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Working Paper

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Center Discussion Paper, No. 18

Provided in Cooperation with:
Yale University, Economic Growth Center (EGC)

Suggested Citation: Maneschi, Andrea; Reynolds, Clark W. (1966) : The Effect of Import Substitution on Foreign Exchange Needs, Saving Rates and Growth in Latin America, Center Discussion Paper, No. 18, Yale University, Economic Growth Center, New Haven, CT

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CENTER DISCUSSION PAPER NO. 18

THE EFFECT OF IMPORT SUBSTITUTION ON FOREIGN EXCHANGE NEEDS, SAVINGS RATES AND GROWTH IN LATIN AMERICA

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December 20, 1966

The Effect of Import Substitution on Foreign Exchange Needs, Savings Rates and Growth in Latin America*

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I. Introduction. The widely different growth performances among less-developed countries during the past twenty-five years, and especially among those of Latin America, are a challenge to the explanatory power of development economics. Economists who are accustomed to neoclassical theories of international trade and growth search for an answer to these disparities both in the systems' respective market imperfections and their abilities to increase desired savings rates to achieve socially determined target growth rates. For this group the ultimate constraint on growth is domestic savings capacity. There is always in principle an exchange rate for the open economy which will insure that the marginal efficiency of a unit of domestic resources will equal that of a unit of imports. Any inflow of foreign savings will merely serve as a supplement to domestic savings.

To other analysts of the process of trade and growth this position is untenable, since market imperfections, both internal and external, are facts of life with which the policy-maker and planner must deal. Due to both pragmatism and the convenience of the assumption for model building, it has become customary to accept price relatives and market imperfections as given, at least during the time-horizon of the analysis, and to regard excess demands for goods and services as capable of relief through trade. It is this approach which has given rise to the concept "foreign exchange constraint."

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*The authors gratefully acknowledge comments received from various members of the Yale Economic Growth Center, including visiting Research Associate Staffan B. Linder.

A third position, somewhat between these extremes, is beginning to assert itself today as a bridge between the methodology of development planners and theoretical models of trade and growth. While it is convenient to regard market structures as rigid, and elasticities of demand and supply as sticky, if not completely ossified, and while economies at the lowest stage of development may be closer to these assumptions, the very fact of development makes the use of such assumptions logically inconsistent. Resources are reallocated in the production process as scarcities arise, consumers do respond to relative price changes, and the very possibility to save and invest is reflective of the degree of internal flexibility of the system as it is acted upon by exogenous shocks which are customarily felt through the foreign sector and measured by the "capacity to import" barometer.[1] As the process of development begins to occur, such changes in the structure of supply and demand take place with increasing intensity, reflecting underlying changes in factor availability, technology, income distribution and tastes. They are responses to what might be called the evolution of comparative advantage.

It would be most illustrative of this process of evolution to be able to specify empirical production functions, at least for major sectors of a developing economy, and to prepare indexes of factor stocks plus technology, to estimate the

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[1] In this paper, "capacity to import" is normally defined as "the capacity to import generated by exports of goods and services." Net autonomous and induced capital flows are not included, since they are less-reflective of the potential for growth occasioned by changes in the domestic structure of production, although such changes will in themselves alter rates of return on capital and give rise to an additional flow of foreign savings over and above that implicit in a balance of payments deficit on current account.

structure of final demand, and then to compare the set of price relatives resulting in a state of autarchy to those faced in the world market. By establishing such relationships for any point in time, and then comparing the trade effects of alternative rates of factor growth, technology and final demand over time, one might assess the distribution and growth effects of an evolution in "comparative advantage" at least under ceteris paribus assumptions for the rest of the world, provided that the nation being analyzed was a price-taker in the world market. Within such a hypothetical analysis the ambiguous concept "import substitution" would find its proper place, as a term which attempts to synthesize the congeries of supply and demand effects which are reflected in pro-or anti-trade-based growth. Apart from the lack of a precise definition for the term, it is important to note that import substitution may ultimately promote export expansion and therefore increased imports (while of course - changing the composition of traded goods).

