FOREIGN TRADE ASPECTS OF CAPITAL FORMATION*

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1. *Introduction*

Imports were given a treatment as a leakage similar to a savings leakage in income-multiplier analysis. Little attention was paid to the role of imports as a factor either facilitating or limiting economic development. Imports of capital goods and intermediate materials used as input in production called attention in economic literature some years ago.

In this study we shall deal only with capital goods imports and especially with the import-content of investment in the course of economic development measured by per capital income. Capital, labour and natural resources are the determining factors of production and economic growth. The framework within capital problems are tackled here is formed by assumptions such as :

(a) There exists, if at all, a narrow range of factor substitution in underdeveloped countries, in contrast to what was maintained untriedly in developmental economics literature (1). W. Leontief stresses the fact that interrelationships in an interdependence system are determined largely by technology and approximately turn out to be constant both in underdeveloped and advanced economies (2).

(b) As a by-product of the first assumption, the constant coefficients hypothesis in an interdependence system seems to be close to reality.

(c) Skilled-labour shortage may be effective from an operation scale on and it may operate as a constraint on the possibility curve.

(d) Natural endowment differs from country to country and necessary inputs for a certain output mix are made available through trade.

(e) I.C.O.R's are expected to rise at advanced stages of development and

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1. Cf. *A. O. Hirschman*, The Strategy of Economic Development, 1964, p. 151.

2. *Input - Output Economics*, 1966, Chapter 4, The structure of Development, p. 42.

domestic capital formation curve shifts upward as the economy is more «capitalised».

(f) The possibility of imported technology in underdeveloped economies increases the likelihood for trade in capital goods to be a factor of growth and consequently a constraint on growth. We rather assume a common process of production in many lines both in advanced and underdeveloped countries, that is when the production of a certain commodity requires machinery, we exclude the possibility of producing it without machinery.

(g) Complex machinery or strategic capital goods are imported and not domestically produced in underdeveloped countries.

Apart from the analysis of import-content of investment, a theoretical model, based on various assumptions, is described combining growth and trade considerations. Implications and discussion on regression models of import-content of investment and dependence on foreign resources for investment finance, and connexion of regression findings with the theoretical growth-trade model are the main points in this paper.

2. *Capital Formation and Foreign Trade: A discussion of models*

Capital goods are not particularly treated in traditional trade models and if they are, little attention is paid. First of all, classical models assume capital immobility as between countries, and capital stocks unchangeable. Even when international capital movements were introduced by neoclassical models the discussion was limited to the so-called «transfer problem».

The so prevalent theory of comparative cost in its static sense does not contribute much to the solution of practical problems and to the explanation of the changing pattern of production and trade of countries which economically emerged in the twentieth century. *Heckscher-Ohlin* theory as an analytical tool cannot contribute much in showing the possibility of a change in the physiognomy of the economy. The Heckscher-Ohlin model, according to which one country exports goods having the relatively abundant factor, holds with the hypothesis that factor supply does not change; however, when trade occurs we should expect the factor supply to change. We must add that according to the late *S. Valavanis* (1), Ohlin was clear on the point that produced means of production (capital goods) are irrelevant to a country's comparative advantage and not a fundamental feature of its factor endowment (2). Whether we accept this last proposition or not, the critique on the Heckscher-Ohlin theory remains.

S. Valavanis - Vail, «Leontief's Scarce Factor Paradox», *Journal of Political Economy*, December 1954.

2. *R. Caves*, Trade and Economic Structure, Models and Methods, Harvard University Press, 1963, p. 95.

Moreover, in this discussion we must cite *C. Inversen's* (1) opinion that capital goods are not capital (meaning funds) but a part of traded goods no less (and no more) than consumers' goods. International capital movements imply the purchasing — lent and borrowed — power over goods and services and they do not comprise particular goods (2).

However, trade in capital goods is not the same as trade in consumption goods since the former add to the economy's capital stock and hence to productive capacity. Generally, capital accumulation affects the terms and volume of trade and this in turn affects capital accumulation in a two-way causation. More appropriate to deal with problems of accumulation and trade is dynamic theory, which has not yet been formally formulated, though some interesting models appeared during the last years. Dealing with capital accumulation, these models bring out the whole point by presenting non-trading and opening-up-trade situations leaning to, more or less, the Austrian concepts of capital.

In this connexion changes in factors supply, as capital accumulation, may arise changes in output patterns, increasing the production of one product and decreasing the production of another which does not use intensively the expanding factor. In this way another produce, intensive in the factor which is expanding, will start to be produced. Scrutinising the relationships of trade and production patterns we must take account of the dynamics of alterations occurred, which according to *J. Bhagwati* (3), form the given «data». Modifications of classical analysis take into account likely shifts in «data» (like changes in factor supply, demand, factor movements, etc.), and along this line of thought a number of theoretical models were elaborated. But since all the models hitherto presented are purely theoretical failed to give any explanation of the real world.

H. Johnson (4) using Harrod-Domar and Keynesian approaches presented a model in 1953 with the purpose of tracing the equilibrium rate of growth as influenced by external trade. His analysis proceeds from a single country to a two-country model, and from certain assumptions (like : investment and intermediate goods exclusion, capital inflow as only accommodating not involving interest payments) to a successive dropping of these assumptions. The conclusions he reached are of limited practical application as he himself admits (5). In this context we are not interested in this theoretical model but

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1. *C. Inversen*, Some Aspects of the Theory of International Capital Movements, Copenhagen 1936.
2. *R. Caves*, op.cit., p. 134.
3. *J. Bhagwati*, «The Pure Theory of International Trade : A Survey», in *Surveys of Economic Theory*, Volume II, 1965, pp. 203 - 206.
4. *H. Johnson*, International Trade and Economic Growth, Studies in Pure Theory, Chapter V.
5. Ibid., p. 120.

only probably in the part of his model which considers the case in which import-content of investment expenditure is involved, and is described by the following formula :

$$r = \frac{a}{1 - m'} \left(s + m - \frac{X}{Y}\right)$$

where r is the rate of growth, m' is the fraction of investment expenditure spent on imported goods (assumed to be constant), a is the reciprocal of the capital coefficient, s is the savings ratio, m represents the fraction of income spent on consumption imports (constant), X stands for exports current rate, and Y is the capacity rate of output.

The above formula can be written as

$$r = \frac{a}{1 - m'} (s \pm b)$$

where b is the country's export surplus (—) or deficit (+) expressed as a fraction of her output. It is obvious from this formula that a increases by dividing it by (1 — m') and hence the rate of growth increases too.

Again H. Johnson (1) in another paper presented in 1955 examines the results of an expansion, coming from particular factors, on volume and terms of trade in cases of both complete and incomplete specialisation between two countries, an industrial (Mancuria) and an agricultural one (Agraria). He begins with international immobility of labour, capital and technology (Part I and II) and concludes with relaxation of this assumption (Part III).

The more interesting model of trade and capital accumulation was presented by *D. M. Bensusan-Butt* (2) studying the effects of accumulation on trade. D.M. Bensusan-Butt's model is a two-country, multi-commodity model with two alternative processes for each commodity production (with and without machinery). The countries are similar in all respects except their stock of capital. He unfolds a sequence of phases (seven) in which capital accumulation leads to mechanisation and emergence of exports of accumulating country, and in this sense the model is a dynamic one. A certain merit of the model is that it considers the size of countries which, as we demonstrate in many points of this study, is important in the study of relationships of trade and development. If a country is small then the accummulation will occur in one sector which absorbs all the factors and the country is obliged to import in order to satisfy the demand of the people who acculumate in the expanding sector.

