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STRUCTURAL ASPECTS OF CAPITAL FORMATION: A CROSS-COUNTRY ANALYSIS DURING EARLY 1960s

By

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1. Introduction

This paper[1] deals with some structural aspects of capital formation and stresses the role of capital and its demand pattern during the course of economic development, especially during the transition to sustained growth.

To trace the pattern of capital goods demand is necessary before any investigation in imports of capital goods is taken up, since the structural aspects are those which could give an explanation to the balance of payments problem in countries at different stages of economic development, and since the whole issue shifts from the problem of capital formation to the foreign trade problem. Thus the following analysis is intended to set forth only those elements which will cast light on the demand for capital goods and its subsequent problem of imported component of capital accumulation [2]. We proceed with an analysis of structural aspects of capital formation, a statistical cross-section exercise on capital formation proportions and ca-

1. This is a part of my Ph. D. thesis, written in 1966-68, when I was at the Economics Dept., Bristol University.

2. See S. A. Sarantides, Foreign Trade Aspects of Capital Formation, Reprint from «SPOUDAI», 1975, Graduate School of Industrial Studies, Piraeus-Greece.

pital-output ratios, and conclude with some considerations of trade-development relations dominated by the comparative advantage doctrine.

2. Capital formation and transition to sustained growth

To reach a certain critical level of per capita income in a definite time horizon, a certain quantum of investment should take place. The procedure of this necessary bulk of investment may be either of a «bit-by-bit» type or of an «overall» type. Some economists speak of a necesarry «shock» to happen in the economy and which is a mixture of economic, social and political factors.

The first procedure which suggests small injections of investment will probably cause a waste of financial means, spreading them over a long span of time without any dynamic power, and leaving the economy in the same position. Our thesis, far from being involved in the balanced/unbalanced-growth discussion, dictates a considerable minimum amount of [investment in order for the system to be capable of elevating itself to a desired level. From that level onward the system feeds itself and growth becomes easier.

Rosenstein-Rodan[1] in two celebrated articles exposed his «big-push» theory according to which «launching a country into self-sustaining growth is a little like getting an aeroplane off the ground. There is a critical growth speed which must be passed before the craft can be airborne». A minimum quantum of investment is a necessary, though not sufficient, condition of success.

In the economic literature of growth and development, capital formation has been the classical strategic variable which most of the scholars on the subject have been dealing with (Nurkse, Rosenstein-Rodan, Harrod, Domar, Lewis, Rostow etc.). But growth ecomomists usually overemphasize the role of capital in the development process and reaction from several sides came to oppose this over-emphasis given to capital. Among the latter are A. Cairncross, S. H. Frankel, J. H. Alder, et al. Colin Clark[2] in a short article

1. R. N. Rosenstein--Rodan, «Problems of Industrialisation of Eastern and Sou th Eastern Europe», Economic Journal, June-Sept-, 1943, and «Notes on the Theory ofthe 'Big Push'», in H. S, Ellis, (éd.), Economic Development fot Latin America, New York 1961.

2. C. Clark, «The fundamental Problems of Economic Growth», Weltwirschaftliches Archiv. Band 94, 1965.

argues that the use of some concepts in economic theory, like the capital-output ratio, is not more soundness and productivity rests on a variety of human and material factors.

Capital is not considered, of course, the deus ex machina in solving the problems of backwardness, but it is the most important among the «key factors» in the development process. Recent studies on production movements show that capital and labour alone do not make the entire increase in output and growth. Other factors, coined as «residual factors» of economic growth, apart from capital, labour and natural resources, contribute to output and growth [1]. M. Abramovitz found that almost the entire increase in net product for capita in U.S.A., since 1800, was associated with rise in something other (residual) than the input of physical capital and services of labour[2]. In answering the question, if education accelerates economic growth, D. C. McClelland found that: (1) countries investing more heavily in education have tended to develop more rapidly; (2) the return on higher education investments may be as high as 21 per cent; and (3) adequate educational grants for underdeveloped countries to set for rapid economic development are 20 students in secondary school and two students in higher education for every 1,000 inhabitants in the country[3]. Some Swedish economists found also that investment expenditure only in education can increase national income without any other investment.

Nevertheless, investment in construction, machinery and transport equipment was the only means for the most developed or semi-developed countries in their developmental course to reach a reputation in industrialisation. In Japan, for instance, after the Meiji Restoration (1868), the Japanese Government, and the private enterprise after 1880, embarked on an active industrialisation with high capital formation out of national product[4]. The Government regulations strongly encouraged investment and reduced consumption. According to Professor Kuznets' data the proportion

1. Organization for Economic Cooperation and Development, The Residual Factor and Economic Growth, Paris, 1964. See also T. W. Schultz, The Economic Value of Education, New York, 1963.

2. M. Brown, On the Theory of Measurement of Technologicl Change, Cambridge 1966.

3. David O. McClelland, «Does Education Accelerate Economic Growth», in Economic Development and Cultural Change, Vol. XIV, No. 3, April, 1966.

4. See H. Rosovsky, «Japanese Capital Formation: The Role of the Public Sector», The Journal of Economic History, Sept., 1959, pp. 350-73.

of G.D.C.P. to G.D.P. (based on current price totals) rose from 10.8 per cent in 1897-1916 to 17.0 per cent in 1922-40 and 28.1 per cent in 1952-58'.

A big pusb, including «education push», is badly necessary for the economy to make a jump up to an appropriate income level after which things become easier. Speaking in economic terms, the key variable for such a movement in the system should not be other than capital formation. Not only this. The injection at the beginning must be massive and well-planned, granted that the time horizon is a definite one. This is a logical emanation of the urgent nature of the developmental problems and it is supported by many economists, though H. S. Ellis[2] opposes the idea of a massive injection of capital as a precondition of growth. Thus we have to agree till now that the main «key-factor» is capital and that a well-planned and significant minimum quantum of capital formation is indispensable for countries in the lowest income bracket which want to break out of the vicious circle of poverty. Precisely this is what calls for heavy tasks and causes a host of problems in designing economic development.

Sketching out the implications of capital formation we add tbe following:

1) Capital formation presupposes an abstinence from consumption. This implies that productrve factors should be released from the consumption sector and be dedicated to the capital goods sector. Production of investment goods involves time which is usually much longer that the time needed for production of consumption goods. This is the classical two sector model and presupposes two elements: (a) a saving decision, that is, abstinence from consuming a portion equal to the desired amount of investment goods and (b) a «waiting» for the construction of these goods in the capital sector of the economy. The more capital goods we want and the longer the «waiting», the more abstinence it requires. Thus, for a country in the first stage of development the completion time of constructing a certain stock of capital will depend on the above two aspects.

The above model was followed by the advanced countries when they first initiated their development, and the classical theory, product of that era and the then experience, was correct in their case.

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1. S. Kuznets, Quantitative Aspects of Economic Growth: VI Long term trends in Capital Formation», Economic Development and Cultural Change, Vol. IXX, Part II, No. 4, July 1961, Table 3.

2. H. S. Ellis, «Accelerated Investment as a Force of Economic Development», Quartely Journal of Economics, November, 1958.

Today, underdeveloped countiies are confronted with both problems of savings and of «waiting». Moreover, population pressures make the development problem more difficult. Absistence at a very low consumption level is impossible. «Waiting» is an irony. Underdeveloped countries want to spur their development and to narrow the gap between them and the advanced countries. External relations make it possible for the economy to overcome, on the one hand, the savings constraint through foreign grants and loans, and on the other hand, the time constraint through importing the necessary investment goods and equipment. In this way the classical closed model becomes an open one involving foreign trade. Without any or without a sufficient capital sector in the economy, opening up trade makes possible capital formation in a shorter time than otherwise. Thus capital formation involves imports of capital goods.

We shall call the above aspects the structural aspects of capital formation.

2) Next to the structural aspects of real capital formation the foreign trade aspects lie. From the underdeveloped countries' point of view, it is generally correct to assume that no or insufficient capital sector exists in the economy and these countries have to import all or part of their capital goods which are necessary for their development. From the developed countries point of view as well, opening up trade facilitates capital formation by allowing the specialisation in a few or a line of capital goods and exchanging these for other capital goods imported from other countries. Thus the structural problem reduces to a trade problem in a different degree. Whilst, however, this shift of the problem creates balance of payments difficulties in underdeveloped countries, in advanced countries it creates specialisation in capital goods production, and it pushes the overall transformation curve upwards to the right. The present-day advanced countries did not have the same problem during their early stages of development as the underdeveloped countries have nowadays. The slowly growing and/or small export earnings coming from agricultural commodities in poor countries cannot suffice to finance both consumption goods imports and large scale capital goods imports at the same time. In free countries the demonstration effect on consumption is very strong, but at the same time the real needs in consumption goods are very heavy, taking into consideration the low living standards. Planners are faced with the conflict between consumption goods imports and capital goods imports. Granted the foreign exchange constraint, the foreign exchange limit problem emerges, threatening economic development and putting a ceiling in the rate of growth of G.N.P. In under-

developed countries capital formation and demonstration effect problems boil down to a foreign exchange problem through the import content of both investment and consumption.

3) Another problem which emanates from the above discussion and is of much concern to planners, is that of the criteria for allocating capital and other resources in such a way as to achieve desired outcomes. Planners should be aware of the repercussions of overall investment plans or special investment projects on the balance of payments.

4) Allowing for a given proportion of domestic savings to total capital formation, the difference between actual savings and the desired level of investment will be financed by external resources. The finance problem is of paramount importance in development plans and it poses a large problem for international agencies and institutions. The finance problem can be seen from two points of view:

(a) as a problem of financing the difference between savings and investment in which case the «savings gap» determines the inflow of external capital, and

(b) as a problem of financing the difference between current foreign exchange receipts and payments, in which case the so-called «trade gap» is the determining factor of capital inflow.

In making projections the «two gap» approach is used to determine capital inflow and aid requirements. The bigger of the two gaps usually determines the capital inflow. If the «savings gap» is larger, then actual imports will be greater than required by projected growth; if the «trade gap» is larger, then actual saving will be less than potential savings, the two gaps being equal ex-post.

3. Structural aspects of capital formation : Demand for Capital and Interindustry Flows

We discussed two separate functions in the capital formation. First, abstinence from consumption; second, the construction of capital goods, or the execution of investment. The first can be identified as the supply of capital funds, and the second as the demand for capital.

The demand for capital depends on a host of factors among which are the following: (a) population increases; (b) additional capital permits

the introduction of roundabout methods and a widening of the production structure; (c) technical progress is allowed to take place by additional capital; and (d) the introduction of innovational and inventions is accompanied by a «multiplier effect» in the sense that many things should be changed or additional activities should be created to accomodate it. Moreover, according to the traditional «cycle theory», the demand for capital is the most sensitive variable to different phases of economic cycle. This sensitivity expresses itself through the «acceleration principle» according to which an increase in demand brings about a multifold increase in demand for investment goods; and, conversely, a decrease in demand for consumption goods brings about a multifold decrease in demand for investment goods. Thus fluctuations in capital goods production are bigger than in the consumption goods sector. Generally, increasing per capital income leads to higher levels of demand for consumption and this in turn leads to an additional demand for investment goods.