Although such an analysis is conceptually possible, it is utopian owing to limitations of time, statistics, and technique. This paper therefore represents an attempt to quantify the nature and extent of import-substitution by three-stage least squares given available data for selected Latin American countries.

The model employed for this purpose, as described in detail in Part II, utilizes quantum indexes for six countries, Argentina, Brazil, Chile, Colombia, Mexico, and Peru, plus a terms-of-trade adjustment to account for the single most relevant set of price relatives in an export economy, and estimates functions relating to savings, various categories of imports, the construction component of gross investment and growth of income. We have estimated the above relationships

since 1940 for two countries, and since 1951 for the other four, breaking the data into subperiods wherever possible. The coefficients derived from the model reflect a pattern of import-substitution which has varied widely among these countries and within each country for the years considered.

First, the rates of growth of income, exports, and investment of the six countries are compared and contrasted in Part II to illustrate the need for more detailed analysis. Then a description of the model and its principle results are presented in Section III. In Section IV the findings are interpreted as they infer differences in the underlying structure of the respective economies and changes in the structure through time. In Section IV some conclusions and possible policy recommendations are offered in the light of these findings.

II. Disparities in Growth Rates for Selected Latin American Countries

The simplest models of trade and growth imply identical rates of growth for exports, investment, and output (6, 8). Others suggest stages of growth through which export economies gradually pass, freeing themselves from dependence upon trade through import-substitution (9). Some writers have even suggested that the process of trade-induced growth will be self-defeating if left to simple market forces (4). Theories are not lacking to describe the process, but little has been done to quantify the relationships between trade and growth in terms of formal models so as to shed light on the actual import substitution process in Latin America.[1]

The first step in this direction is to examine the behavior of the three key variables in each economy, exports, investment, and income. If the rates of

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[1] An extensive literature on the subject has been prepared by the Economic Commission for Latin America (e.g. /12/), over the past two decades, including invaluable statistical source material.

growth of these variables were to follow similar patterns in each country, and if they showed greater divergencies among countries than within them, the task would be immensely simplified. However, Table 1 reveals no such symmetry for Latin America. Even the most pessimistic assumptions about the quality of the available data do not alter this fact.

For example, the three countries showing the fastest rise in income during the fifties included only one (Peru) which ranked highest in export growth. Two of the three leaders in export growth (Chile and Argentina) ranked last in growth of income. Moreover, no perfect relationship between exports and investment can be seen, although this pattern is definitely clearer than any of the others. The four leaders in export growth also lead in investment growth during the fifties. Yet Peru is first among these in exports and last in investment. Still more important for the relationship between trade and growth, Chile and Argentina are among the top three in export and investment growth while at the bottom of the list when it comes to increases in income.

Furthermore, the internal patterns of growth of the three countries for which the data have been analyzed by subperiod, Mexico, Peru, and Chile fail to reveal any simple trade-growth relationships. It is true that in two of the three cases (Mexico and Peru) the period of fastest growth is the same for all three variables. But in Mexico exports lagged behind income in the second (slower) period, while in Peru they led income. In the case of Chile the behavior is still more puzzling, since investment grew much faster than exports in the forties while the reverse was true in the fifties, and income grew at approximately the same rate in both periods.

Table 1

GROWTH RATES OF GROSS DOMESTIC INCOME (GDY), CAPACITY TO IMPORT (X_{-1}), AND GROSS INVESTMENT (I) IN SELECTED LATIN AMERICAN COUNTRIES

(in percent)

		PERIOD I	PERIOD II	PERIODS I & II
Mexico	Y	6.7	5.8	6.1
	X_{-1}	8.0	2.4	5.3
	I	13.1	5.4	8.6
		(1940-50)	(1951-62)	(1940-62)
Peru	Y	3.8	6.5	5.3
	X_{-1}	4.0	10.2	7.7
	I	N.S.T.	4.3	4.1
		(1951-60)	(1956-65)	(1951-65)
Brazil	Y	...	5.1	...
	X_{-1}	...	N.S.T.	...
	I	...	3.6	...
			(1950-63)	
Colombia	Y	...	3.9	...
	X_{-1}	...	N.S.T.	...
	I	...	2.5	...
			(1951-62)	
Chile	Y	3.6	3.6	3.8
	X_{-1}	N.S.T.	3.5	2.1
	I	7.7	5.7	5.6
		(1941-50)	(1951-63)	(1941-63)
Argentina	Y	...	2.7	...
	X_{-1}	...	2.7	...
	I	...	5.0	...
			(1951-63)	

... = Data not available

N.S.T. = no significant trend in the variable.

