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FOREIGN AID AND ECONOMIC DEVELOPMENT: THE CASE OF GREECE*

Irma Adelman and Hollis B. Chenery

I. Introduction

Although the advanced countries are now providing public grants and loans to less developed countries at a rate in excess of six billion dollars per year, there is as yet no scientific basis for determining the effects of this resource transfer on the recipient's economic development. In the absence of a valid quantitative analysis, there is a wide range of intuitive judgments as to the importance of foreign aid, ranging from "vital" to "negligible".

Suggestions for a strategy for more rapid development which utilizes substantial amounts of external assistance have been set out in several recent papers.[1] These studies

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1 H. B. Chenery and M. Bruno, "Development Alternatives in an Open Economy: The Case of Israel", Economic Journal, March 1962, 79-103; H. B. Chenery, "Foreign Assistance and Economic Development", paper presented to the Econometric Society, Dec. 1963; R. McKinnon, "Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation", Economic Journal, June 1964, 388-409.

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suggest that a moderate volume of external resources may make possible a substantial increase in the rate of growth through financing additional investment as well as providing the additional imports required to sustain a higher level of income. The key elements in this process are the response of the country to the availability of additional resources and its ability to replace these resources over time by changes in its structure of production and use of income.

Although these studies establish some of the criteria for effective programs of foreign assistance, the extent to which aid recipients are able to carry out the required policies can only be determined from a study of actual cases. Since the time span required for a successful process of development-through-aid may be from ten to thirty years or more, there are few less-developed countries which have received substantial external assistance for a long enough period to make possible an evaluation of its effectiveness. There are, however, several countries in which successful programs of economic development have originated from postwar recovery programs -- notably Greece, Taiwan, Israel, and the Philippines. All of these have received substantial amounts of assistance, have had an accelerated growth of national income, and have steadily reduced their dependence on external assistance

for continued growth. We have selected Greece from this group as best suited for an econometric investigation of (1) the effects of aid on growth and (2) the policy problems which dependence on external assistance present.[1]

II. Foreign Assistance and Development Policy

A transfer of external resources enables the recipient to raise the level of investment and to increase the supply of commodities that are not domestically produced. The first requirement of development policy under these circumstances is to allocate a sufficient portion of the import surplus to increased investment and to the import of commodities needed to prevent bottlenecks in production. Continuation of a substantial resource transfer implies adjustments in the structure of domestic production and income use to accommodate this element in total supply. Once a growth process is established, changes in the economic structure in the direction of increased savings, import substitution, and increased exports are required in order to reduce the dependence on external resources. The development policies which were appropriate to the earlier period of maximizing growth with a large volume of foreign

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1 Some aspects of this problem were investigated for Israel in Chenery and Bruno, op.cit., but the Israeli data are not adequate for time-series estimation of the type attempted here.

aid will then have to be modified in order to bring about the structural changes required.[1]

These problems have been particularly acute in Greece over the past fifteen years, since her dependence on external assistance at the beginning of the period was abnormally high. In 1950, the Greek import surplus was equivalent to 24% of GNP, 78% of imports, and nearly 100% of gross investment. While a comparable degree of dependence in the recent past can be found in Taiwan, Israel, Korea, Jordan and a few other countries, an upper limit of 5% of GNP and 30% of investment is typical of underdeveloped countries as a whole. Greece has therefore had both the advantages and the adjustment problems of reliance on external resources to an extreme degree.

Over the period covered by this study (1950-1961) Greece's dependence on external resources was reduced by more than 50% while a growth rate of 6% was maintained with relatively stable prices. This performance implies a set of development policies which were consistent with the supply of external resources, her export possibilities and other limitations. The results of these policies are

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1 A fuller statement of these requirements is given in H. B. Chenery and A. Strout, "Foreign Assistance and Economic Development", loc.cit.

reflected in the quantitative estimates of the model developed in the next section. Changes in these structural relations will be required to maintain the growth process, however, since our tests show that a continuation of the existing relations is inconsistent with the policy objectives and limitations likely to prevail in the next decade. We shall therefore make several alternative projections for the next decade which indicate the principal ways in which the transition to more self-sufficient growth can be completed.

III. Description of the Model

In analyzing the role of external resources in development policy, it is necessary to distinguish between their functions as (a) a supplement to local savings and (b) a net addition to foreign exchange resources. Development policy must be such as to equate the resource transfer to both the investment-savings gap and the import-export gap. While these two are of necessity equal in the past, since savings are defined as a residual, one or the other may be the limiting factor in determining the need for a capital inflow in the future.[1] The present model is designed to bring out the determinants of the two gaps and to suggest the types of policy change that may be needed to bring them into equilibrium.

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[1] This problem is treated in Chenery and Bruno, op.cit. and McKinnon, op.cit.

A. Elements in the Model

To analyze the need for external assistance and its effects on the performance of the economy, a number of elements of a general equilibrium system should be considered. The most important of these are the structural determinants of imports and investment, the tax and savings functions, and factors affecting exports. Starting from a rather general model of this sort, we have simplified the relations to adapt them to the data available for the Greek economy. Only this specialized version is given here.[1]

After a number of preliminary tests, the model chosen for this study consists of a set of disaggregated functions which describe economic behavior in the following spheres of activity: (1) consumption by households and government; (2) private and public gross capital formation; (3) imports of goods and services; and (4) exports of goods and services. The statistical portion of the model also incorporates a depreciation function, and two tax-transfer functions. These are supplemented by a set of non-statistical accounting definitions, a balance of payments equilibrium condition, and, implicitly, a savings-investment equilibrium condition.

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1 Further work has been done by the present authors at the Agency for International Development and Johns Hopkins to test the usefulness of more general models. Tests on Greece and other less developed countries suggest that it will not be possible to secure satisfactory statistical estimates for more complicated models until there has been a greater accumulation of data.

No production function is included in the initial estimation of the model since, in the absence of data on the rate of utilization of capital stock and of continuous employment or wage series, no meaningful production relationship could be obtained. Similarly, while it would have been desirable to incorporate also a description of price-wage interactions into the model, this was precluded by the absence of continuous statistics on Greek wage rates.

B. The Consumption Functions

The dependence of consumer expenditures upon the level of disposable income has been well established in both budget surveys and cross-country analyses. It is therefore assumed in this investigation that private consumer expenditures are a linear function of after-tax income. For purposes of this analysis private consumption expenditures are disaggregated into (a) consumption expenditures on food plus beverages and tobacco; (b) consumption expenditures on clothing and other personal effects; (c) consumption expenditures on rent, water, fuel, light, furniture, and household operations; and (d) consumption of services. In the case of government consumption it is assumed that by analogy with private consumption, government expenditures are linearly related to the gross national product.

C. The Investment Functions

The behavior pattern of producers in making capital expenditures is represented by three separate investment functions. The first of these describes decision patterns.

governing gross domestic investment in residential construction. Since Keynesian theory stresses the importance of the difference between the marginal efficiency of capital and the rate of interest as a determinant of investment behavior, an indicator of rates of return on capital was incorporated into the investment equation for housing. An interest variable (the bank discount rate) was tried but dropped, as its coefficient was not statistically significant. Similarly, initial experimentation with investment functions which relate construction investments to changes in capacity requirements by an accelerator model yielded unsatisfactory results. Construction investment was therefore assumed to be related to a profitability variable and to time. The latter variable may be considered to be a proxy variable for population growth.

Attempts to relate gross investment in plant and other non-residential construction to profit rates, interest rates, and/or to changes in income yielded generally unsatisfactory results. Capital formation in these forms of construction was therefore related to the value of non-residential construction investment in the previous year[1] and to time.

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[1] The latter variable can be interpreted to represent the effect of expectations. See M. Nerlove, "Distributed Lags and Demand Analysis for Agricultural and Other Commodities", Agricultural Handbook, 141, U. S. Department of Agriculture, 1958.

The third investment function describes gross capital formation in machinery and transport equipment. Since the domestic production of heavy capital goods is very low in Greece, gross domestic investment in transport equipment and in machinery and other equipment was assumed to be linearly related to imports of goods and services. Attempts to introduce profitability, interest, and accelerator variables into this investment function did not substantially improve the fit. These variables were therefore dropped.

No successful explanatory relationship for investments in inventory was found; for this reason, investments in inventory were taken to be exogenously determined.

D. The Import Functions

Total imports are divided into five main components: imports of foods, beverages and tobacco, and animal and vegetable oils; imports of crude materials plus mineral fuels and chemicals; imports of manufactured goods; imports of machinery and transport equipment; and imports of services. Each category of imports is assumed to be a linear function of the gross national product, and of the relative price of imports.

E. The Export Functions

Four categories of exports are distinguished: exports of food, beverages and tobacco, and animal and vegetable oils; exports of crude materials plus mineral fuels and chemicals; exports of manufactured goods and of machinery and transport equipment[1]; and exports of services. Each of these types of

[1] These two categories were combined because each individually is rather small.

Greek exports is expressed simply as a function of time. A proxy variable for world income - world exports - was tried but deleted since it yielded poorer fits. In the preliminary analysis a relative price variable was also considered but dropped, since it resulted in positive price elasticities.

F. Other Statistical Functions

Since both gross investment and net capital formation appear as endogenous variables in the model, it becomes necessary to treat depreciation as a separate endogenous variable. It is assumed that depreciation charges depend in a linear manner upon the size of the capital stock at the beginning of the period. Two additional endogenous variables - direct taxes and transfer payments, and indirect taxes minus subsidies - are taken, for simplicity, to be linearly related to the gross national product.

G. Definitions and Identities

In addition to the usual accounting identities which express consumption, investment, imports, and exports as the sum of their component parts, the model includes definitions of the gross national product, national income, and disposable income. Two equilibrium conditions are also incorporated into the system: (1) a balance of payments condition, which states that the difference between imports and exports of goods and services is represented by net foreign capital inflows; and (2) a definition of capital stock, which expresses the capital stock at the end of a period as the sum of the capital stock at the end of the previous period plus the net capital formation during the period. A savings-investment equilibrium condition is not needed, as it is implicit in the definitions of savings and gross national product.

IV. The Data

The basic data required for the analysis come mostly from the U. N. Yearbook of National Account Statistics, although collateral sources, such as the National Accounts of Greece, were used as well. The time period chosen was 1950 to 1961, as it was felt that the degree of the postwar dislocation of the Greek economy would vitiate attempts to extend the time span to include earlier years. The detailed data and the sources appear as Appendix B.

V. The Statistical Results

A. List of Variables

C_f^* = Consumption expenditures on food, beverages and tobacco, 1954 prices.

C_c^* = Consumption expenditures on clothing and other personal effects, 1954 prices.

C_h^* = Consumption expenditures on rent, water, fuel, light, furniture and household operations, 1954 prices.

C_s^* = Consumption of services, 1954 prices.

G^* = Government consumption expenditures, 1954 prices.

C^* = Total private consumption expenditures, 1954 prices.

I_d^* = Gross domestic investment in residential construction, 1954 prices.

I_c^* = Gross domestic investment in non-residential and other construction, 1954 prices.

I_m^* = Gross domestic investment in transport equipment and in machinery and other equipment, 1954 prices.

I_s = Increase in stocks, 1954 prices.

I^* = Gross capital formation, 1954 prices.

