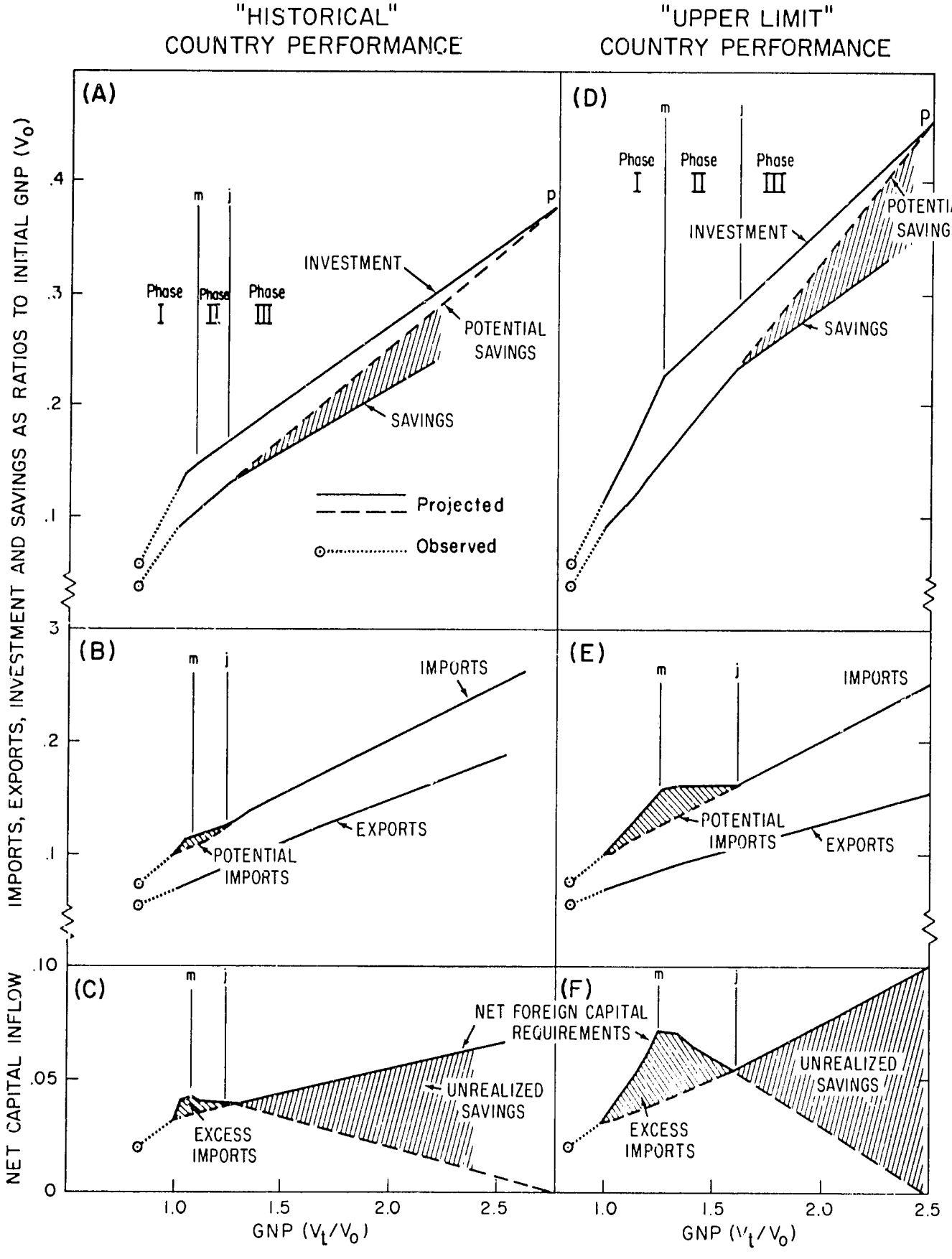

Table 1

An Example of Phase Developments for Pakistan[1], 1962-1975

(All values expressed as ratios to initial GNP)

Year	1956 [2]	1962	1963	1964	1965	1966	1967	1968	1969	1970	1975
Historical GNP growth target and country performance, high export growth											
GNP	.838	1.000	1.041	1.087	1.136	1.188	1.241	1.296	1.355	1.416	1.764
Investment	.059	.122	.138	.147	.153	.160	.168	.175	.183	.191	.200
Potential savings	.039*	.090*	.097	.104	.112	.121	.129	.138	.147	.157	.167
I-S gap	.020	.032	.041	.042	.041	.040	.039	.037	.036	.034	.025
Potential imports	.074*	.100*	.104	.109	.114	.119	.124	.130	.135	.142	.220
Exports	.054	.068	.072	.075	.079	.083	.087	.091	.096	.100	.128
M-E gap	.020	.032	.032	.033	.035	.036	.037	.038	.040	.041	.049
Consumption	.799	.910	.944	.983	1.024	1.067	1.112	1.159	1.212	1.266	1.575
Phase	I	I	IA	II	II	II	II	III	III	III	III
Growth rates:											
GNP	.021	.041	.044	.045	.045	.045	.045	.045	.045	.045	.045
Investment	.130	.130	.065	.045	.045	.045	.045	.045	.045	.045	.045
Exports	.041	.049	.049	.049	.049	.049	.049	.049	.049	.049	.049
Consumption	.015	.037	.041	.042	.042	.042	.042	.045	.045	.045	.045
Upper limit GNP growth target and country performance, high exports											
GNP	.838	1.000	1.041	1.087	1.139	1.198	1.264	1.339	1.419	1.504	2.012
Investment	.059	.122	.138	.156	.176	.199	.225	.241	.256	.272	.364
Potential savings	.039*	.090*	.100	.111	.124	.138	.154	.172	.191	.212	.334
I-S gap	.020	.032	.038	.045	.052	.061	.071	.069	.064	.059	.029
Potential imports	.074*	.100*	.104	.109	.115	.120	.126	.134	.142	.151	.201
Exports	.054	.068	.072	.075	.079	.083	.087	.091	.096	.100	.128
M-E gap	.020	.032	.032	.033	.035	.037	.039	.043	.046	.050	.074
Consumption	.799	.910	.941	.976	1.015	1.060	1.110	1.167	1.228	1.292	1.723
Phase	I	I	IA	IA	IA	IA	IA	II	II	II	III
Growth rates:											
GNP	.021	.041	.044	.048	.052	.055	.059	.060	.060	.060	.060
Investment	.130	.130	.130	.130	.130	.130	.130	.071	.060	.060	.060
Exports	.041	.049	.049	.049	.049	.049	.049	.049	.049	.049	.049
Consumption	.015	.034	.037	.040	.044	.047	.051	.052	.052	.053	.060

Source: A.I.D., Office of Program Coordination, "23-Year Projections," machine listings of September 16, 1964.

1/ Larger of I-S or M-E has been underlined. Parameter values used were: (see also Table A-2)

	$\bar{r}$	i	k	α'	μ'	ε
1956-1962	.045	.13	3.00	.??	.16	.041
1962-1975 ("Historical")	.045	.13	3.00	.16	.10	.0489
1962-1975 ("Upper limit")	.060	.13	3.00	.24	.10	.0489

2/ 1956 figures are trend values for the period 1956-1962. The latest revision of the Pakistan national accounts [8] gives a similar investment level but higher initial savings and a negative marginal savings rate for the period 1954/55 to 1959/60. For the period 1959/60 to 1964/65 the marginal savings shown in the plan document is .22 and the incremental capital-output ratio, 2.8.

*Observed values.

two extreme sets of assumptions for Pakistan-- the "historical" and the "upper limit"--and the growth paths and requirements for external capital that follow from each. These two examples illustrate the effects of changes in parameters on the duration of the three phases of the transition in a fairly typical case. A comparison of the Pakistan data to that for 30 other countries is given in Table A-1 of Annex A.

Phase I: Skill-limited Growth. Phase I assumes that the ability to increase and utilize productive investment is more restrictive to growth than either the total supply of investment resources or of foreign exchange. The phase ends when one of the other two limits--presumed here to be the savings limit--becomes more restrictive. The length of Phase I is therefore determined by the target rate of growth and the time required to increase the investment ratio from its initial starting point to that required to sustain the target growth rate.

Thus the terminal year t=m is reached when:

$$(17) \quad I_m = k\bar{r}V_m$$

Remembering that $I_m = I_o + ki(V_m - V_o)$ gives an expression for GNP in the terminal year:

$$(18) \quad V_m = V_o \left(\frac{i - r_o}{i - \bar{r}}\right)$$

$$\text{where} \quad r_o = I_o/kV_o$$

The length of time required by Phase I is determined by setting eq.(3) equal to (17), rearranging and substituting (18):

$$I_m = I_o(1 + i)^m = k\bar{r}V_m$$

$$(1 + i)^m = \frac{k\bar{r}V_m}{I_o} = \frac{k\bar{r}V_m}{kr_oV_o} = \frac{\bar{r}}{r_o}\left(\frac{i - r_o}{i - \bar{r}}\right)$$

$$(19) \qquad m = \frac{\log\left(\frac{\bar{r}}{r_o}\right) + \log\left(\frac{i - r_o}{i - \bar{r}}\right)}{\log (1 + i)}$$

For the Pakistan examples, the increase is from an initial investment rate of .06 in 1956 to a required rate $k\bar{r}$ of .135 to sustain 4.5% growth or .18 to sustain 6% growth. Phase I will end in 1963 on the first assumption and 1966 on the second.

Since we assume a constant rate of growth in investment, the ratio of foreign capital to GNP increases steadily throughout Phase I. Furthermore, the better the country's performance in increasing investment, the larger becomes the gap between investment and savings and the more aid is required per year. In the case of "upper limit" performance, the share of investment financed by foreign capital stays fairly constant at about 30% while the absolute level of capital inflow rises to a peak of about 6% of GNP.

Phase II: Savings-limited Growth. Phase II starts at the end of Phase I when investment reaches the level required to sustain the target growth rate. It ends when either (a) savings are equal to investment and the net inflow of capital is reduced to zero or (b) when the trade limit becomes more restrictive. We can solve for the terminal year in the first case by setting savings equal to investment in equations (5) and (9), giving the following expression for the level of GNP in year p :

$$(20) \quad V_p = V_m \left(\frac{\alpha' - \alpha_m}{\alpha' - k\bar{r}}\right)$$

The length of time to complete Phase II if the trade limit does not intervene is given by substituting (8) into (20) and solving for (p - m):

$$(21) \quad (p - m) = \frac{\log(\alpha' - \alpha_m) - \log(\alpha' - k\bar{r})}{\log(1 + \bar{r})}$$

In the Pakistan examples, the year p is reached in 1985 on the 4.5% growth assumption and in 1979 on the assumption of a 6% growth target.[1] This is the year at which self-sustaining growth could be maintained at these growth rates if exports could be increased fast enough--

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[1] The new perspective plan for Pakistan [8] sets a growth target of 7.5% starting in 1975. It estimates that the inflow of external resources can be reduced from 8% of GNP in 1964/65 (1964/65 prices) to 1% of GNP in 1985 on the basis of values of $\alpha' = .25$, $k = 2.9$, $\epsilon = 7.9\%$, $\frac{\mu'}{\mu_o} = .45$.

or import requirements sufficiently reduced--to avoid the trade limit. On our assumptions this is not the case, however, and the growth path shifts to Phase III in 1968 on historical assumptions (or 1971 in the upper limit case).

Phase III: Trade-limited Growth. Phase III starts in year j whenever the foreign assistance needed to meet minimum import requirements exceeds the amount needed under the assumptions of Phase II.[1/] With constant values of the growth target and the other parameters, Phase III will continue until the year q when the need for a net inflow of foreign capital is eliminated. Assuming $E_q = M_q$, equations (13) and (14) give the following expression for the GNP at the end of Phase III:

$$(22) \quad V_q = \frac{E_j(1+\epsilon)^{q-j} - M_j + \mu' V_j}{\mu'}$$

The effect of import substitution and export growth on the length of Phase III can be shown by substituting (12) in (22):

$$(23) \quad (1+\bar{r})^{q-j} = \frac{\left(\frac{E_j}{V_j}\right)(1+\epsilon)^{q-j} - \mu_j + \mu'}{\mu'}$$

1/ Phase III may also start at the end of Phase I if the trade gap is the limiting factor at the time when the target growth rate is reached.

This equation can be solved for the length of Phase III.[1/]

In order for the trade gap to be eliminated, either export growth must exceed the target growth of GNP or the marginal import ratio must be substantially less than the average. From equations (13) and (14) we can derive the following condition for the elimination of the trade gap over a given period (q-n):

$$(24) \qquad \frac{E_j}{M_j}(1+\epsilon)^{q-j} - \frac{\mu'}{\mu_j}(1+\bar{r})^{q-j} \geq \left(1 - \frac{\mu'}{\mu_j}\right)$$

In the case of Pakistan, this equation is satisfied by the parameter values in the historical case providing that the 1957-62 export growth rate of 5.8% could be maintained. If this could be achieved and if GNP growth averages 4.5%, the trade gap would be eliminated in 1994. The values of ϵ and μ' would not lead to convergence at the 6% growth rate, however, even with the 5.8% export rate. To eliminate the trade gap by 1990, either ϵ would have to be increased to 7.5% or $\frac{\mu'}{\mu_j}$ would have to be reduced to .56. (With the export growth rate of 4.9% assumed in Figure 1, $\frac{\mu'}{\mu_j}$ would have to fall to .35.)

1/ Equation (23) can be stated in a simpler form by specifying the average import ratio at the end of the period, μ_q. The following expression can then be used to determine the length of Phase III for any given value of ϵ :

$$(23a) \quad \left(\frac{1+\bar{r}}{1+\epsilon}\right)^{q-j} = \frac{E_n}{M_n}\left(\frac{\mu_j}{\mu_q}\right)$$

Total Requirements for External Capital. The total capital required to complete the transition to self-sustaining growth can be determined as the sum of the capital requirements for each phase that the economy goes through. In Phases IA and II, external capital is determined by the difference between investment and savings. In Phases IB and III, it is the difference between import requirements and exports.

The equations for capital inflow in each phase are given in a symmetrical form in Table 2. All variables are expressed as a ratio to the initial level of GNP (Vo). Summing these equations over time gives the total capital inflow during any period that the economy remains in that phase. Table 2 also gives formulae for cumulative capital inflow which are used in subsequent comparisons of growth paths and capital requirements.

The Productivity of External Capital

One of the important results of the preceding analysis is to provide a measure of the productivity of external capital over a specified period of time. Equation (30) enables us to compute the total external capital required to sustain any given rate of growth in GNP so long

Table 2

Summary of Phase Formulae for Foreign Capital Inflow (F_t) and Cumulative Foreign Capital Inflow (ΣF_t) as Ratio to Initial GNP (V_o)

Phase	Growth Constraint	Determinant of Foreign Capital	(Eq. No.)	Dependent Variable	Investment or Imports (equals)	Savings or Exports (minus)
IA	Skills	Investment-Savings	(25)	F_t/V_o	$= \frac{I_o}{V_o}(1+i)^t$	$- \left\{\alpha_o + \frac{I_o}{V_o}\frac{\alpha'}{ki}\left[(1+i)^t - 1\right]\right\}$
				$\sum_o^t F_t/V_o$	$= \frac{I_o}{V_o}\left[\frac{(1+i)^{t+1}-1}{i}\right]$	$-\left\{(t+1)(\alpha_o - \frac{I_o}{V_o}\frac{\alpha'}{ki}) + \frac{I_o\alpha'}{V_o ki}\left[\frac{(1+i)^{t+1}-1}{i}\right]\right\}$
			(26)	or	$= \frac{I_o}{V_o}\left[\frac{(1+i)^{t+1}-1}{i}\right](1-\frac{\alpha'}{ki})$	$- (t+1)(\alpha_o - \frac{I_o}{V_o}\frac{\alpha'}{ki})$
IB	Skills	Imports-Exports	(27)	F_t/V_o	$= \frac{M_o}{V_o} + \frac{\mu'}{ki}\cdot\frac{I_o}{V_o}\left[(1+i)^t - 1\right]$	$- \frac{E_o}{V_o}(1+\epsilon)^t$
			(28)	$\sum_o^t F_t/V_o$	$= (t+1)(\frac{M_o}{V_o} - \frac{\mu'}{ki}\frac{I_o}{V_o}) + \frac{\mu'}{ki}\frac{I_o}{V_o}\left[\frac{(1+i)^{t+1}-1}{i}\right]$	$- \frac{E_o}{V_o}\left[\frac{(1+\epsilon)^{t+1}-1}{\epsilon}\right]$
II	Investable Resources	Investment-Savings	(29)	F_t/V_o	$= k\bar{r}(1+\bar{r})^t$	$- \left\{\alpha_o + \alpha'\left[(1+\bar{r})^t - 1\right]\right\}$
				$\sum_o^t F_t/V_o$	$= k\left[(1+\bar{r})^{t+1} - 1\right]$	$- \left\{(t+1)(\alpha_o - \alpha') + \alpha'\left[\frac{(1+\bar{r})^{t+1}-1}{\bar{r}}\right]\right\}$
			(30)		or $= (k - \alpha'/\bar{r})\left[(1+\bar{r})^{t+1} - 1\right]$	$- (t+1)(\alpha_o - \alpha')$
III	Imported Goods and Services	Imports-Exports	(31)	F_t/V_o	$= \frac{M_o}{V_o} + \mu'\left[(1+\bar{r})^t - 1\right]$	$- \frac{E_o}{V_o}(1+\epsilon)^t$
			(32)	$\sum_o^t F_t/V_o$	$= (t+1)(\frac{M_o}{V_o} - \mu') + \frac{\mu'}{\bar{r}}\left[(1+\bar{r})^{t+1} - 1\right]$	$- \frac{E_o}{V_o}\left[\frac{(1+\epsilon)^{t+1}-1}{\epsilon}\right]$

as the investment-savings gap is the controlling factor. This result for the Pakistan case and the period 1962-1975 is shown as the curve ΣF^s in Figure 2. Equation (32) provides a similar solution for the cumulative gap between imports and exports, which is given by the curve ΣF^m. For simplicity, we defer consideration of the effects of absorptive capacity and variable growth rates until the next section.

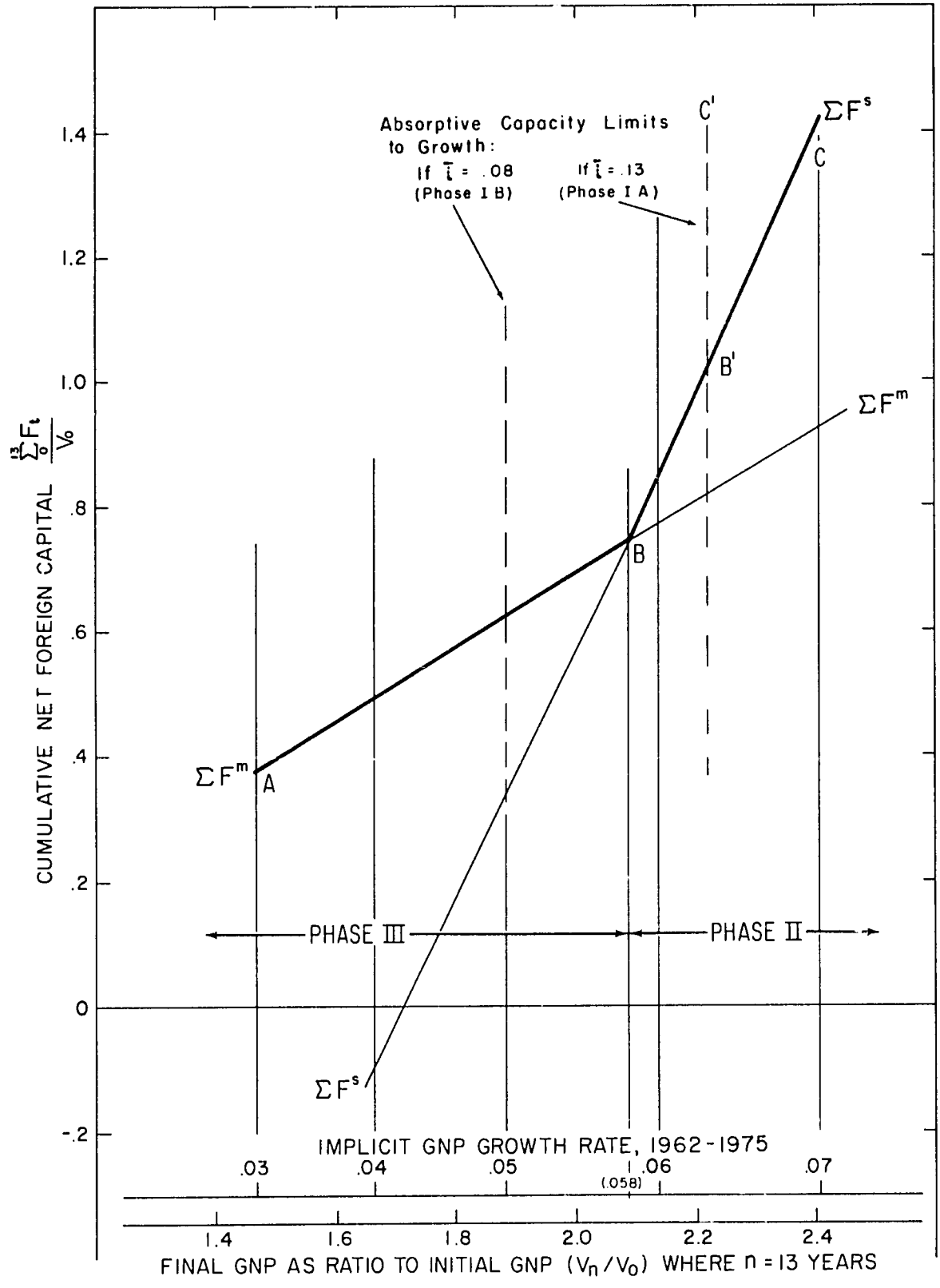
Figure 2 shows that the trade limit requires more external capital than the savings limit to support any growth rate below 5.8%, while the converse is true for higher rates of growth. In the absence of an absorptive capacity limit, the productivity of external capital would be represented by the curve ABC, composed of segments of the Phase III solution for lower values of GNP in 1975 and the Phase II solution for higher values.