These observations suggest that while there is an unmistakable set of interdependencies among exports, investment, and income, the relationships are not sufficiently simple and linear to be accomodated within the confines of the most elementary trade-growth models mentioned above. Allowance must be made for the process of import substitution which has radically altered the nature of certain Latin American economies while failing to alter that of others. The model presented below attempts to illustrate this essentially"non-linear" process within the framework of a set of linear equations.

III. The Model

The variables used in the model are the following:

A) Endogenous variables

Y = real gross domestic income (GDY) at market prices.[1]

S_D = domestic savings.

M = total imports of goods and services.

M_C = imports of consumer goods.

M_{RMF} = imports of raw materials, intermediate products and fuels.

M_K = imports of industrial, agricultural and transport machinery and equipment.

M_S = imports of services.

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[1] This is equivalent to real gross domestic product adjusted for the terms of trade effect. Various expressions are used to designate this concept in Latin America. It is known as "ingreso bruto interno (real)" in Argentina, Colombia and Mexico; "producto geográfico bruto" in Chile, and (on a national rather than a domestic basis) "producto nacional bruto real ajustado para reflejar los términos de intercambio" in Peru. It is identically equal to real GDP plus the terms of trade effect $X(\frac{P_e}{P_m} - 1)$, where X is the value of current exports in base year prices and P_e and P_m are indices of export and import prices related to the same base year. As pointed out in (2 p. 31), real GDP is the more suitable concept for analyzing output changes whereas real GDY is a better index of welfare changes over time reflecting as it does the nation's purchasing power over both domestic and foreign goods. As our paper relates the pattern of import substitution inter alia to the growth of the purchasing power of exports we have found the GDY concept more relevant although we admit that in certain structural equations GDP would be a better measure.

I = gross fixed investment.

I_{CI} = investment in construction[1].

I_{DK} = domestic output of industrial, agricultural and transport machinery and equipment.

B) Exogenous variables

X = purchasing power of exports of goods and services.

X_{-1} = X lagged one period.

I_{inv} = inventory investment.

Most of the above variables are expressed in constant domestic prices of a given year. The import values are generally C.I.F.[2]

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[1] In the case of Mexico this includes investment in installations, as defined in (1, pp. 13-15).

[2] Note however, that (i) total imports for Brazil and disaggregated imports for Brazil and Colombia are expressed in 1955 US $ and (ii) disaggregated imports for Chile are expressed as quantum indices (1947 = 100); except that the M_K series in Chile and Colombia were available in constant domestic prices. Moreover, (iii) the value for M_K in the case of Chile, Colombia and Mexico represents domestic valuation after allowing for customs duties, domestic transport costs and commerce margins. The magnitudes of the estimated coefficients in the equations relating to the variables mentioned in (i), (ii) and (iii) should therefore be interpreted with care. For our purposes, as can be seen below, the ratios of these coefficients to their asymptotic standard errors are of greater interest and these ratios (leaving aside the thorny problems associated with the choice of appropriate deflators) are unaffected by the choice of units.