P/K = Index of average rate of return on capital, 1954 = 100.

M^* = Imports of goods and services, 1954 prices.

M^*_f = Imports of food, beverages and tobacco, animal and vegetable oils, 1954 prices.

M^*_i = Imports of crude materials, mineral fuels and chemicals, 1954 prices.

M^*_m = Imports of manufactured goods, 1954 prices.

M^*_t = Imports of machinery and transport equipment, 1954 prices.

M^*_s = Imports of services, 1954 prices.

X^* = Exports of goods and services, 1954 prices.

X^*_f = Exports of food, beverages and tobacco, animal and vegetable oils, 1954 prices.

X^*_i = Exports of crude materials, mineral fuels and chemicals, 1954 prices.

X^*_{mt} = Exports of manufactured goods and of machinery and transport equipment, 1954 prices.

S^* = Gross savings, 1954 prices.

X_s^* = Exports of services, 1954 prices.

F^* = Net foreign capital inflow, 1954 prices.

V^* = Gross national product, 1954 prices.

Y_d^* = Disposable income, 1954 prices.

T_d^* = Direct taxes and transfer payments, 1954 prices.

T_i^* = Indirect taxes minus subsidies, 1954 prices.

P_m^* = Index of the relative price of imports, 1954 = 100.

K^* = End of year capital stock, 1954 prices.

D^* = Depreciation, 1954 prices.

t^* = Time in years measured from 1950 = 1.

Endogenous variables in this list are marked with an asterisk. Note that in the above list gross capital formation is marked endogenous while the increase in stocks is not; this fact must be taken into account in counting equations and variables. The exogenous variables which appear in the mo are inventory investment I_s, the index of the average rate of return on capital $\frac{P}{K}$ and the index of the relative price of imports P_m. The predetermined variables are K_{-1}, and $I_{c_{-1}}$.

B. The Estimated Equations

The sample consists of yearly observations for the period 1950-1961. The method of estimations used for those equations which contain more than one endogenous variable [(1)-(6), (9)-(13) and (18)-(19)] was Theil's two stage least squares[1,2]. Equations (7), (8), (14)-(17) and (20), which contain only a single endogenous variable were estimated by ordinary least squares. The predetermined and exogenous variables used in the first stage of the two stage least squares procedures were K_{-1}. I_{c-1}. I_s, P/K, P_m and t.

As usual, the standard errors of the coefficients are listed in parantheses below each coefficient, and $\bar{R}^2$ denotes the value of the coefficient of multiple determination adjusted for degrees of freedom.

In addition, for each equation, one of two measures of serial correlation in the residuals is listed. For equations estimated by means of two stage least squares, the measure used is the VonNeumann statistic δ^2/S^2; the Durbin-Watson statistic, d, is computed for equations estimated by ordinary least squares procedures. With our sample size, a value of δ^2/S^2 below .90 indicates significant serial correlation at the 1% level of significance. Similarly, for equations with a single dependent variable, a value of d below .81 indicates significant auto-correlation at the 1% level of significance; a value of d above 1.07 indicated serial independence, while value of d between .81 and 1.07 yields inconclusive results. For equations with two dependent variables, the corresponding limits for d are .70 and 1.25 respectively.

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1 Sec. H. Theil, Economic Forecasts and Policy, 2d ed., North - Holland Publishing Company, Amsterdam, 1961, ch. 6.

2 Actually, there was remarkable little difference between single stage least squares, limited information and two stage least squares estimates of these equations. The single stage, two stage and limited information estimates of the relevant equations are reproduced in Appendix A for comparison purposes.

C. Stochastic Equations

(1)	C_c	= 1024 (510)	+ .1318 Y_d (.0082)		R^2 = .966	δ^2/S^2 = 2.24
(2)	C_h	= -1522 (714)	+ .2121 Y_d (.0116)		R^2 = .974	δ^2/S^2 = 1.18
(3)	C_s	= -3171 (949)	+ .2182 Y_d (.0153)		R^2 = .958	δ^2/S^2 = 2.21
(4)	C_f	= +11540 (1048)	+ .3151 Y_d (.0169)		R^2 = .975	δ^2/S^2 = 1.63
(5)	G	= 1459 (780)	+ .1046 V (.0095)		R^2 = .931	δ^2/S^2 = 1.80
(6)	I_m	= -4776 (1432)	+ .6714 M (.060)		R^2 = .934	δ^2/S^2 = .78
(7)	I_d	= -2049 (1485)	+ 36.3 P/K (17.3)	+ 264 t (50.9)	R^2 = .907	d = 2.33
(8)	I_c	= -413 (310)	+ 208 t (93.0)	+ .84 I_{c-1} (.19)	R^2 = .959	d = 2.44
(9)	M_s	= -732 (128)	+ .0653 V (.011)	- 21.1 P_m (13)	R^2 = .826	δ^2/S^2 = 2.04
(10)	M_f	= 1695 (964)	+ .0190 V (.008)	- 7.2 P_m (9.7)	R^2 = .419	δ^2/S^2 = 1.22
(11)	M_v	= 2301 (874)	+ .0505 V (.066)	- 17.7 P_m (8.1)	R^2 = .880	δ^2/S^2 = 2.85
(12)	M_m	= -428 (584)	+ .0643 V (.0048)	- 9.7 P_m (5.9)	R^2 = .957	δ^2/S^2 = 3.15
(13)	M_t	= -1801 (2987)	+ .1836 V (.0247)	-76.1 P_m (30.0)	R^2 = .876	δ^2/S^2 = 1.90
(14)	X_f	= 2181 (283)	+ 198 t (46)		R^2 = .665	d = 1.65
(15)	X_i	= 314 (113)	+ 146 t (18)		R^2 = .875	d = 2.44

(16)	X_{mt}	=	146 (39)	+	18 t (6)	$R^2 = .448$	$d = 1.12$
(17)	X_s	=	70 (227)	+	321 t (37)	$R^2 = .894$	$d = 1.50$
(18)	T_d	=	-757 (480)	+	.0921 V (.0058)	$R^2 = .965$	$d = 1.56$
(19)	T_i	=	-1284 (298)	+	.1317 V (.0036)	$R^2 = .993$	$d = 2.28$
(20)	D	=	-88 (163)	+	.0213 K_{-1} (.0010)	$R = .979$	$\delta^2/S^2 = 1.37$

D. Identities

(21) $C = C_h + C_f + C_s + C_c$

(22) $I = I_c + I_m + I_s + I_d$

(23) $M = M_s + M_c + M_i + M_m + M_t$

(24) $X = X_f + X_i + X_{mt} + X_s$

(25) $M = X + F$

(26) $V = C + G + I - F$

(27) $Y = V - D - T_i - T_d$

(28) $K_t = (I - D)_t + K_{t-1}$

(29) $S = V - C - G$

(30) $t = t_{-1} + 1$

VI. The Performance of the Model 1951-61

One test of the descriptive validity of an econometric model[1] may be obtained by comparing the predicted values of the endogenous variables with the values actually observed during a sample period. This test differs from the more usual one, in which one examines the residuals of each individual estimated equation using only the observed values of the explanatory variables. In the present computations, the estimated values of the current and lagged endogenous variables were substituted for their observed values in the solution of the simultaneous equations and the resulting estimates were compared with the observed values. This procedure provides a more stringent test of the performance of the model economy, inasmuch as it tends to reveal systematic biases which may arise because of the cumulative effects of estimation errors introduced by the nature of the simultaneous and dynamic structure inherent in the model.

In Table I, the estimated and actual values of the endogenous variables of the system are listed side by side. The estimated values were obtained by solving the system simultaneously under the assumption that all disturbances (other than those which

1 For a discussion of other tests see, e.g., C. F. Christ, "Aggregate Econometric Models", American Economic Review, June 1956, XLVI 385-408, and I. Adelman and F. L. Adelman, "The Dynamic Properties of the Klein-Goldberger Model", Econometrica, October 1959, Vol. 27, 596-625.

TABLE I

Actual and Estimated Values of the Most Important Endogenous Variables 1951-1961[a, b]

Year	V Estimated	V Actual	C Estimated	C Actual	G Estimated	G Actual	S Estimated	S Actual
1951	49,050	47,819	40,987	40,090	6,590	7,018	1,474	3,111
1952	46,712	47,358	39,257	40,091	6,345	6,922	1,110	2,897
1953	54,967	54,315	44,802	44,181	7,208	6,347	2,957	6,179
1954	55,482	58,690	45,059	47,239	7,262	7,396	3,161	4,475
1955	62,331	63,318	49,658	49,573	7,978	7,657	4,964	8,019
1956	67,822	67,753	53,263	53,584	8,553	8,526	6,006	8,144
1957	78,331	73,914	58,194	57,551	9,339	9,132	7,801	9,596
1958	74,508	76,352	57,388	59,446	9,252	9,171	7,869	1,417
1959	79,274	79,366	60,389	60,585	9,751	10,151	9,136	9,214
1960	79,464	83,076	60,236	63,350	9,771	10,494	9,007	6,794
1961	89,469	92,656	66,767	68,178	10,817	11,125	11,884	13,160

Year	I Estimated	I Actual	X Estimated	X Actual	M Estimated	M Actual	F Estimated	F Actual
1951	9,554	9,502	4,077	3,127	12,154	13,396	8,077	7,727
1952	5,633	7,333	4,760	3,948	9,279	9,775	4,519	5,079
1953	7,056	8,137	5,443	5,422	9,535	9,003	4,092	2,934
1954	6,114	7,745	6,126	6,227	9,072	11,441	2,946	4,341
1955	10,245	10,083	6,809	7,731	12,354	12,318	5,545	3,635
1956	13,503	12,107	7,492	7,488	14,984	14,586	7,492	5,644
1957	16,916	13,450	8,175	8,759	17,330	16,032	9,155	5,321
1958	17,218	16,170	8,858	8,987	18,203	17,892	9,345	7,064
1959	19,495	18,670	9,541	9,156	19,896	19,478	10,355	8,289
1960	19,866	24,715	10,224	9,583	20,628	25,698	10,404	13,578
1961	25,837	26,130	10,907	11,054	24,854	24,716	13,947	10,462

[a] For notation see Section III A.

[b] In millions of 1954 drachmas

arise due to fluctuations of the exogenous variables) are zero. The actual values of the exogenous variables I_s , P_m and $\frac{P}{K}$ and the initial values of $I_{c_{-1}}$ and K_{-1} which were appropriate in 1950 were used in these computations. A comparison of the estimated and the actual values indicates that the model economy reproduces remarkably faithfully the time paths of all endogenous variables. There is little evidence of any systematic bias in the model.

We shall therefore proceed to use the model to investigate the effects of the external capital inflow and to attempt to forecast the future evolution of the Greek economy under varying conditions. In attempting to interpret the results of such studies, especially in the context of "what might have happened", it must be recognized that the present model of the Greek economy has been, in a sense, normalized to actual events during the period 1951-1961. Therefore, while a certain amount of validity may be ascribed to the interpretation of relatively small changes from the actual conditions of the period, one must be extremely cautious in judging the implications of larger departures from actual events. This is due partly to certain economic peculiarities of the period in question. In particular, the period 1951-1961 was characterized by an intensive effort to rebuild the capital stock of Greece in the aftermath of World War II and the internal fighting which followed the expulsion of the German Army. Therefore, the rate

of investment in residential and other construction is significantly higher than that which would normally have been justified by the actual or anticipated growth in GNP. Furthermore, the combination of the devaluation of the drachma in 1953 and the subsequent relaxation of import controls undoubtedly had a tendency to increase the marginal propensity to import above its normal long term equilibrium level.