The introduction of the absorptive capacity limitation limits the initial growth rate of GNP to about 4%. This increases to 8.5% by 1975 for an average of 6.3% over the period. No increases in capital could

FIGURE 2

THE PRODUCTIVITY OF EXTERNAL CAPITAL, PAKISTAN (MODEL 1), 1962-1975

(Assumes "upper limit" country performance factors and export growth rate)



raise GNP growth above the limit shown in Figure 2, line B' C'. 1/

One significant result of this analysis for the Pakistan case is that the marginal productivity of external capital is very much higher in Phase III than in phase II. To determine the generality of this result, we can derive expressions for the derivative of V_t with respect to total capital inflow from equations (30) and (32) in Table 2:

Phase II:

$$(33)\quad \frac{d\,(V_{t+1})}{d\,(\Sigma F_t^{s})} = \frac{1}{k - \sigma'\beta}$$

Phase III:

$$(34)\quad \frac{d\,(V_{t+1})}{d\,(\Sigma F_t^{m})} = \frac{1}{\mu'\,\beta}$$

where $$\beta = \left[\frac{t - \frac{1-(1+\bar{r})^{-t}}{\bar{r}}}{\bar{r}\,(t+1)}\right]$$

The value of β varies as follows with the growth rate and the time period:

1/ A lower skill limit of .08 would reduce the attainable growth rate to 5%. In this case, capital requirements would be determined by the Phase IB formulae.

Values of β

$\bar{r}$	t = 4	t = 9	t = 14
.03	1.8	4.1	5.9
.05	1.8	3.8	5.5
.07	1.7	3.5	4.9
.10	1.7	3.4	4.4

Substituting the values of the parameters in equations (33) and (34) for Pakistan and for the median of all countries in Table 5 gives the following values of the marginal productivity of external capital for a 9-year period:1/

	Pakistan	Median Values
Phase II:	.47	.34
Phase III:	1.70	1.32

There is therefore a pronounced tendency for external assistance to be more productive in Phase III, where the balance of payments limitation is binding.2/ Over longer periods, however, the productivity of assistance in phase II rises because of the additional savings that

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1/ Pakistan values used are: $\bar{r}$ = .06, α' = .24, μ' = .16, k = 3.0. Median values from Table 5 are: $\bar{r}$ = .045, α' = .20, μ' = .20, k = 3.71.

2/ Similar results were derived by Chenery and Bruno [6] and McKinnon [12] for particular sets of assumptions.

are generated and thus the slope of the ΣF^s curve becomes flatter. Conversely the ΣF^m curve becomes steeper as the length of the period is increased, since export growth is assumed constant.

The welfare aspects of different growth paths -- of which the productivity of external capital is only one -- are analyzed more fully in the next section. The subsequent projections for 50 countries suggest that the high productivity of external capital for countries in phase III is empirically quite significant.

C. More Efficient Growth Paths

The preceding analysis has been designed to explore in very simple terms the characteristics of a process which uses external assistance first to accelerate the growth of an economy and later to eliminate the need for further assistance. Having established a feasible growth sequence corresponding roughly to what we observe in several developing countries, we shall now examine ways in which this growth path might be modified to make it more efficient. To do so, it will be necessary to relax some of the simplifying assumptions that have been made so far, which produce a single process of transition for

any set of initial assumptions. We shall, however, retain our basic view of an underdeveloped economy as characterized by structural limitations which can be modified only gradually through government policy.

We define a more efficient growth path as one which increases the welfare of either recipient or donor countries subject to limitations as to the allowable welfare reduction of the other. In our aggregate model, welfare can most conveniently be measured as a function of:

(1) The level of GNP attained at the end of a given period relative to the initial GNP;

(2) The discounted sum of consumption in the economy during the given period;

(3) The discounted sum of the external resources required during the period.

(4) The degree of dependence on external resources at the end of the period.

In the subsequent discussion we assume specified values for the terminal GNP and analyze variations in total consumption and external resources. An optimal path from the donors' point of view might be one which minimized the external resources needed to attain a given GNP target or a condition of self-sustaining growth. The recipient,

however, should explicitly weigh the value of increased consumption against the cost of the additional resource inflow it requires.

The model used so far--model 1--is characterized by structural rigidities which usually cause either consumption or imports to be above their structurally determined minima. While excess consumption contributes to the recipient's welfare, its value may be less than the cost of the extra aid needed to secure it. Similarly, excess imports will increase the need for assistance above what would be desirable on other assumptions. We shall therefore modify model 1 to permit the differences between the structurally determined resource gaps to be reduced or eliminated.

The two principal methods of reducing the differences between the two resource gaps are (i) to allow the growth rate to vary and (ii) to plan for substitution between the two scarce factors, capital and foreign exchange. In addition, we shall allow foreign exchange reserves to vary and concern ourselves only with the cumulative values of all variables over a planning period of ten years or more.

In this framework, we define the cumulative structurally determined savings gap as:

$$\Sigma F_t^s = \Sigma I_t - \Sigma \bar{S}_t \tag{35}$$

where all summations apply to any planning period of n years. Similarly, the structurally determined import gap is defined as:

$$\Sigma F_t^m = \Sigma \bar{M}_t - \Sigma E_t \tag{36}$$

The barred values $\bar{M}$ and $\bar{S}$ are determined from the structural relations in equations (13) and (5) and represent the minimum import needs and the maximum savings potential for a given sequence of values of V_t .

The appropriate adjustment policies depend on which of the two gaps is larger under the assumptions of model 1. We shall say that the economy is predominantly in Phase II when the savings gap is the larger of the two and predominantly in Phase III when the import gap is larger. (Pakistan, in Figure 2, would thus be predominantly in Phase II at an average GNP growth rate of greater than .058 between 1962-1975, and predominantly in Phase III at a lower growth rate.)

Model 2: Variable Growth Rates. Although we assume a constant target GNP at the end of the period, the cumulative

production ΣV_t over the period will be increased by more rapid growth at the beginning of the period or reduced by starting slowly and accelerating at the end. Since savings and imports both depend on the cumulative GNP, they can be varied upward or downward from the levels of model 1 by such variations in the growth path. The other two totals are unaffected by the growth path: total investment depends only on the target GNP while exports are exogenously determined.

The conditions for eliminating the difference between the two cumulative resource gaps are shown by setting them equal and rearranging terms so that the constant terms are grouped together on the left side:

$$\Sigma F_t = \Sigma I_t - \Sigma \bar{S}_t = \Sigma \bar{M}_t - \Sigma E_t$$

$$(37) \quad \Sigma I_t + \Sigma E_t = \Sigma \bar{M}_t + \Sigma \bar{S}_t$$

Since the terms on the right-hand side are functions only of the total GNP, we can substitute for $\bar{S}_t$ and $\bar{M}_t$ from equations (5) and (13) and sum over time.[1] Solving for the total GNP gives:

$$(38) \quad \frac{\sum_{o}^{n} V_t}{V_o} = \frac{B + (n+1)(\alpha' - \alpha_o + \mu' - \mu_o)}{\alpha' + \mu'}$$

$$\text{where} \quad B = \frac{\Sigma I_t + \Sigma E_t}{V_o}$$

[1] In Model 2 we assume that: $\bar{M}_t = \bar{M}_j + \mu'(V_t - V_j) = M_o + \mu'(V_t - V_o)$

In this formulation we assume that short-term differences between the two gaps can be offset by increasing or decreasing foreign exchange reserves so long as the net difference over the planning period is zero. The net capital inflow can then be determined as the difference between total required imports and total exports:

$$\Sigma F_t = \Sigma \bar{M}_t - \Sigma E_t$$

$$(39) \qquad \frac{\Sigma F_t}{V_o} = (n+1)(\mu_o - \mu') + \frac{\mu' \Sigma V_t}{V_o} - \frac{\Sigma E_t}{V_o}$$

The second welfare measure--the total consumption over the period (ΣC_t)--is determined as the difference between the total GNP and savings, or:

$$(40) \qquad \frac{\Sigma C_t}{V_o} = (n+1)(\alpha' - \alpha_o) + (1-\alpha')\frac{\Sigma V_t}{V_o}$$

A comparison of the results of model 2 to those of model 1 is given in Table 3 and Figure 3.[1/] At a constant growth rate of 5.8%, the two resource gaps would be equal in model 1 and there would be no difference between the two models. At higher growth rates, model 1 is dominated by the

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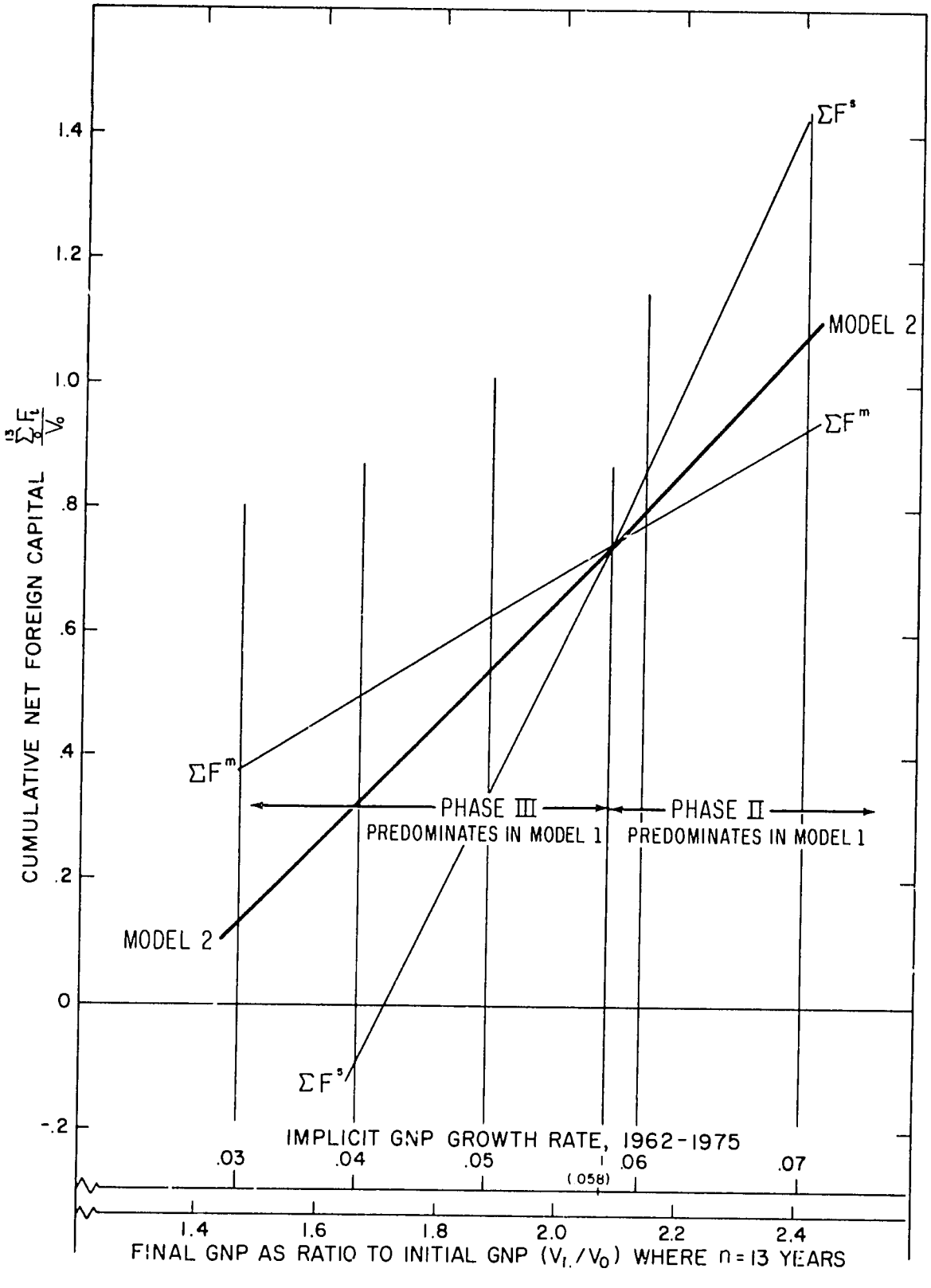
1/ To isolate the effects of the variable growth rate, the limitation on the increase of investment in model 1 has been removed, so that only Phase II and Phase III are shown. Furthermore, foreign exchange reserve changes are assumed for model 1 which would permit capital requirements to be set by the cumulative needs for the dominant phase. For model 2, no restrictions have been placed on the time path of GNP or investment. The "single dominant phase" equations for model 1, as well as those used for the rest of Table 3 and for the efficiency measures discussed later in this section, are developed in Annex B.

FIGURE 3

GAP EQUALIZATION THROUGH VARIABLE GNP GROWTH RATE (MODEL 2), PAKISTAN, 1962-1975



savings gap--i.e., is predominantly in Phase II. Here model 2, by raising cumulative GNP and savings, produces a reduction in external capital requirements equal to about 70% of the excess imports required by model 1. At rates of growth below 5.8%, where the economy is predominantly in Phase III, model 2 is less effective. The difference between the two gaps is eliminated by a slower initial growth rate, which reduces potential savings as well as import requirements. At 4% growth, for example, Table 3 shows that the net reduction in external capital (.18) is about 30% of the excess consumption (.59) in model 1.

The relative efficiency of model 2 in the two phases can be determined in general terms by solving for the change in cumulative GNP required to eliminate the difference between the two gaps.[1/] The excess of consumption or imports of model 1 is eliminated in model 2 through variation in two components: imports and savings. In Phase II the capital inflow is reduced by raising GNP and savings with an offsetting rise in imports. In Phase III, where the import restriction is dominant, the required capital inflow is reduced by lowering GNP and imports with an offsetting fall in savings.

The following equations express the efficiency of the variable growth rate mechanism as ratios of the

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1/ Relative efficiency measures are derived in Annex B.

Table 3

Effects of Gap Equalization Policies
Pakistan, 1962-1975[1]/

(All figures expressed as ratios to 1962 GNP)

Line		Alternative Growth Targets				
1	Target 1975 GNP	1.468	1.665	1.886	2.133	2.410
2	(GNP compound growth rate)	(.03)	(.04)	(.05)	(.06)	(.07)
3	Cumulative Exports (all models)	1.33	1.33	1.33	1.33	1.33
	Model 1 (Cumulative Values)					
4	GNP	17.09	18.29	19.60	21.02	22.55
5	Investment	1.54	2.19	2.94	3.78	4.74
6	Savings: (Potential)	(2.00)	(2.29)	(2.60)	(2.94)	(3.31)
7	Savings: Realized	1.16	1.70	2.31	2.94	3.31
8	Imports: (Potential)	(1.71)	(1.83)	(1.96)	(2.10)	(2.26)
9	Imports: Realized	1.71	1.83	1.96	2.17	2.76
10	Excess Consumption	.84	.59	.29	.0	.0
11	Excess Imports	.0	.0	.0	.07	.50
12	Net Capital Inflows	.38	.50	.63	.84	1.42
13	(Dominant Phase)	(III)	(III)	(III)	(II)	(II)
	Model 2 (Cumulative Values)					
14	GNP	14.62	16.55	18.74	21.22	24.02
15	Investment	1.54	2.20	2.94	3.78	4.74
16	Savings	1.41	1.87	2.40	2.99	3.67
17	Imports	1.46	1.65	1.87	2.12	2.40
18	Net Capital Inflows	.13	.32	.54	.79	1.07
	Model 3 (Cumulative Values)					
19	GNP	17.09	18.29	19.60	21.02	22.55
20	Investment	1.81	2.38	3.03	3.76	4.58
21	(% Investment in Import Substitution)	(44%)	(24%)	(9%)	(-2%)	(-10%)
22	Savings	2.00	2.29	2.60	2.94	3.31
23	Imports	1.14	1.43	1.76	2.15	2.60
24	Net Capital Inflows	-.20	.09	-.43	.82	1.26
	Cumulative Consumption					
25	Model 1	15.93	16.60	17.29	18.07	19.24
26	Model 2	13.21	14.68	16.34	18.23	20.36
27	Model 3	15.09	16.00	16.99	18.07	19.24

1/ Assumes no contraints on growth of investment or GNP. This means that country could invest sufficient capital in each year to attain the GNP growth rate given in line 2. Actual 1962 investment was sufficient for an initial GNP growth rate of about .04.

Model 1 is described in equations 5, 8, 9, 11-15. Realized savings or imports are equal to potential savings or imports (eqs. 5 and 13) plus an amount necessary to equate the two gaps on the assumption that foreign capital is sufficient to fill the larger of the two gaps.

Model 2 differs from Model 1 only in permitting that variable GNP growth rate which will raise or lower cumulative GNP sufficiently to equate the cumulative F^S with the cumulative F^m gap over the 13-year period.

Model 3 has the same growth path as Model 1 and differs only in permitting the excess consumption and imports of lines 10 + 11 to be used for additional import substituting investment.

Details on the equations used for these three models are given in Annex B.

total capital saved to the initial cumulative gap difference:

$$(41a)\quad \text{Phase II:}\ \frac{\Sigma\Delta F}{\Sigma F^{S} - \Sigma F^{M}} = \frac{\alpha'}{\alpha' + \mu'} = \frac{.24}{.34} = .71$$

$$(41b)\quad \text{Phase III:}\ \frac{\Sigma\Delta F}{\Sigma F^{S} - \Sigma F^{M}} = \frac{\mu'}{\alpha' + \mu'} = \frac{.10}{.34} = .29$$

where $\Sigma \Delta F$ is the difference in cumulative foreign capital between model 1 and model 2. The greater efficiency in Phase II in the Pakistan case is due to the fact that the marginal savings rate is greater than the marginal import ratio. For other countries the median values of those two parameters are about the same, so that typically the ratio is about .5 in both phases.

When realistic limits are imposed on the variation in growth rates, the potential savings in assistance due to the variable growth mechanism may be severely reduced. If GNP must grow at least as fast as population but the rate cannot exceed 8% or so, the savings due to variable growth will be small when average desired GNP growth is close to either limit. At intermediate growth targets, however, there can be more flexibility in varying the path of GNP; savings may run to 20% of the foreign capital requirements determined by model 1.

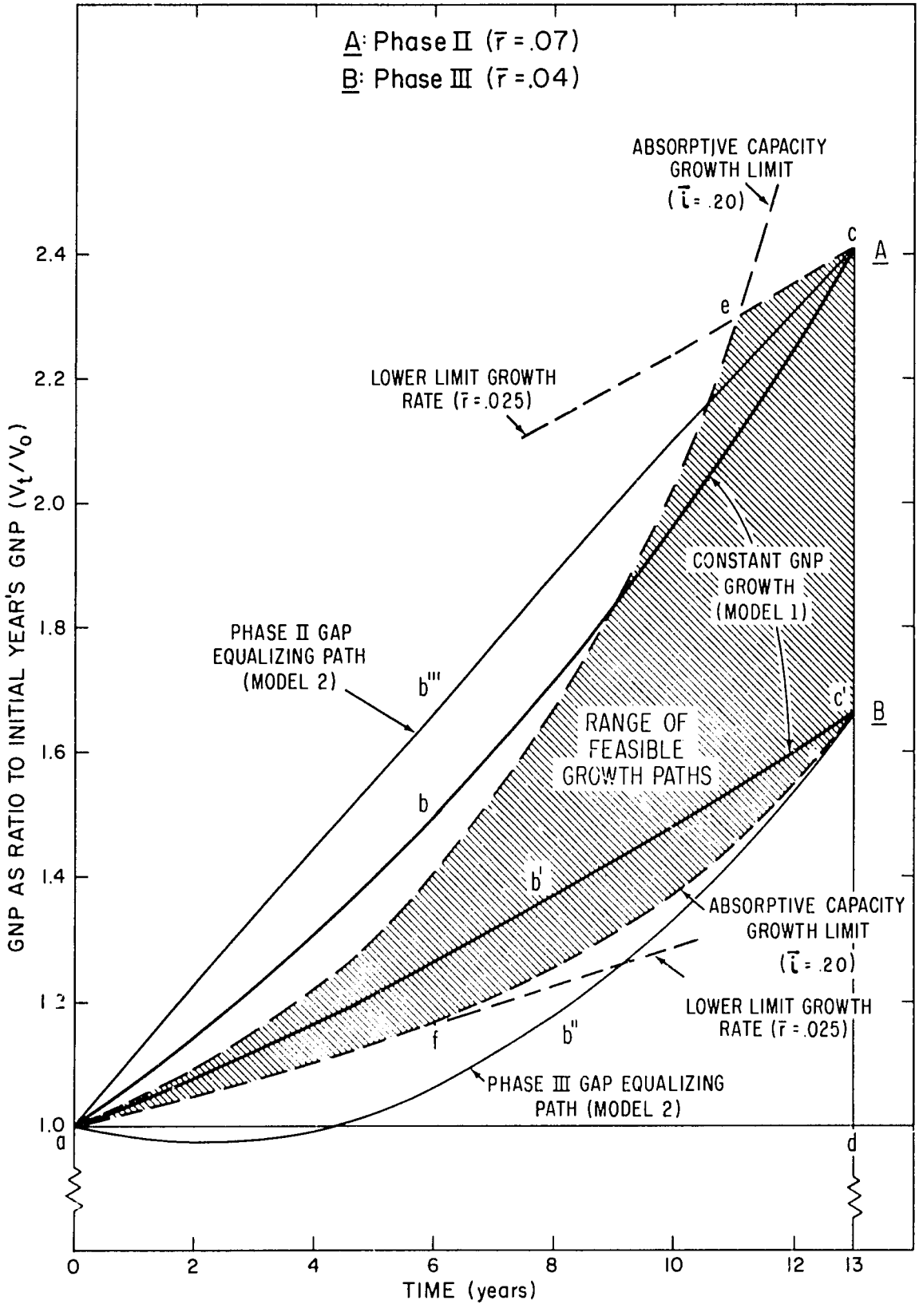
Figure 4 illustrates alternative growth paths which would equalize the two cumulative gaps. The constant growth rate paths of model 1 are shown for two different GNP targets by the lines abc and ab'c'. When Phase II predominates under model 1, faster initial growth (path ab'''c, for example) may permit gap equalization. On the other hand, if Phase III predominates, a slower initial growth rate (path ab''c', for example) would be indicated. In either case the desired cumulative GNP must be equal to the area under the curve.