We use a simple aggregative model in order to highlight the pattern of import substitution. Its specification differs somewhat among countries depending on data availability. These differences will become evident from an examination of the estimated structural equations given in the Appendix. The general form of the model is the following:

$$(1) \qquad S_D = s_o + s_1 Y$$

$$(2) \qquad M = m_o + m_1 X_{-1} + m_2 Y$$

$$(3) \qquad M_C = m_{Co} + m_{C1} X_{-1} + m_{C2} Y$$

$$(4) \qquad M_{RMF} = m_{RMFo} + m_{RMF1} X_{-1} + m_{RMF2} Y$$

$$(5) \qquad M_K = m_{Ko} + m_{K1} X_{-1} + m_{K2} I$$

$$(6) \qquad M = M_C + M_{RMF} + M_K + M_S$$

$$(7) \qquad S_D + M = I + I_{inv} + X$$

$$(8) \qquad I_{CI} = i_{CIo} + i_{CI1} I$$

$$(9) \qquad I = I_{DK} + I_{CI} + M_K$$

$$(10) \qquad Y - Y_{-1} = b_o + b_1 I_{-1}$$

The model consists of 10 equations in the 10 endogenous variables listed above. Apart from the constant term it contains the two exogenous variables X_{-1} and $I_{inv} + X$ (since I_{inv} and X only occur summed together they may be amalgamated into one exogenous variable) and the two lagged endogenous variables Y_{-1} and I_{-1}. It can be readily verified that all equations are overidentified. Before describing our estimation procedure we shall briefly discuss the nature of each equation.

Eq. (1) relates domestic savings linearly to GDY, where domestic savings is defined as the savings of the country's factors of production whether domestically or foreign owned (thus including net factor income going abroad).

Eqq. (2) - (5) are import functions relating total imports and three out of four import categories to two separate "budget constraints", namely Y and X_{-1} (except for M_K which is related to I and X_{-1}).[1] They differ from the import functions normally found in growth models which relate imports of noncapital goods to aggregate or sectoral outputs and those of capital goods to total investment. Such functions postulate a complementarity between domestic and imported factor inputs (or commodity outputs) which in the case of most Latin American countries is simply not borne out by the facts. As we observed before, the prevailing tendency, especially since the Korean War, has been for the capacity to import (represented in our model by X_{-1}) to grow at a slower rate than either GDY or I. Such differentials are maintainable only in the face of a decline in what have too often been assumed to be downwardly rigid import coefficients with respect to GDY or I.[2] Our use

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[1] The omitted import category was selected on the basis of trial- and-error or of data availability. Thus M_S rather than M_C was selected for Mexico (the functional form remaining unchanged) both because the data for M_S was available and because the fit turned out to be closer than with M_C. For Mexico an additional type of imports, "frontier" imports (MFR) was introduced, as explained below.

[2] In fairness mention should be made of those models (e.g. 10 Model B) which have incorporated in at least some of the import functions a domestic - foreign price relative as independent variable, thus permitting some escape from absolute import rigidity.

of both Y (or I) and X_{-1} as explanatory variables, combined with a knowledge of their relative growth rates, allows us to ascertain the existence and examine the nature of the process of import substitution over time.[1] We can thus reach some conclusions regarding the degree of emancipation from the foreign exchange constraint attained by or anticipated for the various countries studied.[2]

Eqq. (6) and (7) are identities. The first of these may be used to calculate the "missing" import category as a residual between total imports and the remaining categories; the second derives gross fixed investment from domestic