In underdeveloped countries, a strong demand for capital is apparent nowadays because of developmental requirements which stem from their desire and aspirations to close the income gap which exists between them and the rich countries. The need for capital is even stronger in these countries since they realise that they can import innovation and investment goods from abroad speeding up, in doing so, their development rate.

In developmental planning, planners start by fixing targets of growth and assessing the resources requirements which are: natural resources, manpower, and capital goods. In the estimation of capital requirements, planners use different methods and approaches.

A neoclassical approach to the problem is usually based on the concept of a production function of the Cobb-Douglas type, like

$$Y = f\ (K,\ L)$$

where Y is the net output, K stands for capital, and L for labour.

Aggregating this function first over all firms in an industry and then over all industries we obtain a theory from which we can derive the allocation of the primary factors to different uses and the distribution of the share of the national product between the owners of the factors[1]. From this type of

1. R. Stone and Alan Brawn, A Programme for Growth, I. A Computable Model of Economic Growth, Cambridge, 1962, p. 81.

function we can estimate capital requirements, but we are not able to see the interflow relations between sectors of the economy and the impact one each other.

Another familiar approach to assessing capital requirements in development programmes is the incremental capital output ratio (1.CO.R.) based either on historical or cross-section data, or on standardised technical prescriptions [1].

Suppose we know approximately the value of a capital - output ratio, then the required capital will be as in the following equation:

$$I = \bar{k}\bar{r}Y \tag{1}$$

where I stands for investment or increase in capital stock (ΔK),

k stands for the capital-output ratio,

r stands for the target rate of growth,

and Y stands for national product.

The above expression (1) can be written as

$$\bar{r} = \frac{I/Y}{k} = \frac{a}{k} \tag{2}$$

where a is the capital formation proportion.

Expression (2) tells us that the growth rate of G.D.P. depends on the capital formation proportion and on the capital-output ratio. If we fix a target rate of growth and a constant capital output-ratio (I.C.O.R.), then it is obvious that the policy parameter will be the investment ratio. If we hold a as constant then the policy parameter will be the 1.CO.R. Usually the later is more difficult to manipulate by government policies, for it is a purely technical concept, and therefore we take it from historical data (ex-post), or we have to postulate it. If we fix a growth rate of G.D.P. and an investment ratio, we get the required 1.CO.R. (k), which may differ from the technically optimal one[2]. In the case in which the growth rate of G.D.P. is given and the investment-to-G.D.P. ratio is fixed, planning policy would influence

1. The 1.CO.R. may be considered as a special form of productin function.

2. As technically optinal I.G.O.R. can be considered the one which corrasponds to optmimal technological conditions of the operation of a capital equipment.

the direction of technological advance in order to make (k) approach the technically optimal value. This is to say that economic planning should plan projects with I.CO.R. as low as possible to permit a higher rate of growth; however, the task is difficult in this case because there are often not many alternatives for investment projects and we are compelled to adopt the existing technology. Comparing, of course, I.C.O.Rs. in the agricultural sector on the one hand and in the manufacturing sector on the other hand, it may be, according to H. Singer[1], higher in the latter than in the former; however, agriculture is not a substitute, or an alternative choice, for manufacturing since underdeveloped countries suffer from lack of industrialisation and they are not therefore going to invest in agricultural simply because of lower I.C.O.Rs.

The problem is associated with the notion of «capital-using» and «capital-saving» techniques. Trying to lower the I.CO.R. by using «labour-using» techniques, the productivity of labour may drop because of scarce capital. Relevant to mention here is K. Kurihara's[2] paradox according to which «an attempt to economise on capital relatively to labour could result in an increase in the amount of capital required to produce a given output, because if we identify labour-using techniques as techniques with low I.C.O.Rs. and we accept the more labour-using techniques reduce the net outcome, then low I.C.O.Rs. give low rate of growth, or, tantamount to it, with a given output we require more investment». Evidently, this paradox stems from the fact that substitution of one factor for another cannot be pushed very far, and the complementarity of capital and labour is a strong feature of many production processes.

In this case assuming constant factor inputs, factor intensity is clear-cut; one process may be capital-intensive, another may be labour-intensive along the whole sale of production regardless of the levels of production. We shall return to the foregoing concepts later because of the paramount importance they possess for the capital formation problem and hence for its trade implications.

As was said earlier, direct calculations of capital requirements from an aggregate production function of Cobb—Douglas type or from capital out-

1. H. Singer, The Mechanics of Economic Development, Indian Economic Review, Aug., 1952.

2. K. Kurihara, The Keynesian Theory of Economic Development, London, 1959, pp. 94-95.

put ratios of the different sectors and of the overall economy, do not give the entire network of inter-relationships between the sectors, nor do they give the indirect effects of an amount of investment in a sector on the others, and in this sense they are of a partial equilibrium nature. Even in a general equilibrium approach, the traditional theory is dealing with the optimum point of a production possibility curve, given productive factors, without considering the interindustry flows. However, production of commodity X requires inputs of commodity Y apart from inputs of primary factors like capital and labour. Thus producing more of commodity X (which may be a capital good) does not imply necessarily withdrawal of commodity Y (which may be a capital good as well) as the conventional transformation curve shows. Each economic system has a complicated internal structure and its performance is determined by the mutual relations of the different components from which it consists of and various factors operating under the surface.

The most useful technique, provided that the data are available, would be an «input-output» construction which would tell us the investment requirements of each sector and the intermediate uses and investment deliveries of each sector to the others. Thus, fixing a target level for consumption we can determine the investment interdependence of the sectors simultaneously and in a general equilibrium approach. We exemplify this idea in terms of the following input-output construction.

Table 1 shows the input-output relationships of the economy. Part I shows the deliveries of intermediate goods and services from one industry, or activity, to another. The rows show what industry i sells to industry j, and the column show what industry j receives from industry i plus the value added.

Part II shows the interindustry deliveries of investment goods or goods identified as capital goods. The rows show investment goods allocated to industry j by industry i, and the columns show investment goods received by j from industry i. Investment goods are a part of the final product of different activities.

Part III shows the vector of final product for consumption.
Part IV shows the total output of each activity.
The rows of the table satisfy the accounting identity

$$Q_i = \sum_j Q_{ij} + \sum_j I_{ij} + C_i, \qquad i, j = 1, 2, 3, \ldots \tag{1a}$$

which implies that the sum of the amount of intermediate deliveries of industry i to other industries plus the amount of intermediate deliveries of industry i to other industries plus the amount of investment goods sold by industry i to other industries plus the amount of consumption goods sold to the final consumer equals the total output of industry i.

From Part I, which is a transactions matrix between industries, we get the input coefficient

$$a_{ij} = \frac{Q_{ij}}{Q_j}, \quad \sum_i a_{ij} < 1 \tag{2b}$$

which implies the amount of output of industry i which must be used up per unit of output of industry j.

The accounting identity (la) becomes

$$Q_i = \sum_j a_{ij} Q_j + \sum_j I_{ij} + C_i \tag{3}$$

By summing up the columns of Part I of the table we get

$$\sum_i Q_{ij} + Y^j = Q^j \text{ and} \tag{4}$$

$$Y^j = Q^j - \sum_i Q_{ij} \tag{5}$$

By summing up the columns of Part II we get

$$\sum_i I_{ij} = I^j \tag{6}$$

and summing up the rows we get

$$\sum_j I_{ij} = I_i \tag{7}$$

For the total investment in the economy we have

$$\sum_j \sum_i I_{ij} = I = \sum_j I^j = \sum_i I_i \tag{8}$$

Table 1

Interindustry Relationships

	I					II					III	IV
Industries	1	2	3	.	n	1	2	3	.	n	Consumption of final products	Total Output
1	Q_{11}	Q_{12}	Q_{13}	.	Q_{1n}	I_{11}	I_{12}	I_{13}	.	I_{1n}	C_1	Q_1
2	Q_{21}	Q_{22}	Q_{23}	.	Q_{2n}	I_{21}	I_{22}	I_{23}	.	I_{2n}	C_2	Q_2
3	Q_{31}	Q_{32}	Q_{33}	.	Q_{3n}	I_{31}	I_{32}	I_{33}	.	I_{3n}	C_3	Q_3
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
n	Q_{n1}	Q_{n2}	Q_{n3}	.	Q_{nn}	I_{n1}	I_{n2}	I_{n3}	.	I_{nn}	C_n	Q_n
Interindustry total	$\sum_j \sum_i Q_{ij}$					$I^{(1)}$	$I^{(2)}$	$I^{(3)}$	.	$I^{(n)}$	C	Q
Value added	$Y^{(1)}$	$Y^{(2)}$	$Y^{(3)}$	.	$Y^{(n)}$							
Total output	$Q^{(1)}$	$Q^{(2)}$	$Q^{(3)}$	.	$Q^{(n)}$							

Now the interdependence table for the whole economy could be presented in the equation

$$\sum_i \sum_j Q_{ij} + \sum_i \sum_j I_{ij} + \sum_i C_i = \sum_i Q_i, \tag{9}$$

or

$$\sum_i \sum_j Q_{ij} + I + C = Q \tag{10}$$

In order for an industry to increase its output next year by ΔQ_j, the capital stock must increase by a certain amount, $\sum_i L_j$, in which case we have

$$\frac{\sum_i I_{ij}}{\Delta Q_j} = k_j, \text{ and } \sum_i I_{ij} = k_j \Delta Q_j, \tag{11}$$

where k_j is the sectoral incremental capital-output ratio which tells us about the amount of investment to be installed in industry j for a per unit increase in output. For the whole economy the incremental capital-output ratio (I.CO.R.) is $\sum_j k_j = k$, and

$$\sum_i I_I = \sum_j k_j \sum_j \Delta Q_j, \text{ or} \tag{12}$$

$$I = k \Delta Q \tag{13}$$

As in the case of the transactions matrix we established constant input coefficients in the same way we may establish capital-input coefficients. Thus we can speak of a transaction coefficients matrix, and of a capital coefficients matrix as well.

From (2b) we get for the whole economy $\sum_i \sum_j a_{ij} Q_j$, and let us substitute it by AQ, where A is the constant input coefficients' matrix.

If we denote the capital input coefficients' matrix by K then the total amount of investment required to increase output by ΔQ next year will be

$$I = K \Delta Q \tag{14}$$

The flow equation of the whole system will be

$$Q = A Q + K \Delta Q + C \qquad (15)$$

and its solution is

$$Q = (I - A - K\Delta)^{-1} C \qquad (16)$$

In the above described model we have a high degree of disaggregation in the I.C.O.Rs. and the presentation of a capital input-output matrix was made on purpose to show the benefits of the technique in planning investment in underdeveloped countries. An input-output model is superior to an aggregate estimation based on capital-output ratios in development plans as those of United Nations in Latin American Countries (U.N./E.CF.L.A., An Introduction to the Technique of Programming) and in some case studies [1].

Equation (14) is exactly equation $V = K \Delta q$ in the Stone-Brown model, where K denotes the matrix of capital input-output coefficients, Δq the excess of next year's output over this year's output, and V the additional investment to be undertaken this year [2].