Structural or other constraints may make it impractical or undesirable to equate the two gaps in this way. These constraints are represented in Figure 4 by absorptive capacity limits (ae and fc') and by minimum growth rate limits (af and ec). The range of feasible growth paths lies within the shaded area aecc'f. Complete equalization of the two gaps could therefore not be obtained for the extreme growth rates of % or 7% shown in the figure. The larger gap would be reduced as much as possible within the assumed limits by following the feasible paths aec or afc'.

odel 3: Import Substitution. A more important modification n the original model consists in allowing for additional hanges in the productive structure of the economy over time. hese changes are designed to prevent a cumulative difference

FIGURE 4

VARIABLE GNP GROWTH PATHS OVER TIME, MODELS 1 AND 2



between the two resource gaps from emerging during a planning period of 10 years or more. The implications of such a policy can only be worked out in detail in a sectoral model in which the capital costs of increased production are compared to the value of the foreign exchange saved or earned through import substitution or additional exports. A mathematical programming analysis of this sort is given in Chenery /57/, which shows the possibility of varying the ratio of imports to GNP with a constant level and composition of total demand. We utilize these results to formulate an aggregate import substitution function.[1/]

In model 3 we assume that additional production in replacement of imported goods can only be achieved by a greater investment per unit of output than the value of k that applies to the average increment of GNP. We define the capital requirement for import substitution as: $k_m = bk$ where b is greater than 1. We also allow for the possibility that investment goods will have a higher import content than the average, which will reduce thenet import substitution. With these two assumptions, we write the following production

---

1/ The analysis applies equally well to export variation, but for simplicity it is assumed that the variation will take place entirely in the imports required for a given level of GNP.

equation describing the possibilities of changing import requirements in year t by an amount Mm_t :

$$(42) \quad -Mm_t = \frac{1}{bk} \sum_{o}^{t-1} Im_t - aIm_t$$

where Im_t is investment in import substitution and a is the additional import content of Im_t.

Adding the import substitution element to the original import equation of model 1 gives:

$$(43) \quad M_t = M_o + \mu'(V_t - V_o) + Mm_t$$

In addition to the modified import equation, we must specify the amount of investment that is devoted to import substitution in each period. For the present illustration, we assume (1) sufficient import substitution to eliminate the difference between the two gaps over a planning period of 13 years and (2) that the amount of investment in import substitution will increase linearly throughout the period. These assumptions enable us to compute the gap equalization solutions given for model 3 in Table 3, which are plotted in figure 5.[1/]

1/ We assume equal annual increments in Im_t as given by: $Im_t = Im_o(t+1)$. The value of b in equation (42) is taken as 1.5, which is the aggregate ratio derived in the study of Southern Italy [5]. The additional import content of investment, a, is assumed to be .25.

FIGURE 5

GAP EQUALIZATION THROUGH ADDITIONAL IMPORT SUBSTITUTION (MODEL 3), PAKISTAN, 1962-1975

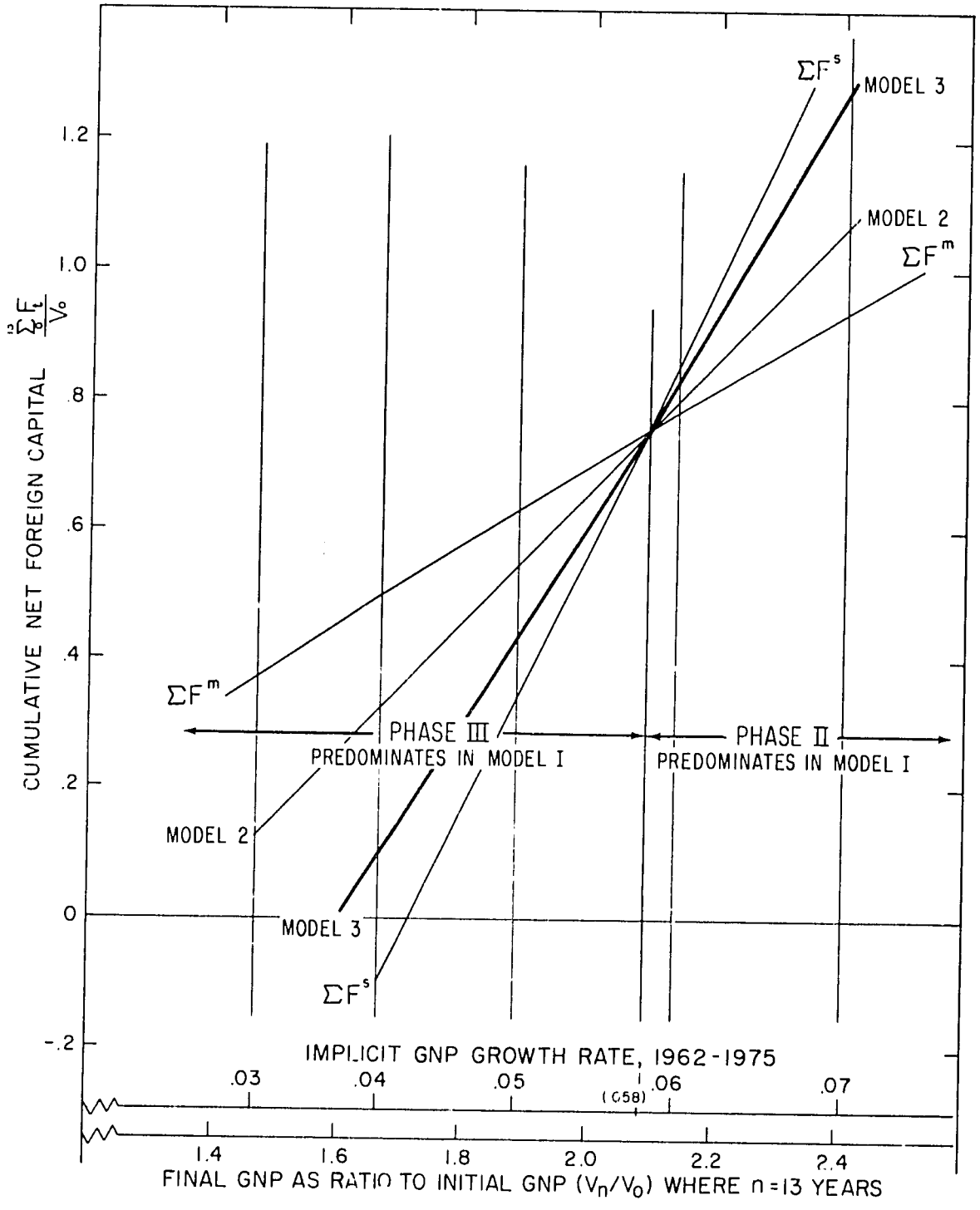


Figure 5 shows that the import-substitution model is considerably more effective in reducing requirements for external assistance in Phase III than is model 2, but it is less effective in Phase II. In Phase III, the potential excess of savings existing in model 1 is utilized to increase investment and thereby reduce the requirement for imports. At a growth rate of 4%, for example, the excess consumption (difference between actual and potential savings) of .59 in model 1 is converted in model 3 into an increase in cumulative investment of .19 and a reduction of cumulative imports of .40. The efficiency of the import substitution mechanism is thus about .68 in this example, or in general terms:1/

$$(44) \qquad \frac{\Sigma\Delta F}{\Sigma F^S - \Sigma F^M} = \frac{-\Sigma Mm_t}{\Sigma\Delta I_t - \Sigma Mm_t}$$

where $\Sigma\Delta F$ is the reduction in ΣF from model 1 to model 3, $-\Sigma Mm_t$ is the additional import-substituting production for the period, and $\Sigma\Delta I_t \quad (1 - \frac{1}{b})\ \Sigma Im_t$ represents the extra cost of the additional import-substituting investment made during the period.

In Phase II, the process is reversed and excess imports are used to replace investment that would otherwise

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1/ An explicit solution for this ratio depends on the form of import substitution path assumed; the example used here (see note p. 42) is given in Annex B.

be needed. The efficiency of this process is only 32% of the excess imports, or much less than that of odel 2 in the Pakistan example.

The realism of the import substitution model can be judged by the portion of total investment going into additional replacement of imports. This share is shown in line 21 of Table 3. Values in excess of 15% of total investment are quite implausible, which suggests that below growth rates of 4.5% or so it would not be feasible to close the two gaps completely and reduce the capital inflow to the extent indicated.

Welfare Aspects

Some of the welfare measures derivable from the three growth models are set out in Table 4 for the Pakistan example. For any given growth rate we can compare the cost in reduced consumption of saving on external capital through varying the growth rate (model 2) or import substitution (model 3).

In Phase III, the saving of external capital through slower growth in model 2 reduced consumption by $1l for each dollar saved (lines 17 and 20). Model 3 is not only more efficient in reducing the capital inflow through import

Table 4

Welfare Effects of Alternative Growth Models, Pakistan, 1962-1975

(All values expressed as relative to initial GNP)

Line		Alternative Growth Targets (1)	(2)	(3)	(4)	(5)
1.	Target GNP, 1975	1.468	1.665	1.886	2.133	2.410
2.	(Implicit Growth Rate)	(.03)	(.04)	(.05)	(.06)	(.07)
	Cumulative Values, 1962-1975, Undiscounted					
	Net Capital Inflows					
3.	Model 1 1/	.38	.50	.63	.84	1.42
4.	Model 2 (minimum)	.13	.32	.54	.79	1.07
5.	Model 3 (minimum)	-.20	.09	.43	.82	1.26
	Consumption					
6.	Model 1	15.93	16.60	17.29	18.07	19.24
7.	Model 2	13.21	14.68	16.34	18.23	20.36
8.	Model 3	15.09	16.00	16.99	18.07	19.24
	Cumulative Present Values, Discounted at 8%					
	Net Capital Inflows					
9.	Model 1	.25	.31	.37	.59	.94
10.	Model 2	.11	.22	.34	.49	.65
11.	Model 3	-.08	.10	.31	.54	.81
	Consumption					
12.	Model 1	9.78	10.07	10.34	10.79	11.42
13.	Model 2	8.21	9.08	10.03	11.11	12.33
14.	Model 3	9.30	9.76	10.25	10.79	11.42
	Differences in Consumption and Foreign Capital among Alternative Models					
	Model 1 vs. Model 2					
15.	Consumption (line 7 minus 6)	-2.72	-1.91	-.95	+.16	+1.12
16.	Capital Inflow (line 4 minus 3)	-.25	-.17	-.09	-.05	-.35
17.	(Ratio, line 15 ÷ 16)	11.0	11.0	11.0	-3.17	-3.17
18.	Consumption, discounted (line 13 minus 12)	-1.57	-.99	-.31	+.32	+.91
19.	Capital Inflow, discounted (line 10 minus 9)	-.14	-.09	-.03	-.10	-.29
20.	(Ratio, line 18 ÷ 19)	11.0	11.0	11.0	-3.17	-3.17
	Model 1 vs. Model 3					
21.	Consumption (line 7 minus 6)	-.84	-.59	-.29	0	0
22.	Capital Inflow (line 4 minus 3)	-.57	-.40	-.20	-.02	-.16
23.	(Ratio, line 21 ÷ 22)	1.47	1.47	1.47	0	0
24.	Consumption, discounted (line 14 minus 12)	-.48	-.31	-.09	0	0
25.	Capital Inflow, discounted (line 11 minus 9)	-.33	-.21	-.06	-.05	-.13
26.	(Ratio, line 24 ÷ 25)	1.47	1.47	1.47	0	0

Source: Table 3 and underlying worksheet

1/ Model assumes flexible reserves; therefore dominant phase is used throughout time period.

substitution, but the loss in consumption is only $1.47 per dollar of saving in external capital (lines 23 and 26). Model 3 is clearly the preferred alternative at growth rates below 5.8%.

In Phase II, model 2 is more efficient than the other alternatives with respect to both external capital requirements and the effect on consumption. Reduction in external capital is achieved by accelerating growth, which adds to consumption as well as savings. In this situation, unlike Phase III, there is no conflict between the donor's objective of maximizing total aid and the recipient's objective of maximizing consumption.

The choice of an optimum growth rate is likely to present a conflict between the interests of aid donors and aid recipients. For example, it is in Pakistan's interest to increase its rate of growth so long as the productivity of the additional external capital required is greater than the cost of servicing additional external debt. Table 3 shows that the marginal productivity of aid in raising the growth rate from 6% to 7% varies from $\frac{\Delta V}{\Sigma \Delta F} = .5$ in model 1 to 1.0 in model 2. Under the model 2 assumptions, two-thirds of the increased investment over the period would be financed out of increased savings.

While, from Pakistan's point of view, this prospective gain would be well worth the additional cost under current assistance terms, the donor countries must also consider the productivity of aid elsewhere and other welfare objectives in relation to the resources available for assistance over time. These broader aspects of aid strategy are taken up in Part III.

II. PROSPECTS FOR THE TRANSITION

Although many countries are now attempting to achieve more rapid growth through increased use of external assistance, it is too soon to reach any firm conclusions as to their prospects for success. We can, however, use the models developed in the preceding section to evaluate current performance and to determine the needs for future assistance under various assumptions.

A survey of the performance of a large number of underdeveloped countries has been undertaken for this purpose. Since experience with efforts to accelerate growth through foreign assistance is concentrated in the past few years, we focus on the period 1957-1962. For this period, rough estimates of the basic relations in model 1 can be made for 50 countries accounting for 90% of the GNP of the non-communist underdeveloped world. This maximum sample will be used for a general assessment of future aid requirements. The past performance of 31 of these countries for which the data for our model are more reliable will be studied in more detail.[1/]

1/ The only large countries omitted from the 31 country sample are Ceylon, UAR, Ethiopia, Sudan, Indonesia and South Vietnam.

The analysis highlights the quantitative significance of the central concept in our models: the notion that the need for external resources is determined by several structural limitations whose relative importance varies over time and among countries. We attempt to identify some of the countries that are currently in each of our three phases of growth and also to determine the future importance of the three phases if present development policies are maintained.

A. Estimates of Current Performance

Our estimates of current performance are intended primarily to establish representative values for the key parameters and to indicate the extent to which developing countries have established the structural conditions required to carry out the transition. For this survey we have adopted a uniform statistical procedure for all countries, supplemented by detailed studies of some of the significant aid recipients.[1/] The additional knowledge gained from the more detailed country studies is utilized

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1/ Preliminary results of the more detailed studies are available for Greece [ ], Turkey [21], and Colombia [20]. Other countries for which more detailed models have been constructed by A.I.D. in order to test the "two gap" analysis of aid requirements and performance include India, Pakistan, Argentina, Brazil, Korea, Jordan, Nigeria and Chile.

in making projections of future performance and aid requirements.

Our statistical procedures are outlined in Annex A. To start with, all time series were smoothed by fitting a linear trend for the period 1957-1962. Marginal savings and import rates and marginal capital-output ratios were then determined from the fitted trends for the variables involved.1/ The annual growth of exports was determined without correction for price changes; it thus measures the growth of foreign exchange earnings.

An indication of absorptive capacity has been obtained by taking the highest compound growth rate for investment observed over any five-year period in the past decade. The upper range of these values suggests the limit which can be attained. The observed rate does not necessarily indicate the absorptive capacity for a given country, however, since growth may have been constrained by other factors.

The initial average values of the parameters for 31 countries and marginal values for the period 1957-

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1/ The marginal capital-output ratio for the period is measured with a one-year lag:

$$k = \sum_{t=o}^{4} I_t / (Y_5 - Y_o)$$

where subscript o = 1957, 4 = 1961, 5 = 1962

1962 are given in Table A-1 of Annex A. The median values and extent of variation in the principal parameters are shown in Table 5. The median values for this sample are quite close to the mean values of savings, investment and growth rates for the underdeveloped world as a whole.1/

These estimates can be used to determine the extent to which recent performance conforms to the criteria derived in section I for a successful transition to self-sustaining growth. While six years is too short a period to establish reliable estimates for any single country, a comparative assessment for the whole group of countries is quite suggestive.

We have proposed three sets of criteria for a successful transition to a given rate of self-sustaining growth:

(i) Investment criteria. In Phase I, the rate of growth of investment must be greater than the target growth rate ($i > \bar{r}$). Thereafter, the investment rate must be adequate to sustain the target growth rate ($\frac{I}{V} \geq \bar{r}$).

(ii) Savings criteria. The marginal savings rate must be greater than the target investment rate

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1/ U.N. calculations for 1960 show investment at 16% of GNP and a growth rate of 4.4% of GNP for the previous decade. See United Nations, World Economic Survey, 1963, Part I. Trade and Development: Trends, Needs, and Policies, United Nations, New York, 1964, pp. 19 and 37.

Table 5

Distribution of Parameter Values, 31-Country Sample

Parameter	Symbol	Upper Quartile	Median	Lower Quartile
Highest 5 years in recent past compound growth rate of gross investment	$\bar{i}$	.187	.144	.103
Relationships during 1957-1962				
Compound growth rate of gross investment	i	.11	.06	.01
Incremental capital-output ratio (assuming 1-year lag)	k	4.69	3.71	2.93
Compound growth rate of GNP	r	.066	.045	.032
Ratio of gross investment to GNP in 1962 (after time-trend fitting)	I_o	.20	.16	.14
Ratio of net foreign capital inflow to GNP in 1962 (after time-trend fitting)	Φ_o	.09	.03	.02
Ratio of national gross savings to GNP in 1962 (after time-trend fitting)	α_o	.15	.12	.09
Marginal national savings ratio (change in savings and change in GNP)	α'	.32	.20	-.01
Ratio of gross imports of goods and services to GNP in 1962 (after time-trend fitting)	μ_o	.37	.21	.17
Marginal import ratio (change in gross imports of goods and services ÷ change in GNP)	μ'	.46	.20	.02
Compound growth rate of exports of goods and services	e	.077	.043	.009
Change in gold and convertible foreign currency reserves, December 1956 to December 1962 (after time-trend fitting) ÷ change in GNP 1957-1962, GNP first converted to 1962 US dollars (a)/	ρ'	.13	0	-.07

Source: Table A-1

(a) / Excludes Trinidad-Tobago, Liberia, and Mauritius because of lack of data.

($\alpha' > k\bar{r}$) unless the average rate of savings is already above this level.

(iii) Trade criteria. To close the trade gap, either the growth rate of exports must exceed the target growth of GNP ($\varepsilon > \bar{r}$) or the marginal import ratio must be very low.1/

To have a common basis for the comparison, we have adopted a uniform target rate $\bar{r}$ of 5% for all countries. Since the identification of countries in Phase I depends on their actual target rate and cannot be adequately based on aggregate data, we shall apply only the tests for the approach to self-sustaining growth which are appropriate to Phases II and III.2/

Table 6 classifies 26 of the 31 countries in our 31 country sample into four groups according to their savings-investment performance and their trade

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1/ To achieve self-sustaining growth in year p, a solution to eq.(24) gives the condition:

$$\frac{\mu'}{\bar{\mu}_n} \leq \frac{\frac{E_n}{M_n}(1+\varepsilon)^{p-n} - 1}{(1+\bar{r})^{p-n} - 1}$$

where E_n/M_n is the ratio of exports to imports at the beginning of Phase III. For example, when $r=.05$, $\varepsilon=.03$, $E_n/M_n = .75$, and $(p-n)=30$, the marginal import ratio (μ') must be less than 25% of the average import ratio at the beginning of the phase (μ_n).

2/ In Phase I the main test of performance is the achievement of a high rate of growth of investment. This is clearly met by Liberia, for example, which falls far short of the savings and trade criteria.

performance.[1] The 12 countries which satisfy both tests are in group A.[2] The 5 countries in group D satisfy neither, while the other 9 meet one or the other criterion.

One of the most suggestive features of this grouping of countries is the predominant role played by exports. Nine of the 12 countries in group A have export growth rates of 5% or more and hence would satisfy the trade criterion even if their import ratios remained constant. Conversely, one of the most important aspects of the unsatisfactory performance of countries in group D is the stagnation of their exports, which has typically led to increased requirements for external assistance and falling savings rates. There is almost no example of a country which has sustained a growth rate substantially higher than its growth of exports through continuing import substitution. Brazil, Colombia and India have done so for considerable periods, but each has run into severe balance of payments difficulties in recent years.