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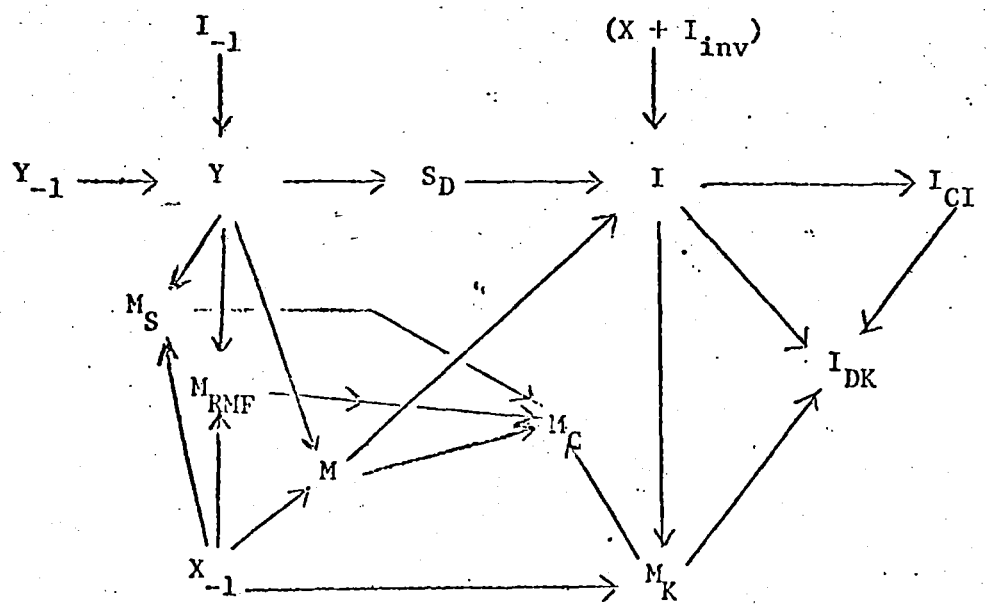
[1] It may seem misleading to look upon X_{-1} as an "explanatory" variable of imports without adding to it net autonomous and perhaps also compensatory capital movements. Our analysis, however, is based on the assumption that in the long run the total capacity to import of the Latin American countries will depend on the purchasing power of their exports, X_{-1}. If net autonomous capital movements, net foreign investment income and amortization of trade arrears and balance -of- payments loans are added to X_{-1}, the resulting "import capacity" measure for Latin America as a whole with the exception of Venezuela has not differed appreciably from the value of exports during the fifties and the difference has become even smaller in the course of the sixties. Even though compensatory capital movements may have served to palliate foreign exchange scarcity in the short-run, such financing is usually precluded in the longer run with which we are concerned. The interesting question to ask of a country for which X_{-1} has grown on the average more slowly than GDY is how its various categories of imports have adapted themselves to the longer term import constraint approximately represented by X_{-1}.

[2] One of the authors of this paper is currently investigating the nature of the concept of import substitution and has found some theoretical justification for the form of the import equations given above.

savings, imports, inventory investment and exports. Eq. (8), which makes I_{CI} a function of I, expresses a relationship between total fixed investment and that part of it devoted to residential and nonresidential construction and public works. I_{DK} is obtained as a residual between total fixed investment and $I_{CI} + M_K$ in identity (9).

The final equation (10) attempts to relate the increase in GDY over that of the previous year to the previous year's gross fixed investment. Various attempts were made to estimate more sophisticated production functions in terms of imported and domestically produced capital stocks in the case of Mexico, but the results obtained were statistically insignificant because of multicollinearity. In the estimation of (10), $Y - Y_{-1}$ was treated as a single endogenous variable.

To appraise the model as a whole it is interesting to set out its entire causal structure. This is symbolically expressed in the following diagram in which causal relationships are represented by arrows and which is seen to give rise to a non-cyclical causal chain:



The model therefore satisfies one of the necessary conditions for recursiveness since the matrix of coefficients relating to the current endogenous variables may be rearranged in the following triangular form:

$$\begin{bmatrix}
1 & -0 & -0 & -0 & -0 & -0 & 0 & 0 & 0 & 0 \\
-s_1 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-m_{C2} & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
-m_{RMF2} & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
-m_2 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & -1 & 0 & 0 & -1 & 1 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -m_{K2} & 1 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -i_{CI1} & 0 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 1 & -1 & -1 & 1 & 0 \\
0 & 0 & -1 & -1 & 1 & 0 & -1 & 0 & 0 & 1
\end{bmatrix}$$

each row of which refers to a different equation and is multiplied by a column vector of endogenous variables which in row form may be written:

$$\begin{bmatrix} Y & S & M_C & M_{RMF} & M & I & M_K & I_{CI} & I_{DK} & M_S \end{bmatrix}$$

It seems, however, too restrictive to assume that the contemporaneous covariance matrix of the disturbances in different equations is diagonal, this being a necessary condition for obtaining consistent estimators by regressing each endogenous variable located on the diagonal of the above matrix on the other jointly dependent and the predetermined variables in the equation.[1]

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[1] The properties of recursive models are discussed in Malinvaud (7, pp. 59-62 and 511-14). Though discarding recursive estimation we shall adopt the third assumption necessary for recursiveness, namely that all disturbances are serially uncorrelated with the disturbances appearing either in the same equation or in the other equations of the model.