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1. *H. Johnson*, op.cit., Chapter III.
2. *D. M. Bensusan - Butt*, «A Model of Trade and Accumulation», *A.E.R.*, September 1954, pp. 511 - 29.

A similar model studying the effects of capital accumulation on trade lies embedded in *W.A. Lewis*' «Economic Development with Unlimited Supplies of Labour», *Manchester School*, May 1954 (1).

Another elegant mathematical model was presented by *H. Oniki* and *H. Uzawa* (2) studying the effects of trade on capital accumulation over time, and in this connexion the model is a dynamic one. The analysis is based on a two-country, two-factor, two-sector model assuming constant technology, constant returns to scale, identical quality of labour and capital in both countries, constant average propensity to save throughout the accumulation process, and specialisation to depend on factor endowments. Nevertheless, the comparative advantage of each country varies over time as the capital accumulation process proceeds and the changing terms of trade effect, in turn, the rate of accumulation. In this model trade in capital goods enters into via the following equation:

$$Y_I^i(t) = F_I\,[\,K_I^i(t), L_I^i(t) + X_I^i(t)\,].$$

where gross investment in country i at time t ($Y_I^i(t)$) depends upon the domestic production of the investment goods in the I-sector $F_I(K_I^i(t)), L_I^i(t)]$ and foreign import of investment goods ($X_I^i(t)$).

The model does not consider the size of countries, as Bensusan - Butt's does, but it takes into account the relative size of labour forces in the two countries.

In a short article *R. E. Baldwin* using comparative statics analyses the effects both of trade in capital goods on growth and of growth on trade of capital goods making explicit the importance of capital goods trade so far neglected in conventional theory (3). He begins with considering the pattern of accumulation within a country in the absence of both trade in capital goods and international capital movements; he proceeds considering the effects on accumulation process if international trade in both consumption and capital goods is opened up; and he concludes by dropping the assumption that capital is immobile between the two countries.

In Baldwin's model, savings is made a function both of the interest rate and the level of income, whereas in Oniki - Uzawa's model a constant average propensity to save throughout the accumulation process is postulated which does not get any support from empirical evidence.

As has been understood from the above mentioned models the appro-

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1. See *R. Caves*, op.cit., p. 250.
2. *H. Oniki and H. Usawa*, «Patterns of Trade and Investment in a Dynamic Model of International Trade», *Review of Economic Studies*, January 1965, pp. 15 - 38.
3. *R. E. Baldwin*, «The Role of Capital Goods Trade in the Theory of International Trade», *A.E.R.*, September 1966, pp. 841 - 7.

ach to the problem was based both on trade and on growth theory. In the above way growth theory intruded into trade models and in this respect growth theorists helped in forming an integrated body of theory. Today, neither body of theory, trade or growth theory, remains waterproof, and from this integration more complete models started to appear.

Although the contribution of these theoretical models to the pure theory is important, they have not been susceptible to empirical testing. As far as we are concerned with empirical investigation of trade-development relationships and patterns, some econometric or statistical models developed recently are of more interest. Some studies appeared dealing with trade as a factor of growth and a potential constraint on growth are :

H. Chenery and M. Bruno, «Development Alternatives in an Open Economy : The Case of Israel» (1),

H. Chenery and I. Adelman, «Foreign Aid and Economic Development : The Case of Greece» (2),

H. Chenery and A. M. Strout, «Foreign Assistance and Economic Development» (3),

R. I. Kinnon, «Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation» (4), and a study by *J. Vanek*, «Estimating Foreign Resource Needs for Economic Development : Theory, Method and a Case Study of Colombia», 1967.

Apart from the above mentioned studies which deal with foreign capital requirements as determined by the «two gaps» approach and the importance of trade as a constraint on growth, it might be relevant with this chapter to mention two other studies : the vast volume of important work of *A. Maizels* (5), who in Chapter 7 is dealing with the pattern of imports in relation to economic growth, and in Chapter 10 with the demand for capital goods and the import-content of investment for eighteen countries; and an article by *J. C. Du Plessis* (Investments and the Balance of Payments of S. Africa) (6), dealing with the role played by balance of payments in development problems and especially in small countries dependent on foreign trade. He starts with investigating the contribution of each sector to the S. African Balance of Payments and then the import-content of investment in each industry.

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1. *Economic Journal*, March 1962, pp. 79 - 103.
2. *Review of Economics and Statistics*, February 1966, pp. 1 - 19.
3. *A.E.R.*, September 1966, pp. 679 - 733.
4. *Economic Journal*, June 1964, pp. 368 - 409.
5. Industrial Growth and World Trade, Cambridge, 1963.
6. *S. African Journal of Economics*, December 1965.

3. *A Model of Trade and Capital Formation : A theoretical formulation of constraints on growth*

In this section we attempt to construct a model of growth and trade in capital goods distinguishing a non-trade case and a trading case with sub-cases.

Our formulation uses the familiar Harrod - Domar production function and social accounting concepts to show the impact of capital goods imports on productive capacity of the economy by separating investment into a home produced content and an imported content, on the one hand, and to establish different constraints imposed on growth under different assumptions, on the other hand.

A. *Non-Trade Case*

The economy produces two final products : consumption and capital goods. Capital goods, though final products, do not appear in a separate column like consumption goods (Ci), but they are determined by the interflows in the capital input - output matrix.

Accumulation of capital is possible by abstaining from consumption and thus devoting resources to capital goods production. Production of capital goods calls for more time, and the more capital goods we want, the more savings and «waiting» are necessary. In this case two constraints on growth arise, coming from savings propensity and «time».

The basic Domar relation is

$$\Delta Q = \sigma I \tag{1}$$

which denotes the increase in capacity output, measured by the value of output produced, caused by investment made in previous periods being in a certain relation shown by σ.

In a closed economy we assume always equilibrium between savings and investments

$$S = I \text{ (equilibrium condition)} \tag{2}$$

From (1) and (2) we have

$$\Delta Q = \sigma S \tag{3}$$

and

$$\frac{\Delta Q}{Q} = \sigma s \qquad 0 < s < 1 \quad \left(\text{where } s = \frac{S}{Q}\right) \tag{4}$$

Equation (4) is a Harrod - Domar - type production function and on integration we get

$$Q_t = Q_0 e^{\sigma s t} \quad \text{or} \quad Q_t = Y_0 (1 + \sigma s)^t$$

From the above simple model it turns out that productive capacity depends on investment, and in equilibrium situation net income accommodates itself in equating increased capacity with increase in income

$$\Delta Q = \Delta Y \quad \text{(equilibrium condition in Domar)} \qquad (6)$$

Investment depends on savings, and savings on per capita income. If per capita income is very low we shall expect low or negligible savings, capital accumulation very slow, and the possibility for production possibility curve of the economy to shift outward very slight.

From equation (4) it turns out that the effective constraint on growth (growth rate) is savings (as a proportion over income) holding σ constant. Since σ depends upon a number of factors any change in them might cause a disturbance in σ in a particular country, in which case we should revise the constant relationships in our system. In advanced stages of economic development the capital-output ratio has turned to be high and it might turn to operate as a constraint on growth.

However, we must not get into the illusion that at low levels of per capita income the only constraint on growth is savings. As we have already seen savings may be unexploited when there is no inducement to invest, no absorptive capacity, and so on, because of discouragement due to the small size of economy, low per capita income, absence of banking system, etc.; and more likely because of absence of entrepreneurship and appropriate skills. In this case skills operate as a constraint on growth.