This comparative assessment also tends to dispel the notion that performance as measured here is necessarily associated with the initial income level. In this period, at least, there is no apparent correlation between initial income

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1/ Where the classification based on data for 1952-1962 conflicted with that based on 1957-62, the former estimates were used in place of the latter. This test changed the classification of Brazil and Mexico, of the 5 countries to which it was applied.

2/ Four of these 12 have unsatisfactory growth rates during this period, however.

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Table 6

Indicators of Progress in Attaining Self-Sustaining Growth 1/

Ident. No.			Investment Performance			Savings Performance		Trade Performance			Growth in GNP
			$k\bar{r}$	I_o/V_o	i	α_o	α'	E_o/M_o	ϵ	μ'/μ_o	r
	A. Countries meeting both savings and trade criteria 2/										
21.	Honduras		.195	.14	.06	.15	.51	1.05	.028	-.05	.034
6.	Israel		.155	.30	.09	.11	.16	.54	.191	1.12	.101
45.	Korea		.187	.14	.04	.04	.42	.44	.165	-4.44	.038
49.	Malaya		.257	.18	.14	.22	.43	1.08	.056	2.72	.027
23.	Mexico	1957-62	.102	.15	.06	.13	.09	.83	.038	.58	.050
		1953-63**	.124	.15	.06	.14	.14	.94	.051	.84	.062
25.	Panama		.121	.19	.14	.12	.28	.81	.063	.78	.066
27.	Peru		.170	.20	.04	.21	.35	1.04	.144	.87	.066
46.	Philippines		.130	.13	.04	.11	.26	.90	.046	.33	.050
43.	Taiwan		.132	.22	.11	.15	.31	.65	.083	.90	.075
47.	Thailand		.096	.16	.09	.14	.19	.90	.077	.80	.081
28.	Trinidad-Tobago		.182	.32	.09	.21	.20	.86	.107	1.21	.088
29.	Venezuela		.371	.19	-.08	.32	.56	1.45	-.025	-5.72	.037
	B. Countries meeting savings criterion only 2/										
11.	Argentina		.502	.24	.08	.22	.70	.86	.043	2.28	.021
3.	Greece		.155	.20	.10	.14	.23	.70	.051	1.05	.059
4.	India	1957-62	.140	.14	.06	.12	.21	.71	.030	.29	.045
		1953-63**	.165	.15	.07	.13	.19	.68	.027	1.07	.037
36.	Nigeria		.224	.16	.10	.11	.27	.76	.007	2.24	.031
8.	Pakistan		.150	.12	.13	.09	.31	.68	.058	1.60	.070
13.	Brazil	1957-62	.146	.14	-.02	.11	-.08	.77	-.021	-.08	.058
		1953-63**	.140	.18	.07	.15	.16	.77	-.013	.09	.062
	C. Countries meeting trade criterion only 2/										
20.	Guatemala		.233	.10	-.05	.08	-.07	.87	.009	-.40	.029
5.	Iran		.188	.15	.00	.14	.11	.96	.080	.79	.046
7.	Jordan		.060	.15	.18	-.13	.02	.33	.083	.67	.117
	D. Countries meeting neither criterion within 50 years										
12.	Bolivia		.234	.13	.01	.04	-.11	.59	-.011	4.72	.029
9.	Turkey	1957-62	.246	.16	.06	.13	.08	.75	.050	2.66	.030
		1953-63**	.170	.15	.06	.11	.14	.68	.030	1.06	.042
15.	Chile		.157	.14	.12	.07	-.12	.67	.060	2.15	.032
16.	Colombia	1957-62	.215	.21	.06	.18	-.01	.82	-.025	1.18	.048
		1953-63**	.220	.20	.03	.17	.11	.80	.013	.56	.047
17.	Costa Rica		.228	.16	-.01	.11	-.11	.82	.016	.57	.040

(Continued)

Table 6 (Continued)

Source: Table A-1

Symbols: $k\bar{r}$ = ratio of investment to GNP needed for 5% GNP growth rate ($\bar{r} = .05$)

I_o/V_o = investment/GNP ratio in 1962

i = annual growth rate of investment

α_o = 1962 ratio of savings to GNP

α' = marginal savings/GNP ratio

E_o/M_o = 1962 ratio of exports to imports

ϵ = export growth rate

μ'/μ_o = ratio of marginal to average import/GNP coefficients

r = annual GNP growth rate

1/ Unless otherwise indicated, refers to 1957-1962

2/ Savings criterion: $\alpha' \geq k\bar{r}$, where $\bar{r} = .05$

Trade criterion: $\frac{\mu'}{\mu_o} \leq \frac{E_o/M_o\ (1+\epsilon)^p - 1}{(1+\bar{r})^p - 1}$, for some $p \leq 50$ years where $\bar{r} = .05$

*This table and classification are to be reworked using revised national accounts data available through February 1965 and perhaps using estimates of marginal import and savings coefficients more nearly reflecting structural limitations on savings and imports. A determination that the high marginal import ratios for Pakistan and Chile, for example, reflect Phase II slackness in the foreign trade constraint, might mean that Pakistan should be moved from Group B to A and Chile from Group D to C.

**Based on revised time series available in March 1965 and not necessarily comparable with 1957-62 data shown.

levels and either marginal savings rates or balance of payments performance.

B. The Limits to Growth

It is important for both development policies and assistance policies to identify the factors which effectively limit more rapid growth. In a well organized economy, domestic and external resources would be allocated in such a way that no single restriction would be controlling; the balance of payments and the capital requirements would be equally restrictive. There is considerable evidence that this is not the typical case, however, and that in many underdeveloped countries growth is better described by the disequilibrium paths of model 1 than by models in which the two gaps are equalized.

The comparative analysis of the preceding section pointed out some of the symptoms of countries in Phase II and Phase III. Our diagnosis can be pushed somewhat further by looking for additional evidence of the effects of shortages or surpluses of savings and foreign exchange.

There are a variety of short-run adjustments, planned and unplanned, that combine to bring about the necessary ex post equalization of the two resource gaps.

Short-run adjustments through varying the rate of growth and the level of reserves have already been discussed. Other planned adjustments include policies of reducing less productive investment and measures to alter the import content of final demand without affecting the level of income--by exchange rationing, taxes, etc. Ex post equilibrium in the two gaps is achieved by further (unplanned) adjustments, such as rationing of imported raw materials and spare parts and market responses to shortages of imports.

Some of these symptoms of disequilibrium can be observed fairly readily. Others require more detailed and qualitative piecing together of market information on individual sectors. Some of the more noticeable symptoms of the predominance of one or the other major limit to growth are the following:

Indicator	Restrictive Import Limit	Restrictive Savings Limit
Foreign exchange reserves	Low or falling	High or rising
Ratio of capacity to production	Significant excess capacity	
Marginal capital output ratio	Higher than normal	Normal or low
Capital markets	Slack	Active demand
Marginal savings ratio	Lower than initial average	
Supply of imports	Rationed supply	Normal or surplus supply
Marginal import ratio	Substantially lower than initial average ratio	Normal or high

While none of these indicators taken alone can be conclusive, several in combination may be strongly suggestive of the predominance of one or the other limiting factor.[1]

To allow for these effects in combination, we define the observed value of each variable as the sum of its structurally determined value and a deviation from it.[2] Allowing for changes in reserves, the ex post identity between the two gaps may be written as:

$$(45)\quad F_t = (\bar{I}_t + I^*_t) - (\bar{S}_t - S^*_t) = (\bar{M}_t + M^*_t) - E_t + \Delta R_t$$

The deviations have the following interpretations:

I^* is investment above that required to maintain the current rate of growth

S^* is the shortfall in savings from its potential level

M^* is excess imports

ΔR is the change in foreign exchange reserves

In linear programming terminology, they have the character of slack variables, indicating that the constraint is not binding.

1/ This categorization excludes the possibility of insufficient aggregate demand, which would prevent the economy from pushing against either limit. While not typical of underdeveloped countries, this situation may be produced by excessive stabilization policies. In Table 7, Iran suggests this condition.

2/ There is no structurally determined value for exports.

When the economy is constrained by the savings-investment limit, the following inequalities hold:

$$\begin{matrix} \bar{I}_t - \bar{S}_t > \bar{M}_t - E_t \\ (46) \\ I^*_t + S^*_t < M^*_t + \Delta R_t \end{matrix}$$

The converse conditions hold for the import-export limit:

$$\begin{matrix} \bar{M}_t - E_t > \bar{I}_t - \bar{S}_t \\ (47) \\ M^*_t + \Delta R_t < I^*_t + S^*_t \end{matrix}$$

If we have estimates of the structurally determined values from analysis of an earlier period, these relations can be used to identify the dominant limit.[1] Since there are few countries in our sample for which this kind of analysis is possible, we have based tentative judgments on the departures from the initial average savings ratio or--in the case of capital and import ratios--from norms established by statistical comparisons of a large number of countries.[2]

1/ This kind of analysis was carried out for Greece for the period 1950-61 in [7], from which it can be determined that by 1961 the two *ex ante* gaps were approximately equal.

2/ See footnote to Table 7.

Table 7

Tentative Identification of Growth Limits, 1957-1962

Country	Phase Indicators: Reserve Increase $(1/3\rho')$ [1]/	Excess Imports $(\mu_o-\bar{\mu}_o)$	Excess Investment $(k-\bar{k})$	Savings Shortfall $(\alpha_o-\alpha')$
	Savings Limited (Phase IA or II)			
Israel	.19	.09	-.60	-.07
Jordan	.15	.06	-2.51	-.15
Korea	.08	0	.03	-.38
Malaya	.38	.26	1.44	-.21
Peru	.04	.02	-.32	-.14
Thailand	.08	.03	-1.78	-.05
	Import Limited (Phase IB or III)			
Bolivia	-.01	-.07	.98	.15
Brazil	.00	-.01	-.78	.19
Chile	-.02	-.01	-.56	.19
Colombia	-.02	-.03	.59	.19
Costa Rica	-.01	-.11	.85	.22
Guatemala	-.06	-.14	.96	.15
Turkey	.02	-.05	1.22	.05
	Closely Balanced			
Greece	.03	-.04	-.61	-.09
India	-.06	0	-.91	-.09
Iran	.02	.06	.06	.03
Mexico	-.01	-.04	-.66	.04
Pakistan	.00	-.03	-.71	-.22
Philippines	-.03	.04	-1.10	-.15
Taiwan	.03	-.01	-1.07	-.16

Source: Table A-1, except as indicated. All ratios based on "adjusted" data derived by fitting linear time trend to observed values.

(Continued)

Table 7 (Continued)

Symbols:

ρ' = marginal foreign reserve/GNP ratio = $\Delta R \div \Delta V$.

μ_o = average import/GNP ratio in 1962.

$\bar{\mu}_o$ = average import ratio for a country of a particular size and income, 1962.
= M_o/V_o
and $\log M_o = -.3305 + .9775 \log V_o - .2436 \log N_o$
(.2721) (.1029) (.0835)
Where the standard errors are shown in parentheses, $\bar{R}^2 = .869$, V_o = 1962 GNP ($ millions), N_o = 1962 population (millions) and data for 36 less developed countries were used in the computing of this average relationship.

k = incremental capital-output ratio, assuming 1-year lag.

$\bar{k}$ = median incremental capital-output ratio, 31-country sample (Table A-1).

α' = marginal national savings ratio.

α_o = average national savings ratio, 1962.

1/ A weight of 1/3 has been applied to the marginal reserve change coefficient. This permits direct comparison with the measure shown for excess imports on the assumption that excess foreign currency can be used either for additional imports or increased reserves. This is because $(\mu_o - \bar{\mu})$ must be multiplied by the sum of the annual GNP increases over the base year $\left[\sum_o^t (V_t - V_o)\right]$ to give excess imports while reserve increases are found by multiplying ρ' by the total increase in GNP $(V_t - V_o)$. The ratio of $(V_t - V_o)$ to $\left[\sum_o^t (V_t - V_o)\right]$ for a six-year period (t = 5) is approximately 1/3 for compound GNP growth rates in the normal range of .03 to .07.

If we assume no slack in the limiting factors, the normal pattern of deviations corresponding to the two growth limits would be as follows:

Indicator	Import Limit	Savings Limit
Change in reserves (ΔR)	-	+
Excess imports (M*)	o	+
Excess Investment (I*)	+	o
Savings shortfall (S*)	+	o

Examples of countries in which these two patterns appear and are corroborated by other indicators are shown in table 7.[1/] A third group is also shown in which there is little evidence of slack for either constraint, indicating that the two structural gaps have been fairly equal over this period.

The five countries in Group D of table 6 show the clearest evidence of the disequilibrium effects of foreign exchange shortages. The successful cases of group A in table 6 are either in Phase II or show little evidence of a difference between the two gaps.

1/ Excess investment is the least significant of the four indicators, since variations in k are caused by a number of other factors. Large positive deviations in k are probably significant indicators of excess capacity.

C. Projections of Future Growth

Since less developed countries vary widely in their ability to mobilize their own resources and to utilize external resources, estimates of future assistance requirements based on aggregate models are not very useful. We shall therefore make a series of projections for each of fifty countries in order to explore the range of future growth possibilities and corresponding assistance requirements. While the projection for any single country is fairly crude, this approach has the great advantage of taking account of absorptive capacity, import requirements, and other limitations which can only be judged on a country basis.

Our analysis is designed to explore the possibilities for accelerating growth through a combination of improved country performance and additional external resources. We therefore specify a considerable range of performance possibilities, based on the preceding survey of current performance. The range of values chosen for each parameter is designed to show the extent to which the performance variables affect the country's growth and its aid requirements.

Methodology. The methodology to be followed has already been indicated in our discussion of Pakistan in

section I. A similar range of variation in performance has been specified for each of the fifty countries in the sample. Principal attention has been given to the 25 countries having the largest effect on assistance requirements.

As a starting point for the analysis, we made estimates of the six parameters in model 1, based mainly on the historical performance in each country but modified in some cases by the experience of similar countries. The average of the target growth rates for all countries (projected to 1975) is 4.4% for the historical elements, approximately the same as the recent past.

These historically based estimates for all six parameters are shown in Table A-2 of Annex A. They differ from the estimates in Table A-1 for 1957-1962 primarily in the elimination of abnormal or biased values that are not expected to persist--e.g., falling export and savings rates, abnormally high capital coefficients, etc. In large part, these abnormal values represent the effects of disequilibrium conditions rather than being measures of underlying structural relationships.

To evaluate the possibilities for accelerated growth, we divided the six policy parameters into three

groups: the growth limits for investment and GNP (i and $\bar{r}$); internal performance factors (k, α' , and μ'); and export growth ($_e$). Starting from the historical estimates, we then made two sets of more optimistic assumptions for growth targets and internal performance factors and one alternative set of export projections.1/ These alternative sets of parameters values are shown in Table A-2. The possible combinations of the sets of values for the parameters provide a basis for 18 projections for each of the 50 countries.

In judging the range of possible performance for each country, we took into account its historical performance, its development plan, the observed performance of other countries and some aspects of political performance. We relied heavily on the development programs of the major countries in making the intermediate or "plan" estimates of both growth targets and internal performance. Plan targets and performance are defined here as those achievable with moderate improvements in development policies in relation to past experience. The most optimistic ("upper limit") estimates assumed that almost all countries could attain the median observed value of the marginal savings rate (.20) and could limit the marginal import coefficient to the normal value derived from inter-country comparisons.

1/ Details are given in Annex A.

Our notion of the "upper limit" implies a probability of about 20% that the given target growth and performance could be attained. For all countries, the average of the plan growth targets through 1975 turns out to be 5.2% and the average of the upper limit targets is about 6%. The country estimates range from 3-4% in Mauritius, Indonesia and S.Vietnam to 10% in Israel, with a heavy concentration between 5% and 7%.1/

In order to explore the range of growth possibilities systematically, we have assumed the same degree of optimism for all countries in each trial calculation. Projections on this basis are designed to reveal the range of possibilities that is interesting for policy purposes rather than to forecast the most probable course of development in each country. The projections were made from year to year according to the formulae of the appropriate phase

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1/ Whatever the validity of our subjective judgments as to the possibility of improved performance, this procedure has seemed preferable to a more mechanical approach to testing the sensitivity of the results to various types of change. Our principal conclusions are not greatly affected by differences in judgment as to the possibilities for individual countries, however.

in model 1.[1/] Cumulative results for the 18 combinations of growth targets, country performance and export growth are given in Table A-4 of Annex A.

The projections based on model 1 include measures of excess consumption and excess imports, which show the extent to which aid requirements could be reduced through policies designed to equalize the two resource gaps. Since the empirical possibilities for such policies cannot be ascertained without detailed studies of each country, we have applied the overall factors derived in section 1 to estimate the reduction in capital inflow that might be achieved in this way. For model 2 a detailed 50 country test was also run to ascertain the effect of plausible maximum and minimum limits to growth rates in each country on the total capital requirements.

The Phases of Growth. The projection of growth paths under alternative assumptions provides a more general evaluation of the relative importance of the two resource limitations than does our identification of these limits in current situations.

1/ Machine computations for models 1 and 2 involve a test in each year to determine the appropriate growth phase and set of equations to apply for the next year.

Table 8 shows the proportion of the 50 countries in which the savings-investment gap was the limiting factor--and hence the determinant of capital inflow--in each of the 18 trial projections. The most striking result of this tabulation is the predominance of the trade limit; it is more important than the savings limit in 1975 in 15 of the 18 sets of alternatives.

This breakdown shows the quantitative significance of three factors that have been discussed previously in general terms.

(1) At higher growth rates the savings limit tends to become more important, for reasons analyzed in section I. Under most assumptions as to the other parameters, a rise in the growth rate from the historical average of 4.4% to the upper limit average of about 6% increases by 50% or more the number of countries in which the savings limit is controlling.

(2) The savings limit is increasingly dominated by the trade limit over time under historical conditions of internal performance. This points to the need for more import substitution unless export prospects can be drastically improved.

Table 8

Proportion of Countries with Foreign Capital Requirements Determined by Investment-Savings Gaps

GNP Growth Targets	Internal Performance Characteristics					
	Historical		Plan		Upper Limit	
	Low Exports	High Exports	Low Exports	High Exports	Low Exports	High Exports
1965						
Historical	28%	40%	22%	24%	18%	24%
Plan	52	62	32	46	34	44
Upper Limit	72	80	54	70	48	58
1975						
Historical	32	40	20	34	18	24
Plan	38	58	24	36	18	30
Upper Limit	50	68	30	48	22	40

Source: A.I.D., Office of Program Coordination, "23-Year Projections" of September 16, 1964, for Model 1, 50-country sample.

(3) A 40% increase in the assumed rates of growth of exports (from the low to the high assumptions) removes the trade limit in only 4-6 of the 50 countries under most assumptions. Unrealistically large increases in exports would be required to greatly reduce the importance of the balance of payments limitation by 1975.

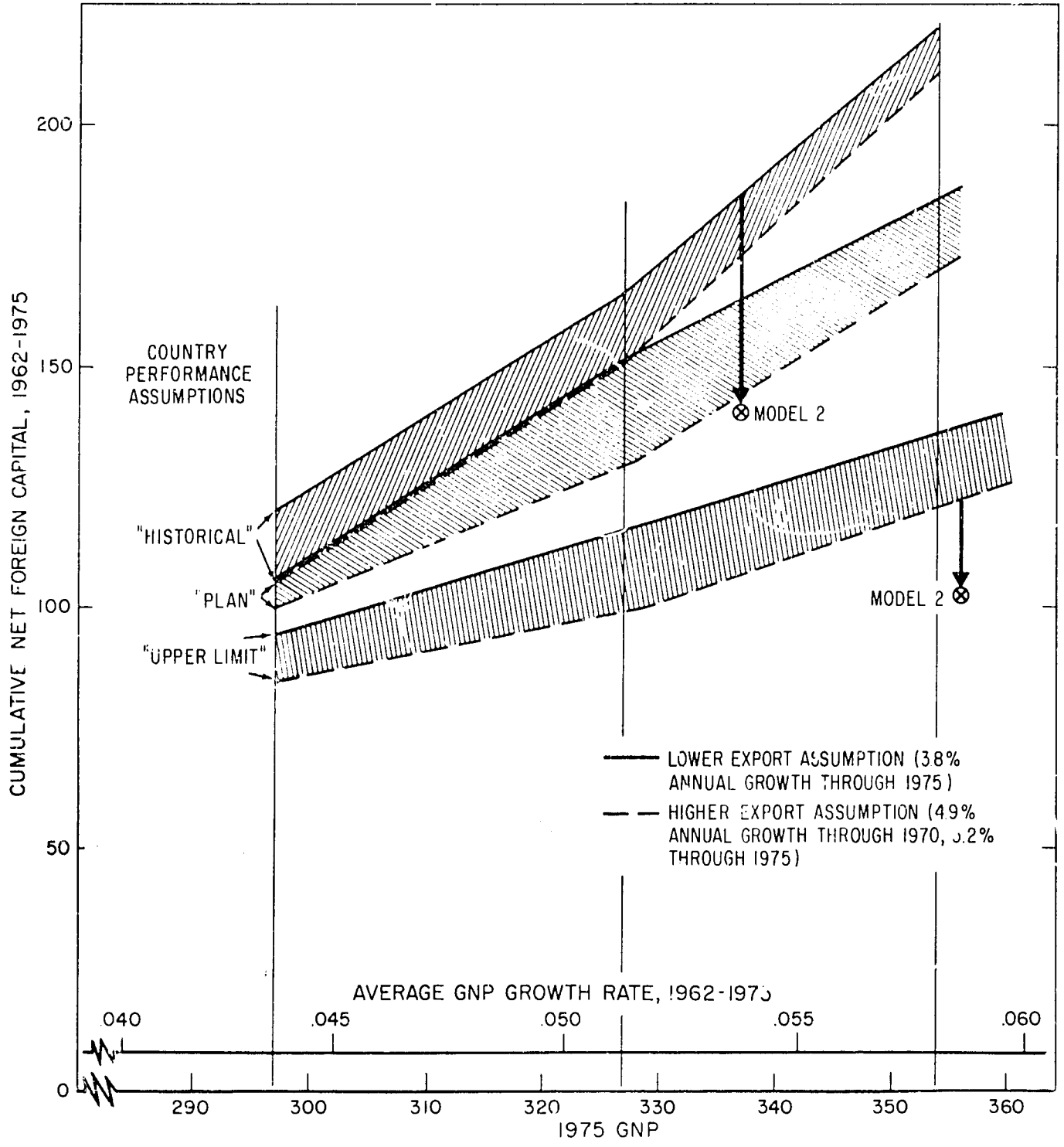
The effects of the separate growth limits on requirements for external capital are taken up in the next section.