VII. Past Effects of Foreign Aid

To make an assessment of the past effects of foreign assistance, we propose to use this model to get an approximate indication of the rate of growth and the behavior of the major aggregates that might have occurred with less capital inflow.[1] Since the equation system is a consistent and determinate one, the level of capital inflow can only be varied on the assumption that one of the behavioral equations is not binding.

The estimated effect of variation in the capital inflow will depend on which of the two functions of foreign assistance sets the limit to growth in given circumstances. The two possibilities are: (1) investment-limited growth, in which it is assumed that the investment determined by the model is essential to sustain the level of GNP; (2) import-limited growth, in which it is assumed that the amount of imports determined by the system are required

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[1] The estimates can only be approximate, since they do not allow for possible adjustments in the economic structure to a reduction in F.

by the structure of demand at a given level of GNP.

The value of GNP on the assumption that investment is the limiting factor can be determined by combining equations (1)-(5), (18)-(20), (22) and (27)-(30) to arrive at:

$$(31) \quad V_2 = 52210 - .0872\, K_{-1} + 4.662\, (I-F).$$

The desired level of investment I is now computed from equations (6)-(8) using the value of investment in machinery and transportation equipment inherent in the limitation of the value of imports from the balance of payments equations. Investment in stock is taken at its observed level each year, and the level of F is set at its assumed value. In this case, it is assumed that the volume of imports will be adequate to sustain the level of GNP that results through adjustments in composition of demand.

If, however, import requirements are the limiting factor, the corresponding level of GNP is determined by combining equations (9)-(13):

$$(32) \quad V_1 = 2.61\, M + 344.92\, P_m - 2704.47$$

The permissible value of M is found by adding the assumed value of foreign capital inflows to exports as calculated from equations (14)-(17).

The alternative GNP values calculated from equations (31) and (32) for four lower levels of net foreign capital inflows ($F = 0$, $F = 1/4$ of its observed value, $F = 1/2$ of observed, $F = 3/4$ of observed, and F = actual) are reproduced in Table II. One interesting question is, "Which of the two constraints would have tended to dominate the evolution of the economy as the permissible level of net foreign capital inflows is varied?" It is apparent from Table II that, except when net foreign capital inflows are abnormally high[1], the value V_1 constrained by imports is smaller than the value V_2 constrained by savings.

To calculate foreign-aid multipliers $\Delta V/\Delta F$, we set the "actual" value of GNP equal to the minimal value. These results are presented in Table III for the period 1951-1961. The foreign aid multiplier varies nonlinearly with the level of foreign aid; however this result may be peculiar to the Greek economy during the sample period rather than of general significance. Since the import constraint has tended to dominate the time path of Greek GNP for this period, the effectiveness of foreign aid would have been enhanced by a reduction

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1 In years 1954 and 1960 for $F = 3/4$ and F = actual.

TABLE II

GNP Levels Permitted by Different Foreign Aid Constraints, 1951-1961[a]

Year	F=0		F = ¼ Actual		F = ½ Actual		F = 3/4 Actual		F = Actual	
	Import Constrained GNP	Savings Constrained GNP	Import Constrained GNP	Savings Constrained GNP	Import Constrained GNP	Savings Constrained GNP	Import Constrained GNP	Savings Constrained GNP	Import Constrained GNP	Savings Constrained GNP
1951	27,954	61,439	33,002	58,480	38,050	55,521	43,097	52,561	48,145	49,602
1952	34,913	54,143	38,231	52,084	41,549	50,026	44,866	47,968	48,184	45,911
1953	44,288	62,090	46,202	60,781	48,118	59,472	50,035	58,164	51,952	56,855
1954	47,795	61,121	50,631	59,235	53,466	57,348	56,302	55,462	59,138	53,575
1955	47,854	72,098	50,229	70,423	52,603	68,748	54,978	67,073	57,353	65,398
1956	48,259	80,845	51,947	78,353	55,633	75,862	59,320	73,370	63,007	70,879
1957	51,424	91,243	54,900	88,799	58,326	86,356	61,852	83,913	65,328	81,469
1958	51,104	91,139	54,719	87,959	59,333	84,779	63,948	81,599	68,563	78,419
1959	52,234	97,888	57,639	94,146	63,114	90,403	68,478	86,661	73,593	82,918
1960	52,294	98,636	61,619	92,759	70,034	86,882	78,904	81,004	87,773	75,127
1961	53,044	114,541	59,879	109,673	66,713	104,805	73,547	99,937	80,381	95,268

[a] in millions of 1954 drachmas

TABLE III

Foreign Aid Multipliers 1951-1961[a]

ΣF_t t=51 [a]	ΣV_t t=51 [a]	ΔF	ΔV	$\frac{\Delta V}{\Delta F}$	$\frac{\Delta V}{\Delta F}$ [b]
0	510,160	-	-	-	-
18,518	558,550	18,518	48,390	2.61	2.87
37,037	606,940	18,518	48,390	2.61	2.87
55,555	656,587	18,518	49,646	2.68	2.95
74,074	699,422	18,518	42,835	2.31	2.54

[a] In millions of 1954 drachmas.

[b] Multipliers with 10% reduction in import propensity.

in the marginal propensity to import. The effects of a 10% reduction in import propensity upon the values of the foreign capital multipliers are indicated in the last column of Table III.[1]

VIII. Extrapolation to 1971

As is well known, any extrapolation from existing data must be made with extreme caution. In the case of the Greek economy, because of the anomalous features of the 1951-61 period discussed above, this dictum applies with especial force. In the present context, the extrapolations which follow are in no sense a forecast of what is expected to happen. Rather, they are designed to indicate the kinds of economic phenomena that might be anticipated if certain features of recent Greek economic history were to continue without modification or alteration into the future. Under these circumstances, the following projection may serve to reveal points of potential stress or strain and to indicate where changes in policy measures might prove desirable.

Before using this model to trace out the future time path of the economy, it is necessary to make some estimate of the future values of the exogenous variables. First of all, the average rate of return on capital (P/K) and the relative price of imports (P_m) were extrapolated by linear least-square fits to the years 1951-1961:

$$(33) \quad P/K = 84.6 + 2.14\ t$$

$$(34) \quad P_m = 81.5 + .80\ t.$$

1 Similar calculations for the Israeli economy are given in Chenery and Bruno, op. cit., p. 102.

Investment in inventories, I_s, was taken to be constant at its average value

$$(35) \quad I_s = 1076,$$

as this variable exhibted no obvious trend during the sample period.

With this set of exogenous extrapolations, the projected values of the endogenous variables for 1962-1971 were calculated; the most important are presented in Table IV. If one were to accept these calculations at face value, they suggest that there would be a slowing down in the rate of growth of GNP from an average rate of about 6% for 1952-1961 to an average rate of about 4% for the 1962-1971 decade in the absence of policy changes.

This slowdown in the growth rate is not consistent with the rapid rise in savings and investment that is estimated, which implies a rise in the capital/output ratio from 2.5 to 3.9 over the period. This implausible result is traceable to equations (6) - (8) in the model, in which investment is determined primarily as a function of import availabilities and time. While these functions provided a good explanation of investment rates in the past, they are an inadequate basis for analyzing alternative development possibilities in the future because they omit the link between increased capacity and output.

On the balance of payments side, the projection of past trends gives an export growth of 4.9% against a need for an annual increase in imports of 5.4%. As in the case of investment, these trends are not consistent with the requirements of the current economic situation and alternative possibilities need to be explored.

TABLE IV

Projected Values of Selected Endogenous Variables in Greece 1962-1971 Without Structural Changes [a,b]

t	V	C	G	S	I
1962	96,648	71,408	11,568	13,671	27,950
1963	101,670	74,391	12,094	15,184	30,594
1964	106,674	77,333	12,617	16,734	33,266
1965	111,646	80,192	13,137	18,317	35,960
1966	116,574	82,992	13,653	19,929	38,667
1967	121,447	85,715	14,162	21,569	41,380
1968	126,258	88,359	14,666	23,233	44,095
1969	131,002	90,920	15,162	24,921	46,807
1970	135,674	93,395	15,650	26,629	49,512
1971	140,272	95,784	16,131	28,357	52,209

K	X	M	F[c]
244,668	11,590	25,849	14,259
270,138	12,273	27,661	15,388
297,738	12,956	29,465	16,509
327,445	13,639	31,257	17,618
359,225	14,322	33,032	18,710
393,042	15,005	34,786	19,781
428,854	15,688	36,517	20,829
466,614	16,371	38,222	21,851
506,276	17,054	39,899	22,845
547,789	17,737	41,548	23,811

[a] For notation, see Section III A of the text.

[b] All variables are in 1954 million drachmas.

[c] Due to rounding of coefficients in the reduced form equations, the net foreign capital inflow from F = M -X differs slightly from I - S.

Should these recent trends in Greece continue unchecked into the future, then, severe difficulties may be anticipated. These arise primarily in two areas: foreign trade and investment.[1]

IX. Alternative Development Strategies 1962-1972

We shall now study the effects of varying investment policies upon the future foreign aid requirements of the Greek

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1 These conclusions reinforce those of Papandreou, who, in his "A Strategy for Greek Economic Development", Research Monograph Series, Center for Economic Research (Athens, 1962) (p.22), writes: "Without doubt, the problem of a widening trade gap looms for the Greek economy as a critical problem in the years ahead." And (p.24), "An investigation of the structure of investment in the 50's discloses that the leading factors were two, namely, dwelling construction and transport and communications . . . In sharp contrast, investment in manufacturing has remained anemic, dropping from around 20% of the total in 1950 to about 8% in 1960."

economy at alternative rates of growth. We shall start from the alternatives suggested by Papandreou[1], who provides us with three possible development targets for 1972 and with disaggregated marginal capital/output ratios by sector of economic activity.

Our inital calculation assumes no change in the structure of output from that of 1951-1961. To calculate foreign capital inflow requirements, we replace investment functions (6)-(8) by a planning function which contains a relation between investment and output:

$$(36) \quad I_t = 2.975\ (V_t - V_{t-1}) + 1076.$$

The first term on the right hand side of (36) represents gross fixed capital formation requirements, with an accelerator coefficient which is equal to the average incremental capital/output ratio weighted by the composition of gross domestic product in 1961.[2] The second term reflects investment in inventories.

For each assumed percentage rate of growth of GNP we calculate the desired savings, investment, import, and export levels implied by the model of equations (1)-(5), (9)-(30), (33)-(36) and

$$(37) \quad V_t = V_o\ (1 + r)^t.$$

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1 Papandreou, op. cit.

2 The incremental capital/output ratios derived in Papandreou, op. cit., p. 65, represent ratios of gross fixed capital formation to gross domestic product. For computational convenience, these ratios were adjusted to have the gross national product in the denominator by multiplying the capital/output ratios cited by Papandreou by the average percentage of gross domestic product to gross national product during 1951-1961. It may be worthwhile explaining the basis on which the Papandreou ratios were derived. In his own words, "The sectorial capital/output ratios used for our projections are not statistical estimates. Qualitative information (including expert opinion) was used side by side with quantitative information drawn from the experience of the fifties." (loc. cit.)