In a interdependence system (accounting matrix) we have schematically :

	Production	Accumulation	Appropriation	Total
Production	AQ	KΔQ	C	Q
Finance	O	O	S	S
Income	Y	O	O	Y

The flow equation of the system is :

$$Q = AQ + K\Delta Q + C$$

where A is the constant input coefficients'matrix

Q is gross output

K is the capital input coefficients'matrix

Finally, the solution of the flow equation is

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

B. *Trading Case*

Compared with the situation where no trade takes place, trade in capital goods accelerates capital accumulation since it provides the possibility of increasing capital stock in the economy by exchange of consumption goods for capital goods or by foreign loans. In this sense foreign trade can increase the possibilities of capital accumulation and hence to increase output and per capita income in a definite period of time. Capital accumulation facilitated by foreign trade changes the range of comparative advantage pattern of underdeveloped countries, it opens up the possibility of industrialisation and it makes them potential exporters of manufactured goods or at least producers of import - substitutables. In this way per capita incomes are increasing faster and savings potential and future capital accumulation are increasing as well.

The assumptions made in the introductory section of this paper hold in this case and especially it should be noted that in our interdependence system a minimum of imported inputs is necessary to attain an increase in output. Thus the item of investment consists of a domestic input and an imported component, and hence an increase in output presupposes an increase both in the domestically produced component and in the imported component of investment required for this purpose.

We shall divide this case into sub-cases as follows :

(a) *Imports of capital goods are financed by exports of consumption goods*

By exchanging consumption goods for capital goods the economy can enhance its productive capacity and push the production possibility curve outward.

We a sume international immobility of capital and we discern two cases as follows :

(i) *Infinite elasticity of export supply and constant demand for countries' exports*

Any requirement of imported inputs is accommodated by exports. The model will be the same as the previous one, but investment is composed of domestically produced $(1 - \mu_v)$ and imported (μ_v) capital goods, i.e.

$$I = \mu_v I + (1 - \mu_v) I \tag{7}$$

and hence

$$\Delta Q = \sigma [(\mu_v I + (1 - \mu_v) I] \tag{8}$$

The Harrodian equilibrium condition holds, i.e.

$$S = I \tag{9}$$

and

$$\frac{\Delta Q}{Q} = \sigma s \tag{10}$$

The Domar equilibrium condition holds as well

$$\Delta Q = \Delta Y \tag{11}$$

through an investment multiplier.

Since we assume that export supply is completely elastic, the demand for countries'exports constant and σ constant, the effective constraint on growth is savings and the allowable rate of growth is determined by (10). Moreover, in an open (trade) model time is not a limiting factor any more.

Our interdependence system, after accounting for imported inputs of investment, exports and savings will be schematically as follows :

	Production	*Accumul.*	*Appropr.*	*Exports*	*Total*
Production	AQ	$(1-\mu_v)K\Delta Q$	C	X	$=Q$
Finance	0	0	S	0	$=S$
Income	Y	0	0	0	$=Y$
Imports	0	$\mu_v K\Delta Q$	0	0	$=Mv$

From the above system we have the domestic production equation

$$AQ + (1-\mu_v)K\Delta Q + C + X = Q \tag{12}$$

and its solution

$$Q = (1 - A - K\Delta + \mu_v K\Delta)^{-1}(C + X) \tag{13}$$

The investment equation is

$$K\Delta Q = \mu_v K\Delta Q + (1-\mu_v)K\Delta Q \tag{14}$$

or

$$I = \mu_v I + (1-\mu_v)I \tag{15}$$

and he following identities hold

$$AQ + Y = AQ + (1-\mu_v)I + C + X \tag{16}$$

$$S = (1 - \mu_v)\, K\Delta Q + \mu_v\, K\Delta Q = I \qquad (17)$$

$$Y = C + S \qquad (18)$$

$$\mu_v\, K\Delta Q = M_v = X \qquad (19)$$

From (17) and (19) we get

$$S = (1 - \mu_v)I + M_v \qquad (20)$$

which shows that savings equal the sum of domestically produced and imported capital goods.

The balance of payments equation is

$$B = X - M_v = 0 \qquad (21)$$

(we could have $X > Mv$, but we exclude this case). If we insert balance of payments into equation (8) we get

$$\Delta Q = \sigma (S + B), \text{ where } B = 0 \qquad (22)$$

and

$$\frac{\Delta Q}{Q} = c(s + b) \qquad (23)$$

where $b = \frac{B}{Q}$, and ΔQ is the increase in output capacity.

(ii) *Dropping Assumption (i)*

The assumption of infinite elasticity of exports and constant demand for countries'exports does not hold any more. Capital inflow is excluded and requirements for imported inputs hold.

The model will be the same as in case (i); however, in case (ii) the effective constraint on growth is not savings but the import - content of investment ($\mu_v I$), and the desired increase in output capacity

$$\Delta Q = \sigma\mu_v I + \sigma (1 - \mu_v)I$$

will be frustrated by the minimum requirements in imported inputs ($\sigma\mu_v I$) which cannot be accommodated by exports. Thus the allowable rate of growth is restricted by $\sigma\mu_v s$:

$$\frac{\Delta Q}{Q} = \sigma\mu_v s + \sigma (1 - \mu_v)\, s$$

The external accounts will be balanced, but at a low equilibrium growth rate. In this case the balance of payments equilibrium does not help the ex-

ploitation of economic resources of a country and hence economic development is slow.

(b) *Imported capital goods are financed partly by exports and partly by foreign loans*

The assumption of international immobility of capital is relaxed here and capital goods imports are partly financed by foreign loans, which is the purchasing power acquired by borrowing country over capital goods and which was termed as capital movement in neoclassical trade models (Ohlin). By definition, the elasticity of export supply is not infinite any more since additional imports are made through borrowing.

In this case the import - content of investment, technologically determined by our interdependence system, is beyond the export potential of the economy and capital inflow is necessary. The allowable rate of growth or the increase in output will be higher than the rate of growth that country could achieve by using its own resources. As long as foreign capital is available easily and painlessly, balance of payments is not a limit to growth.

Our interdependent system, after accounting for foreign finance (F), is presented schematically as follows :

	Production	*Accumul.*	*Appropr.*	*Exports*	*Total*
Production	AQ	$(1-\mu_v)\,K\Delta Q$	C	X	$=Q$
Finance	0	0	S	F	$=S+F$
Income	Y	0	0	0	$=Y$
Imports	0	$\mu_v\ K\Delta Q$	0	0	$=M_v$

The above accounting matrix shows that the following identities hold :

$$Y + AQ = AQ + (1-\mu_v)\,K\Delta Q + C + X \tag{24}$$

$$S + F = (1-\mu_v)\,K\Delta Q + \mu_v\,K\Delta Q = I \tag{25}$$

$$Y = C + S \tag{26}$$

$$X + F = \mu_v\,K\Delta Q = M_v \tag{27}$$

The solution of the production equation

$$Q = AQ + (1-\mu_v)K\Delta Q + C + X \tag{28}$$

is again

$$Q = (I - A - K\Delta + \mu_v\,K\Delta)^{-1}\,(C + X) \tag{29}$$

The balance of payments equation is

$$B = M_v - X = F \tag{30}$$

We write down again the production function

$$\Delta Q = \sigma\mu_v I + \sigma (1 - \mu_v) I \tag{31}$$

where ΔQ is the increase in output capacity.