Development Performance and Assistance Requirements. Requirements for external capital in the 18 solutions to the model are shown in Table A-4 and graphically in Figure 6. This figure shows the increase in total capital inflow over the period 1962-1975 as average rates of growth increase from 4.4% to 5.9%. Two curves are shown for each of the three sets of performance assumptions, the upper one corresponding to the low export projection and the lower one to the high export projection. Along the "plan" performance curve with high exports, for example, cumulative foreign capital requirements rise from $100 billion to $173 billion as the 1975 GNP rises from $297 billion to $356 billion.

FIGURE 6

FOREIGN CAPITAL REQUIREMENTS OF 50 DEVELOPING COUNTRIES, ALTERNATIVE DEVELOPMENT PATTERNS, MODELS 1 AND 2, 1962-1975

(All values in billions of 1962 U.S. dollars; Source: Table A-4 for Model 1 and special machine computations for Model 2.)



The effects of individual elements can be isolated in Table A-4. Starting from the central estimate of $131 billion in capital imports for plan growth and plan performance, we can identify the following effects of changes in different groups of policy variables:

(i) A decrease in export growth from 5.2% to 3.8% causes a reduction of exports of $39 billion and an increase of total capital inflow of $21 billion.

(ii) An increase in internal performance to the upper limit (with a constant growth rate) causes a reductio of capital inflow by $32 billion.

(iii) A fall in the growth rate to 4.4% (with no change in internal performance) causes a reduction in external capital requirements of $31 billion and of consumption by $98 billion.

The relative importance of these changes varies with the starting point and depends largely on which of the growth limits predominates. At the upper limit growth rates, where the savings constraint is more important, the effect of increasing exports on aid requirements is less.[1/] At plan growth rates, about half of any increase

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1/ This effect is more pronounced at low growth rates if we do not exclude countries having capital exports.

in exports is reflected in a reduced need for external resources in the model 1 solutions, since the external requirements of countries in Phase II are not affected. (Under the less rigid assumptions of models 2 and 3, the saving in external capital would be greater.)

Perhaps the most notable feature of the analysis is the sensitivity of aid requirements to variations in internal performance. The maximum reduction due to improved performance is about 20% at historical growth rates, but at the 6% growth rate upper limit performance would reduce external capital needs by 40%. Put in other terms, the capital inflow required to sustain 4.4% growth with historical performance would sustain 5.4% growth if all countries could achieve the upper limit standards. The main cause of the greater sensitivity at higher growth rates is the greater importance of savings out of increased income as GNP grows. This sensitivity would be even more pronounced if we assume that savings depend on per capita rather than total income levels.

To compare our results to other estimates, they may be stated in terms of the net capital inflow in 1970 and the implied increase in external assistance between 1962

and 1970. Omitting the less likely combinations of assumptions, the indicated range of capital requirements in 1970 is from perhaps $10-17 billion, corresponding to a rate of growth of external capital of 5% to 12% from its $6.6 billion value in 1962.[1] This range compares to the UN estimate for 1970 of $20 billion and to Balassa's range of $9-12 billion. [4] Our estimates have the advantage of making explicit assumptions as to country performance and of showing how the total depends on them.

The possibility of further reduction in assistanc needs is indicated by the magnitude of the excess imports for countries in Phase II and unrealized savings for countries in Phase III. With the moderate improvement in performance that is represented by the plan growth targets and plan performance, there would be $98 billion of unrealized savings and $20 billion of excess imports. The predominant need is to convert the unrealized savings into additional investment which will substitute for imports or increase exports.

The theoretical possibilities for reducing aid requirements in this way are shown in Tables 9 and 10. As

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1/ We have used a factor of 1.3 to convert our sample results to the requirements of all less-developed countries The 1962 figure of $6.6 billion is based on balance of payments figures in [18, Table 1] and is lower than the OECD estimate of $8.5 billion of capital inflow in the same year The discrepancies between the U.N. and OECD estimates are discussed in [13, pp. 28-29] and [19, Annex pp. 6-7].

explained in section I.C, the efficiency of the import substitution mechanism in converting surplus savings into a reduction in capital requirements may be on the order of 50-65% under plausible assumptions. More massive import substitution would raise the marginal capital coefficient for the additional production and lower the possibilities for efficient saving on external capital.

To illustrate the extent to which further import substitution or additional exports might reduce assistance requirements by 1975, we have made a set of projections with model 3 on the assumption that not more than 10% of total investment in each country could be devoted to this purpose. The results are given in Table 9. They suggest that better planning might reduce requirements for external capital by a third or more at plan growth rates.

The realistic possibilities for reducing assistance requirements through varying the growth rate are more difficult to estimate. To determine the order of magnitude of possible savings, we have made two projections to 1975 in which the variable growth paths indicated by model 2 were followed within minimum and maximum limits set for each country.[1/]

1/ The GNP growth rate was determined by minimum and maximum limits on the increase of gross investment. The maximum investment increase for each country was set by the estimated absorptive capacity measure, $\bar{I}$, for that country, i.e., $I_t = I_{t-1}(1+i)$. As a minimum limit, the investment in one year had to be equal to or greater than the country's investment in the previous year, i.e., $I_t = I_{t-1}$.

Table 9

Effect of Performance on External Capital Requirements, 50-Country Sample, 1975[1]/

(billions of 1962 U.S. dollars)

GNP Growth Targets	Internal Performance Characteristics					
	Historic		Plan		Upper Limit	
	Low Exports	High Exports	Low Exports	High Exports	Low Exports	High Exports
Model 1						
Historical	11.8	9.7	11.5	8.7	9.1	6.8
Plan	18.4	15.9	17.1	13.7	11.7	8.9
Upper Limit	25.8	23.9	22.2	19.3	15.6	12.6
Model 3 (Approximate[2]/)						
Historical	7.6	5.8	7.4	5.1	5.2	3.2
Plan	10.8	10.0	10.0	6.6	5.2	2.6
Upper Limit	20.5	20.5	13.8	13.4	7.3	5.7

Source: A.I.D., Office of Program Coordination, "23-Year Projections," machine listings of September 16, 1964.

1/ External capital requirements exclude negative flows (capital outflows) from countries estimated to be net potential capital exporters by 1975.

2/ Estimated by assuming conversion of "excess imports" (Table A-4) to additional import substituting investment in amounts not exceeding 10% of total investment estimated for equivalent Model 1 development alternati 1975 external capital "savings" under this assumption range from $5.4 to $9.5 billions.

These results are shown by the arrows in Figure 6. They suggest maximum savings on the order of 15% -- half the estimate from the unrestricted application of model 2 -- with upper limit performance and a high growth rate. At lower growth rates, a higher proportion of the theoretical savings indicated in Table 10 (line 5) might be realized and the capital inflow reduced by 20-25% from model 1.

Of the two adjustment mechanisms suggested, import substitution is a much more realistic possibility. The most important conclusion from this set of projections is the need for further adjustments in balance of payments variables beyond those realized in the recent past or envisioned in current plans.

Welfare Aspects. Since the desirability of any given policy cannot be judged by the savings in foreign capital alone, we have computed the three welfare measures already suggested in Table 10. For the 50 countries as a whole, the implications are much the same as in the Pakistan example. When capital is saved by retarding initial growth, as would often be the case under model 2 at low terminal GNP targets (see Figure 4, lines aB), it is very costly in terms of lost consumption. This is shown by the ratio of 5.5:1 in column I of Table 10, line 14. When model 2

calls for accelerating initial growth, however, the consumption cost relative to capital savings is lower (line 14, column 4). The consumption cost of model 3's import substitution (line 17) is also moderate under the assumptions made here, although it would increase if pushed too rapidly.

Table 10

Welfare Effects of Alternative Growth Models, 50-Country Sample, 1962-1975

(All figures in billions of 1962 US dollars, cumulated for the years 1962 through 1975)

Line		Historical Growth Targets and Country Performance, Low Exports (1)	Plan Growth Targets and Country Performance Low Exports (2)	Plan Growth Targets and Country Performance High Exports (3)	Upper Limit Growth Targets and Country Performance High Exports (4)
	Gross National Product				
1	Model 1	3186	3363	3363	3522
2	Model 2	2918	3146	3255	3503
3	Model 3	3186	3363	3363	3522
	Net Capital Inflows				
4	Model 1	111	142	118	116
5	Model 2 (minimum)	52	89	66	78
6	Model 3 (minimum)	34	72	57	76
	Consumption				
7	Model 1	2821	2933	2909	2967
8	Model 2	2494	2663	2749	2910
9	Model 3	2711	2835	2834	2924
10	Unrealized Savings Model 1	110	98	75	43
11	Excess Imports Model 1	19	20	36	36
	Differences in Consumption and Foreign Capital among Alternative Models				
	Model 1 vs. Model 2				
12	Consumption	-327	-270	-160	-57
13	Capital Inflow	-59	-53	-52	-38
14	(Ratio, line 12÷13)	5.5	5.1	3.1	1.5
	Model 1 vs. Model 3				
15	Consumption	-110	-98	-75	-43
16	Capital Inflow	-77	-70	-61	-40
17	(Ratio, line 15÷16)	1.4	1.4	1.2	1.1

(Continued)

Table 10, Continued

NOTES

Marginal savings and import rates used for the Model 2 approximations were taken from the implicit 50-country weighted averages derived from the Model 1 results. The multipliers for obtaining changes in net capital flows from line 10 or 11 were:

	μ'	α'	$\frac{\mu'}{\mu'+\alpha'}$	$\frac{\alpha'}{\mu'+\alpha'}$
Historical country performance:	.15	.19	.44	.56
Plan country performance:	.15	.21	.42	.58
Upper limit country performance:	.13	.24	.35	.65

Data for lines 1, 4, 7, 10, and 11 are from Table A-4 (Appendix A). The GNP estimate for Model 2 was obtained by subtracting

$$\left[(\text{line 11} - \text{line 10}) \div (\mu' + \alpha')\right]$$

from the GNP for Model 1, and consumption was estimated by subtracting

$$\left[(\text{line 1} - \text{line 2})(1-\alpha') - \text{line 10}\right]$$

from Model 1 consumption.

For the Model 3 approximations, the value of k = 3.4 is a 50-country weighted average. The capital-output ratio for additional import-substituting investment was increased by 50% (see text). The additional import content of the new investment was assumed to be 25% (i.e., a = .25), based on an estimate of 35% for capital investment and 10% for average GNP. With a time period of n = 13, this gives an efficiency factor, q, relating foreign-capital to excess consumption (see Annex B):

$$q = \frac{1}{\frac{3k(b-1)}{n-3abk} + 1} = .64$$

The factor relating foreign capital to excess imports is equal to 1 - q. These factors were used for all alternatives shown to derive lines 16 from lines 10 and 11. GNP for Model 3 equals that for Model 1, while consumption (line 9) equals line 7 minus line 10.

III. INTERNATIONAL ASSISTANCE POLICIES

Our analysis has shown the conditions under which external assistance may make possible a substantial acceleration in the process of economic development. It has focussed on the interrelations among external resource requirements and the development policies of recipient countries. Analysis of these interrelations leads to several principles of general applicability to international assistance policy.

The central questions for assistance policy are the measurement of the effectiveness of external assistance, the policies which recipient countries should follow to make best use of external resources, and the basis for allocating assistance among countries. This concluding section summarizes the main implications of our analysis for each of these questions and adds some qualitative elements which have been omitted from the formal analysis.

A. The Effectiveness of Assistance

In the short run the effectiveness of external resources depends on their use to relieve shortages of skills, savings and imported commodities. The productivity of additional amounts of assistance over short periods can be measured by the increase in output that results from the fuller use of domestic resources which they make possible.

Over longer periods, the use that is made of the initial increase in output becomes more important. Even if the short-run productivity of aid is high, the economy may continue to be dependent on external assistance indefinitely unless the additional output is allocated so as to satisfy the savings conditions and trade conditions that were set out in the preceding section. Over the whole period of the transition to self-sustaining growth, the use that is made of the successive increments in GNP is likely to be more important than the efficiency with which external assistance was utilized in the first instance.

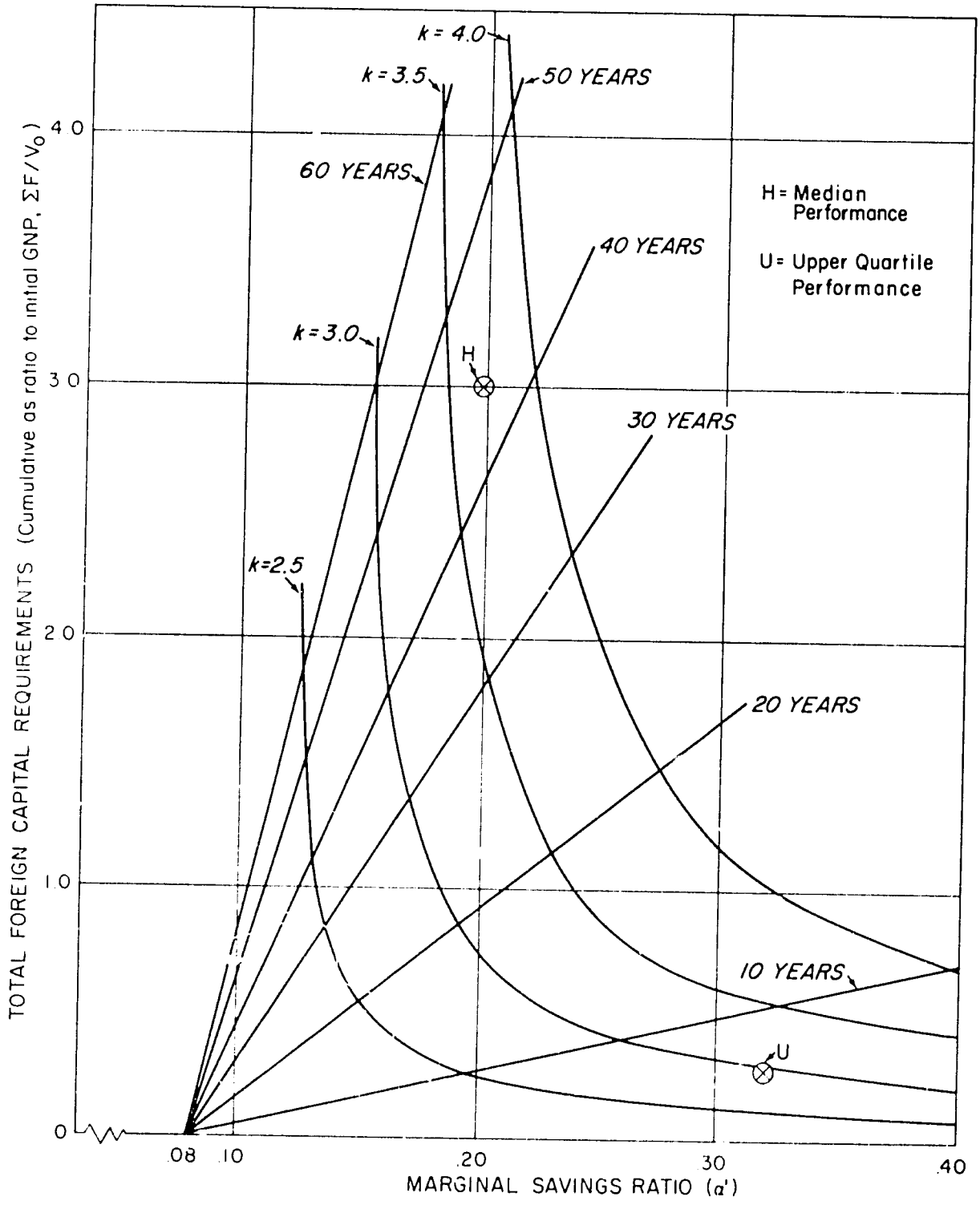
The quantitative significance of the allocation of the incremental resources is shown by the effect on total aid requirements of a variation in marginal savings rates and the efficiency of use of additional capital. These two variables determine the aid requirements and length of the transitional period in Phase II. Their combined effect on aid requirements and the time to complete the transition is shown in Figure 7.

Two points are plotted on the chart to illustra the difference between average performance and very good

FIGURE 7

TOTAL CAPITAL INFLOW REQUIRED TO REACH SELF-SUSTAINING GROWTH

(Assumes 5% GNP growth rate, initial savings/GNP ratio of .08, and Phase II throughout)



performance. Point H corresponds to median values of the parameters[1] and Point U to upper quartile values. The median values -- s' of .20 and k of 3.7 -- require total capital inflow of 3.0 times the initial GNP and a period of 43 years to complete the transition to self-sustaining growth.[2] The upper quartile values -- s' of .32 and k of 2.9 -- require a capital inflow of only 25% of the initial GNP over a period of 6 years to reach self-sustaining growth at the same rate. Between these two extremes, we might distinguish as "good performance" combinations of k and s' which would achieve the transition with a total capital inflow of not more than the initial GNP.[3]

These calculations bear out our assertion that the use that is made of successive increments in GNP is

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1/ Taken from the 31 country sample in Table 5.

2/ This calculation is based upon the lower-than-median initial savings ratio of .08 used in computing Figure 7. If the median savings ratio of .12 from Table 5 were used instead, the transition period would be 35 years and the ratio of total capital inflow to initial GNP would be 1.4.

3/ The addition of an absorptive capacity limit would increase the requirements, but allowance for a variable growth rate would reduce them.

more important than the efficiency with which aid was used in achieving the initial increments. To emphasize this point, let us assume that the productivity of investment in the first five years of the "upper limit" development sequence outlined above for Pakistan had been one-third lower, requiring a correspondingly larger amount of investment and external aid to achieve the same increase in GNP. The effect would be to increase the total aid required over the 17 year period to Phase II self-sufficiency by some 45%. This, however, is less than the effect of a reduction in the marginal savings rate from .24 to .22. The critical elements in the sequence are getting the initial increase in the rate of growth, channeling the increments into increased savings and allocating investment so as to avoid balance of payments bottlenecks. These long-run aspects are likely to be considerably more important than the efficiency with which external capital is used in the short run.

The effectiveness of assistance is also likely to be increased in the long run by supporting as high a growth rate as the economy can achieve without a substantial deterioration in the efficiency of use of capital. This conclusion was derived from our models in section I. There are several factors omitted from the formal model which also argue for more rapid growth:

(1) The fact that a smaller portion of the increase in GNP is offset by population growth;

(2) The gain in political stability and governmental effectiveness that is likely to result;

(3) The greater likelihood of being able to raise marginal savings rates and export growth after GNP is growing;

(4) The greater likelihood of attracting foreign private investment to finance the needs for external capital.

While the last three factors cannot be measured with any accuracy, they appear to have been important in most countries that are successfully completing the transition, such as Israel, Greece, Taiwan, Mexico, Peru and the Philippines. These examples support the theoretical conclusion that the achievement of a high rate of growth, even if it has to be initially supported by large amounts of external capital, is likely to be the most important element in the long-term effectiveness of assistance. The substantial increases in internal savings ratios that have been achieved in a decade of strong growth -- from 7% to 12% in the Philippines, 11% to 16% in Taiwan,

6% to 14% in Greece, and -9% to 12% in Israel -- demonstrate the rapidity with which aid-sustained growth can be transformed into self-sustained growth once rapid development has taken hold.

B. Policies for Recipient Countries

While the receipt of external assistance may greatly reduce the time required for a country to achieve a satisfactory rate of growth, dependence on substantial amounts of external resources creates some special policy problems. The principal lesson from the preceding analysis is that the focus of policy should vary according to the principal growth limitations. Just as optimal counter-cyclical policy dictates different responses in different phases of the business cycle, optimal growth policy requires different "self-help" measures in different phases of the transition.

In Phase I, where the growth rate is below a reasonable target rate, the focus of policy should be on

increasing output, implying an increase in the quality and quantity of both investment and human resource inputs. Our statistical comparisons suggest that a rate of growth of investment of 10-12% is a reasonable target for countries whose initial investment level is substantially below the required level. Phase I can be completed by most countries in a decade if this rate can be maintained with sufficient improvement in skills and organization to make effective use of the additional capital that becomes available. Although it is probably more important in this phase to focus on securing increases in production and income, a start must also be made on raising taxes and savings if international financing is to be justified by performance.