The proportion of investment in industry j to the total investment in the economy is

$$\lambda_j = \frac{I_j}{I} \qquad (17)$$

and the proportions of all industries must sum up to 1.

$$\sum_j \lambda_j = 1 \qquad 0 \leqslant \lambda \leqslant 1 \qquad (18)$$

1. Professor A. Papandreou in his «A strategy of Greek Economic Development», Athens, 1962, estimated gross fixed capital requirements for each sector using sectoral incremental capital-output ratios derived from National Accounts Statistics since data on inter-sectoral relationships were lacking in Greece. He gives the following equation:

$$Ij\ (t) = kj \Delta Y_D j\ (t+1)$$

Where Ij(t) stands for sectoral investment in year t, kj stands for I.C.O.R. and ΔYDj (t+1) stands for increase in net income next year. (See his Mathematical Appendix, op. cit-, p. 115).

2. R. Stone and Alan Brown, op. cit., p. 74.

From (17) we have

and for the entire economy

$$\sum_j \lambda_j I = I \tag{20}$$

Equation (13) becomes

$$\Delta Q = \sum_j \lambda_j I/k \quad \text{or} \tag{21}$$

$$\Delta Q = \sum_j \lambda_j I k^{-1} \tag{22}$$

which is the expected increase in output from investment in the various industries (or sectors) of the economy and depending on the sectoral efficiencies ($\sum_j \lambda_j k^{-1}$), summing up to the overall efficiency of the economy (k^{-1}) which is the reciprocal of the I.C.O.R.

Now, putting equation (13) or (22) in a simple form we get the familiar Harrod-Domar model

$$\Delta Q = I\sigma \text{ (Domar)} \tag{23}$$

(where ΔQ is the increase in the output capacity and σ is the overall productivity of investment),

or $$\frac{\Delta Q}{Q} = \frac{I}{Q} \cdot \frac{1}{k} \quad \text{(Harrod)} \tag{24}$$

(where Q is net income and k is the capital-output ratio).

In this way we have been able to derive a Harrod-Domar model from a table describing the interindustry relationships and to show that the overal efficiency, or inversely the overall I.C.O.R. of the economy, depends upon the sectoral ones. The implication of this is that to maximise output capacity in a Domaresque way or to maximise income in a Harrodian. way we must allocate investment, in industries and sectors which have the highest

productivity or the lowest I.CO.Rs. But since the analysis is not of partial but of general equilibrium, we are not to ignore sectors or industries with low efficiency, because each sector must provide a minimum level of output for consumption. The necessary condition for the operation of the system is the consistency of the interindustry relationships.

Thus the whole problem might be reduced to a linear programming model in which

$$\sigma = \sum_j \lambda_j k_j^{-1} = \max. \tag{25}$$

subject to a constraint condition

$$\sum_j C_i \geqslant \sum_i C_i^m \geqslant 0 \tag{26}$$

where C_i^m is the minimum level of consumption to be secured.

From the flow equation (15) we have

$$Q - AQ = I + C = Y \tag{27}$$

and by replacing C by C^m, we get the inequality

$$Y > I + C^m \quad \text{or} \tag{28}$$

$$Y - C^m \qquad I \tag{28a}$$

The difference between $(Y-C^m)$ and $(I = Y-C)$ is allocated to the most efficient industries.

In the above model we did not take into account the foreign sector of the economy. Nonetheless we can say that in the above formulation exports could be shown as a column vector among the autonomous demands, and imports as a row, with other non-produced inputs.

In a long-term planning model, it may be of interest to make behaviouristic assumptions concerning imports and set a trend value for exports. Such a treatment of foreign sectors is given in the Stone-Brown model for the British economy[1]. In an input-output table for the Israeli economy, imports were transferred as negative items to the autonomous sector among exports and final demand[2].

2. W. Leontief, Input-Output Economics, 1966, p. 52

4. Capital **formation proportions : Cross-section analysis in comparison with** long-run **data.**

Identifying demand for investment with the gross capital formation proportions to G.N.P., we can trace the pattern of demand by examining capital formation proportions at different levels of per capita income. In this respect, we shall make a statistical analysis of gross domestic capital formation to G.N.P., or what we may call investment rates or ratios, in relation to per capita income as an index of economic development.

We can set a priori notions about the investment ratios at different levels of per capita income in that these ratios increase as income increases. Thus a priori we might expect a positive association between these two variables. Increasing per capita income permits increases in savings and more financing ability emerges. Moreover, increasing per capita income constitutes a promising indicator for inducement to invest and makes things easier for economic transformation. If we accept a constant I.G.O.R., then higher rates of G.N.P. growth can be achieved only by higher investment rates; or to put it another way, with rising I.G.O.Rs., or decreasing capital efficiency, a high rate of growth may be maintained only by high investment ratios.

Now, the question is: does the historical evidence agree with the above a priori notion ? Does the capital formation proportion continuously increase with per capita income or does it stop at some point ? What is the range of investment ratio which stems from the historical evidence?

For our statistical exercise we took the ratio of G.D.CF. to G.N.P. as found in national accounts statistics of the countries for which data are available.

Table 2 shows the number of countries arranged in each cell as to income class and the investment ratio. An average for each income class is givem both for a sample of 58 and for 47 countries. In the latter case the number of countries was reduced to reconcile with Table 3, which shows the gross savings ratios for the same number of countries. The data relate to an average of jears 1963-64.

The findings of the analysis and discussion on them are as follows:

(1) The cross-country analysis shows that investment ratios increase with increases in per capita income. A correlation coefficient of .60 (adjusted for degrees of freedom), a determination coefficient of 42%

Table 2

Investment Ratios in relation to per capita income, Average 1963/64 Fifty-Eight Countries

Investment Ratios (%)	Income classes ($) 0-149	150-249	250-449	450-649	650-1149	1150-above	Total
6-10	1						1
11-15	5	3	4	1			13
16-20	5	5	4	2	2	3	21
21-25		1	3	1	3	5	13
26-30				1	3	5	9
31-35							0
36-40				1			1
	11	9	11	6	8	13	58 countries
Arithmetic Mean	14.8	16.9	17.5	23.0	23.6	23.7	
	15.4	16.0	18.0	23.0	23.0	23.7	47 countries

Source: Statistical Appendix.

or 36% (adjusted), and an F-test for correlation significance show that there is a significant association between these two variables. (Table 4).

(2) The range of capital formation proportions in relation to different stages of economic development for the specified period is between 15 % and 24 % on average.

(3) The most eminent characteristic of the cross-country capital formation averages is that they are clustered approximately into two groups: the first group consists of the averages in the first three income classes, and the second group consists of the averages in the rest of the income classes. The capital formation proportions in the first three stages of development (or income classes) range from 15 % to 17.5 %, then it jumps to 23 % in the fourth stage, and it remains more or less constant from then on.

The above-mentioned fact lends itself to a number of interesting comments and possible explanations:

'a) The level of capital formation in the first stages of economic development should be expected to be low because of lack of savings. Even in the case that external resources might be used, the possibiltties for high investment ratios are limited because of limited absorptive capacity in under-developed countries. However, albeit the low level of investment ratios in the first stages of development, there exists a variation in them in relation to income, the range being from 15 % to 17.5 %. We should expect variations in investment ratios in relation to per capita income, thanks to investment requirements in infrastructure and other indispensable amenities. The same distinct pattern of low investment proportions is observed in savings ratios. As can be seen from Table 3 the savings ratios are very low in the first three income classes too.

Table 3

Gross Savings Ratios in relation to per capita income, Average 1963/64, Forty-Seven Countries

Savings Ratios (%)	Income Classes ($)						
	0-149	150-249	250-449	450-649	650-1149	1150-above	Total
6-10	1	1	3		1		6
11-15	3	3	2	2			10
16-20	3	1	4	2	1	3	14
21-25				1	4	6	11
26-30					1	4	5
31-35							0
36-40				1			1
	7	5	9	6	7	13	47 countries
Arithmetic Mean	14.4	13.0	13.5	20.5	20.9	23.4	

Source : Statistical Appendix.

(b) The last three income classes of our arbitary classification show a distinctly high level of both investment and savings ratios; the in-

crease occurs between the third and the fourth income class. In these advanced stages of development the investment ratios just maintain their proportion in G.N.P. Possible explanations and remarks to this phenomenon might be the following:

(i) The general framework of infrastructure and overhead capital is established and the economy is well-equipped with machinery and plants.

(ii) In advanced stages of development there are items of expenditure which are not statistically included in the Gross Capital Formation as stem from national accounts, such as land improvements by farmers, expenditure on high education and research, and generally investment in human capital which is considered as current expenditure, as it escapes measurement.

Table 4

(a) Investment Ratios ($\bar{Y}$) tabulated as a function of per capita Income (X)

X	$\bar{Y}$	σ_y	N (countries)
0-149	14.8 %	1.02	11
150-249	16.9	1.11	9
250-449	17.5	1.25	11
450-649	23.0	3.65	6
650-1149	23.6	1.47	8
1150-above	23.7	1.11	13
Total average	19.7	0.75	58

(b) Analysis of Variance

Source	Sum of squares	degr. of freedom	Variance
Total	1877	57	32.9
Among cells	783	5	157.0
Within cells	1094	52	21.0

$F = 7.5$

$(n_1 = 5,\ n_2 = 52,\ F_{.05} = 2.39,\ F_{.01} = 3.39)$

$R^2 = 0.42,\ \bar{R}^2 = .36,\ R = .65,\ \bar{R} = .60.$

Most of the items of this sort are considered a luxury in underdeveloped countries; but since they are of a significant magnitude in advanced countries their exclusion from G. D.CF. gives a bias to constancy in G.D.G.F. proportions.

(iii) Technical progress and innovation might make possible increases in income with very small additions to the existing stock of capital; and a significant part of capital formation proportions tends to be replacement investment.

(iv) Income inequality becomes less in the upper income classes. As soon as income reaches a high level, its distribution, which is related with saving propencity and hence with investment propensity, becomes more equal and saving propensity is not subject to significant variations thereafter.

(v) The population increases do not exercise as big an influence as in countries at lower stages of development because they are very slight.

(vi) Another reason may be the fact that the highly advanced countries lend or grant aid abroad with the consequence that domestic capital formation tends to be stable or lower than the nation's savings ratio. In this case the amount of savings lent abroad is included in the capital formation (G.D.C.F.) account with a minus sign and the opposite happens in borrowing countries.

In order to give a good explanation about the pattern of capital formation proportions, we require an explanation of the distribution of incomes by size, the financial mechanism for mobilizing savings, the relations with the network of foreign trade and capital movements, etc. Among all of them let us look at the relation between the patterns of investment and the savings ratios as shown in Table 5.

The pattern of savings is more or less the same as the pattern of investment proportions, which implies that investment proportions to G.N.P. are determined by the savings patterns.

By inspection of Table 5 we see that : (1) the savings proportion in the first income class is higher than in the subsequent two classes. Although the values shown are averages for grouped countries, the same thing can be

Table 5

Savings Ratios, Investment Ratios and Differences, 1963/64, Forty Seven Countries

Income Classe (1) $	Growth Rates (2) *	Savings Ratios (3)	Investment Ratios (4)	Differences (3) - (4)
0-149	4.8%	14.4%	15.4%	—1.0
150-249	4.6	13.0	16.0	—3.0
250-449	5.6	13.5	18.0	—4.5
450-649	6.7	20.5	23.0	—2.5
650-1149	5.2	20.9	23.0	—2.1
1150-above	4.9	23.4	23.7	—0.3

Source : Tables 2, 3, and Statistical Appendix.