Now, the savings-investment equilibrium condition will be equation (25), $S + F = I$, and consequently

$$\Delta Q = \sigma(S + F) \tag{32}$$

In equation (32) the balance of payments is inserted, and being analysed it becomes

$$\Delta Q = \sigma(S + M - X), \tag{33}$$

or

$$\Delta Q = \sigma S + \sigma F, \text{ and } \frac{\Delta Q}{Q} = \sigma s + \sigma f \tag{34}$$

$$\Delta Q = \sigma S + \sigma M - \sigma X, \text{ and } \frac{\Delta Q}{Q} = \sigma s + \sigma m - \sigma x \tag{35}$$

(where $f = \frac{F}{Q}$, $m = \frac{M}{Q}$, $x = \frac{X}{Q}$).

As shown by the above equations the allowable increase in output capacity (keeping in mind the equilibrium condition that $\Delta Q = \Delta Y$), or the rate of growth is now determined not merely by domestic savings but additionally by foreign savings flown into the economy.

If we assume that a rate of growth equal to σs is the allowable one by countries' own resources, then a rate of growth equal to $\sigma(s + f)$ which can be achieved through usage of foreign resources, is greater.

The same conclusion can be arrived at by following an algebraic procedure similar to that used by *R. J. Ball* (1):

We postulate a simple relationship like

$$F = \lambda\Delta Q, \ \lambda > 0, \tag{36}$$

denoting that the annual capital inflow is induced by changes in output (but

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1. *R. J. Ball*, «Capital Imports and Economic Development: Paradoxy or Orthodoxy?», *«Kyklos»*, Vol. XV, 1962, pp. 610 - 21.

part of F may be exogenous) and where λ is a «debt accelerator». Then we have

$$\Delta Q = \sigma S + \sigma\lambda\Delta Q \tag{37}$$

by combining (34) and (36); and

$$\frac{\Delta Q}{Q} = \sigma s + \sigma\lambda \frac{\Delta Q}{Q} \tag{38}$$

$$\frac{\Delta Q}{Q} = \frac{\sigma s}{1 - \sigma\lambda} \tag{39}$$

It is obvious that equation (39) gives a higher growth rate than equation $\frac{\Delta Q}{Q} = \sigma s$ if $\sigma\lambda < 1$.

Up to here everything is all right. Foreign capital leads to accelerated capital accumulation which in turn might lead to structural changes in the economy and likely change in trade structure. As long as a country can obtain imported inputs without any foreign exchange difficulty, no import constraint appears and a high growth rate can be achieved (1).

However, unlimited foreign finance is impossible in practice from many points of view. Firstly, foreign loans are sometimes undesirable because of high interest rates, short repayment periods and short, if any, grace periods. Capital imports can continue as long as the burden per unit of borrowing capital is less than its marginal productivity. Theoretically, as soon as interest rate (including other burden) equals marginal productivity no foreign lending is assumed, or capital imports cease (2). *B.F. Massell*, in his critique on J.R. Ball's article, asserts that capital imports increase the rate of growth of national income if the marginal output-capital ratio exceeds the interest rate (3). Thus the rate of growth is allowed to increase in an accelerating fashion up to the point where marginal productivity of capital equals interest rate; that point can be considered in this connexion to

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1. According to H. Chenery's model (AID model), external capital requirements are determined by the cumulative difference between import requirements and exports in case minimum imports are necessary to sustain a given level of G.N.P., and by the cumulative difference between investment and savings in case investment is essential to sustain a given level of G.N.P.

2. *M. C. Kemp*, The Pure Theory of International Trade, New Jersey, 1964, pp. 192 - 207.

3. *B. F. Massel*, «Exports, Capital Imports and Economic Growth», *«Kyklos»*, Vol. XV, 1962, p. 633.

be essentially a limitation to past acceleration of growth rate.

Secondly, it is debatable if the so far or currently foreign loans and assistance given to developing countries suffice to accomplish purpose such that to increase per capita income to a level from which sustained growth starts and income disparities between rich and poor countries close. It is more problematic and ambiguous if underdeveloped countries can continuously secure foreign finance to accommodate a high rate of growth. Since without capital imports underdeveloped countries would be unable to achieve high rates of growth, the availability of foreign exchange imposes a definite ceiling on the rate of growth; and from this point of view some economists are pessimistic (1).

Thus it turns out that as long as inflow of foreign capital and assistanse is easily accessible on good terms, economic development can go on without any constraint imposed by import requirements. But when capital inflow becomes a problem and export earnings are insufficient, an import constraint is more likely to appear. The so far made discussion is to be connected with the following statistical analysis and enhanced in the following sections.

One more point should be made here. Then economic development is constrained by trade, a wise export promotion policy (for small countries) and a careful import-substitution policy (for large countries) should be pursued by underdeveloped countries in order to cope with such difficulties.

3.1. *A diagrammatic representation of trade and capital formation*

The fact that imports of capital goods and foreign finance facilitate and augment the economy's possibilities to exploit internal resources and accelerate development can be presented by means of diagrammatic representation corresponding to situations described in the preceding section.

We can discern and present three situations in Figure 1.

Situation (a) represents a closed economy where domestic product is devoted to consumption OC and to savings CY (= S). The productive capacity OQ is limited by exclusive internal resources. Investment OI equals savings (S = I).

Situation (b) represents a trading case where half of savings are devoted to production of exportables (X) which is exchanged for capital goods imports M_v. Thus investment goods are the sum of domestically produced, OId, and imported investment goods, IdM_v. Imported investment goods equal exports (M_v = X). Assuming that imported investment goods are important and they exploit and supplement internal resources in a fuller manner, the productive capacity of the economy is augmented from OQ_1 to OQ_2,

1. *H. J. Bruton*, «Growth Models and Underdeveloped Economies, in *Agarwala and Singh*, The Economics of Underdevelopment, Oxford, 1963, pp. 238 - 9.

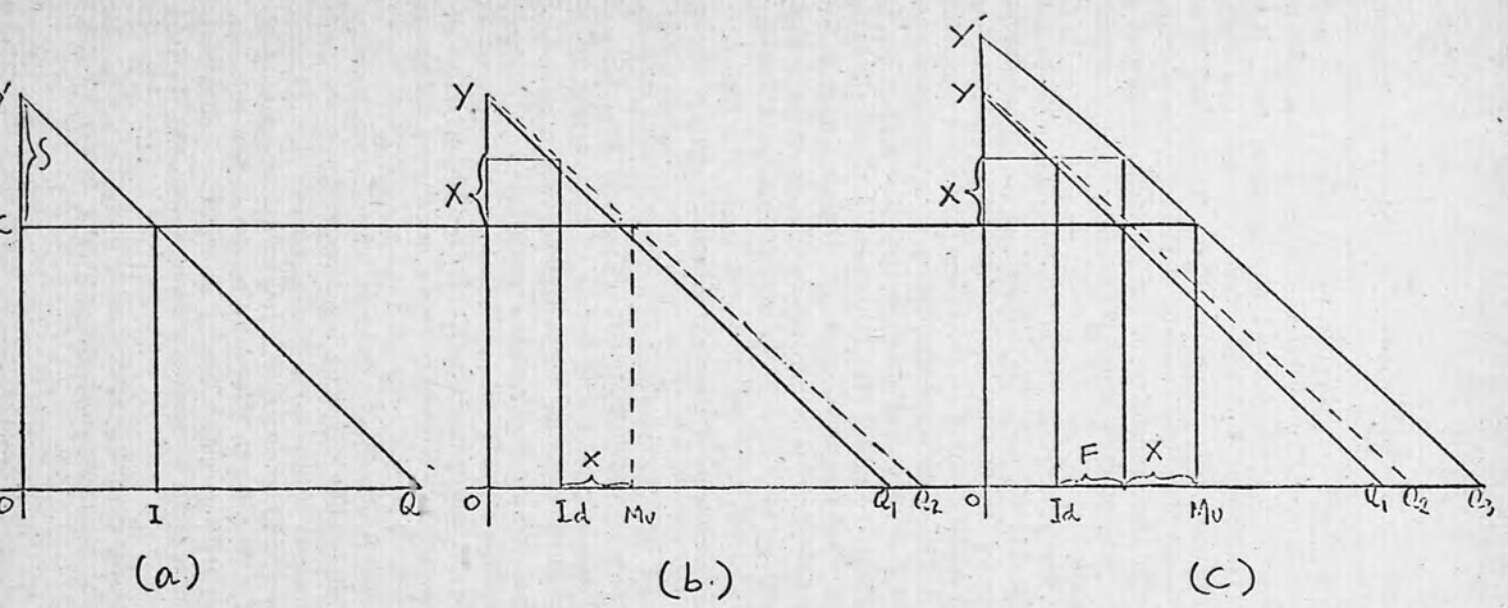

Fig. III-1 Diagrammatic representation of Trade and Capital formation relationships.