In the transition from Phase I to Phase II, the rate of increase in investment can be allowed to fall toward a feasible target rate of GNP growth, which is unlikely to be more than 6-7%. The focus of development policy should then be increasingly on (a) bringing about the changes in the productive structure needed to prevent a further increase in the balance of payments deficit, and

(b) channeling an adequate fraction of increased income into savings. Although theoretical discussion has tended to stress the second requirement, the first appears to have been more difficult in practice for many countries. Since substantial import substitution is required to prevent the ratio of imports to GNP from rising, export growth at least equal to the target growth of GNP is likely to be necessary in order to reduce external aid.

As the focus of development policy changes, the instruments of policy must change accordingly. Somewhat paradoxically, successful performance in Phase I, which would justify a substantial and rising flow of foreign assistance, may make the transition to Phase II more difficult. If investment and other allocation decisions are based on the exchange rate that is appropriate for a substantial flow of aid, they are not likely to induce sufficient import substitution or increased exports to make possible a future reduction in the capital inflow. Planning needs to be based on the higher equilibrium exchange rate that would be appropriate to the reduced flow of aid in the future in order for the necessary changes in the productive structure to be brought about in time.

It is this need for rapid structural change which probably sets the lower limit to the time required to complete the transition. Even though the simplified model underlying Figure 7 suggests the possibility of completing the transition in less than 20 years starting from typical Asian or African conditions, it is unlikely that any such country can meet all the requirements of skill formation, institution building, investment allocation, etc., in less than one generation.

C. Policies for Donor Countries

The problems of particular concern to donors are the allocation of aid among recipients, the standards against which it is to be provided, and the means for controlling its use. Allocation among countries is complicated by the mixture of objectives that motivate international assistance, the most important of which are the economic and social development of the recipient, maintenance of political stability in countries having special ties to the donor, and export promotion. This mixture of motives has led to a complex system of aid administration in all countries.

The predominant basis for capital assistance is the individual investment project, for which external financing is provided to procure capital goods from the donor country. Substantial but declining amounts of grants are also furnished for budgetary support of ex-colonies and other dependent areas. In a few countries loans not limited to equipment for specific projects are provided against the balance of payments needs of development programs.1/

Our analysis suggests some directions in which improvements can be sought in the present system while recognizing the problems resulting from mixed motivation and lack of confidence in recipient performance. We consider first donor policies toward individual countries and then the allocation of assistance among countries.

The Transfer of Assistance. Any system for transferring resources must include: (i) a basis for determining the amount of the transfer, (ii) specifications of the form of resources to be furnished, and (iii) a basis for controlling their use. On all these counts the project system

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1/ In the terminology of A.I.D. /2/ the latter are called program loans. About half of U.S. development lending is on a pr gram basis, but only a small portion of that of other D.A.C. members or the World Bank.

has the virtue of simplicity. It also provides for detailed evaluation of the investments that are directly financed from external aid--which may be 10% or so of total investment--and for increasing their productivity through technical review.

While the project system has much to commend it when the main focus is on increasing the country's ability to invest, it becomes increasingly inappropriate as the development process gets under way. As the rate of growth increases, we have shown that the effectiveness of aid depends more on the use that is made of the additional output than on the efficiency with which a limited fraction of investment is carried out. Furthermore, an attempt to finance the amount of external resources needed during the peak period of an optimal growth path--which may imply aid equal to 30-40% of total investment--by the project mechanism alone may greatly lower the efficiency of use of the external resources. Limiting the form of assistance to the machinery and equipment needed by substantial investment projects is likely to distort the pattern of investment and prevent the development of local production of investment goods if the offer of assistance is accepted, or to lower the rate of investment if it is not.

In these circumstances, it is clear that the assistance will be more useful to the recipient if the range of commodities that can be procured is broadened so that the recipient's pattern of investment and production can evolve in accordance with the principle of comparative advantage. While domestic supply can--and indeed must--lag behind demand in some sectors to accommodate the needed resource transfer, the country should also be preparing to balance its international accounts by the end of a limited transitional period. This observation applies to aid in the form of agricultural commodities as well as aid in the form of machinery or any other fraction of total imports. A restriction as to form lowers the productivity of assistance when (a) it inhibits the operation of comparative advantage on the allocation of investment over time; or (b) it reduces the total assistance received below the amount needed to complete the transition as efficiently as possible.

A shift to non-project--i.e., program--assistance raises questions of how to control the amount of aid supplied and to evaluate its effectiveness. Donors fear that uncontrolled imports may be wasted in increased consumption

rather than producing growth. In principle, the answer is to relate the amount of aid supplied to the recipient's effectiveness in increasing the rate of domestic saving, so that the added aid will actually increase savings as income grows. As development planning and statistics on overall performance improve, this "program approach" is becoming increasingly feasible both from the point of view of determining the amounts of assistance needed and of assessing the results.1/

The strongest argument for the program approach arises for countries in Phase III, where the balance of payments is the factor limiting growth and there is typically excess capacity in a number of productive sectors. In this situation, the highest priority use of imports is for raw materials and spare parts to make more effective use of existing capacity; project priorities should give primary weight to import substitution and increased exports. Control of the effectiveness of aid should be primarily concerned with the efficient use of total foreigr

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1/The U.S. government currently uses the program approach in India, Pakistan, Turkey, Tunisia, Chile, Colombia, and Brazil. See A.I.D. /2/, and /3/.

exchange resources, which can only be assessed adequately in the framework of a development program.

Allocation among Countries. If the objectives of the donor countries could be expressed as some function of the growth of the recipients, it would be possible to allocate aid primarily on the basis of expected development performance. The varying political objectives of the donors complicate the problem because each would give somewhat different weights to a unit of increase in income among recipients. Even with this limitation, however, there may be considerable scope for reallocating the existing amount of aid so as to increase its effectiveness, or for selective increases in individual country totals in accordance with criteria of self-help.

The predominant project approach now in use biases the allocation of aid toward countries whose project preparation is more efficient and away from countries whose overall performance may be better. The total demand for assistance tends to be equated with the direct imports needed to carry out projects that are approved by the lending agencies. This approach assumes that the ability to prepare and execute fairly substantial units of investment

must be achieved before an underdeveloped country is eligible for other than technical assistance or politically motivated grants. Other qualities that are equally important to successful development--tax collection, private thriftiness, small-scale investment activity, export promotion--are ignored in focussing on only one of the many aspects of better resource use. It is perhaps more than coincidence that most of the striking successes in development through aid--Greece, Israel, Taiwan, etc.,--were financed largely on a non-project basis.

While it is easy to point out the inefficiency of the present system of allocation, an acceptable alternative to the project system of allocation and control is needed to improve it. Where fairly reliable statistics are available, an alternative would be to set minimum performance standards according to the country's point of departure and to share the aid burden among interested donors through a consortium or other coordinating mechanism. For example, a country starting in Phase I might have as its principal performance criteria: (i) growth of investment at 10% per year at a minimum standard of productivity, and (ii) the maintenance of a marginal savings rate of .20 (or alternatively a marginal tax rate). There would be

little possibility to waste aid on these terms, since the required increase in savings would finance a large and increasing proportion of total investment. Appropriate overall standards for savings rates and balance of payments policies for countries in Phase II and Phase III could also be established without great difficulty. A country maintaining high standards--say a marginal savings rate of .25 and a capital-output ratio of less than 3.3--could safely be allotted whatever amount of aid it requested in the knowledge that the larger the amount of aid utilized the higher would be the growth rate and the more rapid the approach to self-sufficiency.

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Annex A

The 50-Country Projections

This section presents results of the model 1 projections described in the text and discusses the data on which the projections are based. The model was applied to each of 50 countries and the estimates then aggregated. The results for 1962-1975 are given here.

Most of the basic data are from United Nations or country publications of national accounts and from the IMF Balance of Payments Yearbook. Alternative and contradictory sources frequently exist, and most of the data are estimates that tend to be revised often and radically. Data for the 50-country projections were the "best obtainable" during the first half of 1964 and include many of the more substantial revisions appearing in the United Nations' Yearbook of National Accounts, 1963 (available in July 1964). Selection of data sources were made by A.I.D.'s Statistics and Reports Division and Office of Program Coordination. Computations for the projections were made by electronic computor and were completed in September 1964.

Table A-1 shows the observed 1957-1962 values of the various structural parameters described in the text, and Table A-2 shows the three alternative sets of values that were used for these parameters in the projections. The first set of the Table A-2 estimates is "historical" in that it represents a continuation of past trends subject to certain adjustments leading to a slightly optimistic bias (see below). The third set, "upper limit" values, represents conditions likely to be achieved no more frequently than in one of five cases and only when accompanied by structural changes in the economy. The second set, "realistic" or "realistic plan" values, reflects intermediate possibilities.

The values of the parameters are based on studies (including country plans and planning documents) available to A.I.D. as well as detailed country studies made by A.I.D. A considerable degree of judgment was nevertheless needed in chosing the various growth characteristics, and heavy reliance was placed upon the informed judgments of country experts within the Agency.

Some considerations taken into account in these judgments are:

	"Historical"	"Upper limit"
GNP growth rates	at least as high as population growth	highest target is 10% (Israel
Maximum rate of growth of investment	at least 5-6%	no greater tha 15-16%
Capital-output ratio	less than 5.0 (except for Argentina)	no lower than
Marginal savings rate (potential)	non-negative	generally abou 20-25%; these estimates usua were set so as permit eventua self-sustainir growth (i.e., $\sigma' > k\bar{r}$).
Export growth rates and potential marginal import ratios	non-negative	(See below)

The marginal import coefficients conceptually represent the minimum import requirements which are technologically necessary for the production of gross national product and for satisfying a minimum level of consumer demand. Historical rates were largely based upon past actual imports and thus may be higher than the structurally defined minimum level. The upper limits for these coefficients were chosen, except when detailed country projections were available, by estimating the relationship of past imports for a large number of

less developed countries to country measures of GNP and population. The theory was that countries with substantial internal markets would be able to produce more of their own goods and would have to import smaller quantities and that countries with higher per capita incomes will wish to import more than countries with smaller incomes. The theory explains much of past country-to-country differences in imports of goods and services. Where average values obtained from this theory were less than actual import coefficients experienced by a particular country, the average values were taken as the upper limit to that country's ability to reduce its import requirements. Where average values obtained from the intercountry comparison were higher than those found for a particular country, no change was made in the country coefficient. The procedure, therefore, in the absence of detailed studies was always to take the lower of two alternative values of the import coefficient. 1/ (This produced an intentional downward bias in the upper limit coefficient.)

1/ While "realistic plan" marginal import coefficients were generally taken as equal to or less than "historical" ratios, detailed country studies indicated that in some cases (Pakistan, Turkey, Argentina, Chile, Colombia), relative imports were more likely to increase with faster GNP growth. "Upper limit" estimates, on the other hand, uniformly include enough import substitution to bring them equal to or below the "historical rates".

Export growth rates were based originally upon the historical experience of each country modified by judgments of a "most probable" future growth path, and upon a more optimistic forecast of export possibilities. Combining the implied future exports for the fifty countries, however, gave overall growth rates ranging from 5.5 per cent to 6.5 per cent. Since these potential increases were considerably higher than most forecasters believe possible for the less developed world, each country's rate was proportionately reduced so as to give a 1962-1970 combined export growth rate of 3.7 per cent as one alternative and a rate of 4.9 as a second alternative.

The base year (1962) data used for beginning the 50-country projections are given in Table A-3. The "1962" figures shown are not actual observations but estimates for that year obtained by fitting a linear trend over time to data for the period 1957-1962. This procedure was helpful in removing the effect of erratic year-to-year fluctuations in exports, savings, investment, production, and imports. Where an observed 1962 value above or below the trend represented not an erratic fluctuation but a permanent shift to a higher or lower level, however, the procedure could (and did) produce a bias in the starting figure. This is one of the reasons why the projections for individual countries, while useful

for illustrative purposes, are not as reliable or as convincing as the total for a group of countries where some of these biases may be expected to cancel each other out.

The notes to Table A-3 give additional information on sources and definitions.

Table A-4 presents results of the 50-country projections for nine of the eighteen combinations of alternatives described in the notes to Table A-2. Full details for the nine high export assumptions are not shown, but GNP, investment, and potential savings and imports (lines 5, 6, 7, 9) will be the same for both low and high exports. Capital inflow and consumption estimates for both sets of export assumptions are shown in lines 14-19 and cumulative exports themselves are given in lines 3 and 4. The cumulative capital inflow data (lines 16 and 17) have been plotted against 1975 total GNP (line 1) in Figure 6 of the main text.

Table A-5 gives estimates for the single years 1970 and 1975, by region, for four of the eighteen combinations of alternatives. Potential savings and imports have not been shown in this table, but the potential savings-output and imports-output marginal coefficients are given in Table A-6.

Table A-6 shows the 50-country average growth rates and structural relationships implicit in the detailed country assumptions and initial conditions discussed in the preceding section. The growth rates of GNP, investment, and exports are essentially weighted averages of the country rates shown in Annex A, Table A-2. The marginal coefficient for "potential" savings and imports are also weighted averag while the coefficients for "realized" savings and imports represent projected actual savings and imports after adjustments to equalize the investment-savings and import-export gaps. Since our procedure has been to set an upper limit to savings and a lower limit to imports, the realized aggregate savings coefficient is always less than the potential saving coefficient while realized aggregate imports are higher than potential imports.

The historical GNP growths of 4.3% for this 50-country sample is close to that actually experienced by the entire less developed world during the past decade. The fact that the planned growth rate of 5.1% per year between 1962 and 1970 is close to the target of the U.N.'s development decade, on the other hand, is completely coincidental; no conscious effort was made to choose planned target growth rates that would average out to 5.0%. The

upper limit growth rate is held by absorptive capacity constraints to 5.3% per year between 1962 and 1967, but increases to 6.0% between 1967 and 1970 and to 6.2% between 1970 and 1975. The average for 1962-1970, shown in Table A-6, is 5.7%.

Investment growth potential was increased slightly between historical and upper limit growth rate assumptions in order to permit attainment of the postulated higher GNP growth rates. While these latter rates increase from 4.3% to about 5.7%, average potential investment rates are assumed to increase from 9.1 to 10.2 per cent. These estimates of absorptive capacity suggest an upper limit to the average annual GNP growth of the less developed world average of close to 9 to 10 per cent per year.

While the weighted average capital-output ratio is not greatly affected by variations in country growth rates, it is affected by the internal performance option chosen. If the investment-savings gap were the factor determining foreign capital requirements in all countries (which it is not), the 50-country calculations show that achieving plan performance with regard to the capital-output ratio would save perhaps one billion annually over the period 1962-1970 while achieving the upper limit

capital-output ratio would save an additional amount of foreign capital of almost as great a magnitude. Because the import-export gap is also an important determinant of foreign capital requirements and because this gap is not affected by improvements in the capital-output ratio, actual savings would be considerably less than $1 billion, especially at lower GNP growth rates.

Average potential savings increases, under our assumptions, would range from about 19% of additional GNP under historical performance to about 24% under the best possible performance. Realized savings, however, because of the depressing effect on savings of large import-export gaps, would turn out to be considerably smaller. Largest differences exist under historical growth rates and performance assumptions where the import-export gaps appear to be quantitatively most important. Under these conditions the realized marginal savings coefficient might be only about 12%. Realized import coefficients, on the other hand, are usually considerably greater than potential coefficients because of the "unplanned" imports made necessary by the frequent dominance of the investment-savings gap. This dominance is most pronounced at upper limits of growth and

performance, and consequently the average realized import coefficient would exceed the average potential coefficient most noticeably under those conditions.

PROVISIONAL

Table A-1

Summary of Past Structural Relationships, Developing Countries with Moderately Satisfactory Economic Data (Data as of early 1964) [1]

No. [3]	Country	Highest 5 Years in Recent Past [2] i	Period	Relationships during 1957-1962 [2] i	k	r	I_o	ϕ_o	α_o	α'	μ_o	μ'	ϵ	ρ'
3	Greece	.210	1954-1958	.10	3.10	.059	.20	.06	.14	.23	.19	.20	.051	.10
4	India	.154	1953-1957	.06	2.80	.045	.14	.02	.12	.21	.07	.02	.030	-.17
5	Iran	.103	1957-1961	.00	3.77	.046	.15	.01	.14	.11	.24	.19	.080	.05
6	Israel	.129	1953-1957	.09	3.11	.101	.30	.19	.11	.16	.41	.46	.191	.57
7	Jordan	.215	1958-1962	.18	1.20	.117	.15	.28	-.13	.02	.42	.28	.083	.44
8	Pakistan	.198	1960-1964	.13	3.00	.070	.12	.03	.09	.31	.10	.16	.058	-.01
9	Turkey	.102	1959-1963	.06	4.93	.030	.16	.03	.13	.08	.12	.32	.050	.05
11	Argentina	.113	1956-1960	.08	10.04	.021	.24	.02	.22	.70	.14	.32	.043	.06
12	Bolivia	.084	1960-1964	.01	4.69	.029	.13	.09	.04	-.11	.22	1.04	-.011	-.04
13	Brazil	.154	1956-1960	-.02	2.93	.058	.14	.03	.11	-.08	.13	-.01	-.021	-.001
15	Chile	.169	1958-1962	.12	3.15	.032	.14	.07	.07	-.12	.21	.43	.060	-.07
16	Colombia	.078	1958-1962	.06	4.30	.048	.21	.03	.18	-.01	.17	.20	-.025	-.06
17	Costa Rica	.108	1950-1954	-.01	4.56	.040	.16	.05	.11	-.11	.28	.16	.016	-.03
20	Guatemala	.208	1953-1957	-.05	4.67	.029	.10	.02	.08	-.07	.15	-.06	.009	-.18
21	Honduras	.155	1960-1964	.06	3.90	.034	.14	-.01	.15	.51	.20	-.01	.028	-.07
23	Mexico	.144	1953-1957	.06	3.05	.050	.15	.02	.13	.09	.12	.07	.038	-.03
25	Panama	.144	1958-1962	.14	2.43	.066	.19	.07	.12	.28	.37	.29	.063	-.90
26	Paraguay	.100	1951-1955	-.08	-7.74	-.013	.08	.06	.02	.61	.25	-.31	.028	.0
27	Peru	.155	1959-1963	.04	3.39	.066	.20	-.01	.21	.35	.24	.21	.144	.12
28	Trinidad-Tobago	.192	1955-1959	.05	3.65	.088	.32	.11	.21	.20	.76	.92	.107	(n.a.)
29	Venezuela	.056	1955-1959	-.08	7.43	.037	.19	-.13	.32	.56	.29	-1.66	-.015	-.77
34	Liberia	.446	1958-1962	.38	7.80	.046	.67	.58	.09	.11	1.23	3.85	.031	(n.a.)
36	Nigeria	.051	1956-1960	.10	4.48	.031	.16	.05	.11	.27	.21	.47	.007	-1.13
40	Tunisia	.275	1958-1962	.24	3.71	.041	.25	.16	.09	-.53	.39	.80	-.198	.28
42	Burma	0	1957-1961	-.02	5.51	.032	.15	-.01	.16	.32	.18	-.30	.024	.15
43	Taiwan	.164	1956-1960	.11	2.64	.075	.22	.07	.15	.31	.20	.18	.083	.08
45	Korea	.187	1960-1964	.04	3.74	.038	.14	.10	.04	.42	.18	-.08	.165	.24
46	Philippines	.078	1958-1962	.04	2.61	.050	.13	.02	.11	.26	.21	.07	.046	-.09
47	Thailand	.126	1958-1962	.09	1.93	.081	.16	.02	.14	.19	.20	.16	.077	.24
49	Malaya	.157	1957-1961	.14	5.15	.027	.18	-.04	.22	.43	.50	1.36	.056	1.14
50	Mauritius	.143	1956-1960	.08	4.97	.034	.19	.11	.08	-.39	.48	.56	0	(n.a.)

1/ All data derived from fitting time trends to actual points for period covered. All data except imports, exports and reserves expressed in 1962 prices. Imports, exports and reserves expressed in current U.S. dollars.

2/ Symbols for column headings are:

- i = compound growth rate of gross investment.
- k = incremental capital-output ratio (assuming 1-year lag).
- r = compound growth rate of GNP.
- I_o = ratio of gross investment to GNP in 1962 (after time-trend fitting).
- ϕ_o = ratio of net foreign capital inflow to GNP in 1962 (after time-trend fitting).
- α_o = ratio of national gross savings to GNP in 1962 (after time-trend fitting).
- α' = marginal national savings ratio (change in savings ÷ change in GNP)
- μ_o = ratio of gross imports of goods and services to GNP in 1962 after time-trend fitting).
- μ' = marginal import ratio (change in gross imports of goods and services ÷ change in GNP).
- ϵ = compound growth rate of exports of goods and services.
- ρ' = change in gold and convertible foreign currency reserves, December 1956 to December 1962 (after time-trend fitting) ÷ change in GNP, 1957-1962. GNP first converted to 1962 US dollars.

3/ Country numbers correspond to those in Tables A-2 and A-3.

Source: Imports, exports and reserves largely from IMF, Balance of Payments Yearbooks. Other data from U.N. Yearbooks of National Accounts and from Statistics and Reports Division, Agency for International Development.