*Average annual geometric rates of real GDP Growth (1960-64) for 50 countries.

observed for individual countries when the economy is primitive and the hoarding propensity is very strong. (2) The difference between savings and investment proportions in the first income class is insignificant and Λ might expect even savings surpluses in some individual countries. A numb of reasons may explain this fact among which are: the absoprptive capacity is very low in these countries; the savings potential may be high as the proportion of population out of which savings come may be the same as in advanced countries, but there is absence of entrepreneurship and presence of «feudal» system leaving us with the paradox of investment rates falling short of savings potential. It is well known that the phenomenon of hoarding and piling-up of durable goods (carpets, for instance) and precious stones is practised in some Asiatic countries. Another reason is the non existence of financial institutions or organised markets to assemble and channel savings resources into productive activities. (3) The savings-investment gap is bigger in the second and third income class then in the others and it is the biggest in the third income class. The fact implies that countries in the third income class have a satisfactory investment performance than] to an increasing absorptive capacity which they possess as emerging countries. The proportion of current account deficit to G-D.P. and the proportion of G.D.CF. financed by external resources are both high in these countries As is seen from table 5 the elevation of capital formation proportion occurs between the third and the fourth income level. (4) The averages of savings

rates are distinctly grouped into two groups. The first group consists of the first three income classes, and the second group consists of the rest of the income classes. The savings propensity is kept low unless the country reaches a certain level of per capita income. As soon as that level of incone is reached, the pattern of savings changes, leaving a much higher saving proportion out of income. For each drift from one income class to another takes time, the whole pattern of savings proportions from the lowest to the highest class might be taken to resemble a long - run saving function, or inversely a long-run consumption function ; and in our case, as the data show, the consumption function is non-linear and nonproportional throughout its range, from the lowest income class to the highest one.

It is out of the scope of this paper to deal with the above problem which is of the most debated in macroeconomic theory (Kuznets, Smithies, Duesenberry, Friedman, Modigliani, Brumberg et al). However, in this context and in relation to the existence of two different groups of countries in international income distribution (heterogeneity), we should stress the fact that countries are separated into two groups and in each group there is a saving proportion which is more or less stable. Thus there are two different patterns of savings and hence, two different saving or consumption functions, each of which is approximately proportional. Thus we can accept Kuznets' constancy of consumption proportions in U.S.A. in part only, that is to say, not for the whole range from the lowest income to the highest one, but for each group separately.

Professor Kuznets, investigating the share of consumption in gross product in a cross-section comparison for the years 1950-59, found that the higher the per capita income the lower the share of private consumption (or the higher the share of private savings) in either G.N.P. or total domestic uses. Since the post-war cross-section pattern for countries at different levels of economic development may not be typical of that in the past, he brings historical evidence for all countries. In 6 countries (U.K., Germany Italy, Norway, Sweden and Canada) the share of household expenditure in G.N.P. declines ; in the remaining 5 countries, for which there was no separation between household and government data, U.S.A. and Argentina experienced a roughly constant share in the long run and Denmark, Japan and Australia a declining share [1].

1. S. Kuznets, «Quantitative Aspects ... VII. The Share and Structure of Consumption» Economic Development and Cultural Change, Vol. X, No. 2, Part II, June, 1962, pp. 5,

Let us return to capital formation proportions. Insofar as we can generalise from the cross-section view to a longitudinal model, we may say the following :

(1) The long-term capital formation proportions may lie between 15 % and 25 %. Of course, the cross-country data are means for groups of countries in each income class and thus averaging gives a grosso modo uniformity to the data, which does not exist for individual countries in the long-run period.

(2) As per capita income rises \ve should expect capital formation proportions to rise

(3) If we assume that countries which are in the first income classes are at the same stage of development that present-day advanced countries were over a century ago, we shall conclude that low - income countries will reach capital formation proportions of over 21 % value in an over-hundred-years period. However, we are not inclined to support this inference nowadays for a number of reasons : foreign aid, development plans supported and financed by leading rich nations, government intervention and participation in investment plans, acceleration in capital formation by importing capital goods, etc., etc., are some of these.

(4) We are not inclined, either, to infer a single overall investment function from the cross-section data. On the contrary, we shall assume two separate investment functions : one for the first three income classes and one for the second three income classes. The former is non-proportional because the capital formation proportion in per cent is increasing, though slightly, as income increases, but the latter is proportional, because the proportion is kept constant. Combining both groups of income classes in one scale we see a drift of the investment curve upward, and the separation is between the third and the fourth income class. Thus, advanced countries seem to reside on the second floor. Immediately a further question arises (see Tables 2, 5 and figure l).Why is the capital formation proportion more or less constant in the second group and does not rise as income increases ? Once the switch is in progress, why should it be halted ? Is it not self-financing ? And if not then why is it not [1] ? Some explanation to this question was already given above.

1. A. K. Cairncross, Factors in economic development, Unwin University Books, 1965, Chapter 7.

We shall mention here, in addition to what was foregoing, that S . Kuznets 1 finds the proportion of resources devoted to increasing the capital stock that forms the material basis of the highly productive economic civilisation of advanced countries to be surprisingly low. He suggests two answers: (a) technical progress consists not only of inventions which need heavy capital requirements but also of a stream of relatively cheap changes whose cumulative effect is a drastic reduction in inputs leading to increase in output. Technological progress thus permits output to increase without additions to the stock of capital goods; and (b) the esential investments are largely in human beings and many categories are now treated under «flow of goods» to ultimate consumer which should be included under «capital». Capital itself helps labour to increase its productivity but there are many other factors which increase labour's productivity. Thus if all these are included in the capital formation item, the discrepancy between poor and rich countries' proportions would be larger than is observed. As a consequence of this fact, high proportions of consumption and their maintenance are associated with increases in the part of consumption goods which is functionally similar to capital formation[2].

Apart from the inference we made as to long-term trend of capital formation proportions from our cross-section data for the specified 1960's period, it would be worth while to outline Kuznets' findings from his historical data for 12 advanced countries[3]. Kuznets' data are averages—-and this reduces variability in long-term trends-for two overlapping long periods. The first period extends from the mid-19th century to World War I, and and the second begins toward the end of the 19th century extending to the years after World War II. Both periods exclude world war quinqennia from the average if the proportions are distinctly different from these in peacetime.

(1) Germany, Canada, Australia, and the United States have high capital formation proportions and they have enjoyed a high rate of income growth.

(2) Countries with low proportions have divergent growth rates. Japan has a high, and the United Kingdom and Italy have a low growth rate.

1· S. Kuznets, Economic Growth and Structure, London, 1966, pp. 34-35.

2. S. Kuznets, op. cit., p. 36.

3. 8. Kuznets, «Quantitative Aspects of the Economic Growth of Nations: VI. Long Term Trends in Capital Formation Proportions», Economic Development and Cultural Change, Vol. IX, Part II, No. 4. July, 1961.

(3) National capital formation proportions fall into two groups—high. and low.

.....

(4) There is a significant long-term rise in capital formation proportions in ten out of the 12 countries.

(5) The long-term rise in capital formation proportions came rather resently.

The above sketchy historical evidence is more or less in agreement with our cross-section data as the analysis has so far shown.

5. The Capital- Output Ratios and Economic Growth.

5.1. Use of and restrictions to capital-output ratio

In Section 4 we referred to the concept of capital-output coefficient in estimating capital requirements in underdeveloped countries. This concept can be explicity used in a straightforward way or implicitly it can be derived from a capital input-output table for the whole economy as it was shown in the fore-mentioned section.

The incremental capital-output ratio—we shall always mean gross domestic capital formation to G-N.P. ratio—is a simple and useful tool for planning purposes, but at the same time it is of a complex nature because of the interwoven functional relations of capital formation, growth rates of G.N.P., and technology. In order to probe further into the capital requirements of development plans and to assess their impact on foreign trade (as manifested in the form of capital goods imports and international capital flows and aid) we have to outline the interrelationship of capital formation, growth rates and I.C.O.R's.

The idea of I.CO.R. stems mainly from growth theory and though it is expressed in the simple formula

(where r = rate of growth of G.N.P., α = capital formation proportion and k = I.CO.R.)) H is surrounded with many difficulties and ambiguities. In advanced countries new investment creates new capacity, and income demand is necessary to support full employment in a Domar sense, and hence the left hand part of the above formula is crucial in this respect. In underdeveloped countries capital cumulation is indispensable to generate income

above the subsistence level and growth rate becomes a target in development plans; hence the right hand part of the above formula being the crucial determinant.

Planners should be aware of the I.C.O.R's pattern over time and at different stages of economic development in order to be able to assess realistically overall capital requirements in their plans. The implications of assessing or choosing I.G.O.R's is very importan from the point of view of factor-intensity in the development process. The factor intensity as influenced by chosen methods and techniques has repercussions on trade. The overall I.C.O.R. in a country depends on many factors and it is subject to a number of restrictions. Some of them are the following:

(a) The sectoral composition of investment. As shown in Section 4 the overall I.C.O.R. is the weighted average of sectoral I.C.O.R's $(= \sum_j k^{(j)})$; hence the investment policy should aim at minimizing the overall I.C.O.R. or maximizing the overall efficiency

$$(= \sum_j k^{(j)-1})^{1,2}.$$

(b) The differences in the gestation period and the speed with which new capital assets are efficiently utilised in productive process.

"1. W. B. Reddaway («The Development of the Indian Economy») has offered a summary of what needs clarification about a marginal capital-output ratio for a sector and he divided output and investment for a section into various components giving a detailed sectoral capital-output ratio, (pp. 207-8).

2. S. Kuznets' findings about the sectoral capital-output ratios could be summarised as follows :

(a) Capital-output ratios in agriculture are higher than in manufacturing. H. Singer gives a higher capital-output ratio for industry than for agriculture («The mechanics of economic development», Indian Economic Review, August, 1952).

(b) The sectoral capital-output ratios for dwellings, transportation and communication or the total public utilities are among the highest.

(c) The decline, in the share of agriculture and the rise in the share of manufacturing in the process of growth should have made for a declining overall capital-output ratio in the economy; while the rise in the share of transporation and communication and residential construction should have made for a rise in the capital-output ratio. The net outcome of these shifts will depend thus on the inter-sectoral shifts. (See his «Long-term Trends in Capital Formation Proportions», Table 15, pp. 46-47).

(o) The differences in life spans and the time of estimating I.CO.R's for specified capital assets. To depict the whole idea let us take two activities, A and B, in which two plants are installed in period 1 of a value of £ 100 and £ 150, respectively. The output are £ 100 for activity A and £ 125 for activity B.

According to the usual capital-output-ratio approach, activity B [illegible] higher capital output ratio, e.g. it is more capit

because $k_A = \frac{100}{100} = 1$, $k_B = \frac{150}{125} = 1.2$, and $k_B > k_A$. However, if we assume that the life span of capital assets in A is 3 years and in B 5 years, and the annual output is the same as in the first year, then in activity A the capital «is consumed» in a three years period yielding a total output of £ 300, and in activity B in five years' time yielding a total output of £ 625. Consequenty, the capital output ratios are $k_A = \frac{100}{300} = .33$, $k_B = \frac{150}{625} = .24$, that is, activity A has a higher capital output ratio, or it is more capital intensive than activity B. Thus, calculating capital output ratios throughout the life period of capital assets, we get a different value to that one which we get dividing investment made in a specified period by total output in the same period.