TABLE 1

(a) *International Comparison of Import Coefficient of G.D.C.F., 1960 - 63, in relation to per capita income, 1963, Fifty nine countries.*

Import Coefficient of G.D.C.F. (%)	Income Classes ($)						Total
	$ 0 - 149	150 - 249	250 - 449	450 - 649	650 - 1149	1150 - above	
0 - 9				1 (Japan)		3 (U.S.A., U.K., Germany)	4
10 - 19				2 (Spain, Uruguay)	1 (Italy)	1 (France)	4
20 - 29	3	4	2		1	3	13
30 - 39	4	3	3	3	3	2	18
40 - 49	3	4	4		1 (Cyprus)	3	15
50 - 59		1 (Jordan)	2 (Mauritius, Br. Guiana)		1 (Ireland)		4
60 - 69							0
70 - 79	1 (Kenya)						1
80 - 89							0
90 - 99							0
	11	12	11	6	7	12	59 (Countries)
Arithmetic mean	38.6	36.7	40.5	23.3	35.0	25.8	34.0
Arithmetic mean (Averages)		37.6		34.4		29.2	

TABLE 1 (cont'd)

(b) *Import Coefficients of G.D.C.F. (Y) tabulated as a function of per capita income (X)*

X	Y	$\sigma_{\bar{y}}$	N (Countries)	
$ 0 - 149	38.6	4.3	11	$R^2 = .22$
150 - 249	36.7	3.0	12	$R = .47$
250 - 449	40.5	3.1	11	
450 - 649	23.3	5.4	6	
650 - 1149	35.0	4.8	7	
1150 - above	25.8	4.5	12	
Total	34.0	1.8	59	

$F = 3.1$ ($n_1 = 5$, $n_2 = 53$; $F_{.05} = 2.39$, $F_{.01} = 3.39$)

as a consequence of the fact that investment is a bit more than in situation (a), i.e. $OM_v > OI$.

Situation (c) is similar to situation (a), but savings are supplemented by transfer of foreign savings equal to YY'. These additional foreign resources are used to finance imports of capital goods equal to F. Thus total investment goods imports are equal to (F + X), and the total investment in the economy is OM_v (= Id + F + X).

4. *The Import Content of Investment: A cross-section regression analysis*

Any increase in output calls for investment determined technologically by an input-output system. At different levels of output the demanded volume of capital goods will be different.

The relationship between denand for capital goods and economic development is positive. Since capital formation contains an imported ingredient, it turns out that demand for imported capital goods will be higher as economic activity rises. *A priori* notions about the import content of investment in relation to various stages of economic growth and other variables are testified by the following cross-section statistical model.

As can be seen from Table I, there is a very fair association between the import coefficients (percentages) of Gross Domestic Capital Formation and Per Capita Income Levels, the correlation coefficient and the determination coefficient being .47 and .22 correspondingly. The F-value, testing the significance of correlation, is significant at the .05 level but not at the 0.1 level.

The analysis dœs not show any significant correlation between the import content of investment in Machinery and Equipment and per capita incomes either. The observed F-value is smaller than F.05. (Table 3).

Things are different when we correlate the variable under consideration with the size of country measured by population. Indeed, it seems that the import coefficient of G.D.C.F. decreases as the size of country increases, the correlation and determination coefficients being .65 and .42 correspondingly. The F-value is significant at both levels. (Table 2) Again, correlating the import content of investment in Machinery and Equipment with the size of countries we found a significant association between these two variables. (Table 4).

TABLE 2

(a) *International Comparison of Import Coefficient of G.D.C.F.* (1960 - 63) *in relation to population*, 1963, *Fifty-nine countries*

Import Coefficient %	Population (million)				
	Up to 12	13 - 24	25 - 36	37 - above	Total
0 - 9	0	0	0	4	4
10 - 19	1	0	1	2	4
20 - 29	6	5	2	0	13
30 - 39	15	1	1	1	18
40 - 49	13	1	1	0	15
50 - 59	4	0	0	0	4
60 - 69	0	0	0	0	0
70 - 79	1	0	0	0	1
80 - 89	0	0	0	0	0
90 - 99	0	0	0	0	0
Total	40	7	5	7	59 Countries
Arithmetic mean	39.2	29.2	29.0	12.1	34.0

(b) *Population*	*Import Coefficient*	$\sigma_{\bar{y}}$	*N*	(Countries
Up to 12.9 mil.	39.2	5.6	40	$R^2 = .42$
13.0 - 24.0	29.2	3.0	7	$R = .65$
24.1 - 36.0	29.0	5.1	5	$F = 13$
36.1 - above	12.1	4.2	7	
Total	34.0	5.6	59	

($n_1 = 3$, $n_2 = 55$; $F_{.05} = 2.78$, $F_{.01} = 4.16$)

TABLE 3

(a) *International Comparison of Import Coefficient of Investment in Machinery and other Equipment, 1960 - 63 (average), in relation to per capita income, 1963, Fifty-one countries*

Import Coefficient %	Income Classes ($)						
	0 - 149	150 - 249	250 - 449	450 - 649	650 - 1149	1150 - above	Total
0 - 9	0	0	0	1 (Japan)	0	1 (U.S.A.)	2
10 - 19	0	0	0	0	0	3 (U.K. France Germany)	3
20 - 29	0	1	0	0	1	0	2
30 - 39	1	0	0	1	0	0	2
40 - 49	4	1	0	0	1	0	6
50 - 59	1	1	1	1	1	1	6
60 - 69	0	1	2	2	0	2	7
70 - 79	2	1	0	0	0	3	6
80 - 89	0	2	4	0	2	1	9
90 - 99	1	4	1	0	2	0	8
Total	9	11	8	5	7	11	51
Arithmetic mean	57.2	74.0	77.5	45.0	69.3	49.5	62.8
Arithmetic mean (averages)	66.4		61.2		56.7		

(b) *Import Coefficients (Y) tabulated as a function of per capita income, (X)*

	X	Y	$\sigma_{\bar{y}}$*	N	
$	0 - 149	57.2	6.6	9	$R^2 = .21$
	150 - 249	74.0	7.2	11	$R = .46$
	250 - 449	77.5	4.9	8	$F = .27$
	450 - 649	45.0	11.4	5	
	650 - 1149	69.3	10.4	7	
	1150-above	49.5	9.2	11	
	Total	62.8	3.6	51	

($n_1 = 5$, $n_2 = 45$; $F_{.05} = 2.42$, $F_{.01} = 3.45$)

* ($\sigma_{\bar{y}}$ shows the stendard orror of means)

TABLE 4

(a) *International comparison of Import Coefficients of Investment in Machinery and Transport Equipment* (1960 - 63), *in relation to population*, 1963. *Fifty-one countries*