TABLE A-2

VALUE OF PARAMETERS USED IN PROJECTIONS[1/]

No.	Country	Target Growth Rate of GNP (r) (H)is-	(P)lan	(U)pper Limit	Maximum Rate of Growth of Investment H	P	U	Incremental Aggregate Capital-Output Ratio A	B	C	Marginal Gross Savings Ratio A	B	C	Marginal Import Ratio (a)	(b)	(c)	Annual Growth Rates Exports 1	Exports 2	Population (1963)
	Near East																		
2	Cyprus	.009	.030	.050	.060	.060	.070	5.00	4.00	3.50	.140	.190	.230	.470	.470	.410	.0088	.0116	.017
3	Greece	.060	.065	.070	.100	.100	.100	3.10	3.10	3.10	.230	.230	.250	.190	.190	.180	.0544	.0712	.009
5	Iran	.044	.055	.065	.060	.070	.090	3.70	3.70	3.50	.140	.150	.250	.232	.232	.180	.0544	.0712	.025
6	Israel	.090	.090	.100	.120	.120	.150	3.19	3.00	3.00	.220	.300	.300	.400	.400	.300	.1122	.1468	.035
7	Jordan	.056	.056	.080	.160	.160	.160	3.37	3.37	3.37	.200	.200	.250	.370	.370	.330	.0571	.0748	.027
9	Turkey	.053	.060	.070	.080	.080	.090	2.91	2.91	2.91	.200	.256	.256	.110	.170	.110	.0306	.0400	.029
10	U.A.R.	.045	.055	.060	.050	.070	.080	2.68	2.68	2.68	.150	.170	.200	.200	.200	.150	.0136	.0178	.025
	South Asia																		
1	Ceylon	.042	.050	.060	.095	.100	.100	3.24	3.24	3.24	.110	.150	.200	.220	.220	.190	.0177	.0231	.028
4	India	.043	.053	.065	.100	.100	.100	3.20	3.20	3.20	.180	.210	.250	.070	.070	.050	.0204	.0267	.021
8	Pakistan	.045	.053	.060	.130	.130	.130	3.00	3.00	3.00	.160	.240	.240	.100	.150	.100	.0374	.0489	.026
	Latin America																		
11	Argentina	.031	.043	.055	.150	.150	.150	7.21	5.30	4.30	.220	.220	.250	.070	.170	.020	.0286	.0374	.017
12	Bolivia	.033	.045	.056	.060	.080	.080	4.00	4.00	4.00	.100	.150	.200	.220	.220	.220	.0068	.0089	.023
13	Brazil	.055	.055	.070	.080	.080	.080	2.90	2.90	2.50	.270	.270	.280	.090	.090	.070	.0286	.0374	.031
14	British Guiana	.029	.040	.050	.100	.100	.100	5.00	5.00	5.00	.200	.250	.330	.470	.470	.470	.0544	.0712	.030
15	Chile	.035	.050	.055	.060	.080	.100	3.40	3.40	3.00	.120	.160	.200	.120	.190	.120	.0190	.0249	.023
16	Colombia	.050	.061	.070	.060	.080	.100	4.80	4.80	4.80	.200	.260	.300	.200	.230	.170	.0272	.0356	.029
17	Costa Rica	.055	.060	.069	.060	.080	.100	3.27	3.27	3.27	.130	.200	.250	.280	.280	.280	.0354	.0463	.039
18	Ecuador	.042	.050	.055	.060	.080	.080	3.74	3.74	3.74	.140	.200	.240	.206	.206	.206	.0340	.0445	.030
19	El Salvador	.050	.060	.065	.060	.100	.100	2.50	2.50	2.50	.110	.180	.210	.268	.268	.210	.0374	.0489	.027
20	Guatemala	.040	.050	.055	.060	.080	.080	4.67	3.50	3.50	.150	.200	.250	.149	.149	.149	.0340	.0445	.030
21	Honduras	.037	.045	.050	.064	.070	.080	3.90	3.50	3.50	.120	.150	.200	.195	.195	.195	.0190	.0249	.030
22	Jamaica	.040	.045	.055	.060	.080	.100	4.00	3.50	3.50	.160	.180	.200	.206	.206	.206	.0340	.0445	.013
23	Mexico	.050	.060	.070	.067	.080	.100	2.52	2.52	2.52	.170	.170	.220	.110	.110	.100	.0537	.0703	.031
24	Nicaragua	.042	.050	.055	.063	.080	.080	3.72	3.72	3.72	.150	.200	.220	.281	.281	.281	.0340	.0445	.034
25	Panama	.050	.050	.060	.144	.140	.140	2.50	2.50	2.50	.120	.200	.200	.385	.385	.350	.0143	.0187	.030
26	Paraguay	.020	.030	.040	.060	.140	.140	5.00	4.00	4.00	.130	.130	.150	.249	.249	.249	.0054	.0071	.022
27	Peru	.055	.055	.070	.100	.100	.100	4.94	4.94	4.77	.285	.285	.285	.240	.240	.200	.0524	.0685	.023
28	Trinidad-Tobago	.050	.060	.088	.090	.100	.100	3.65	3.65	3.65	.200	.250	.250	.700	.500	.300	.0952	.1246	.030
29	Venezuela	.045	.060	.070	.080	.080	.100	3.64	3.64	3.64	.290	.290	.290	.214	.180	.160	.0211	.0276	.034
	Africa																		
30	Algeria	.020	.035	.050	.060	.060	.060	3.30	3.30	3.30	.060	.100	.200	.200	.200	.090	.0272	.0356	.025
31	Ethiopia	.045	.045	.050	.150	.150	.150	2.50	2.50	2.50	.140	.170	.200	.116	.116	.116	.0544	.0712	.014
32	Ghana	.045	.055	.060	.098	.098	.098	3.70	3.50	3.20	.130	.150	.200	.220	.220	.220	.0156	.0205	.025
33	Kenya	.017	.035	.050	.060	.060	.060	5.00	4.00	4.00	.120	.150	.200	.266	.266	.040	.0340	.0445	.030
34	Liberia	.057	.060	.060	.150	.150	.150	5.00	5.00	5.00	.110	.150	.200	.573	.573	.573	.0422	.0552	.015
50	Mauritius	.034	.034	.034	.083	.080	.080	4.97	4.97	4.97	.080	.080	.080	.456	.456	.456	.0000	.0000	.032
35	Morocco	.028	.049	.060	.050	.060	.070	5.00	4.00	3.50	.130	.150	.200	.150	.150	.150	.0204	.0267	.027
36	Nigeria	.040	.045	.050	.082	.082	.082	3.80	3.80	3.80	.090	.110	.200	.280	.280	.280	.0544	.0712	.020
37	Rhodesia-Nyasaland	.043	.040	.045	.060	.060	.060	5.00	5.00	5.00	.160	.180	.200	.513	.513	.220	.0755	.0988	.028
38	Sudan	.051	.055	.055	.140	.140	.140	2.50	2.50	2.50	.110	.150	.200	.220	.220	.190	.0612	.0801	.028
39	Tanganyika	.042	.050	.056	.060	.060	.080	2.93	2.93	2.93	.110	.150	.200	.188	.188	.100	.0333	.0436	.020
40	Tunisia	.041	.050	.060	.150	.150	.150	4.62	4.00	4.00	.150	.200	.250	.260	.190	.190	.0340	.0445	.021
41	Uganda	.017	.040	.050	.060	.060	.080	5.00	4.00	4.00	.110	.150	.200	.168	.168	.090	.0272	.0356	.025
	Far East																		
42	Burma	.032	.040	.050	.060	.060	.060	5.00	4.00	4.00	.160	.180	.200	.177	.177	.177	.0782	.1023	.022
44	Indonesia	.010	.030	.040	.010	.035	.050	2.75	2.75	2.75	.050	.100	.150	.070	.070	.070	.0109	.0142	.023
45	Korea, South	.043	.050	.060	.050	.060	.080	3.27	3.27	3.27	.100	.150	.200	.240	.260	.180	.0578	.0756	.029
49	Malaya	.040	.050	.060	.119	.120	.120	2.52	2.50	2.50	.190	.200	.200	.419	.419	.419	.0211	.0276	.032
46	Philippines	.050	.055	.060	.051	.060	.070	2.58	2.58	2.58	.260	.260	.260	.170	.170	.170	.0313	.0409	.032
43	Taiwan	.060	.070	.080	.133	.133	.133	2.62	2.62	2.62	.210	.210	.250	.205	.190	.190	.0544	.0712	.029
47	Thailand	.050	.060	.065	.091	.091	.091	2.50	2.50	2.50	.250	.250	.250	.160	.160	.150	.0462	.0605	.031
48	South Vietnam	.029	.035	.040	.060	.060	.060	3.69	3.70	3.70	.000	.100	.150	.217	.217	.217	.0252	.0329	.028

1/ For footnote, see Page 2.

(Continued)

1/ The projections are based on three sets of values of para eters - one set corresponding roughly to historical rates; a second set based on higher yet realistic target rates of GNP growth, and a third set based on upper limits to GNP growth, achievable only when accompanied by structural changes in th economy. In these tables, the classifications are symbolize by:

	"Historical"	"Realistic Plan"	"Upper Li
Target GNP growth rate; maximum investment growth rate	H	P	U
Capital-output ratio; marginal savings ratio	A	B	C
Marginal import ratio	(a)	(b)	(c)
Export growth rate	1	-	2

The following 18 combinations of these factors were use for the results presented in this paper:

H-A(a)-1*	P-A(b)-1	U-A(b)-1
H-A(a)-2	P-A(b)-2	U-A(b)-2
H-B(a)-1	P-B(b)-1	U-B(b)-1
H-B(a)-2	P-B(b)-2	U-B(b)-2
H-C(c)-1	P-C(c)-1	U-C(c)-1
H-C(c)-2	P-C(c)-2	U-C(c)-2

*This symbolic arrangement says that the H growth rates of and maximum investment were used in conjunction with the capital output and marginal savings alternatives, with th (a) marginal import ratios, and with the first of the two port growth options.

Table A-3

BASE YEAR DATA[1] (Millions of 1962 $US)

No.	Country	(1) Gross National Product	(2) Gross Investment	(3) Gross National Savings	(4) Net Foreign Capital Inflow	(5) Trade in Goods and Services Imports	(6) Exports
	Near East						
2	Cyprus	250	52	35	17	132	115
3	Greece	3861	777	547	231	704	474
5	Iran	4610	705	654	50	1070	1020
6	Israel	2107	635	229	405	854	448
7	Jordan	339	52	-45	97	141	43
9	Turkey	6082	968	770	198	699	501
10	U.A.R.	3692	575	312	263	1002	739
	South Asia						
1	Ceylon	1454	223	196	27	447	420
4	India	37211	6423	5584	839	2529	1690
8	Pakistan	7551	922	683	239	756	517
	Latin America						
11	Argentina	12166	2956	2625	331	1656	1326
12	Bolivia	470	61	20	41	104	62
13	Brazil	14053	1912	1494	418	1792	1374
14	British Guiana	149	50	26	23	100	77
15	Chile	3458	468	271	197	765	568
16	Colombia	4259	909	759	150	722	572
17	Costa Rica	467	74	52	22	130	108
18	Ecuador	857	138	112	26	180	154
19	El Salvador	527	64	56	8	144	136
20	Guatemala	1077	112	81	31	161	130
21	Honduras	418	60	63	-3	81	83
22	Jamaica	737	137	98	39	296	257
23	Mexico	14175	2180	2039	141	1639	1498
24	Nicaragua	369	60	51	9	103	94
25	Panama	478	90	57	34	186	153
26	Paraguay	233	18	6	12	59	47
27	Peru	2444	500	525	-24	595	620
28	Trinidad-Tobago	558	177	117	60	479	419
29	Venezuela	5741	1085	1812	-726	1801	2527

[1] Data shown pertain to the year 1962. They are not actual 1962 figures, however, but averages derived from a 1957-1962 time trend.

Annex B

The following notes give a line-by-line derivation of the formulas used to compute Tables 3 and 4 as well as efficiency factors for the differences between Model 1 and Models 2 and 3. Superscripts denote the model number; e.g. F_t^2 represents the variable F for Model 2 in year t. Δ_{ij} before a variable indicates the difference between two models. Thus, the symbol $\Sigma\Delta_{21}V$ reads as "the change in cumulative GNP from Model 1 to Model 2."

All summations are over time for t = 0, 1, 2, ... n unless otherwise indicated. All variables shown have been divided by the initial year's GNP (i.e. V_t represents V_t/V_o, M_t represents M_t/V_o, etc.). Other symbols are the same as those used in the text.

I. Derivation of Equations for Table 3

A. All Models

Line 1. $V_n = (1+\bar{r})^n$, where n = 13.

2. GNP target growth rate = $\bar{r}$

3. $\Sigma E_t = E_o \left[\frac{(1+\epsilon)^{n+1} - 1}{\epsilon}\right]$

B. Model 1

Line 4. $\Sigma V_t^1 = \left[\frac{(1+\bar{r})^{n+1} - 1}{\bar{r}}\right]$

5. $\Sigma I_t^1 = k\bar{r}\,\Sigma V_t^1$

6. $\Sigma \bar{S}_t^1 = (n+1)(\alpha_o - \alpha') + \alpha'\Sigma V_t^1$

7. $\Sigma S_t^1 = \Sigma \bar{S}_t^1 + \Sigma S_t^*$

where $\Sigma S_t^* = \min(0, \Sigma F_t^s - \Sigma F_t^m)$

and $\Sigma F_t^s = \Sigma I_t^1 - \Sigma \bar{S}_t^1$

$\Sigma F_t^m = \Sigma \bar{M}_t^1 - \Sigma E_t$ (see line 8 for $\Sigma \bar{M}_t^1$)

Line 8. $\Sigma \bar{M}_t^1 = (n+1)(\mu_o - \mu') + \mu' \Sigma V_t^1$

9. $\Sigma M_t^1 = \Sigma \bar{M}_t^1 + \Sigma M_t^*$

where $\Sigma M_t^* = \max(0, \Sigma F_t^s - \Sigma F_t^m)$

and ΣF_t^s, ΣF_t^m are as in line 7.

10. $\Sigma C_t^* = -\Sigma S_t^*$

11. ΣM_t^* (see line 9)

12. $\Sigma F_t^1 = \max(\Sigma F_t^s, \Sigma F_t^m)$

13. Dominant phase $= \begin{cases} \text{II} & \text{if } \Sigma F_t^1 = \Sigma F_t^s \\ \text{III} & \text{if } \Sigma F_t^1 = \Sigma F_t^m \end{cases}$

C. Model 2

Line 14. $$\Sigma V_t^2 = \frac{\Sigma I_t^1 + \Sigma E_t - (n+1)(\alpha_o - \alpha' + \mu_o - \mu')}{\alpha' + \mu'}$$

This is derived from the following balance equation for gap equalization:

$$\Sigma I_t^2 - \Sigma S_t^2 = \Sigma M_t^2 - \Sigma E_t$$

$$\text{or } \Sigma I_t^2 + \Sigma E_t = \Sigma S_t^2 + \Sigma M_t^2$$

Substituting the formulas for ΣI_t^2, ΣS_t^2, and ΣM_t^2 (see lines 15, 16, and 17 below) and solving, we obtain the above equation for ΣV_t^2.

TABLE A-3 Page 2

No.	Country	(1) Gross National Product	(2) Gross Investment	(3) Gross National Savings	(4) Net Foreign Capital Inflow	(5) Trade in Goods and Services Imports	(6) Expo
	Africa						
30	Algeria	3680	560 2/	156	404	1207 2/	8C
31	Ethiopia	881	91	64	28	133	1C
32	Ghana	1513	298	195	103	577	47
33	Kenya	718	99	87	12	297	28
34	Liberia	139	93	13	80	159	7
50	Mauritius	167	32	13	18	86	6
35	Morocco	1977	209	150	60	515	45
36	Nigeria	3434	564	381	183	738	59
37	Rhodesia-Nyasaland	1505	268	245	23	795	77
38	Sudan	1237	177	139	38	283	21
39	Tanganyika	597	67	40	27	223	19
40	Tunisia	739	185	64	121	296	17
41	Uganda	454	44	30	14	182	16
	Far East						
42	Burma	1405	209	231	-22	248	2'
44	Indonesia	8348	745	486	259	1206	91
45	Korea, South	2178	315	82	233	393	15
49	Malaya, Fed. of	1896	347	419	-72	941	10
46	Philippines	3789	479	404	75	762	68
43	China (Taiwan)	1805	401	273	128	371	21
47	Thailand	2879	455	414	41	572	5
48	South Vietnam	1381	157	-50	207	305	

Source: Agency for International Development, Statistics and Reports Division and Office of Program Coordination, data as of September 1964.

2/ Reflects largely arbitrary downward adjustment of 1957-1962 averages to reflect post civil-war conditions.

GENERAL NOTES TO ANNEX A, TABLE A-3

GNP and gross investment data used for preparing the 1957-1962 trends were largely taken from the 1963 edition of the United Nations' Yearbook of National Accounts Statistics. Modifications were made in a number of instances where revisions to a country's national accounts had not yet been incorporated in the published U.N. estimates or where independent A.I.D. estimates were believed superior to the official figures. Dollar estimates were derived by converting national currency values to constant 1962 prices and then converting the values for all years through a 1962 dollar exchange rate. In chosing dollar exchange rates a few adjustments were made to approximate more closely "equilibrium" rates (especially when devaluations had occurred in 1962 or 1963). No adjustments, however, were made on the basis of internal purchasing power comparisons of the national currencies.

Dollar values of exports and imports of goods and services were either taken directly from the IMF, Balance of Payments Yearbook, vols. 14 and 15, or else converted from Yearbook national currency estimates at annual exchange rates suggested by the IMF. The difference between imports and exports corresponds, therefore, to the IMF's "balance on goods and services" and includes net merchandise, net freight, insurance, tourist, and other services, and also net factor income (dividends, interest, but not transfers of capital) to or from abroad. No attempt was made to change the imports and exports to a "constant" dollar basis on the grounds that there was little perceptible change in the international purchasing power of the dollar during the period 1957-1962.

Estimates of gross national savings were derived as residuals by subtracting the balance on goods and services (or foreign savings) from gross domestic investment. The definition of savings corresponds to the pre-1961 U.N. usage in that no adjustment was made to reduce foreign savings by the amount of current account transfers from abroad. The revised U.N. procedure is to treat some transfers not as foreign "savings" but as foreign contributions to current consumption. The effect is to decrease estimates of foreign and to increase estimates of national savings. While we have no quarrel with the revised concept, we believe that it has been extremely difficult in practice to estimate the true volume of transfers contributing to increased current consumption. For this reason we feel that less error is made, particularly in estimating trends, by reverting to the former U.N. savings definition.

Table A-4

Results of Alternative Development Patterns, Model 1,
50-Country Sample, 1962-1975[1]

(All figures in billions of 1962 US dollars; cumulative values include the years 1962 through 1975)

Line No.		Historical Country Performance			Plan Country Performance			Upper Limit Country Performance		
		Historical Growth Targets	Plan Growth Targets	Upper Limit Growth Targets	Historical Growth Targets	Plan Growth Targets	Upper Limit Growth Targets	Historical Growth Targets	Plan Growth Targets	Upper Limit Growth Targets
1	1975 Gross National Product	297	327	354	297	328	356	298	329	360
2	(Implicit GNP growth rate)	(.044)	(.051)	(.058)	(.044)	(.052)	(.058)	(.044)	(.052)	(.059)
	Cumulative values of variables									
3	Exports: Low growth (3.8% per year)	441	441	441	441	441	441	441	441	441
4	Exports: High growth (5.2% per year)	480	480	480	480	480	480	480	480	480
5	Gross National Product	3186	3356	3485	3188	3363	3502	3195	3373	3522
6	Gross Investment	476	591	703	461	572	684	448	557	670
7	National Savings (potential)	(475)	(502)	(526)	(495)	(528)	(556)	(521)	(562)	(598)
8	National Savings, realized	365	435	491	353	430	505	364	451	538
9	Imports (potential)	(533)	(561)	(581)	(533)	(562)	(583)	(509)	(541)	(560)
10	Imports, realized	552	596	652	548	582	620	525	547	573
11	Unrealized Savings (line 7 - 8)	110	67	35	142	98	53	157	111	60
12	Excess Imports (line 10 - 9)	19	35	71	15	20	36	16	6	23
13	Total Unrealized Savings and Excess Imports (line 11 - 12)	129	101	106	157	118	89	173	117	82
14	Net Capital Inflow: Low exports	111	156	212	108	142	179	84	106	133
15	Net Capital Inflow: High exports	90	138	201	83	119	164	60	84	116
	Capital Inflow, excluding countries with net capital outflow:[2]									
16	Low exports	120	165	220	106	152	187	94	117	141
17	High exports	105	150	211	100	131	173	85	99	125
18	Consumption: Low exports	2821	2920	2995	2835	2933	2997	2831	2922	2984
19	Consumption: High exports	2800	2903	2984	2811	2909	2981	2807	2899	2967

Source: Agency for International Development, Office of Program Coordination, machine listings of September 16, 1964.

1/ See Table 7 for values of parameters used and Table 8 for countries included and initial values of variables used.

2/ Foreign resource flows are measured on a net basis. In any particular year most net flows are capital inflows, but some countries (e.g., Venezuela, Malaya, Burma) may have estimated potential capital outflows under the assumptions made. This alternative net capital estimate shown here excludes these potential capital outflows.