In equation (37) r is the assumed growth rate of GNP and V_o is the level of GNP in 1961. Since, by virtue of the assumed growth rate, we are again dealing with an overdetermined system, there are two relevant foreign capital inflow requirements which can be calculated: The net foreign capital inflow requirements determined by the balance of payments equilibrium condition and the net foreign capital inflow requirements set by the savings-investment identity.

In Fig. 1 the average yearly net foreign capital inflow requirements projected on this basis for Greece for 1962-1972 are plotted against the growth rate of GNP. A unique foreign capital figure is derived by setting necessary capital inflows at their maximal level. The dominant constraint is indicated on the graph by using solid lines to connect growth rates for which the savings investment condition sets foreign capital needs over most of the relevant time span. Dashes are employed for growth rates associated with foreign capital inflows stemming primarily from balance of payments considerations. To see to what extent the dominant constraint changes with the level of GNP, the same calculations are repeated with V_o at the 1950 level.

One interesting generalization emerges from these calculations. At low levels of GNP (the 1950 lines), the time rate at which savings are generated falls significantly short of the rate necessary to satisfy investment requirements. Desired imports, on the other hand, while still in excess of capacity

to export, are relatively low. For low levels of GNP, therefore, it is the savings investment-constraint which fixes foreign capital requirements. At high levels of income (those represented by the 1961 curve), the picture is different. Now it is import desires which exceed export capabilities by a significant margin. For rates of growth of output slightly less than 6%, domestic savings are on the average more than adequate to finance investment needs. As the rate of growth of income increases, however, the absorptive capacity of the economy rises more rapidly than does its rate of savings. The savings-investment gap therefore becomes increasingly more important. Consequently, at high income levels, the balance of payments constraint determines foreign capital needs until the assumed rate of growth of GNP exceeds 11%. At this point the savings-investment constraint begins to take over.

Some typical time paths of savings, investment, imports, exports, and foreign capital inflows for varying rates of growth of GNP and varying initial levels are portrayed in Figures 2-6. They lend support to the above generalizations. In addition, they indicate that, in the absence of structural changes, there exists a tendency for foreign aid needs to increase with time.

Since a growth policy which leads to ever increasing foreign capital inflow requirements is obviously neither feasible nor attractive, alternative development strategies must be explored. As argued by Papandreou[1], in view of the fact that