Imort Coefficient %	Population (million)				
	Up to 12	13 - 24	25 - 36	37-above	Total
0 - 9	0	0	0	2	2
10 - 19	0	0	0	3	3
20 - 29	1	0	0	1	2
30 - 39	1	1	0	0	2
40 - 49	3	2	1	0	6
50 - 59	5	0	1	0	6
60 - 69	5	1	1	0	7
70 - 79	5	1	0	0	6
80 - 89	7	2	0	0	9
90 - 99	7	1	0	0	8
Total	34	8	3	6	51
Arithmetic average	71.5	66.2	55.0	13.3	62.8

(b) *Population*	*Import Coefficiont*	$\sigma_{\bar{y}}$	N	
Up to 12.9 mil.	71.5	3.3	34	$R^2 = .51$
13.0 - 24	66.2	7.8	8	$R = .71$
24.1 - 36	55.0	5.7	3	$F = 16$
36.1 - above	13.3	3.1	6	
Total	62.8	3.6	51	

($n_1 = 3$, $n_2 = 47$; $F_{.05} = 2.80$, $F_{.01} = 4.23$)

Taking into account both explanatory variables, per capita income and size, we constructed a cross-section regression model for 60 countries and the results are shown in Table 5. The equations are semi-logarithmic assuming that preportionate rather than absolute changes explain the results better. For instance a change in per capita income by $ 50 means nothing to a level or $ 2,000; but it does mean something to a level of $ 100 (1). Figures in parentheses under the equations show the standard errors of the regression parameters (ß i).

The regression model (a) of import coefficient of G.D.C.F. in 1960 - 63 for 60 countries on per capita income and population in 1963 showed that the import content varied, on average, by some 10 units for a doubling (in the reverse direction) in per capita income, and by over 10 units for a doubling (again in reverse direction) in total population size. From the standard errors of regression coefficients it turns out that the latter are significantly different from zero. The multiple correlation coefficient and determination coefficient are .61 and .38 correspondirgly. Though the F-test showed that the correlation is significant enough at both levels (.05 and .01), the determination coefficient is not high. This implies that many other factors play a role in determining the import content of G.D.C.F. However, out of the two explanatory variables, the population size is the most crucial and this comes out of the partial correlation coefficients (zero order correlation coefficients matrix).

The multiple regression model (b), for 42 countries, of import coefficient of investment in machinery and transport equipment in 1960 - 63 on per capita income and population (1963) showed that the import content of investment varied, on average, by some 9 units for a doubling (in the reverse direction) in per capita income, and by 26 units (again in the reverse direction) in population size. The difference between the regression of import coefficient of G.D.C.F. (a) and the regression of import coefficient regarding machinery and equipment (b) is that the latter demonstrates more sensitivity to the population variable (X_2) than to the growth variable (X_1), the standard error of the per capita income regression coefficient being too high showing that the resultant coefficient is not significantly different from zero. As a rule of thumb we should expect the regression coefficient of X_1 to be twice its standard error. The association of the import content proportion with per capita income is loose, but with population size is stronger. The coefficients of multiple correlation and determination are

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1. See *B. M. Russett et al.*, World Handbook of Political and Social Indicators, N. Haven and London, 1964, p. 312.

TABLE 5

Regression Models Results

(a) *Import Coefficient of G.D.C.F. on per capita income* (X_1) *and Population* (X_2)

Equation : $Y = 67.02 - 9.60 \log X_1 - 10.37 \log X_2$
(60 observations) $\qquad\qquad (\pm 2.93) \qquad (\pm 2.05)$

$\bar{R} = .61, \ \bar{R}^2 = .38$

Zero - order correlation coefficients matrix :

	Y	X_1	X_2
Y	1.00	−.36	−.53
X_1		1.00	.04
X_2			1.00

F-test : $F = 18.7$ ($n_1 = 2, \ n_2 = 57; \ F_{.05} = 3.16, \ F_{.01} = 4.99$)

(b) *Import Coefficient of Investment in Machinery and Equipment on per capita income* (X_1) *and Population* (X_2)

Equation : $Y = 109.10 - 9.22 \log X_1 - 26.16 \log X_2$
(42 observations) $\qquad\qquad (\pm 7.52) \qquad (\pm 6.53)$

$\bar{R} = .56, \ R^2 = .31$

Zero - order correlation coefficients matrix :

	Y	X_1	X_2
Y	1.00	−.28	−.57
X_1		1.00	.23
X_2			1.00

F - test : $F = 10.5$ ($n_1 = 2, \ n_2 = 39; \ F_{.05} = 3.24, \ F_{.01} = 5.20$)

(c) *Import Coefficient of G.D.C.F. on per capita income* (X_1), *Population* (X_2) *and Heavy Manufacturing* (X_3)

Equation : $Y = 65.72 - 6.78 \log X_1 - 10.32 \log X_2 - 4.22 \log X_3$
(49 observations) $\qquad\qquad (\pm 4.31) \qquad (\pm 2.81) \qquad (+ 8.95)$

$\bar{R} = .59, \ \bar{R}^2 = .35$

Zero - order correlation coefficients matrix

	Y	X_1	X_2	X_3
Y	1.00	−.34	−.54	−.45
X_1		1.00	.05	.66
X_2			1.00	.40
X_3				1.00

F - test : $F = 9.6$ ($n_1 = 3$, $n_2 = 45$; $F_{.01} = 4.25$, $F_{.05} = 2.82$)

.56 and .31. respectively (1).

In regression (c) an extra variable for the proportion of heavy manufacturing in total manufacturing was tried, but the resultant coefficient was not significantly different from zero. Besides, an almost strong intercorrelation appeared to exist between per capita income and heavy manufacturing shares (0.66) (2).

Another way of looking at the import coefficients of investment is Table 6 which shows the average import content of G.D.C.F. separately for each group of countries, both for large and small, and for developed, semi - developed and underdeveloped countries. The categorization is quite arbitrary.

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1. *A. Maizels* (op.cit., p. 267 - 8) tried a regression of import - content of investment in 1954 - 56 on per capita income and population in 1955 for 18 countries with the following results :

$$\log I = \log b_o - \underset{(\pm 0.13)}{0.38 \log Y/N} - \underset{(\pm 0.18)}{0.66 \log N} \qquad R^2 = 0.766$$

where I represents the import-content, and Y/N and N the real income per head and total population. Ten per cent variation in income corresponds to 3.8 per cent variation (in reverse direction) in import-content (in comparison with 1.5 % of ours), and a variation of 10 % in population corresponds to 6.6 % variation (in reverse direction) in import-content (in comparison with 4 % of ours). The goodness of fit is much better than ours; the determination coefficient being over twice as high as ours. However, Maizels' regression is limited because of the small number of observations of his sample.

2. Maizels, again, tried an extra variable for the proportion of exports of goods and services in the gross domestic product but the resultant coefficient was not significantly different from zero, (op.cit., p. 268, footnote).

TABLE 6

Import coefficients of G.D.C.F. (1960 - 63) *grouped according to per capita income level and population size* (1963)

(Unweighted Averages)

	Large (13 *mil. - above*)	*Small* (*up to* 12.9 *mil.*)
1. Advanced countries ($ 600 - above)	14.0 (8)	36.1 (14)
2. Semi-advanced countries ($ 200 - 600)	24.0 (3)	41.1 (14)
3. Underdeveloped countries (up to $200)	30.4 (7)	34.2 (13)

(Numbers in parentheses show the number of countries)

As shown by Table 6 small countries have a higher import content of G.D.C.F., whether rich or poor, than large countries. In the group of large countries, the import coefficient of investment decreases as the level of development rises. In the group of small countries, countries at medium levels of per capita income have the highest import content of investment. Another feature of Table 6 is that while for the first two (1 and 2) groups of countries the difference in import coefficients between large and small ones is large, for underdeveloped countries the difference is quite small. This means that developed (or semi-developed) countries' dependence on capital goods imports is more sensitive to size than that of underdeveloped countries [1].