(d) The rates of depreciation in old assets and differences in the magnitude of the replacement component of capital formation. The more the replacement component of capital the more capital is needed to increase income by a certain amount. Assuming constant capital formation proportions, the I.CO.R's will be higher in this case than in the other. We expect high replacement components in advanced countries and hence higher I.CO.R's than in developing countries. Since tehnical progress is introduced through new investments, and it happens to be fast, then old assets should disappear faster than their physical life-time permits hence the replacement component and the I.CO.R's. is likelf to be high.

(e) The use of different techniques in saving (or using intensively) capital or labour.

(f) The prices of productive factors. Long-run variations in factor prices are inducive to more or less use of cheaper factors.

(g) The degree of capacity utilisation and former indivisibilities in capital assets.

(h) The changing pattern of demand. Shifts in demand from «capital-intensive» goods to «labour intensive» goods lower the capital output ratio through the corresponding production.

(i) If other factors unrelated to capital are conducive to variation in output, then the I.C.O.R. lacks its prime meaning[1].

(j) The increase in output brought forth after an increment in capital employed cannot be attributed to capital only, because of a simultaneous increase in labour employed with the new capital which usually occurs.

(k) The traditional concept of the capital-output ratio is not independent of other variables in the economic system as it is assumed traditionally in the simple formula. Therefore, applying an overal I.C.O.R. to aconomic planning we have to specify conditions under which such a ratio is observed or it is to occur. As it is been already said, the I.C.O.R. as a policy parameter is very difficult to deal with since there is not much choice on factor substitution and on production techniques.

5.2., Capital-output ratios in the course of economic growth

A priori notion or historical evidence about the I.C.O.R. in the course of economic growth is indespensable for planners in assessing capital requirements. Opinions in the matter are divided.

H. Leibenstein[2] accepts a declining I.C.O.R. as economic development proceeds, but he does not consider it to be conclusive. He distinguishes factors that are conducive to increasing from factors that are conducive to diminishing ratios. Among the former ares: (a) the tendency to substitute capital for labour when the wage rate rises as economic growth proceeds; (b) the more durable the capital assets, the higher the capital-output ratio; however the relation is not so simple, though there are reasons to believe that durability is greater in earlier than in later stages of economic development because of needs in construction; and (c) assuming fixed factor

1. Harvey Leibenstein, op. cit., p. 177.

2. Harvey Leibenstein, op. cit., Chapter 11.

coefficients in production, the I.C.O.R. will be larger in low-income countries than in high-income ones, because the labour component in the total cost will be cheap and the capital component dearer and hence greater.

Among the factors contributing toward declining I.C.O.R's are :

(a) increases in the capacity and the size of the labour force;

(b) increased ability of the economy to overcome capital indivisibilities;

(c) a shift in the demand towards services that require little capital per unit of output; and

(d) expenditure on «non-capital» investment, which adds to output without increases in capital stock incurring.

E.C.A.F.E.[1] claims that the I.C.O.R. is fairly stable over longer periods at a level of 3 to 4.

G. M. Meier concluding his critique on the capital-output literature says «that the marginal capital output-ratio is unlikely to be constant over time».[2]

V. V. Bhatt[3] supports the thesis that capital output ratios are rising because of the sibstitution of labour for capital that occurs when labour becomes expensive in the course of economic growth.

Colin Clark[4] maintains that the capital-output ratio declines as development proceeds owing to a shift in the productive structure from primary to tertiary production where, he thinks, capital output ratios are low.

R. Bicanic[5] suggests that the capital output ratio undergoes three stages during the process of economic growth. Starting from a low level in the first stage of economic growth, the capital output ratio rises considerably

1. E.C.A.F.E., Programming Techniques for Economic Development, Bangkok, 1960, pp. 8-13.

2. C. Meier, Leading Issues in Development Economics, Oxford University Press, 1964 (paperback), p. 104.

3. V. V. Bhatt, «Capital-Output Ratios of Certain Industriess : A comparative study of certain countries», Review of Economic Studies, August, 1954, pp. 309-320.

4. Colin Clark, Conditions of Economic Progress.

5. R. Bicanic, «The Threshold of Economic Growth», KYKLOS, Vol. XV, 1962, pp. 7-28.

in the second stage, and stabilises its position àt a low level in the third srage.

H. J. Bruton[1] considers capital - output ratios to be constant, and he gives four factors explaining the stability: (a) the behaviour through time of the interest rate; (b) the nature of technological innovations; (c) the nature of the production function with respect to returns to scale; and (d) the nature of changes in the composition of output. Factors (a) and (c) contribute toward increasing the capital output ratio, and factors (b) and (d) are counteracting forces which keep the balance supporting Bruton's hypothesis of constancy in the capital output ratio in the long run.

J. Tinbergen made a distinction between national and international industries and hence he attached different values of capital-output ratios to them. In national industries, whose products cannot be traded, the value of the capital-output ratio ranges from high to low. In international industries, whose products are traded, the value resides in the middle portion of the range. This means that developing countries do not have many possibilities of selecting low capital-output ratio industries so as to develop «cheaply», because national industries (with low ratios) cannot be expanded beyond national demand, and national industries with high ratios have to be expanded as a result of industrialisation to the extent of the home market; there only remains a restricted choice in the middle range[2].

So much about theorizing and hypothesizing about capital-output ratios. Let us now deal with Kuznets'[3] findings on incremenrtal capital-output ratios. In his international comparison for the post-war years 1951-57, Kuznets found that the incremental gross domestic capital-output ratio ranged from 7.3 to 2.6. The I.C.O.R. was higher for high-income countries than for low-income countries, with the exception of the medium-income countries whose I.C.O.R. was the lowest (2.6).

Our attempt at estimating ex-post incremental gross domestic capital-output ratios from cross-section investment ratios and total growth rates of G.N.P. for the early years in the 1960's gave Table 6.

.:. .:

i. H. Bruton, «Growth Models and Underdeveloped Economies» in Agarwala and Singh, The Economics of Underdevelopment, 1963 p. 223.

2. J. Tinbergen, «International, national, regional, and local industries», in Trade, Growth and Balance of Payments, Essays in honour of G. Haberler, 1965, pp. 119-20.

3. 8. Kuznets, op. cit., and his «V. Capital Formation : International comparison», in Economic Development and Cultural Change, Vol. VIII, No. 4, Part II, July, 1960.

Table 6

International Comparison of I.CO.R's for 50 countries in relation to per capita income

Income Class $	Investment Ratios (1963-64)	Average Growth Rates of GNP (1960-64)	I.C.O.R.
—149	15.4 %	4.8 %	3.2
149-249	16,0	4.6	3.4
150-449	18.0	5.6	3,2
450-649	23.0	6.7	3.4
650-1149	23.0	5.25	4.4
1150-above	23.7	4.9	4.9

Source : Statistical Appendix.

Attaching only a relative meaning and value to the l.C.O.R's above, because they are averages for each income class and the periods for investment ratios and tnose for growth rates do not coincide, we conclude that the I.C.O.R. increases as per capita income rises with the exception of the medium-income classes. The I.C.O.R. rises from the first to the second stage then it falls to the value of the first stage and rises again in the fourth stage, but not over the value of the second stage; after that it distinctly rises to higher levels.

The results of Table 6 are more or less in agreement with Kuznets' findings, although the range between the highest and the lowest value is narrower. They are in sharp contrast with Clark's and Bicanic's suggestions, leaving alone other suggestions as not conclusive enough to be taken into account[1].

The inference from the cross-section evidence to the long-run aspects is always subject to certain restrictions and qualifications. In this case we shall make the following remarks: (a) the findings are identified and held

1. H. Chenery and A. M. Strout, (pp. 685-6, footnote 11) referring to the relation between capital and output write: «Intercountry analyses suggest that there is a reduction in the capital-output ratio at higher growth rates but little relation to per capita income». (See their «Foreign Assistance and Economic Development», A.E.R., Vol. LVI, No· 4, Part I, September, 1966).

for the period specified and which is short; (b) the values are averages for each class and this may give a reduction to the differences between countries as it were; (c) the long-term capital-output ratio for some individual countries may be more stable than the short-term capital output ratio; (d) statistical differences among countries in estimates of G.D.F.C. give variations in the capital-output ratios; (e) investment made under the same conditions in different countries have different «multiplier effects» on income and hence different capital-output ratios, etc.

Insofar as we can generalise from the cross-section data we should expect rising I.C.O.R's in the most advanced stages of economic development, or a rise in the long-term trend. In this respect Kuznets' findings for the long period are in agreement with the cross-section findings.

The following remarks might be considered as an attempt at explaining the stage-by-stage or the time behaviour of the observed I.C.O.R's:

(a) We should expect the actual I.C.O.R. to be low in the lowest income class for some reasons: (i) the existing capital stock and the annual investment are very low at this stage; (ii) the annual output is attributed to natural resources and to labour and much less to capital; and (iii) because we can identify the lowest income class with the beginning of a capital-output ratio trend curve, the average capital-output ratio might be equal to the marginal one.

(b) In the second stage, as shown in Table. 6, the I.C.O.R. rises due to some heavy investments in construction such as roads, transportation facilities, dwelling houses, etc., which are necessary for the transition from the primitive stage to a more tolerable one.

(c) In the third stage the I.C.O.R. undergoes a reduction. During that stage growth rates are high because of the realised rises in productivities of labour and in agriculture, which outweigh the increasing effect on the capital-output ratios coming from higher capital formation proportions.

(d) In the fourth income class the I.C.O.R. is still low, though a little higher than the I.C.O.R. of the second class. Economies in that stage of development witness the highest growth rate of G.N.P. and a considerable rise in the capital accumuation (see Table 6). These two components of the capital—output ratio balance each other leaving the value of the capital-output ratio more or less the same as in the former stages.

(ρ) The last two income classes witness higher I.C.O.R's and this might be due to several reasons: (i) the changing pattern of demand affects the capital-output ratio as we saw in the foregoing; (ii) the fact that the capital output ratios tend to rise might be explained, inter alia, as a symptom of the rising income in the sense that rising income generates more savings and savings are inevitably equal to investment which being redundant are not so profitable; (iii) lending capital abroad makes the domestic investment ratio lower and this affects the capital-output ratio which would be even greater in advanced countries if domestic savings were all absorbed at home; in this case domestic capacity keeps pace with decreasing income demand; (iv)the factors contributing toward declining and rising capital-output ratios mentioned in the foregoing pages are relevant here as well.

All in all we would see a paradox in that technological progress occurring in advanced countries ought to push the capital-output ratio downwards but as a matter of historical fact it did not.

In early growth models «technical progress» was treated as neutral and this «neutrality» was supported by assuming the capital-output ratio to be constant. Technical progress is assumed to be neutral in two senses: (a) in a Harrod[1] sense that assumed constant interest rate does not disturb the capital-output ratio; and (b) in a Hicks[2] sense that for given inputs of the two factors (labour and capital) the marginal product of labour increases in the same proportion as the marginal product of capital.