1 Op. cit., p. 65-66.

FIG. 1 Effects of Growth Rate upon Mean Net Foreign Capital Requirements

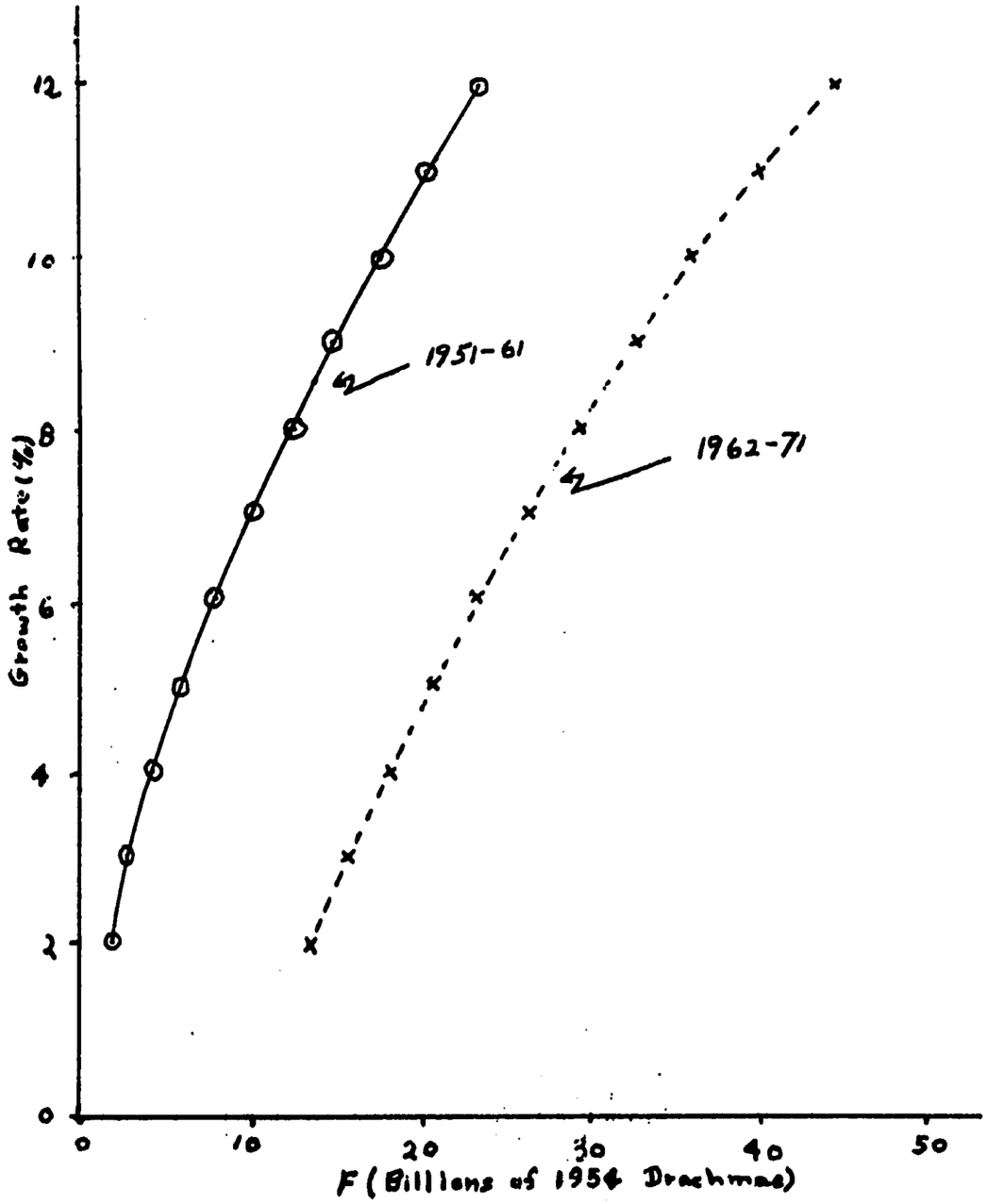


Fig. 2 Growth Rate = 2%
1950 Base

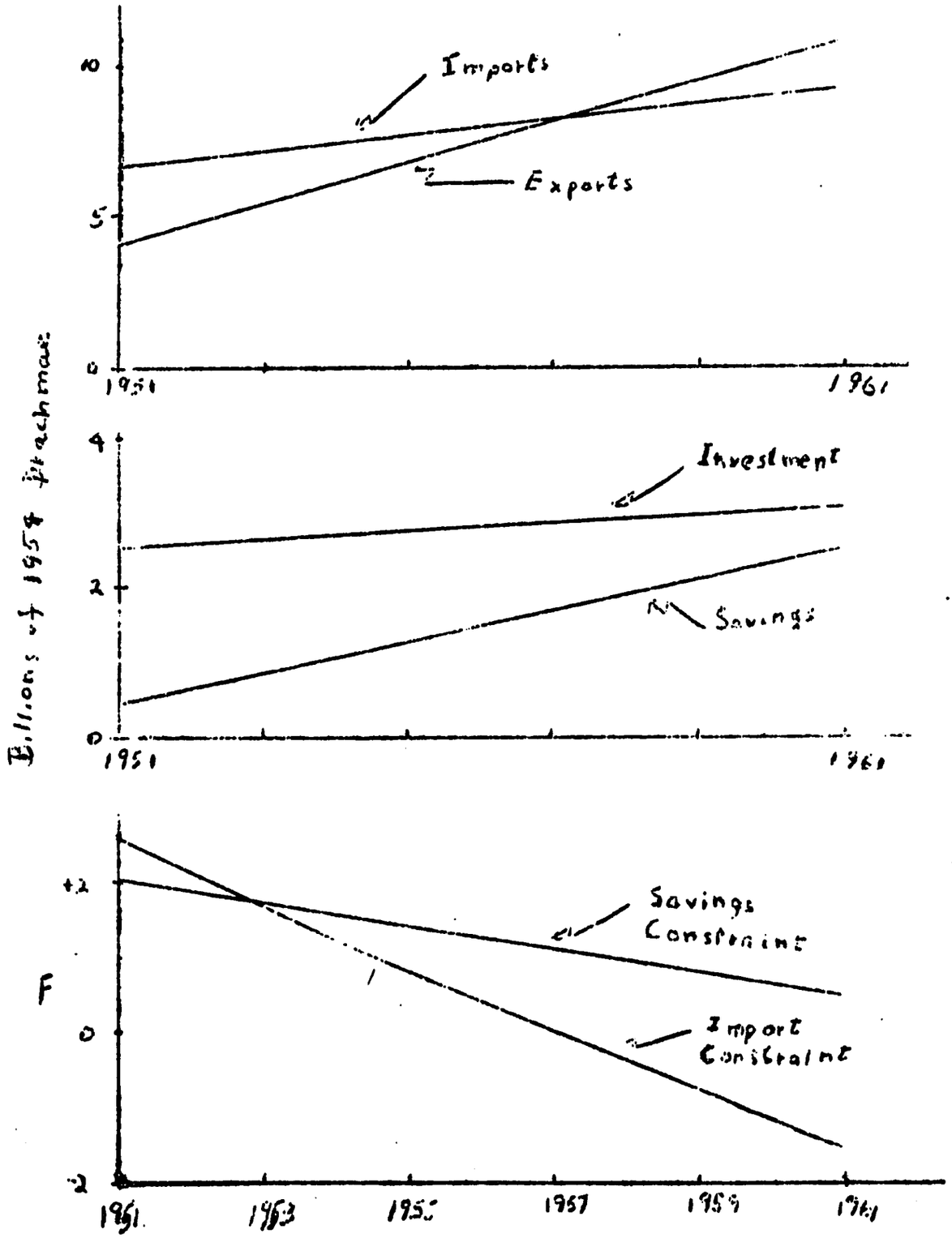


Fig 3 Growth Rate = 6%
1950 Base

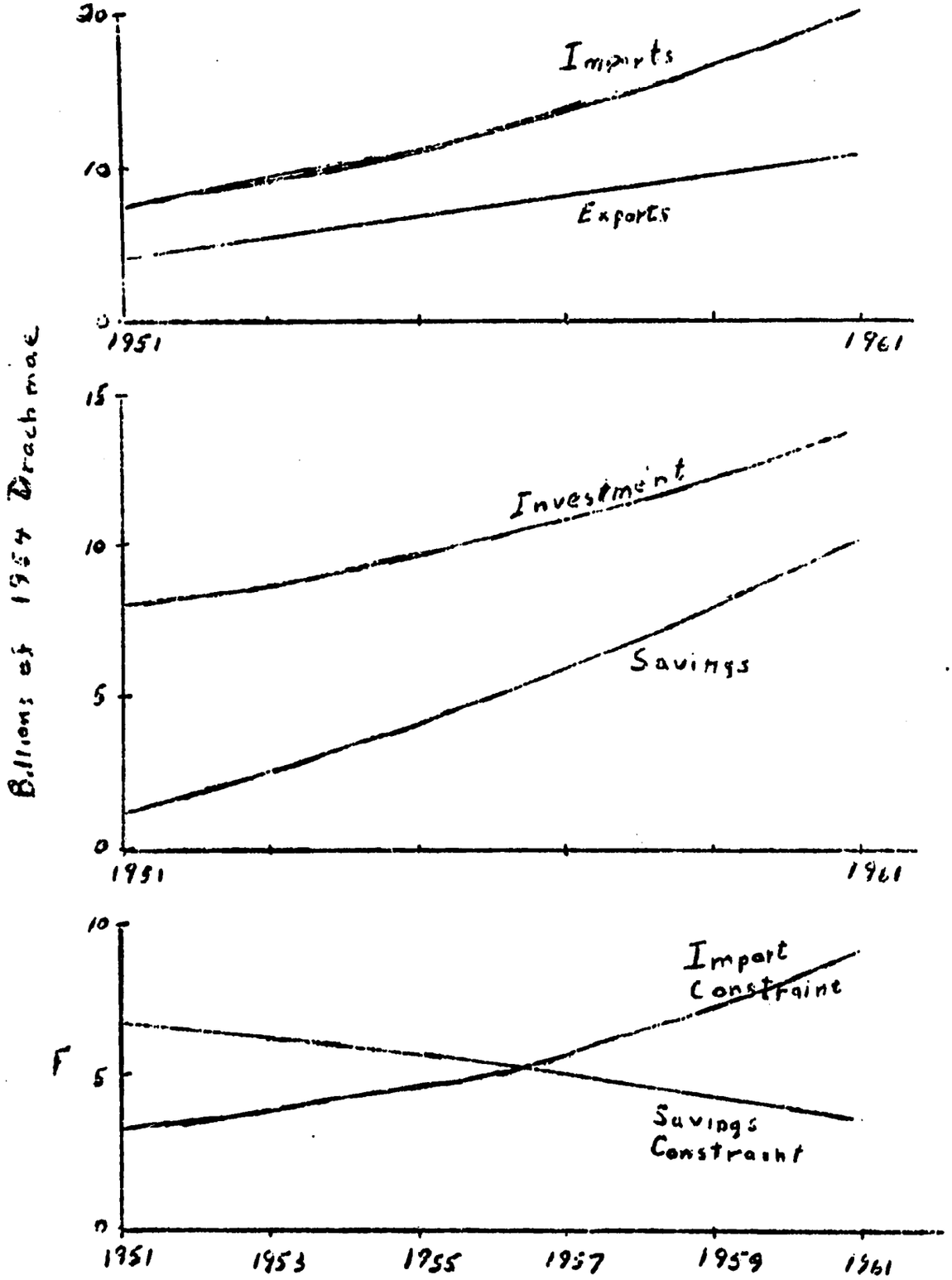


Fig. 4 Growth Rate = 4%
1961 Base

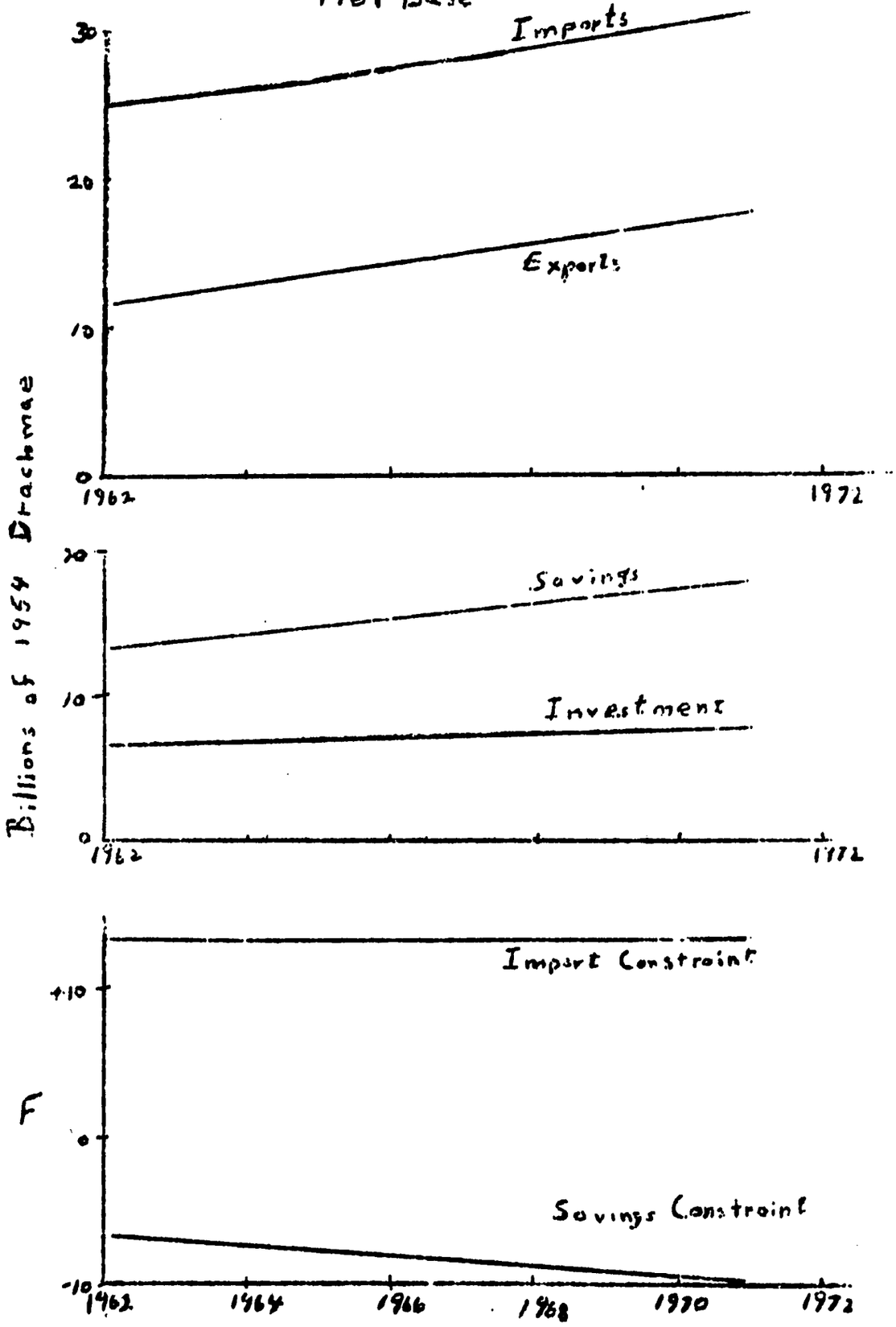


Fig. 5 Growth Rate = 6%
1961 Base

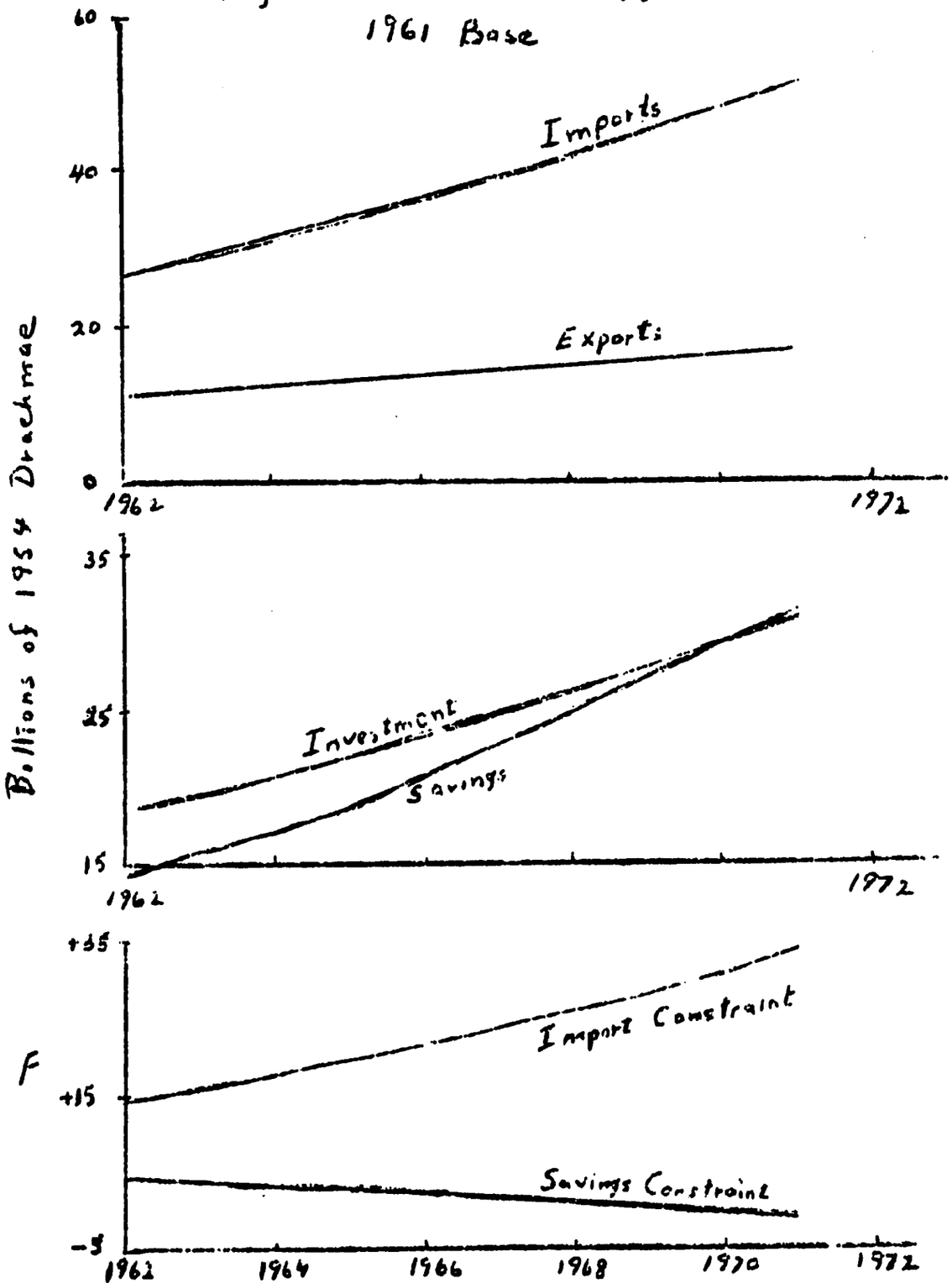
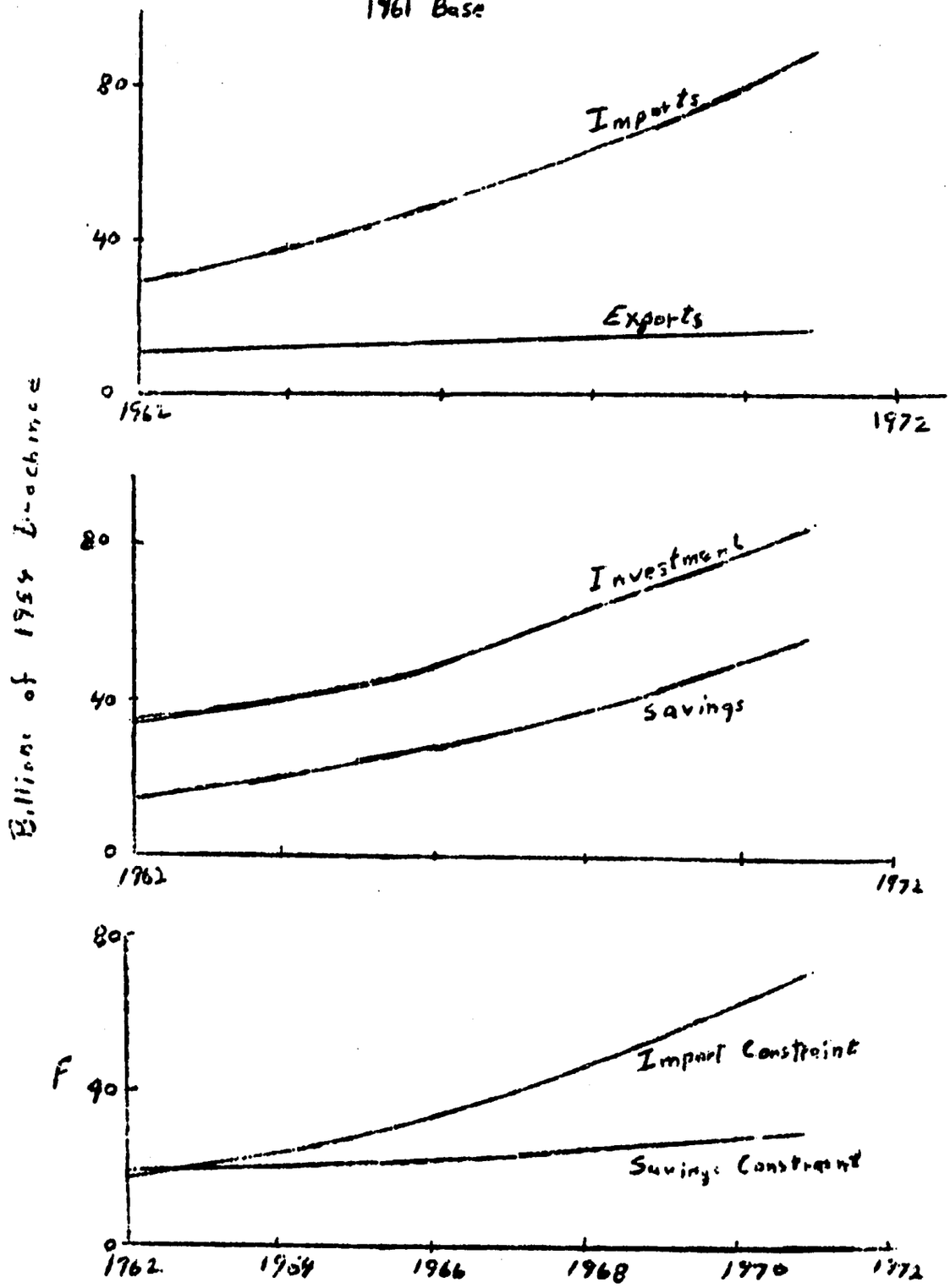