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1. Quite similar results are brought out by two other authors, Professor S. Kuznets and Dr. N. A. Adams. Kuznets' findings are as follows:

	Proportion of producer goods imports to G.D.C.F.	
	Developed	*Underdeveloped*
Large	16.8 (7)	28.8 (7)
Small	49.1 (7)	41.2 (8)
(Small with high trade proportion)		68.8 (8)

(Cf. «Quantitative Aspects of the Economic Growth of Nations: IX. Level and Structure of Foreign Trade: Comparisons for Recent Years» in *Economic Development and Cultural Change*, Vol. XII, No. 1, Part II, October 1964, p. 64).

N.A. Adams' figures are as follows:

	Import Coefficient of Investment (1955 - 58 *Average*)	
	Large (above 20 mil.)	*Small (under 20 mil.)*
Underdeveloped ($ 0 - 299)	32.9 (8)	41.4 (11)
Developed ($ 300 - above)	9.5 (5)	36.3 (11)
Total — 35 countries		

5. *Implications of and discussion on findings*

The foregoing statistical analysis helps our understanding of the dependence of countries on imported investment goods and of the possible pattern of trade in capital goods. The results should be interpreted on an average basis, since special factors determine individual cases. Having this precaution in mind, the findings thus far arrived at are very revealing.

More sensitivity seems to exist in the import coefficient in relation to size rather than in relation to stages of development. The level of import content of investment may fall to a negligible figure at the outmost of economic growth as it happened in the case of the U.S.A. However, it is more likely and logical in a free traded world to assume that the import content of investment cannot fall to zero. A minimum level exists which is justified by international specialisation (even in the case of a very large advanced country), international business and investment, and by policy considerations, or even by random.

In the course of economic development the capital goods industry is sharing more and more portion in total manufacturing and hence the dependence on imported capital goods is diminishing. Moreover, the import content may fall in a large country which believes that autarchy policy is to her benefit or trade barriers and tariffs are conducive to her industrialisation.

In the case of small countries economic advance favours the manufacturing sector and especially the capital goods industry, but this does not lead necessarily to a reduction of import content of investment. Production of capital goods is more concentrated in a relatively small number of large industrial countries, like the U.S.A., United Kingdom, Germany, France and Japan. Small underdeveloped countries have a heavy dependence on imported capital goods, since there is less, if any, possibility of producing capital goods before establishing an industry of consumers'goods (1). The dependence does not diminish as small countries advance. On the contrary, at the middle stages of economic development when the country shows the most dynamic performance (high rates of growth), the dependence is increased. Besides, a high dependence on imported capital goods is demonstrated by the sample of the 14 small advanced countries. (Table 6). This dependence is, as already mentioned, justified by the pattern of world production. Capital goods industry calls for large scale operations and the smallness of size of a country cannot afford to sustain such industries either from the demand side, or from

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(Figures in parentheses show the number of countries).

(Cf. «Import Structure and Economic Growth : A Comparison of Cross - Section and Time - Series Data», in *Economic Development and Cultural Change*, Vol. 15, No. 2, Part I, January 1967, p. 149).

1. *A. Maizels*, op.cit., pp. 183 and 265.

the supply side. Hence, specialisation in capital goods production is an inevitable condition of continuous progress.

Large scale requirements in capital goods industry impose a limit to the extent to which small countries establish plants. But this limit is surpassed by advanced countries by extending their domestic markets, through exports, to foreign markets. Moreover, small countries are more skewed in their resources and their comparative physical advantages cannot be extended to many lines, since production factors are limited in quantity. Thus we verified economic theory about the production pattern in relation to size of a country by our regression analysis. Our analysis is consistent, as well with the theoretical model of Bensusan - Butt as regards the size of country.

As shown by the statistical analysis, the import coefficient of investment in machinery and transport equipment is more sensitive to changes in the size of countries than the import coefficient of Gross Domestic Capital Formation is. This is obvious since total investment is composed of many components, some of which are domestically produced in any country (especially in the sector of construction); investment in machinery and other equipment presupposes production which is, more or less, based upon complex factors which are more influenced by market conditions and hence by the size of the economy.

Turning back once more to the theme of specialisation, we refer to Maizel's[1] conclusion that among the industrial countries there is more specialisation within the expanding groups of commodities (among which are capital goods). Hence trade is not expected to be reduced since there will be an exchange of products, in which a country specialises, for goods produced by another country. Belgium (with 86 per cent import content of machinery and other equipment) specialises in production of and exports basic metals, Denmark (with 54 per cent import content) in internal combustion engines, Italy (with 25 per cent import content) in office machines (calculating machines), the Netherlands (with 77 per cent import content) in some basic metals and radio receivers, Norway (with 72 per cent import content) in nickel, aluminium and refined copper, Sweden (with 62 per cent import content) in telephone cable and electrical equipment, and typewriters, and Switzerland (with 63 per cent import content) in machine tools, precision instruments and watches, etc[2].

The statistical analysis shows that the coefficients of determination (adjusted for degrees of freedom) are not high, which implies that a big part of variations in our dependent variable are determined by factors other than per capita income or population. This is generally true in country compari-

1. *A. Maizels*, op.cit., p. 183.

2. *S. Sarantides*, Specialisation and economic growth, unpublished paper, Bank of Greece, August 1963.

sons where each country, except her general features shows special characteristics and behaviour patterns. Moreover, the latent assumption of linearity in the regression contributes to deviations of normative values from the actual ones leaving large residuals. An improvement to the analysis would be the rejection of some observations and the attempt to find special reasons for some cases. Since these refinements do not practically modify the results and conclusions are not attempted. We should only hint here that the observed import content of total investment of Japan, U.S.A. and Uruguay is very low compared with the regression value; by contrast, the observed value of Belgium and Ireland is very high compared with the regression value.

Since economic growth involves time, relevant to the relationship of import content of investment and economic growth is the examination of the historical pattern. For available data we resort to N.A. Adams' article (1), where five countries are reported. All the reported countries had much lower import coefficients of total investment during their early stages of development (1870's) than the underdeveloped countries of today. Compare a range of 7.4 - 25.0 % for countries like Japan, Canada, Australia, Sweden and Denmark with an average of 38 % for underdeveloped countries of today with per capita income under $ 150. These figures imply that the pattern of growth and the dependence on trade of today's developing countries differ from that which prevailed in the nineteenth century.

Restating the main conclusions of the above analysis and looking at them from the viewpoint of our growth-trade model the following statements can be made.

1) Small countries, whether underdeveloped, semi-developed or developed, are more dependent on imported capital inputs than large countries. Hence, the possibility of a trade constraint to be imposed on growth is greater. Small countries being at the middle stages of development have a heavier dependence on trade than other countries. Therefore, planners in this case have to consider seriously the possibilities of bottlenecks as economic growth proceeds. High import content and trade proportions are not caused by simply monetary-financial causes but by structural ones, and the considerations should be relevant to the causes. Specialisation in the case of small countries is the remedy suggested by facts, and once again economic integration is a wise policy. As an accomplishment to this policy, export promotion is a necessary condition and it is helped by the enlargement of market created by integration.