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Table A-5

BASIC PROJECTIONS OF DEVELOPMENT PROSPECTS AND CAPITAL INFLOW,

50 LESS DEVELOPED COUNTRIES, 1970 - 1975

(All Values in Billions of 1962 U.S. Dollars)

	1962	1970 [1]				1975 [1]				% of Annual Growth, 1962-1975 [1]			
		Historical	Plan		Upper Limit	Historical	Plan		Upper Limit	Historical	Plan		Upper Limit
			Low Exports	High Exports			Low Exports	High Exports			Low Exports	High Exports	
Near East (7 countries) [2]													
GNP	20.94	32.05	33.22	33.22	31.48	42.12	44.92	44.92	48.55	5.5%	6.0%		6.7%
(% of GNP Total)	(78%)												
Investment	3.76	5.56	6.27	6.27	7.27	7.46	8.70	8.70	10.63	5.4%	6.7%		8.3%
Savings	2.51	3.26	3.45	3.92	5.18	4.35	4.48	5.49	7.73				
Imports	4.61	7.28	7.80	8.02	7.76	9.71	10.82	11.53	11.23				
Exports	3.34	4.98	4.98	5.67	5.67	6.60	6.60	8.32	8.32	5.4%	5.4%	7.3%	7.3%
Foreign Resources [3]	1.26	2.30	2.82	2.35	2.09	3.11	4.22	3.21	2.90	7.2%	9.7%	7.5%	6.6%
South Asia (3 countries)													
GNP	46.22	64.83	69.52	69.52	73.45	80.13	89.96	89.96	100.20	4.3%	5.3%		6.1%
(% of GNP Total)	(97%)												
Investment	7.57	8.89	11.66	11.66	14.93	10.99	15.08	15.08	20.37	2.9%	5.4%		7.9%
Savings	6.46	6.85	9.08	9.26	12.83	8.12	11.12	11.47	17.27				
Imports	3.73	5.20	5.74	5.74	5.45	6.42	7.52	7.52	7.02				
Exports	2.63	3.16	3.16	3.35	3.35	3.56	3.56	3.91	3.91	1.0%	1.0%	3.1%	3.1%
Foreign Resources [3]	1.10	2.04	2.58	2.39	2.10	2.86	3.96	3.61	3.11	7.6%	10.4%	9.6%	8.3%
Latin America (19 countries)													
GNP	62.64	88.60	93.44	93.44	98.56	111.01	121.56	121.56	134.42	4.5%	5.2%		6.1%
(% of GNP Total) [4]	(95%)												
Investment	11.05	15.04	17.61	17.61	20.19	18.85	23.13	23.13	28.49	4.2%	5.8%		7.5%
Savings	10.26	13.28	14.95	15.82	18.39	16.13	18.55	20.24	25.92				
Imports	11.00	15.23	16.12	16.48	16.50	18.92	20.79	21.74	21.40				
Exports	10.20	13.46	13.46	14.69	14.69	16.19	16.19	18.83	18.83	3.6%	3.6%	4.8%	4.8%
Foreign Resources [3]	1.55*	2.21*	3.27*	2.58*	2.27*	2.87*	5.00*	3.80*	3.23*	4.9%	9.1%	7.1%	5.6%
Africa (13 countries)													
GNP	17.04	22.28	23.58	23.58	24.56	26.56	29.11	29.11	31.36	3.5%	4.2%		4.8%
(% of Total GNP)	(73%)												
Investment	2.69	2.97	3.61	3.61	4.25	3.63	4.55	4.55	5.59	2.3%	4.1%		5.8%
Savings	1.58	1.65	2.07	2.20	2.85	2.13	2.68	2.94	4.07				
Imports	5.49	7.42	7.63	8.12	8.12	9.09	9.45	10.68	10.59				
Exports	4.38	6.08	6.08	6.75	6.75	7.59	7.59	9.07	9.07	4.3%	4.3%	5.8%	5.8%
Foreign Resources [3]	1.11	1.36*	1.53	1.40	1.40*	1.53*	1.86*	1.61*	1.58*	2.5%	4.0%	2.9%	2.8%
Far East (8 countries)													
GNP	23.68	30.92	33.53	33.53	34.68	36.91	42.07	42.07	44.97	3.5%	4.5%		5.1%
(% of Total GNP)	(86%)												
Investment	3.11	3.11	4.28	4.28	5.01	3.86	5.50	5.50	6.35	1.7%	4.5%		6.3%
Savings	2.26	1.80	2.65	3.00	3.57	2.14	3.10	3.79	4.76				
Imports	4.80	6.41	6.73	6.82	6.98	7.78	8.46	8.70	9.08				
Exports	3.95	5.10	5.10	5.54	5.54	6.06	6.06	6.99	6.99	3.3%	3.3%	4.5%	4.5%
Foreign Resources [3]	.95*	1.31	1.64*	1.31*	1.45*	1.71*	2.41*	1.78*	2.11*	4.6%	7.4%	4.9%	6.3%
50-Country Total													
GNP	170.52	238.68	253.31	253.31	262.72	296.73	327.62	327.62	359.50	4.4%	5.2%		5.9%
(% of All LDC's GNP) [4]	(89%)												
Investment	28.18	35.59	43.45	43.45	51.65	44.79	56.96	56.96	71.93	3.6%	5.6%		7.5%
Savings	23.07	26.84	32.20	34.20	42.82	32.87	39.93	43.93	59.75	2.8%	4.3%	5.1%	7.6%
Imports	29.63	41.54	44.02	45.22	44.81	51.92	57.04	60.17	59.32	4.4%	5.2%	5.6%	5.5%
Exports	24.50	32.81	32.81	36.00	36.00	40.00	40.00	47.12	47.12	3.8%	3.8%	5.2%	5.2%
Foreign Resources [3]	5.97*	9.22*	11.84*	10.03*	9.31*	12.08*	17.45*	14.01*	12.93*	5.6%	7.8%	6.6 %	5.9%

[1] See Table II for values of parameters used. Growth rates are roughly classified as H(istorical), P(lan), and U(pper Limit); internal parameters corresponding to these rough classifications are designated A, B, and C; export growth rates are designated 1 (low) and 2 (high).

[2] Excludes the oil-producing countries except for Iran. Includes Greece, Turkey and the UAR.

[3] Foreign resource flows are measured on a net basis. In any particular year most net flows are capital inflows but some countries (e.g., Venezuela, Malaya, Burma) are estimated to have potential capital outflows under the assumptions made. The figure shown here excludes these potential capital outflows; regional totals are denoted by an asterisk (*) if they include such a country.

[4] Excludes Cuba.

Source: Agency for International Development - AA/PC, November, 1964.

(Continued)

TABLE A-6

AVERAGE VALUES OF GROWTH RATES, SAVINGS, AND IMPORT COEFFICIENTS
50-COUNTRY SAMPLE, VARIOUS ALTERNATIVES
1963-1970

	Internal Self-Help Policy Alternatives					
	Historical Performance		Realistic Plan Performance		Best Possible Performance	
	Low Exports (1)	High Exports (2)	Low Exports (3)	High Exports (4)	Low Exports (5)	High Exports (6)
Historical Growth						
Annual growth rates						
GNP	.043	.043	.043	.043	.043	.043
Exports	.037	.049	.037	.049	.037	.049
Gross Investment (Potential)	.091	.091	.091	.091	.091	.091
Marginal coefficients						
Capital-output	3.39	3.39	3.26	3.26	3.15	3.15
Savings-output (Potential)	.190	.190	.215	.215	.245	.245
Savings-output (Realized)	.115	.141	.113	.143	.132	.161
Imports-output (Potential)	.155	.155	.150	.150	.123	.123
Imports-output (Realized)	.191	.195	.170	.188	.140	.158
Realistic Planned Growth						
Annual growth rates						
GNP	.051	.051	.051	.051	.052	.052
Exports	.037	.049	.037	.049	.037	.049
Gross Investment (Potential)	.096	.096	.096	.096	.096	.096
Marginal coefficients						
Capital-output	3.40	3.40	3.27	3.27	3.15	3.15
Savings-output (Potential)	.187	.187	.211	.211	.243	.243
Savings-output (Realized)	.126	.146	.123	.148	.151	.174
Imports-output (Potential)	.157	.157	.159	.159	.120	.120
Imports-output (Realized)	.184	.204	.172	.187	.133	.149
Upper Limit Growth						
Annual growth rates						
GNP	.057	.057	.057	.057	.058	.058
Exports	.037	.049	.037	.049	.037	.049
Gross Investment (Potential)	.102	.102	.102	.102	.102	.102
Marginal coefficients						
Capital-output	3.40	3.40	3.28	3.28	3.16	3.16
Savings-output (Potential)	.185	.185	.209	.209	.242	.242
Savings-output (Realized)	.157	.165	.171	.183	.197	.212
Imports-output (Potential)	.157	.157	.157	.157	.118	.118
Imports-output (Realized)	.216	.243	.176	.198	.136	.156

SOURCE: AID, AA/PC, "23-Year Projections," machine runs of September 16, 1964.

FOREIGN ASSISTANCE AND ECONOMIC DEVELOPMENT

Hollis B. Chenery and Alan M. Strout

Annex B

Equations for Models 1, 2, and 3*

June 1965

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*The authors are indebted to Carmel Ullman for valuable assistance with this Annex.

Line 15. $\Sigma I_t^2 \equiv \Sigma I_t^1 = k\left[(1+\bar{r})^{n+1} - 1\right]$ (see line 5)

16. $\Sigma S_t^2 = \Sigma \bar{S}_t^2 = (n+1)(\alpha_o - \alpha') + \alpha' \Sigma V_t^2$ (cf. line 6)

17. $\Sigma M_t^2 = \Sigma \bar{M}_t^2 = (n+1)(\mu_o - \mu') + \mu' \Sigma V_t^2$ (cf. line 8)

18. $\Sigma F_t^2 = \Sigma I_t^2 - \Sigma \bar{S}_t^2 = \Sigma \bar{M}_t^2 - \Sigma E_t$

D. Model 3

Line 19. $\Sigma V_t^3 \equiv \Sigma V_t^1$ (see line 4)

20. $\Sigma I_t^3 = \Sigma I_t^1 + (1 - \frac{1}{b}) \Sigma I_{m_t}$

where $(1-\frac{1}{b}) \Sigma I_{m_t}$ is the additional investment over that for Model 1 because of a different capital-output ratio.

Since $\Sigma V_t^3 \equiv \Sigma V_t^1$, ΣI_t^3 will differ from ΣI_t^1 only because a part of ΣI_t^3 (i.e., the import-substituting investment ΣI_{m_t}) has a higher capital-output ratio (k_m) than the k for normal investment.

Hence $\Sigma I_t^3 = \Sigma I_t^1 - \frac{k}{k_m} \Sigma I_{m_t} + \Sigma I_{m_t}$.

Letting $b = \frac{k_m}{k}$ and combining terms gives the equation for line 20.

See below for derivation of ΣI_{m_t}.

21. $\Sigma I_{m_t} \div \Sigma I_t^3$

Line 22. $\Sigma S_t^3 = \Sigma \bar{S}_t^3 \equiv \Sigma \bar{S}_t^1$ (cf. lines 6, 19)

23. $\Sigma M_t^3 = \Sigma \bar{M}_t^3 + \Sigma M_{m_t}$

where $\Sigma \bar{M}_t^3 \equiv \Sigma \bar{M}_t^1$ (cf. lines 8, 19)

and ΣM_{m_t} represents the imports replaced by additional import substitution (See below for derivation)

24. $\Sigma F_t^3 = \Sigma I_t^3 - \Sigma S_t^3 = \Sigma M_t^3 - \Sigma E_t$

25, 26, 27. $\Sigma C_t^i = \Sigma V_t^i - \Sigma S_t^i$

E. Derivation of ΣI_{m_t} and ΣM_{m_t}

The import-substitution production function (equation 42) is:

(1*) $-M_{m_t} = \frac{1}{k_m} \sum_{o}^{t-1} I_{m_t} - aI_{m_t}$

where a is the additional import content of I_{m_t} (obtained by subtracting the average import ratio of V_t from the ratio of imports to investment for I_{m_t})

Summing (1*) over time,

(2*) $-\sum_{o}^{n} M_{m_t} = \frac{1}{k_m} \sum_{o}^{n} \left(\sum_{o}^{t-1} I_{m_t} \right) - a \sum_{o}^{n} I_{m_t}$

$$\text{But} \quad \sum_{o}^{n} \left(\sum_{o}^{t-1} I_{m_t} \right) = I_{m_o} + (I_{m_o} + I_{m_1}) + \ldots + (I_{m_o} + I_{m_1} + \ldots + I_{m_{n-1}})$$

$$= nI_{m_o} + (n-1)I_{m_1} + \ldots + I_{m_{n-1}}$$

$$= \sum_{o}^{n} (n-t) I_{m_t}$$

and $k_m = bk$; thus

$$(2^*a) \quad -\sum_{o}^{n} M_{m_t} = \left(\frac{n}{bk} - a \right) \sum_{o}^{n} I_{m_t} - \frac{1}{bk} \sum_{o}^{n} t I_{m_t}$$

For the calculations in Table 3, a simple linear increase over time was assumed for I_{m_t}:

i.e., $I_{m_t} = I_{m_o} (t+1)$

Now, $\sum_{o}^{n} I_{m_o} (t+1) = \frac{(n+1)(n+2)}{2}$

and $\sum_{o}^{n} t I_{m_o} (t+1) = \frac{n(n+1)(n+2)}{3} = \frac{2}{3} n \sum_{o}^{n} I_{m_o} (t+1)$

Substituting into (2*a) yields:

$$(2^*b) \quad -\sum_{o}^{n} M_{m_t} = \left(\frac{n}{3bk} - a \right) \sum_{o}^{n} I_{m_t} = \frac{1}{g} \left(1 - \frac{1}{b} \right) \sum_{o}^{n} I_{m_t}$$

where $g = \frac{3k(b-1)}{n-3abk}$.

From the balance equation for Model 3,

$$\Sigma I^3 - \Sigma S^3 = \Sigma M^3 - \Sigma E \qquad \text{(Table 3, line 24)},$$

comes $\Sigma I^1 + (1-\frac{1}{b})\Sigma I_m - \Sigma S^1 = \Sigma M^1 + \Sigma M_m - \Sigma E$ (Table 3, lines 20-23)

and hence, by rearranging and combining terms,

$$(3^*) \qquad \Sigma F^s - \Sigma F^m = \Sigma M_m - (1 - \frac{1}{b}) \Sigma I_m$$

Substituting (2*b) into (3),

$$(4^*) \qquad \Sigma M_m = \frac{1}{1+g}(\Sigma F^s - \Sigma F^m) \qquad \text{where} \quad g = \frac{3k(b-1)}{n-3abk} .$$

It follows immediately from this that $(1 - \frac{1}{b}) \Sigma I_m = - \frac{g}{1+g}(\Sigma F^s - \Sigma F^m)$. .

II. Derivation of Equations for Table 4:

Line 1. $V_n = (1+\bar{r})^n$, where n = 13 (see line 1, Table 3)

2. GNP target growth rate = $\bar{r}$ (see line 2, Table 3)

3. $\Sigma F^1 = \max (\Sigma F^s , \Sigma F^m)$ (see line 12, Table 3).

Line 4. $\Sigma F^2 = \Sigma I^2 - \Sigma S^2 = \Sigma M^2 - \Sigma E$ (see line 18, Table 3)

5. $\Sigma F^3 = \Sigma I^3 - \Sigma S^3 = \Sigma M^3 - \Sigma E$ (see line 24, Table 3)

6, 7, 8. $\Sigma C^i = \Sigma V^i - \Sigma S^i$ for all three models (see lines 25-27, Table 3)

9-14. The formulas for lines 9 through 14 of Table 4 are the sa as those for lines 3 through 8 respectively, where all cumulative values of the variables are now discounted. Equations for the variables may be obtained directly from the formulas for Table 3 by substituting

$\Sigma(\frac{1}{1+d})^t$ for $(n+1)$, $\Sigma(\frac{1+\bar{r}}{1+d})^t$ for ΣV_t^1, and

$E_o\Sigma(\frac{1+\epsilon}{1+d})^t$ for ΣE_t.

15. $\Sigma \Delta_{21}C = \begin{cases} (1-\alpha')\Sigma \Delta_{21}V & \Sigma F^s \geq \Sigma F^m \\ (1+\mu')\Sigma \Delta_{21}V & \Sigma F^s \leq \Sigma F^m \end{cases}$

Since $\Sigma C^i = \Sigma V^i - \Sigma S^i$ for all models (see lines 6-8 above) we have

$$\Sigma \Delta_{21}C = \Sigma C^2 - \Sigma C^1 = \Sigma \Delta_{21}V - \Sigma \Delta_{21}S . \quad (15.1)$$

But $\Sigma \Delta_{21} S = \Sigma \Delta_{21} \bar{S} - \Sigma S^*$ (Table 3, lines 7 and 16)

(15.2) $= \alpha' \Sigma \Delta_{21} V - \Sigma S^*$

where $\Sigma S^* = \min(0, \Sigma F^s - \Sigma F^m)$.

Moreover,

$$\Sigma F^s - \Sigma F^m = \Sigma I^1 - \Sigma \bar{S}^1 - \Sigma \bar{R}^1 + \Sigma E \quad \text{(Table 3, line 7)}$$

$$= \Sigma I^1 + \Sigma E - (n+1)(\alpha_o - \alpha' + \mu_o - \mu') - (\alpha' + \mu') \Sigma V^1$$

$$= (\alpha' + \mu') \Sigma V^2 - (\alpha' + \mu') \Sigma V^1 \quad \text{(Table 3, line 14)}$$

(15.3) $$= (\alpha' + \mu') \Sigma \Delta_{21} V.$$

The equation for line 15 is obtained by substituting equation (15.2) and then (15.3) into (15.1).

16. $$\Sigma \Delta_{21} F = \begin{cases} -\alpha' \Sigma \Delta_{21} V & \Sigma F^s > \Sigma F^m \\ \mu' \Sigma \Delta_{21} V & \Sigma F^s < \Sigma F^m \end{cases}$$

Since $\Sigma F^i = \Sigma I^i - \Sigma S^i$ for all models,

we have $\Sigma \Delta_{21} F = \Sigma \Delta_{21} I - \Sigma \Delta_{21} S$.

But $\Sigma \Delta_{21} I = 0$ (Table 3, line 15) and $-\Sigma \Delta_{21} S = \Sigma \Delta_{21} C - \Sigma \Delta_{21} V$ (see equation (15.1) above).

Thus $\Sigma \Delta_{21} F = \Sigma \Delta_{21} C - \Sigma \Delta_{21} V$, and the equation for line 16 may be derived directly from the equation for line 15.

17. $$\frac{\Sigma \Delta_{21} C}{\Sigma \Delta_{21} F} = \begin{cases} \frac{\alpha'-1}{\alpha'} & \Sigma F^s > \Sigma F^m \\ \frac{\mu'+1}{\mu'} & \Sigma F^s < \Sigma F^m \end{cases}$$

This equation is obtained directly from the equations for lines 16 and 17.

18-20. The formulas for lines 18-20 are identical to those for lines 15-17 respectively, where discounted values are used for $\Sigma \Delta_{21} V$.

Line 21. $\Sigma\Delta_{31}C = \min(0, \Sigma F^S - \Sigma F^m)$

Since $\Sigma\Delta_{31}C = \Sigma\Delta_{31}V - \Sigma\Delta_{31}S$ and $\Sigma\Delta_{31}S = \alpha'\Sigma\Delta_{31}V - \Sigma S^*$ (see equations (15.1) and (15.2) for analogous derivation), and since $\Sigma\Delta_{31}V = 0$ (Table 3, line 19) we have $\Sigma\Delta_{31}C = \Sigma S^*$. (See Table 3, line 7)

22. $$\Sigma\Delta_{31}F = \begin{cases} -\frac{g}{1+g}(\Sigma F^S - \Sigma F^m) & \Sigma F^S \geq \Sigma F^m \\ \frac{1}{1+g}(\Sigma F^S - \Sigma F^m) & \Sigma F^S \leq \Sigma F^m \end{cases}$$

Since $\Sigma F^i = \Sigma M^i - \Sigma E$ for all models,

we have $\Sigma\Delta_{31}F = \Sigma M^3 - \Sigma M^1$

$= \Sigma M_m - \Sigma M^*$ (Table 3, lines 9 and 23)

where $\Sigma M^* = \max(0, \Sigma F^S - \Sigma F^m)$

and $\Sigma M_m = \frac{1}{1+g}(\Sigma F^S - \Sigma F^m)$ (Table 3, equation (4*)).

The equation for line 22 follows immediately.

23. $$\frac{\Sigma\Delta_{31}C}{\Sigma\Delta_{31}F} = \begin{cases} 0 & \Sigma F^S \geq \Sigma F^m \\ 1+g & \Sigma F^S < \Sigma F^m \end{cases}$$

This equation is obtained directly from the equations for lines 21 and 22.

24-26. The formulas for lines 24-26 are identical to those for lines 21-23 respectively, using discounted values for $\Sigma F^S - \Sigma F^m$.

III. Derivation of Efficiency Factors

(1) General equation: $q = \frac{\Sigma \Delta F}{\Sigma F^s - \Sigma F^m}$

(2) $q^{21} = \begin{cases} \frac{-\nu'}{\nu'+\mu'} & \Sigma F^s \geq \Sigma F^m \\ \frac{\mu'}{\nu'+\mu'} & \Sigma F^s < \Sigma F^m \end{cases}$

This may be obtained by substituting equations (15.3) and 16 (Table 4) directly into the general equation for efficiency factors.

(3) $q^{31} = \begin{cases} -\frac{g}{1+g} & \Sigma F^s \geq \Sigma F^m \\ \frac{1}{1+g} & \Sigma F^s < \Sigma F^m \end{cases}$

This is obtained directly from the equation for line 22 (Table 4) and the general equation for efficiency factors.