Since the historical evidence shows that the capital-output ratio rises rather than remains constant in the long run, or in the most advanced stages of economic development, we should conclude that technical progress was not neutral in either sense. In the Harrod case technical progress affects the capital-output ratio through a downward trend in the rate of interest which leads to an upward tendency in the capital-output ratio. In the Hicks case it would be more pragmatic to accept that the labour cost gets more in the advanced stages of economic growtti and hence a labour-saving technique would be effected.

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1. R. Harrod, Towards a dynamic Economics, London, 1948.
2. J. R. Hicks, The Theory of Wages, London, 1963.

Therefore, one would accept a non-neutral technical progress, of a capital «deepening» nature and of a labour-saving character.

5.3. On S. Kuznets' «adjusted» incremental capital-output ratios

Kuznets[1] has found tne I.G.O.R's to range among countries from 2.9 to 9.6 in the mid-nineteenth century to World War I period; and in the period from the end of the nineteenth through twentieth century-though the I.G.O.R's were converging—the range was still wide, from 4.3 to 7.3. In order to eliminate the wide range he devised another ratio called the «ratio of capital formation proportions to rate of growth of product per worker», which excludes the effect of differing additions to labour on total output[2].

He thought that the wide range was due to differing additions to labour in the 12 countries of his sample, and he calculated the capital-output ratio, which excludes the contribution of labour to output, as follows : «We computed rates of growth per year in the labour force ... ; and dividing the rate of growth of total product (expressd as a relative) by the rate of growth of labour force (expressed as a relative) we obtained the rate of growth in product per worker (i.e. per member of the labour force). We then divided the capital formation proportions by the rate of growth of product per worket to get the incremental ratios of capital per worker to output per worker[3].

1. 8. Kuznets, op. cit., Table 5.
2. Ibid., Section IV, pp. 27-33.
3. S. Kuznets, op. cit., p. 27. Kuznets[1] formula is :

$$\frac{C_0/O_0}{\frac{O_1/L_1 - O_0/L_0}{Oo/Lo}}$$

where Co stands for capital formation at time o, and O_0, O_1 stands for output in periods O and 1 respectively.
Lo.Ll stand for labour force in periods 0 and 1 respectively. (See overleaf).

Thus the I.C.O.R. per worker reflects more clearly the effect of capital additions alone. The important element accounting for the difference between the «unadjusted» I.C.O.R. and the. «adjusted» one is the rate of growth of labour force and hence «the greater the rate of growth of the labour force, the larger the incremental capital formation per worker to output per worker ratio will be than the incremental capital formation to total output ratios», and «the smaller the rate of growth of the labour force the closer the two I.C.O.R's will be»[1].

After the adjustment he made, the results were not better; on the contrary, a wider range in the I.C.O.R's among countries was created. For this fact Kuznets admitted that besides the allowance for labour additions there is some «residual» factor which may be due to diffeiing and changing supplies of natural resources, quality of labour force and a variety of other factors[2].

If we put Kuznets' definition of the «ratio of capital formation proportions to the rate of growth per worker» in our notation we get the following formula which we shall call «adjusted» I.C.O.R. :

$$\frac{I/Y}{\dfrac{1+\dfrac{\Delta Y}{Y}}{1+\dfrac{\Delta L}{L}}-1} = k\ adj. \qquad (1)$$

By simple manipulations we get

$$\frac{C_0/L_0}{O_1/I_1-O_0/L_0}$$

where the numerator is the absolute increment in capital per worker and the denominator is the absolute increment in output per worker (p. 28).
The above «adjusted» ratio is identical to the «unadjusted» one only if there is no change in the labour force in which case it takes the form: '

$$\frac{C_0}{O_1-O_0}$$

2. Ibid., pp. 27-28.

1. S. Kuznets, op. cit., pp. 27-28.

where I /Y stands for the investment ratio

$1 + \frac{\Delta Y}{Y}$ stands for relative rate of growth of total product

$1 + \frac{\Delta L}{L}$ stands for relative rate of growth in labour force.

The part $\frac{1 + \frac{\Delta Y}{Y}}{1 + \frac{\Delta L}{L}}$ in (1) may be considered as a «deflated» index of growth rate of product with labour as a deflator. But is there such a simple relationship between output or G.N.P., and labour as it exists when deflating values in money terms by current prices?

An index of G.N.P. in money terms can be deflated by a price index because we know that relationships such as Y= QP exist, where Y = value in money terms, Q—quantum and P = prices. In the case of growth rates of G.N.P., nevertheless, we do not believe that such a simple relationship exists between them and the «deflator», the labour force in this case.

Kuznets admits a number of other factors to contribute to output which should be taken into account, but because of scanty, if at all available, data a further analysis is impossible; moreover, «nor are we sure that the familiar concept of a production function, or that the simple equations so prevalent in the literature, can be meaningful in analysis of long-term trends» [1].

However, Kuznets, in spite of his inclination shown in the above quotation, uses a production of function which is but formula 1. Put (1) in absolute terms, and we get

$$\frac{I}{\frac{\Delta Y}{\Delta L}} = k \text{ adj.} \qquad (2)$$

and from (2) we have

$$\Delta Y = I k - i \, AL \qquad (3)$$

Equation (3) is simply a production function derived from the I.C.O.R. «adjusted» formula by simple manipulation.

1. S. Kuznets, op. cit., pp. 27-28,

The same production function can be derived from the simple and traditional capital-output ratio

$$k = \frac{\frac{I}{Y}}{\frac{\Delta Y}{Y}} = \frac{I}{\Delta Y} \qquad (4)$$

and

$$\Delta Y = I k^{-1} \qquad (5)$$

Inserting $(\Delta L)^0 - 1$ into (5) we get

$$\Delta Y = I k^{-1} \qquad (\Delta L)^0 \qquad 6)$$

As shown from (3) and (6), these are two extremes from the point of view of the labour exponent; in (3) the exponent of labour is 1, and in (6) it is 0. Thus Kuznets used a production function with an exponent to labour equal to unity, which is hardly to be found. In familiar econometric studies the labour exponent is about 2/3, and consequently a labour exponent of unity is unlikely.

6. Capital Formation, Technology and Comperative Advantage

The demand for capital goods, as identified with the capital formation proportions, increases more than the increases in income, and from a certain level of economic development it increases proportionally with income. The proportionality during the last stages manifests itself in the constancy observed in the capital formation proportions deal with in Section. 4. The fact that demand for capital goods is positively associated with per capita income cannot lend itself to the belief that annual rates of G.N.P. growth are higher in cointries with high capital formation proportions as might be indicated by the formula.

$$r = \frac{\alpha}{k}$$

because it depends on the valueof kas well. As has been shown, the capital-output ratio is increasing in the course of economic growth except for some phase at medium stages, which implies that the rates of growth of G.N.P. or per capita income are higher in the medium-income classes than in the lower or upper income classes, as Figure 3 shows.

A number of reasons were suggested to explain the pattern of capital formation proportions and capital-output ratios in the proceding sections. Technical progress was found to be rather non-neutral and capital-using biased. The tendency or capital-intensive techniques and methods does not exists only in advanced

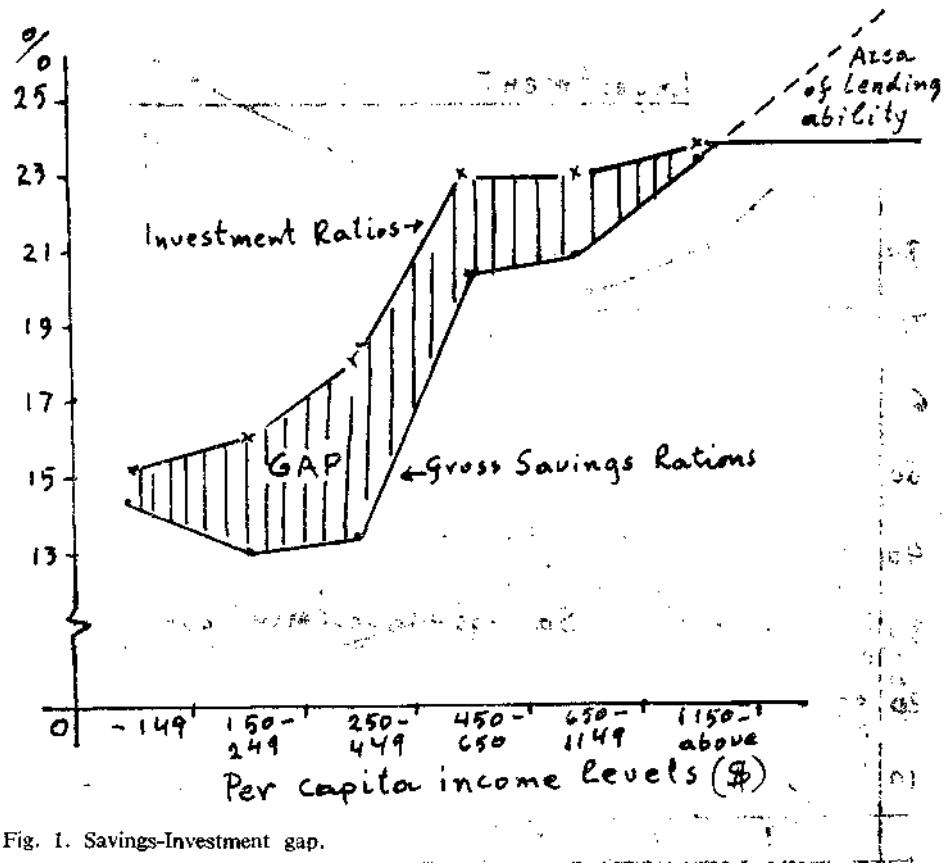

Fig. 1. Savings-Investment gap.

stages of development to-day, but also in earlier stages. An iron and steel plant or a petrochemical complex will be as modern in a developing country as in an advanced country and modern machinery will be used as the technical requirements and the method of production want it.