Fig. 6 Growth Rate = 11%
1961 Base



Greece is a country relatively poor in natural resources and relatively well endowed in human capital, its long run comparative advantage should be in the development of manufacturing, which should receive special emphasis.

Such an industrialization policy has two potential advantages. First of all, since the incremental capital/output ratio estimated for Greek manufacturing is smaller than that of any other form of economic activity except services,[1] an increase in the share of manufacturing would tend to reduce the amount of investment needed to support a given amount of output expansion. Increased emphasis on manufacturing will thus tend to reduce foreign capital requirements as determined by the savings-investment constraint.

A second benefit from such a policy is more important still. Since the bulk of Greek imports is in the form of manufactured commodities, an expansion of domestic manufacturing capacity is needed to permit a greater degree of import substitution. Export expansion via diversification of the export mix would also be facilitated. A program of this type would therefore serve to reduce the economy's needs for foreign capital as determined by balance of payments requirements.

Since we have no independent basis for determining alternative investment programs, we will test the effects of the structural targets for 1972 proposed by Papandreou.[2] The limiting targets set for

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1 Op. cit., P. 65-66.

2 Op. cit., pp. 66-76.

manufacturing are 26% (Program 1), and 28% (Program 2) of the gross domestic product in 1972. Each of these programs is associated with a falling marginal capital/output ratio as development proceeds. The initial incremental capital/output ratios assumed are both approximately 2.8.[1] The rate of decrease assumed for each is .008 per year.[2]

Tables V-VII summarize some of the relevant features of these alternative Greek economic development plans for rates of growth of GNP from 4% to 6%. The second, third, and sixth columns of each table indicate respectively the levels of GNP, savings, and exports corresponding to the assumed rate of growth. The savings-investment constraint determines two alternative foreign capital inflow requirements, F_{s1}, and F_{s2}, corresponding to industrialization programs, 1 and 2, respectively. In addition, for each assumed rate of GNP expansion, five alternative balance of payments gaps, F_{m0} - F_{m4}, are also calculated. F_{m0} is the gap which would arise in the complete absence of import substitution or export expansion. F_{m1} and F_{m2} are those corresponding to programs 1 or 2 under the constraint that the entire increase in

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1. The capital/output ratios are those assumed by Papandreou, converted into gross fixed capital formation to gross national product ratios. In the present calculations they are, respectively, 2.822, and 2.773.

2. This rate corresponds to that assumed by Papandreou.

TABLE V

Foreign Capital Requirements with Different Development Strategies

Rate of Growth of GNP 1962-1971 4% [a,b]

t	V	S	F_{s1}	F_{s2}	X	F_{m0}	F_{m1}	F_{m2}	F_{m3}	F_{m4}
1962	96,362	13,610	-2,764	-2,953	11,590	14,192	13,614	13,421	9,730	6,040
1963	100,217	14,549	-3,306	-3,499	12,273	14,878	13,676	13,275	9,437	5,598
1964	104,225	15,527	-3,871	-4,069	12,956	15,624	13,748	13,123	9,131	5,139
1965	108,394	16,544	-4,461	-4,663	13,639	16,431	13,829	12,962	8,811	4,659
1966	112,730	17,602	-5,076	-5,283	14,322	17,302	13,920	12,792	8,474	4,157
1967	117,239	18,703	-5,718	-5,929	15,005	18,239	14,018	12,611	8,120	3,631
1968	121,929	19,848	-6,386	-6,603	15,688	19,245	14,124	12,416	7,746	3,077
1969	126,806	21,039	-7,084	-7,306	16,371	20,323	14,236	12,207	7,350	2,494
1970	131,878	22,279	-7,811	-8,039	17,054	21,475	14,354	11,980	6,929	1,878
1971	137,153	23,567	-8,569	-8,803	17,737	22,705	14,476	11,733	6,480	1,227

[a] For notation see text.

[b] In millions of 1954 drachmas.

TABLE VI

Foreign Capital Requirements with Different Development Strategies

Rate of Growth of GNP 1962-1971 5% [a,b]

t	V	S	F_{s1}	F_{s2}	X	F_{m0}	F_{m1}	F_{m2}	F_{m3}	F_{m4}
1962	97,289	13,809	-121	-359	11,590	14,547	13,962	13,768	10,042	6,316
1963	102,153	15,017	-691	-937	12,273	15,620	14,394	13,985	10,072	6,160
1964	107,260	16,286	-1,292	-1,546	12,956	16,786	14,855	14,211	10,103	5,995
1965	112,624	17,618	-1,925	-2,187	13,639	18,049	15,347	14,446	10,132	5,819
1966	118,255	19,017	-2,592	-2,863	14,322	19,416	15,868	14,686	10,157	5,627
1967	124,168	20,486	-3,294	-3,574	15,005	20,890	16,420	14,930	10,175	5,419
1968	130,376	22,028	-4,034	-4,324	15,688	22,478	17,002	15,176	10,183	5,190
1969	136,895	23,647	-4,813	-5,114	16,371	24,184	17,613	15,422	10,179	4,936
1970	143,740	25,347	-5,633	-5,946	17,054	26,015	18,253	15,665	10,160	4,655
1971	150,927	27,131	-6,478	-6,822	17,737	27,996	18,921	15,902	10,121	4,341

[a] For notation see text.

[b] In millions of 1954 drachmas.

TABLE VII

Foreign Capital Requirements with Different Development Strategies

Rate of Growth of GNP 1962-1971 6% [a,b]

t	V	S	F_{s1}	F_{s2}	X	F_{m0}	F_{m1}	F_{m2}	F_{m3}	F_{m4}
1962	98,215	14,007	2,574	2,286	11,590	14,901	14,312	14,115	10,353	6,592
1963	104,108	15,489	2,030	1,730	12,273	16,368	15,118	14,702	10,715	6,727
1964	110,354	17,060	1,451	1,138	12,956	17,970	15,983	15,321	11,095	6,868
1965	116,976	18,724	835	508	13,639	19,715	16,908	15,972	11,492	7,011
1966	123,995	20,488	179	-163	14,322	21,612	17,893	16,653	11,904	7,154
1967	131,434	22,358	-520	-877	15,005	23,671	18,939	17,362	12,328	7,294
1968	139,320	24,338	-1,263	-1,637	15,688	25,900	20,049	18,098	12,763	7,427
1969	147,679	26,437	-2,055	-2,446	16,371	28,311	21,222	18,859	13,203	7,547
1970	156,540	28,661	-2,897	-3,307	17,054	30,913	22,460	19,642	13,647	7,651
1971	165,933	31,018	-3,794	-4,224	17,737	33,719	23,763	20,445	14,089	7,734

[a] The notation is explained in the text.

[b] In millions of 1954 crachmas.

manufacturing output over and above that which would have occurred in the absence of structural changes were to reduce import requirements or export capacity.[1] F_{m4} and F_{m5} are the foreign capital import needs determined by the balance of payment constraint under the assumption that, in the implementation of industrialization Program 2, the marginal propensity to import is reduced by 10% and 20%, respectively.

An inspection of these tables indicates that, on the savings investment side, the alternative development programs have little impact upon foreign aid requirements. On the import side, however, the difference between plans one and two is much more noticeable. Thus, at a 4% rate of growth, while Plan 1 still results in ever-increasing foreign capital needs, the import substitution generated by Plan 2 leads to a balance of payments gap which decreases with time. An eventual termination of foreign aid is thus reasonable to expect under Program 2. However, even under Plan 2, in the absence of import constraints, it would appear that the maximal rate of growth which the Greek economy can sensibly support is somewhere between 4% and 5%.[2]

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1. This assumption may be unduly optimistic in view of the fact that, in a resource poor country like Greece, an increase in domestic manufacturing must be accompanied by a certain increase in imports of raw materials and intermediate products. The correction of this bias would strengthen the conclusions of the present investigation.