2) Large countries are dependent on external resources during their first stages of development, but at more advanced stages they are less dependent. In any case, underdeveloped countries, whether small or large, are

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1. *N. H. Adams*, op.cit., Table 9.

dependent on trade for their developmental needs. In their estimation procedure of investment requirements — either by applying available input - output techniques, or by applying crude incremental capital output ratios for assigned levels of income or rates of growth — economic planners should consider the import component of investment requirements, and the possibilities of financing it. They cannot neglect the importance of the imported component of investment, simply because no investment project can be undertaken without some foreign input; and since no hope of financing additional foreign inputs exists they will be forced to revise their targets and stop investment projects half-way.

Empirical studies proved that high rates of G.N.P. growth create large balance of payments gaps which are binding in the subsequent course of development (1). On the other hand, rapid expansion of the capital goods sector to meet with increasing capital inputs is hardly likely in underdeveloped countries. Besides, small countries even at an advanced stage, cannot produce all their capital goods requirements for reasons mentioned above and they have to specialise in some lines of production and to depend more or less on imported capital goods.

6. *Gross Capital Formation Proportions financed by External Resources : A cross-section analysis and discussion*

Rapid economic development presupposes increasing volume of investment and this in turn calls for resources to finance them. Gross domestic savings (savings including depreciation items) is the principal financing resource of gross capital formation, but a large part of it is financed by foreign resources.

It has been already shown that the pattern of the import content of investment in the course of economic growth. From the analysis thereon we saw the likelihood of the imported inputs of investment to be an effective constraint on growth and the degree of dependence on foreign capital goods for various groups of countries (small, large, developed and underdeveloped). We also discussed that rapid growth is associated with some dependence on foreign resources at least for small countries. Now, our task is to show statistically the relationship between the balance of payments deficit on current account over G.D.C.F. and the degree of economic development and size of countries in the early 1960's. Consequently, our dependent variable is the percentage proportion of G.D.C.F. financed by external resources; and these external resources are equal to the balance of external current accounts.

Theoretically the lower the stage of economic development the higher

1. *J. Vanek*, op.cit.

the dependence on foreign resource requirements, provided that countries resort to such resources. *A priori*, perhaps, it is consistent to postulate that small countries (with limited resources by definition) with high rates of growth are more dependent on external resources than other underdeveloped countries with stagnant economies.

Taking into account two explanatory variables, namely per capita income and size as measured by population, we constructed a regression model for 37 countries, all of them being «deficit» countries, in the early 1960's. The results are shown in Table 7.

The regression model shows that (for 37 countries) the G.D.C.F. proportion financed by foreign resources varied on average by some 12 units for a doubling in per capita income (in reverse direction) and by some 8 units for a doubling in population size (in reverse direction again). As shown by the standard errors, the regression coefficients are significantly different (though not highly) from zero. The F-test shows that the correlation, though significant at both levels (.05 and .01), is not high enough. Both explanatory variables explain 25 % of the variation in the G.D.C.F. proportion financed by foreign resources, leaving a larger part to numerous other factors. Although the correlation between the dependent variable and each of the other two independent variables is low enough (.38 and .39 respectively), the correlation between the former and the latter taken together (multiple correlation) is much higher (.50).

The above regression model points out that there is some negative association, albeit not strong, between the observed foreign financing of investment, on the one hand, and per capita income and size, on the other.

Another presentation of the data, which confirms the regression results, is shown in Table 8. As can easily be seen from Table 8, small countries are more dependent on foreign resources than large countries belonging to the same income group. Semi-developed countries, which, as mentioned previously, have witnessed higher rates of growth than other countries, show higher proportions of foreign finance (in either population group) than other advanced or underdeveloped countries. Thus the above figures strongly stress the significance of the size of countries as regards the problem of dependence on foreign resources.

Needless to say, of course, that whatever the regression model and Table 8 show are averages representing «typical» schemes. What is pointed out is that the status of economic development and the size of a country are, *inter alia*, important factors determining dependence on foreign resources in general.

However, big deviations from the theoretical values of a model are observed for individual cases. This implies that many other factors play an important role in each individual case. Special structure of the economy deviating from a typical one, satellitic relations between countries, launching

TABLE 7

Regression of Gross Domestic Capital Proportion financed by Foreign Resources (in per cent) (Y) on per capita income (X_1) *and population* (X_2)

Equation :
(37 observations)

$$Y = 55.02 - 11.84 \log X_1 - 7.88 \log X_2$$
$$(\pm 5.50) \qquad (\pm 3.54)$$

$$R = .50, \ \bar{R}^2 = .25$$

Matrix of zero - order correlation coefficients

	Y	X_1	X_2
Y	1.00	−.38	−.39
X_1		1.00	.17
X_2			1.00

F-test : $F = 5.78$, ($n_1 = 2$, $n_2 = 34$; $F_{.05} = 3.28$, $F_{.01} = 5.29$)

TABLE 8

Proportion of Investment financed by Foreign Resources in relation to per capita income and population in the early 1960's. *Thirty-seven «deficit» countries.*

(Unweighted Averages in per cent)

		Large (13 *mil. - above*)	*Small* (*up to* 12.9 *mil.*)
1. Advanced	($ 600 - above)	3.5 (6)	18.4 (12)
2. Semi-developed	($ 200 - 600)	19.5 (2)	21.9 (10)
3. Underdeveloped	(up to $ 200)	15.7 (3)	19.8 (4)

(Figures in parentheses show the number of countries in each group).

of projects at specific times, foreign exchange reserves, and the like, are some of these factors. For instance, British Guiana and Viet - Nam Republic have lower proportions of investment financed by foreign resources, and Colombia, Jordan, Barbados and Puorto Rico have higher values than those predicted by the regression model.

Thus far the preceding findings and discussion on the relationship

between dependence on foreign resources and economic development and size of population are in conformity with the foregoing discussion on the dependence of investment on imported inputs as regards the role played by the size of countries.

Now, let us look at the findings of this section from the viewpoint of our theoretical growth-trade model. Since a country cannot finance her investment requirements a resort to external resources is necessary. The target rate of growth or the target level of per capita income in this case will be higher than the one which a country could achieve by using only her own resources. From this point of view difficulty in finding out external sources of finance is an effective constraint on growth. As long as imported inputs of growth can be financed by foreign resources no constraint is imposed by trade on growth; but as soon as the possibility of getting foreign assistance drops down, rapid development fails to be accomplished. Small countries are hanging more on this issue than large countries. High rates of growth and developmental achievements of some small countries having satellitic relations with big advanced countries are fully justified on these grounds.

7. *Concluding remarks*

The preceding analysis has shown that when international trade occurs time is not a limiting factor in a country's capital accumulation. However, growth might be constrained by imports of necessary producer goods if sufficient foreign exchange was not available in developing countries.

Provided that foreign exchange is available either through exports or through foreign aid and capital, imports are a *sine qua non* requirement for accelerating development in a definite period of time. Unlike agricultural exports, one country's total exports can be increased on a permanent basis without being subject to heavy fluctuations, if the share of manufactured goods is increased because of the country's specialization in lines where certain comparative advantages exist.

The size of country is very crucial in determining the importcontent of capital accumulation. As the size increases the import requirements decrease; and this might be attributed to import substitution which is effective under the scale effects of large markets. Small advanced countries have a high import-content of investment as a consequence of their specialization in a narrow range of production. Underdeveloped countries, however, are less sensitive to size as regards capital goods imports. Small semi-advanced countries witness the highest import-content of investment, and the same is true as regards the dependence on external resources shown by the deficit on external current account to G.N.P., or alternatively by the savings - investment gap.