A higher capital-labour ratio implies more income to capital than to labour, and since savings come from «capitalists» rather than out of «wage-earners», the savings potential will be greater. (This is the Galenson-Leibenstein criterion of investment). Hence, more investment will be possible and more employment in the

long run. Let us exemplify this idea: A sum of, say, $1,000 is invested in hand looms in the cottage cotton industry providing employment for, say, thirty-five people. There will be no margin for reinvestment, and after a long period say 20 years, the number of jobs will still be the same. Suppose, on the other hand, the

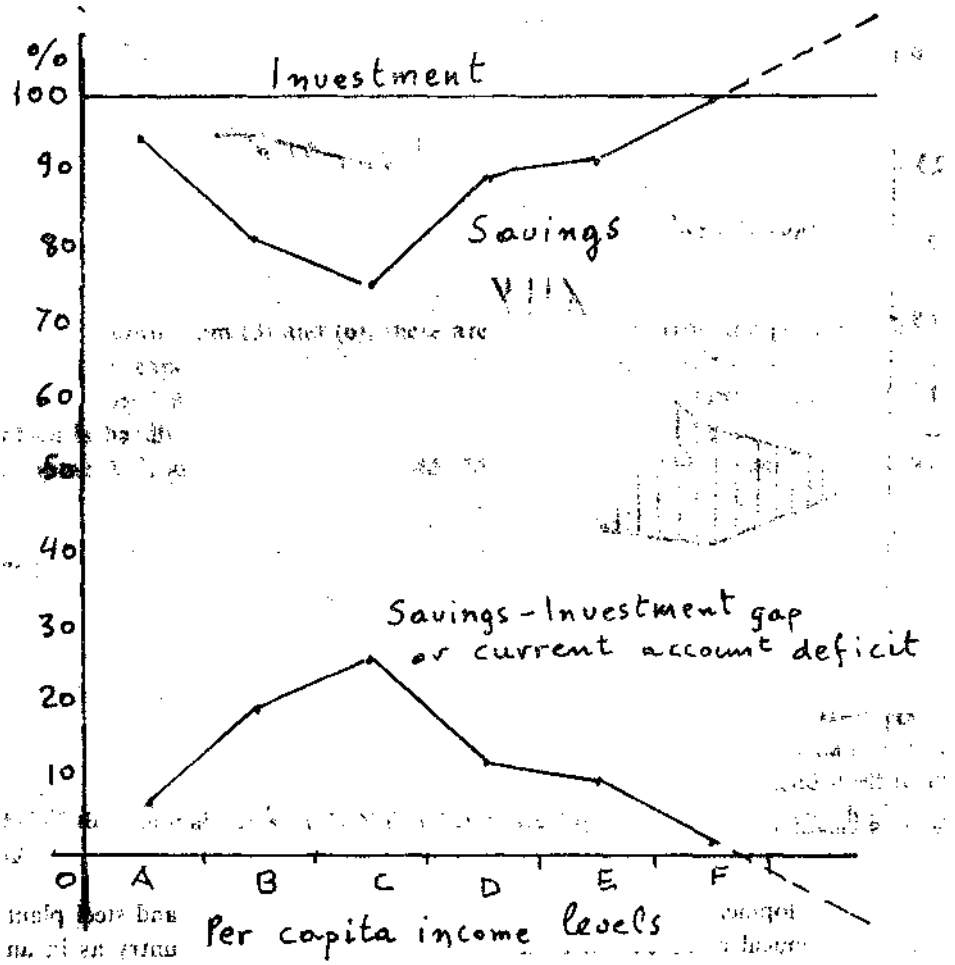

Fig. 2. Savings and savings-investment gap as % of G.D.C.F.
Source : Table 5.

same amount is invested in a large-scale modern mill and it provides employment for, say five people only, thanks to reinvestment of a proportion of income gene-

rated, the employment will increase continuously and it will become much larger after twenty years than in the first case.

More capital and modern techniques provide the opportunities for developing countries to create entrepreneurship, skilled labour and managerial abilities.

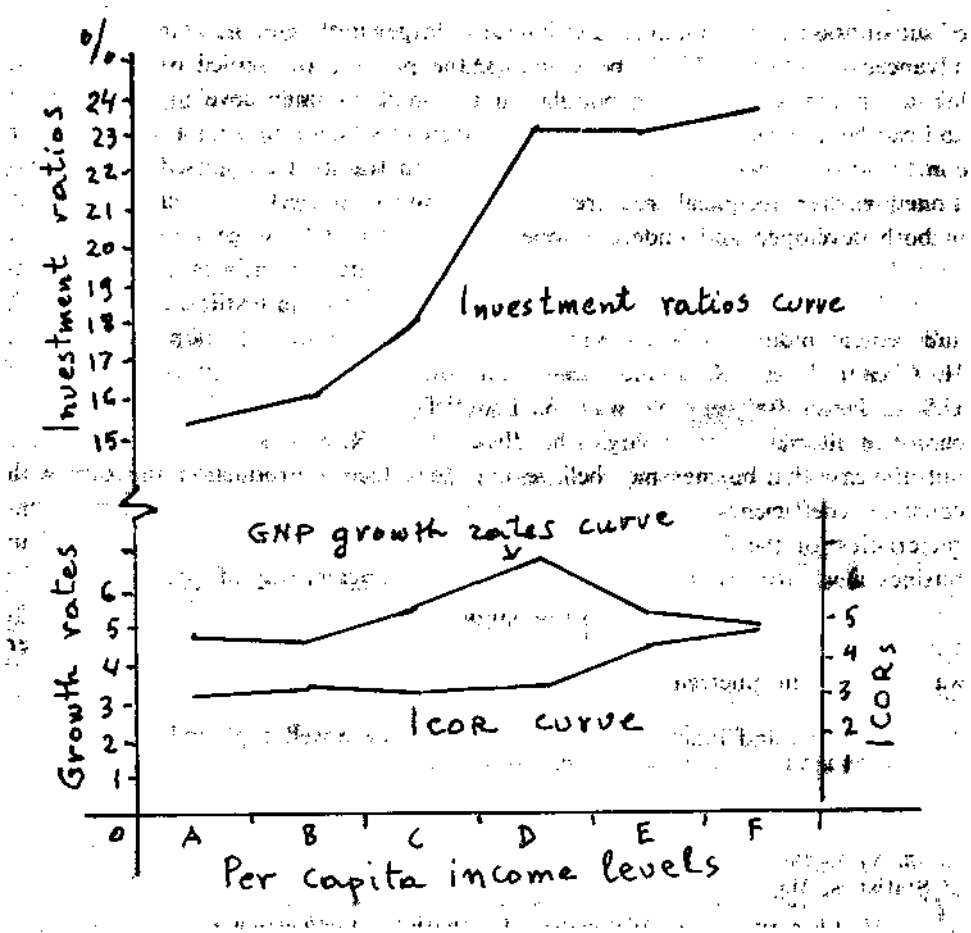

Fig. 3. Investment ratioss, GNP grow rates and capital -output ratios in relation to per capita income leves.

Source : Table 6.

Assuming that the rate of substitution between capital and labour is larger in developing countries than in advanced ones, and the factor prices are the same in both developing and advanced countries, the former will use capital-intensive

technology, and if factor prices are different, the developing countries are still using the same amount of capital but with more labour. We cannot, however, say so easily in which countries labour is relatively cheap, provided that the labour productivity is lower in underdeveloped countries and capital can be borrowed from abroad on reasonable loan terms or even to participate in enterprise established by foreign capitalists. Nor can we say easily, as Hirchman did 1, that the rate of substitution between capital and labour is larger in developing countries than in advanced countries. This is because : (a) the portion of skilled or semi-skilled labour in the total working population is small in underdevelopped countries and can be absorbed very soon as output increases thus imposing a skilled labour constraint on growth just as saving or trade constraints are imposed; (b) as mentioned earlier technical requirements for most projects are just the same in both developed and underdeveloped countries; and (c) wage rates do not fall enough to permit profitable substitution. V. V. Bhatt[2] in an intercountry comparison showed that the equipment used for the production in textiles, iron and steel, and cement industries is the same in both advanced and developing countries. H. Chenery[3], as well, found substantial comparability of input coefficients of U.S.A., Japan, Italy and Norway. W. Leontief points out «... the fact ... that the choice of alternative technologies hardly exists»[4]. R. S. Eckaus, moreover points out the case that businessmen believe that they face a production function with constant coefficients, i. e. no substitution is possible, whatever the actual characteristics of the function and the degree of technical substitutability. Indian businessmen, for example, believe that the Américain way of producing is the best[5]. In tests of the C.F.S. production function made by K. J. Arrow, H. Chenery, B. Minhas and R. Solow, it was found that the substitution parameter was the same in nineteen countries investigated by them[6].

Inventions and innovations in earlier times were well exploited in the count-

1. A. O. Hirschman, op. cit., p. 151.

2. V· V. Bhatt, «Capital Intensity in Industries», Bulletin of the Oxford Institute of Statistics, May 1956.

3. H. Chenery and T. Watanabe, «International Comparison of the Structure of Production», Econometrica, October, 1958, p. 504.

4. Ibid., p. 51.

5. R. S. Eckaus, «The Factor Proportions Problem in Underdeveloped Areas», in A. N. Agarwala and S. P. Singh, The Economics of Underdevelopedment, Oxford University Press (paperback), 1963, p. 353.

6. K. J. Arrow, et al., «Capital-Labor Substitution and Economic Efficiency», The Review of Economics and Statistics, August, 1961, p. 234.

ries where they were first originated and it took a good deal of time to diffuse over other countries. Thus the comparative advantage for a group of countries was working well in this sense. Nowadays inventions are diffused to other countries as quick as lightning and this is important for its implications.

The suggestion made by C.P. Kindleberger that underdeveloped areas, such as Italy, are characterised by «structural disequilibrium at the actor level» is quite true. Complementarity is more important in economic activity than substitutability of productive factors. The redundancy of a factor cannot be eliminated by intensive use of others. Underdeveloped countries are haunted by inappropriate factor endowments, lack of special complementary factors and limited opportunities for technical substitution of factors. The attempt to eliminate unemployment or to use more labour in densely populated areas in which capital is scarce might lead to inappropriate production methods, production of products of bad quality or out of vogue, inflationary pressures and balance of payments difficulties. Redundant labour can only be employed by additional capital and if other complementary factors exist. Labour will cooperate with machines and tools. The more labour in excess the more capital goods are necessary, and the more the demand for capital goods the mere the imports will be. Therefore the factor-proportions problem is very important in economic development since it imposes constraints on growth and it appears to shift finally to an import constraint.

What has been mentioned so far leads to the conclusion that capital requirements in the course of economic development are of a pressing character and since a large part of them are to be met by importing machinery and equipment, a foreign-exchange constraint is likely to be imposed. True, in the above-mentioned example the import content of investment in hand looms and complementary tools is very small, if any, but the import-content of investment in a moderm mill is very high. In advanced countries such a constraint is not likely to appear because machinery and other equipment is domestically produced; the only thing which capital accumulation leads to is the specialization in the production of capital goods and hence an exchange of goods between advanced countries. The import-content of investment may be high specially in small advanced countries, but it is financed by corresponding exports.

Can the foreign-exchange constraint imposed by the tendency of developing countries to adopt new techniques and imitate new processes be relaxed or softened? In a sense it could be if the comparative advantage doctrine were to be applied to a world-wide extent in its real dynamic meaning. Traditional classical theory does not provide an acceptable answer to the problem unless it is modified, extended or interpreted in a dynamic meaning. Long ago the theory was occupied

by questions of what commodities should be traded, what would be the gain from trade, and recently, what would be the impact of the industrialisation of underdeveloped countries on the trade of the rich countries. The theory, as traditionally exposed, failed to recognise the possibility of changes in comparative advantage structure and consider changes in factor supplies, technical progress and the transformative effects of capital accumulation. Thus many of the «constants» in traditional theory must be transformed into variables[1].

Classical economics assumed a given and unchanged technology and the initial exposition of the theory of comparative advantage was based on this assumption, partly for reasons of simplicity of the theoretical analysis and partly because of die interests of the count rie s where it was developed. In its static and narrow interpretation the comparative advantage is based on the initial natural endowment of the economy neglecting the effects and repercussions of capital movements and of technological innovation. An agricultural country should specialise in agricultural production once tor ever, a country poor in natural resources should specialise in tourism, it natural beauties exist, or in exporting labourers, and so on. But the story does not end there. We can see the inconsistency in the static and narrow interpretation of the rigid doctrine in the case of some rich countries which found themselves in a difficult position because they were sticking to productions and activities that should have been abandoned long age. H. Frankel tried to analyse the possibilities and need for a new international division of labour[2].