2. Our conclusions are thus somewhat more pessimistic than those of Papandreou (Op. cit., pp. 85-86) who writes: "Greece ought to be able to experience an annual rate of growth of its gross domestic product of between 6.5% and 6.8%, with 1963 as a base, or of between 6.2% and 6.5% with 1961 as a base ... It should be noted, however, that external financing in the case of Greece has averaged at 3.6% of its gross domestic product at factor cost over the period 1953-1960 ... It seems, therefore, that continuation of this pattern into the future would enable the country to experience at most a 6.5% rate of growth of its domestic product (with 1963 as base year)."

A reduction of the marginal propensity to import by 10% increases the feasible rate of growth to 5%. To enable the Greek economy to attain a 6% rate of growth with a reasonable foreign aid time profile requires a reduction in import propensity of over 20%. The effects of a 10%, 20%, and 40% tariff upon imports, and hence upon foreign aid requirements, are portrayed in Table VIII. A 40% tariff, for example, coupled with a 20% reduction in import propensities would make a 7% rate of economic expansion feasible.

Part of the difference between our results and those of Papandreou is due to a difference in philosophy. While Papandreou regards a non-decreasing time path for net foreign capital inflows acceptable, so long as it remains within reasonable bounds during the first four years (1963-1966) of the programs, our requirements are more stringent. We feel that any development strategy which does not show prospects of leading to self-sustained growth in a reasonable period of time is unsatisfactory, especially for an economy at Greece's level of economic evolution.[1]

It would appear that, if an import substitution and export expansion program faster than the one which would result automatically under Plan 2 were adopted, the spectrum of trade-off possibilities between rates of

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1 Another source of difference is the fact that the (statistically biased) estimate of the overall marginal propensity to import goods derived by Papandreou for years 1954-1961 is about 15% lower than that obtained by us for 1951-1961. The bias due to disregarding the fact that the independent variable in the import regression is endogenous to the system is in the direction of an understatement in the marginal propensity to import. The argument is analogous to the advanced for savings by A. Ando and F. Modigliani, "The 'Life Cycle' Hypothesis of Savings," American Economic Review, March 1963, pp. 80-82.

TABLE VIII

EFFECTS OF ALTERNATIVE STRATEGIES ON FOREIGN CAPITAL REQUIREMENTS IN 1971 [a]

Alternative	Alternative growth rates / Policies	4%	5%	6%
Tariff Changes (Plan 2)	No change	11,733	15,902	20,445
	10% increase	10,566	14,735	19,278
	20% increase	9,399	13,568	18,111
	40% increase	7,065	11,234	15,777
Reduction in import propensities (Plan 2)	No reduction	11,733	15,902	20,445
	10% reduction	6,480	10,121	14,089
	20% reduction	1,227	4,341	7,734
Import substitution or export expansion	None	22,705	27,996	33,719
	As under Plan 1	14,476	18,921	23,763
	As under Plan 2	11,733	17,412	20,445

a Entries in the body of the table are the values of F in 1971 in millions of 1954 drachmas.

growth, import restrictions, and foreign aid would be enlarged, compared with that available under Plan 2 itself. Since, at rates of growth of 4%, 5%, and for later years, 6%, domestic savings exceed investment requirements under any of the plans, it is financially possible to invest more in import substitute or export expanding industries. One can go even further, of course, and utilize external financing as well to supplement the capital requirements for import substitute endeavors.

One example of the impact of the use of external financing upon the import gap is illustrated in Table IX. In this table, the assumptions regarding depreciation, marginal capital-output ratio, and the import content of manufacturing are taken quite arbitrarily. However, it can readily be seen that, under virtually any reasonable set of assumptions for the Greek economy, a very significant reduction in the balance of payments gap can be achieved with the aid of a strong policy of this nature. It should be noted, incidentally, that, because of the depreciation of capital goods, such a program must inevitably be a continuing one; a short period of heavy investment in import substitute manufactures will not provide a permanent reduction in the import gap, unless depreciation is compensated for either by additional external financing or by production of the requisite capital domestically.

Our analysis thus leads to two major conclusions:

(1) An import substitution and export expansion program faster than that contemplated under even the most ambitious industrialization program considered here

TABLE IX

Effects of Five-Year Program of Investment in Import Substitution[a]

Year	Amount of[b] Gross Investment	Output[c] Generated by Investment	Amount of[d] Import Substitution
1	1,000	500	300
2	1,000	950	570
3	1,000	1,350	810
4	1,000	1,700	1,020
5	1,000	2,000	1,200
6	500	2,000	1,200
7	550	2,000	1,200
8	600	2,000	1,200
9	650	2,000	1,200
10	700	2,000	1,200

[a] In millions of 1954 drachmas.

[b] We assume a lifetime of 10 years for the capital stock, and that after the first five years gross investment is just sufficient to maintain the capital stock intact.

[c] For this calculation, the marginal capital/output ratio is taken to be 2. This is the ratio assumed by Papandreou (op. cit., p. 65) for gross fixed investment in manufacturing.

[d] For this calculation it is assumed that the direct and indirect import requirements per unit of domestic output in manufacturing are .40. This number is arbitrary, but is, if anything, conservative. An import content of .40 was the highest direct and indirect import requirement per unit of domestic output derived from alternative solutions of an input-output table for Israel, another resource-poor, high-skill country. See H. B. Chenery and M. Bruno, "Development Alternatives in an Open Economy: The Case of Israel", Economic Journal, March 1962, pp. 79-104.

considered here appears to be desirable.

(2) In the absence of such a program, quantitative restrictions and tariffs will be needed to reduce import propensities to levels low enough to keep foreign capital needs at manageable levels. Since such restrictions are inconsistent with some of the agreements with the OECD, the first alternative would be clearly preferable.

X. Conclusions

Our main interest in this analysis has been to assess the process of growth through reliance on foreign assistance in one of the countries in which it seems to have been most successful. Success of this policy in the past is shown by the relatively high growth of GNP, and the rise in the share of investment and imports that can now be financed from domestic sources. For the future, however, our estimates of the structural relations that have existed in the past decade show that continuation of rapid growth with diminishing reliance on external capital will require substantial further changes in the economic structure. Among these are the adoption of policies to reduce import requirements and expand exports more rapidly in the future.

Johns Hopkins University and
Agency for International Development

APPENDIX A

Alternative Estimates of the Statistical Functions of the Model

A. Notation

The symbols used to identify the variables appearing in each equation are the same as in Section V A of the text. Different estimates are identified as:

SSLS = Single stage least squares,

TSLS = two stage least squares,

or LI = limited information.

B. The Estimates

TABLE I

Consumption Functions

Dependent Variable	Type of Estimate	Y_d	Constant	$\bar{R}^2$
C_c	SSLS	+.1318 (.0082)	+1020 (432)	.966
C_c	LI	+.1317 (.0082)	+1027 (434)	.966
C_c	TSLS	+.1318 (.0082)	+1024 (510)	.966
C_h	SSLS	+.2120 (.0115)	-1517 (606)	.974
C_h	LI	+.2163 (.0117)	-1742 (618)	.974
C_h	TSLS	+.2121 (.0116)	-1522 (714)	.974
C_s	SSLS	+.2190 (.0153)	-3213 (805)	.958
C_s	LI	+.2175 (.0153)	-3135 (809)	.958
C_s	TSLS	+.2182 (.0153)	-3171 (949)	.958
C_f	SSLS	+.3146 (.0169)	+11564 (889)	.975
C_f	LI	+.3177 (.0170)	+11400 (897)	.975
C_f	TSLS	+.3151 (.0169)	+11540 (1048)	.975
G	SSLS	+.1043* (.0095)	+1479 (654)	.931
G	LI	+.1054* (.0095)	+1405 (659)	.931
G	TSLS	+.1046* (.0095)	+1459 (780)	.931

* Independent variable is V

TABLE II

Investment Functions

Dependent Variable	Estimate Type	Constant Term	M	P/K	Dependent Variable Lagged	Time	$\bar{R}^2$
I_m	SSLS	-4799 (987)	+.6729 (.0594)	a	a	a	.934
$\dot{I}_m$	LI	-4469 (1023)	+.6518 (.0611)	a	a	a	.934
I_m	TSLS	-4776 (1432)	+.6714 (.0601)	a	a	a	.934
I_d	SSLS	-2049 (1485)	a	+36.3 (17.3)	a	+264 (50.9)	.907
I_c	SSLS	-413 (310)	a	a	+.84 (.19)	+208 (93.0)	.959

a Not applicable

TABLE III

Import Functions

Dependent Variable	Type of Estimate	V	P_m	Constant Term	$\bar{R}^2$
M_s	SSLS	+.0652 (.011)	-21 (13)	-727 (119)	.826
M_s	LI	+.0654 (.011)	-21 (13)	-742 (120)	.826
M_s	TSLS	+.0653 (.011)	-21 (13)	-732 (128)	.826
M_f	SSLS	+.0190 (.008)	-7.16 (9.71)	1693 (900)	.419
M_f	LI	+.0187 (.008)	-7.07 (9.71)	1710 (903)	.419
M_f	TSLS	+.0190 (.008)	-7.15 (9.71)	1695 (964)	.419
M_i	SSLS	+.0508 (.066)	-17.8 (8.11)	2289 (753)	.880
M_i	LI	+.0502 (.067)	-17.6 (8.12)	2315 (755)	.880
M_i	TSLS	+.0505 (.066)	-17.7 (8.12)	2301 (874)	.880
M_m	SSLS	+.0645 (.0048)	-9.75 (5.87)	-433 (544)	.957
M_m	LI	+.0641 (.0048)	-9.66 (5.88)	-415 (546)	.957
M_m	TSLS	+.0643 (.0048)	-9.73 (5.87)	-428 (584)	.957
M_t	SSLS	+.1832 (.0246)	-76.02 (30.04)	-1784 (2786)	.876
M_t	LI	+.1845 (.0247)	-76.34 (30.05)	-1844 (2795)	.876
M_t	TSLS	+.1836 (.0247)	-76.12 (30.05)	-1801 (2987)	.876

TABLE III

Import Functions

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M_s	SSLS	+.0652 (.011)	-21 (13)	-727 (119)	.826
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M_t	TSLS	+.1836 (.0247)	-76.12 (30.05)	-1801 (2987)	.876

TABLE IV

Export Functions

Dependent Variable	Type of Estimate	t	Constant Term	$\bar{R}^2$
X_f	SSLS	+198 (45.6)	+2181 (283)	.665
X_i	SSLS	+146 (18.2)	+314 (113)	.875
X_{mt}	SSLS	+18 (6.3)	+146 (39)	.448
X_s	SSLS	+321 (36.7)	+ 70 (227)	.894

TABLE V

Tax Functions and Depreciation Function

Dependent Variable	Type of Estimate	V	Constant Term	$\bar{R}^2$
T_d	SSLS	+.0921 (.0058)	-757 (403)	.965
T_d	LI	+.0921 (.0058)	-755 (405)	.965
T_d	TSLS	+.0921 (.0058)	-757 (480)	.965
T_i	SSLS	+.1318 (.0036)	-1294 (248)	.993
T_i	LI	+.1312 (.0036)	-1252 (250)	.993
T_i	TSLS	+.1317 (.0036)	-1284 (298)	.993
D	SSLS	+.0213[a] (.0010)	-88 (163)	.979

[a]Independent variable is capital stock at the beginning of the year.

APPENDIX B

The Data

General Note

The major source of our data is The United Nations, Yearbook of National Accounts Statistics, 1957-62. (referred to as NAS).

Because of the occasional revisions of data, the most recent annual data have been selected:

1950	from	1957	edition
1951	"	1958	"
1952	"	1959	"
1953	"	1960	"
1954	"	1961	"
1955-61	"	1962	"

TABLE I

Greece: GNP National Income, Income Shares
(in millions of 1954 drachmas)

Year	GNP 1	National Income Factor Cost 2a	Agricultural Income 3a	Non-farm Wage and Salary Income 4a	Profits (residual) 5	Price Deflator GNP 6
1950	42,790	37,030	12,927	13,330	10,772	.672
1951	47,819	40,889	15,275	14,883	10,730	.720
1952	47,358	39,734	14,694	14,622	10,417	.762
1953	54,315	45,892	18,091	17,072	10,730	.893
1954	58,690	49,696	17,445	18,704	13,547	1.000
1955	63,318	53,538	18,827	20,118	14,594	1.051
1956	67,753	57,447	19,547	21,816	16,083	1.147
1957	73,914	62,337	21,726	24,004	16,608	1.134
1958	76,352	63,977	20,434	25,667	17,876	1.145
1959	79,366	66,656	20,360	27,399	18,897	1.146
1960	83,076	69,543	19,746	29,572	20,224	1.172
1961	92,656	77,520	23,467	32,264	21,790	1.184

a. Data originally in current prices, converted by implicit GNP deflator.

Sources:

1 1950-61: UN NAS, 1957-62.

2 Ibid.

3 NA of Greece, 1948-59; 1960; 1961 (Greek ed.). Agriculture, animal breeding, forestry, fishing.

4 1954-61: UN NAS 1960-2. 1950-53: extrapolated, on basis of .04 decrease per annum in ratio wage and salary income to national income.

5 Residual: National income less agricultural income less non-farm wage and salary income.

6 UN NAS, 1957-62. Implicit deflator obtained by dividing current price by 1954 constant price series.

TABLE II

Greece: Composition of Private Consumption Expenditure (in millions of 1954 drachmas)

Year	Food, etc. 1	Clothing 1	Household Operations 1	Net Services 1	Total 1
1950	20,890	6,000	6,170	5,114	38,174
1951	22,080	5,890	6,440	5,680	40,090
1952	23,270	6,040	6,680	4,101	40,091
1953	24,510	6,480	7,200	5,991	44,181
1954	26,010	7,140	7,950	6,139	47,239
1955	27,050	7,150	8,390	6,983	49,573
1956	28,330	7,650	9,110	8,494	53,584
1957	29,580	8,030	9,940	10,001	57,551
1958	30,240	8,960	10,740	9,506	59,446
1959	30,770	9,000	11,380	9,435	60,585
1960	31,190	9,130	12,210	10,820	63,350
1961	32,540	10,500	13,450	11,688	68,178

Source:

1. 1950-53: NA of Greece, 1948-59.
   1954-61: UN, NAS, 1961, 1962.

Our categories	UN Categories
food	= food, beverages, tobacco
clothing	= clothing and other personal effects
household operations	= rent, water; fuel, light; furniture; household operations
net services	= all others

TABLE III

Greece: Gross Capital Formation
(in millions of 1954 drachmas)

Year	Residential Construction[1]	Non-residential Construction[1]	Machinery & Transport Equipment [1]	Increase In Stocks[1]	Gross Capital Formation[1]	Depreciation[1]	Net Capital Formation[2]
1950	2062	2125	3999	1895	10081	1892	8189
1951	1547	1708	3630	2618	9502	2037	2456
1952	1677	1930	3008	718	7333	2624	4709
1953	2264	2326	1970	1577	8137	2777	5360
1954	2498	2577	2950	-290	7745	2788	4957
1955	3939	2482	2915	747	10083	2808	7275
1956	4074	3221	3640	1172	12107	2949	9158
1957	3683	3582	4018	2167	13450	3122	10328
1958	4252	4394	6814	710	16170	3414	12756
1959	4075	5195	8670	750	18670	3629	15061
1960	4466	7095	13704	-550	24715	3784	20931
1961	5090	7789	11851	1400	26130	4262	21868

Sources:

[1] UN, NAS, 1957-1962.

[2] Column (5) minus column (6).

TABLE IV

Greece: Net Foreign Capital Inflow, Composition of Exports and Price Deflator
(in millions of 1954 drachmas)

Year	Net Foreign Capital Inflow[1]	Exports Goods & Services[2a]	Exports Goods[3]	Food, etc.[3]	Industrial[3]	Manufacturing & Machinery[3]	Price Deflator Exports 1954 = 100[4]
1950	10,268	2797	2154	1568	440	146	.608
1951	7,727	3127	2408	1753	491	164	.590
1952	5,079	3948	3240	2307	701	32	.555
1953	2,934	5422	4117	2991	896	30	.825
1954	4,341	6227	4556	3392	868	96	1.000
1955	3,635	7731	5159	3582	1355	22	1.063
1956	5,644	7488	5015	3122	1651	242	1.036
1957	5,321	8759	5850	4351	1268	231	1.126
1958	7,064	8987	6444	4540	1622	282	1.079
1959	8,289	9156	6128	4043	1827	258	1.000
1960	13,578	9583	6195	4015	1817	363	.984
1961	10,462	11054	6872	4326	2082	464	.975

a. Does not include income from ocean-going ships under Greek flag or ownership.

Sources:

1 Imports of goods and services (Table V) less exports of goods and services (Column 2) plus income from abroad (Source 2).

2 UN, NAS, 1957-62.

3 UN, Yearbook of International Trade Statistics, 1955, 1957, 1961. Data in current prices; converted to 1954 prices with GNP deflator (see Table I). Data for 1950 and 1951 extended by using average % of total in 1952-54.

Our Categories	UN Categories
Food, etc.	- Food (0); beverages and tobacco (1); animal, vegetable oils (4).
Industrial	- Crude materials (2); mineral fuels, etc. (3); chemicals (5).
Manufacturing	- Manufactured goods by material (6); miscellaneous manufactured articles (8); other commodities and transactions, n.e.c. (9); machinery, transport equipment (7).

4 UN, NAS, 1957-62. Implicit deflators obtained from dividing current price series by the 1954 constant price series.

TABLE V

Greece: Composition of Imports
(in millions of 1954 drachmas)

Year	Imports Goods & Services 1	Imports Goods 2	Imports Food, etc. 2	Imports Industrial 2	Imports Manufac-turing 2	Imports Machinery 2	Imports Services 4	Price Deflator Imports 1954 = 100 3
1950	13,383	12,133	2,722	4,469	2,569	2,373	1,250	.520
1951	11,396	10,317	2,315	3,801	2,185	2,016	1,079	.570
1952	9,775	8,892	1,923	3,346	1,818	1,805	883	.584
1953	9,003	8,160	1,897	2,939	1,788	1,536	843	.811
1954	11,441	9,901	1,644	3,701	2,674	1,882	1,540	1.000
1955	12,318	11,151	2,351	3,795	2,670	2,335	1,167	1.028
1956	14,586	13,163	3,010	3,973	3,104	3,076	1,423	1.057
1957	16,032	14,343	2,802	4,734	3,455	3,352	1,689	1.097
1958	17,892	15,921	2,596	4,906	3,709	4,701	1,971	1.065
1959	19,478	16,792	2,308	4,480	3,716	6,288	2,686	1.009
1960	25,698	21,756	2,366	5,338	4,402	9,650	3,942	.968
1961	24,716	21,294	2,858	5,262	4,536	8,638	3,422	1.006

Source:

[1] UN, NAS, 1957-62; For 1950-51, estimates derived by applying 1952-53 % to total goods and services imports.

[2] UN, Yearbook of International Trade Statistics, 1955, 1957, 1961. Data in current prices; converted to 1954 prices with GNP deflator (Table I, Col. 7). See Table IV, 3, for description of categories.

[3] UN, NAS, 1957-62. Obtained by dividing current price series by the 1954 constant price series.

[4] Column (2) minus Column (3).

TABLE VI

Greece: Export, Import Price Indices; Exchange Rate

Year	Export Price Index 1954 = 100 1	Import Price Index 1954 = 100 1	Exchange Rate Dr./US $ 2	Relative Price of Imports 3
1950			15	
1951	59	55	15	58
1952	55	56	30	73
1953	83	85	30	95
1954	100	100	30	100
1955	110	100	30	95
1956	118	105	30	91
1957	116	108	30	95
1958	113	99	30	86
1959	103	100	30	87
1960	101	96	30	82
1961	102	94	30	79

Sources:

1 1953-61: IMF, International Financial Statistics, July 1963; 1949-53, IFS Supplement. Adjusted to 1954 = 100; 1954 weights.

2 Ibid.

3 Import price index divided by GNP deflator and multiplied by index of exchange rate (1954 = 100).

TABLE VII

Greece: Savings, Capital Stock, Profit Rate, Deflators
(in millions of 1954 drachmas)

Year	Saving Gross 1	Capital Stock[2]	Index of Profit Rate 1954 = 100[3]	Deflator Gross Capital Formation 1954 = 100[4]	Deflator Depreciation 1954 = 100[5]
1950	1597	115065	97.25	596	586
1951	3111	123254	90.50	678	667
1952	2897	130710	82.8	702	707
1953	6179	135419	82.3	910	821
1954	4475	140879	100.0	1000	1000
1955	8019	145836	103.9	1045	1059
1956	8144	153111	109.1	1107	1104
1957	9596	162269	106.3	1133	1152
1958	1417	172597	107.6	1039	1100
1959	9214	185353	106.0	1035	1150
1960	6794	200414	104.8	1008	1167
1961	13160	221345	102.2	1042	1156

Sources:

1 UN, NAS, 1957-1962. Sum of depreciation and net savings, deflated by implicit gross capital formation deflator (see Table III).

2 1950 figure equals three times the Gross Domestic Product. Subsequent figures derived by cumulating net capital formation (Table III).

3 Profit (see Table I) divided by Column (2) and converted into an index.

4 UN, NAS, 1957-1962. Obtained by dividing current price series by 1954 constant price series.

5 Depreciation deflator from Greek Ministry of Coordination, National Accounts of Greece 1948-58, 1960, 1961 (Greek edition). Obtained by dividing current price series by 1954 constant price series.

TABLE VIII

Greece: Taxes, Government Expenditures (in millions of 1954 drachmas)

Year	Direct taxes and transfer Payments[1]	Indirect taxes less subsidies[2]	Government Consumption Expenditures[2]
1950	2689	4124	5559
1951	3656	5036	7018
1952	4154	5173	6922
1953	4113	5870	6347
1954	4587	6206	7396
1955	4945	6959	7657
1956	5177	7481	8526
1957	5846	8413	9132
1958	6184	9070	9171
1959	6540	9034	10151
1960	6991	9732	10494
1961	8149	10946	11125

Sources:

[1] 1950-53: UN, NAS, 1957; 1954: NAS, 1961; 1955-61: NAS, 1962. Current price series deflated by 1954 GNP price deflator (See Table IV). Includes direct tax on corporations, household and private non-profit organizations, and other transfers.

[2] UN, NAS, 1957-62.