We cannot accept a static and narrow interpretation of the theory based on the assumptions of a «given state of arts» and given natural endowment of the economy. Capital-goods imports, capital movements, economic and technical aid, and diffusion of technological progress are all conducive to a continuous modification of the factor supply in all countries, and hence comparative advandage will always be modified and altered. This is the dynamic process in our progressive world, and such a dynamic meaning should be attached to the comparative advantage doctrine which being applied will push the welfare curve beyond its pre-

1. C. M. Meier, rather an adherent of classical theory, recognises that classical theory needs amendment and extension to deal with phenomena of change which are mostly relevant to problems in developing countries- He presents such an extension in a model describing the changing pattern of comparative costs, production and consumption in the course of economic development, drawing rather heavily on Hicks and Harry Johnson. (See his 'International Trade and Development', New York and Evanston, 1968; especially Chapters 1 and 2).

2. H. Frankel, «Industrialisation in underdeveloped countries and the possibilities of a new international division of labour», Economic Journal, 1943.

sent-day limits. Countries with poor natural endowment may pretty well produce and export manufactured goods instead of exporting labourers, or agricultural countries may produce and export manufactures which in a new structure of comparative advantages should cease to be produced and exported by advanced countries [1].

Transistors are an American invention but now the specialists are the Japanese [2]. «Christmas trees» are a christian custom but thousands of them are produced and exported by Japan. Denmark was an agricultural country with poor sub-ground endowment (minerals), but she witnessed a shift from agriculture to manufacturing long age, producing manufactures goods (machines, etc.) by importing the necessary raw materials. Thus the answer to the question about the foreign exchange constraint can be given in terms of a dynamic and real interpretation of the comparative advantage doctrine.

7. Summary

In he preceding analysis we stress the inescapable need for a large quantum of capital accumulation to take place in a short time horizon as a necessary condition in order fer a country to reach a certain level of income after which an acceleration phase starts which enables her to natrrow the income gap. Trade plays an important role in the process of capital accumulation. Under autarchy the domestic capacity and resources of a country cannot produce the desired rate of growth, and if it can, it will take much longer. Trade facilitates the whole process by activating and supplementing the national economy through imported capital, skills and technology.

In the foregoing analysis a priori notion that demand for capital goods is positively associated with per capita income is verified by a cross-country statistical analysis and it is in accordance with the historical evidence.

A two-groups of countries model is assumed relying on the investment ratios pattern. The first group, consisting of the three first income classes, gives

1. Folke Hilgerdt, (Industrialisation and Foreign Trade, League of Nations, 1945) attempted to give a negative answer to the question of whether industrialisation of underdeveloped countries reduces industrial exports from advanced countries. The same question was taken up for investigation after about twenty years by A. Maizels in a vast and excellent study (Industrial Growth and World Trade, Cambridge, 1963) and the answer was more or less the same.

2. C. P. Kindleberger, Foreign Trade and the National Economy, Yale Paperbound, 1962, Chap. 6.

a non-proportional function, and the second group, consisting of the other three income classes, gives a more or less proportional investment function. An explanation of the investment pattern was attempted by the pattern of savings ratios and by gualitative considerations.

A gross estimate of capital-output ratios by cross-country data showed that, with the exception of the third stage or income class, the capital-output ratio is increasing as per capita income increases and this is in agreement, mutatis mutandis, with Kuznets' long-run period data. Moreover, high rates of growth are associated with low capital-output ratios.

Another issue of the preceding analysis is the acceptance of the idea that technology does not very much among countries; this implies that the range of substitution between productive factors in developing countries is narrow. This is an important issue to establish an additional condition for trade to be a growth constraint.

Lastly, it was stressed that the comparative advantage of each country participating in world trade could vary and be modified over time as the capital accumulation continues. As capital accumulation proceeds and technological progress is diffused over developing countries «the state of arts» is not fixed and the structure of comparative costs changes.

STATISTICAL APPENDIX

Investment and Savings Ratios, Nations' Current Accounts De eficit Ratios, Proportions of GDCF financed by External Resources, Annual Rates of Growth of GDP, Implicit Capital Output Ratios, per Capita Incomes, and Population Average 1963/64

Countries	Per capita Income ($)	Ratio of Invest-ment to GNP (%)	Ratio of Savings to GNP (%)	Ratio of Current A/C to GNP (%)	Ratio of Current A/C Deficit to GDCF(%)	Rates of Total Growth %	I.C.O.R's	Population (million)
	1	2	3	4	5	6	7	8
1. Sudan	67	15				6.9	2.17	12.8
2. Viet-Nam Rep.	73	9	8	1	11	2.9	3.10	15.3
3. Uganda	75	12				3.3	3.63	7.2
4. Burma	80	18	19	—1	—5	4.0	4.50	23.7
5. Kenya	88	12						8.8
6. Thailand	113	20				5.5	3.64	28.8
7. Taiwan	122	19	20	—1	—6	7.1	2.67	11.7
8. Phillipines	127	15	18	—3		4.1	3.65	30.2
9. Korea, Rep. of	134	17	15	2	13	6.2	2.74	26.9
10. Ceylyïn	138	13	11	2	16	2.2	5.90	10.6
11. Bolivia	143	16	11	5	30	4.9	3.27	3.6
12. U.A.R.	154	20	15	5	23			28.0
13. Iran	176	14		—4		3.4	4.11	22.2
14. Ecuador	187	17	14	3	16	4.0	4.25	4.7
15. Honduras	195	15	12	3	17	4.0	3.75	2.1
16. Tunisia	198	22				5.2	4.23	4.5
17. Jordan	204	14	7	7	51	4.0	3.50	1.8
18. Ghana	207	18						7.3
19. Malaysia	236	19	16	3	14	6.1	3.11	7.6
20. Zambia	236	16				3.4	4.70	3.5
21. Costa-Rica	266	16	11	5	28			1.3

(continued)

Countries	Per capita Income ($)	Ratio of Investment to GNP (%)	Ratio of Savings to GNP (%)	Ratio of Current A/C to GNP (%)	Ratio of Current A/C Deficit to GDCF (%)	Rates of Total Growth (%)	I.C.O.R's	Population (million)
	1	2	3	4	5	6	7	8
22 Colombia	268	11	7	4	35	4.4	2.50	16.9
23. Mauritius	270	17						0.7
24. Guatemala	283	11	8	3	24	6.1	1.80	4.1
25. Turkey	290	13				4.6	2.82	30.2
26. British Guiana	291	20	18	2	10			0.6
27. Malta + Goso	372	23	17	6	28			0.3
28. Barbados	386	21	10	11	54	5.2	4.04	0.2
29. Portugal	387	18	17	1	8	6.1	2.95	9.0
30. Greece	412	23	19	4	17	8.5	2.70	8.5
31. Chile	446	13	11	2	17	3.5	3.71	8.2
32. Panama	465	19	15	4	22	7.9	2.40	1.2
33. Spain	504	25	24	1	4			31.1
34. Jamaica	510	19	18	1	6	4.0	4.75	1.7
35. Uruguay	558	14	12	2	13	0.2	—	2.6
36. Trinidad-Tobago	608	30	20	10	32	10.6	2.83	0.9
37. Japan	640	38	37	1	3	10.8	3.52	95.9
38. Cyprus	655	28				2.6	10.77	0.6
39. S. Africa	666	21	22	—1	—3	5.9	3.55	17.0
40. Veezuela	716	20	25	—5	—23	5.0	4.00	8.2
41. Ireland	729	20	17	3	15	4.2	4.76	2.8
42. Puerto-Rico	895	27	10	17	63	8.4	3.21	2.5
43. Finland	897	29	27	2	5	5.3	5.47	4.5
44. Austria	966	25	25	—	0	4.1	6.10	7.2
45. Italy	995	23	23	—	0	5.7	4.03	50.6
46. Netherland	1321	27	26	1	0	4.6	5.86	12.0
47. Belgium	1374	20	20	—	0	5.2	3.84	9.3

(continued)

Countries	Per capita Income ($)	Ratio of Investment to GNP (%)	Ratio of Savings to GNP (%)	Ratio of Current A/C to GNP (%)	Ratio of Current A/C Deficit to GDCF (%)	Rates of Total Growth (%)	ICOR's	Population (million)
	1	2	3	4	5	6	7	8
48. France	1498	22	21	1	5	5.4	4.07	47.8
49. Denmark	1557	22	21	1	5	4.9	4.49	4.7
50. United Kingdom	1607	18	18	—	2	3.4	5.29	53.8
51. Germany F.R.	1648	27	27	—	1	4.9	5.51	55.4
52. Australia	1718	29	25	2	8	4.7	5.74	10.9
53. Norway	1743	22	27	−2	8	5.4	5.37	3.7
54. Sweden"	1941	24	24	—	1	5.3	4.53	7.6
55. Switzerland	1976	30	27	3	11	5.5	5.45	5.8
56. Canada	2011	23	22	1	5	5.1	4.50	18.9
57. N. Zealand	2046	24	23	1	5	4.1	5.85	2.5
58. U.S.A.	2853	17	18	−1	4	4.3	3.95	189.4

Notes and Sources to Appendix Table

Column 1 : Per capita income for 1963, taken from United Nations, Yearbook of NationalAccounts Statistics 1965, New York, I966.

Column *1* : Ratio of Gross Domestic Capital Fornation (GDCP) at current market prices to Gross National Product (GNP) at current market prices for 1963/64 (average).
For the following countries the average period was: 1962/63 : Burma, Sudan, Thailand, Iran, Honduras, Jordan, Colombia, Costa-Rica. Trinidad & Tobago, Uruguay.
1961 ,'1963': British Guiana.
1960/61 : United Arabic Republic (U.A.R.).
For Uganda and U.A.R. we have GDP at factor cost. The above-mentioned periods are referred to columna 3, 4 and 5, as well.

Column 3 : Percentage ratio of Gross Savings to GNP at current market prices. «Gross savings» is identical to the national accounting concept of «Savings plus the amount of depreciation (=Provisions for the consumption of fixed capital).

Column 4 : Percentage ratio of deficit of the nation on current external account to GNP at current market Prices. Minus signs (—) denote surplus on current account, and this means that gross savings are more than gross domestic capital formation.

Column 5 Proportion of Gross Capital Formation at current market prices financed by external resources measured by deficit on current external account.

Source for Columns 2, 3, 4 and 5 : United Nations, Yearbook of National Accounts Statistics, 1965, New York 1966 (National Tables No. 1, 3, and sometimes 8).

Column 6 : Average annual geometric rates of growth of real Gross Domestic Product at market prices, 1960-64, except for some countries shown as follows :
1960-62: Sudan.
1960-63: Viet-Nam, Burma, Thailand, Taiwan, 1.an, Honduras, Malaysia, Colombia, Portugal, N. Zealand.
1961-63 : Jordan.
Current prices : Barbados, Jordan.
Source: U. N. National A/c Statistics, Table 4A.

Coiumn 7 : Ex-post Capital-Output Ratios arrived at by dividing investment rates (Column 2) by rates of Growth of GDP (Column 6). The periods for investment rates and giowth rates of GDP do not coincide, but we made the assumption that investment rates for individual countries are held constant in such a short period. like 1960-64.

Columns : Population in million 1963, mid-year estimates, taken from U.N. Monthly Bulletin of Statistics, Sept. 1963, May 1966 and Démographie Yearbook, 1961.