To obtain consistent estimates of the coefficients of the model and at the same time allow for contemporaneous interdependencies between the disturbances of different equations we estimated it by three-stage least squares (3SLS).[1] In the first stage the reduced-form equations for Y and I were estimated by regressing these variables on all predetermined (exogenous and lagged endogenous) variables found in the model.[2] The calculated values of Y and I, denoted by YE and IE, were then used as instruments for the corresponding observed values in the structural equations of the model (after elimination of the identities) to obtain two-stage least-squares (2SLS) estimates. The contemporaneous covariance matrix of the residuals of those equations was used to derive 3SLS estimators, the advantage being a gain in asymptotic efficiency with respect to the 2SLS estimators.[3] In the Appendix, we present only the 3SLS estimators together with the ratios of these estimators to their asymptotic standard errors. These ratios are in general higher, sometimes considerably higher, than the corresponding 2SLS ratios, as one might expect from the asymptotic properties of these two estimators.

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[1] The program used was the Program for Computing Two-and Three-Stage Least Squares Estimates and Associated Statistics, by A. Stroud, A. Zellner and L.C. Chau, Dec. 11, 1963 revised by H. Thornber and A. Zellner, 4 July 1965 (Social Systems Research Institute, University of Wisconsin).

[2] The modest size of our model permitted this without our running into problems either of excessive multicollinearity among the predetermined variables or of insufficiency of degrees of freedom. These difficulties in larger models are discussed by F. Fisher in ( ).

[3] See (11).

IV. Interpretation of the Results obtained for each Structural Relationship

The results presented in the Appendix may be interpreted either by equation or by country. We shall begin with the former.[1]

Eq. (1) : Domestic Savings

The fit obtained was in general satisfactory except in the case of two ten-year subperiods in Chile and Peru. Separate investigations of the behavior of the savings ratio over time have shown this to be one of the most stable ratios in Latin American countries, in general more so than the investment ratio. Its stability seems to have been greater in later than in earlier subperiods.

Eq. (2) : (Discussed Below)

Eq. (3) : Imports of Consumer Goods

Since the early fifties, these have stagnated or even experienced a slight downward trend in all countries considered except for Chile and Peru. These results are consistent with the commonly held view that the consumer goods sector is that of "easiest" import substitution. Chile is an interesting exception to this both because for the period 1941-63 as a whole M_c has tended to rise and because a significant downward trend in the forties was followed by a rise during the fifties and early sixties which was more closely related to GDY than to X_{-1}. In Peru, as one might be led to expect from the growth rates given in Table 1, M_c was more closely dependent on X_{-1} than on GDY except during the period 1956-65 in which X_{-1} grew at the phenomenal average rate of 10.2% p.a.

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[1] The usual caveat is in order regarding the difficulty of interpreting asymptotic properties and relating them to their small-sample counterparts. Thus when we speak of 'significant' or 'highly significant' coefficients these terms should be taken as suggestive rather than statistically rigorous.

Equation (4): Imports of Raw Materials and Fuels

Here we find considerable diversity from one country to the next. In Argentina, Colombia and Chile these imports are highly sensitive to income changes, indicating a certain vulnerability to balance of payments crises because of the considerable importance of M_{RMF} in total imports. In the case of Chile this vulnerability seems to have been increasing over time. Brazil must also rely to an uncomfortably great extent on M_{RMF}. Mexico, on the other hand, has succeeded in insulating its income growth from the need for M_{RMF} to grow pari passu. This insulation was effected during the fifties and sixties, the significance of the coefficient with respect to X_{-1} being much greater than that of the coefficient with respect to Y in spite of a much lower growth rate of the former than of the latter. This has been partly due to Mexico's ability to substitute for fuel imports to such an extent as to be able to reduce their absolute value since 1957. In Peru, the higher dependence of M_{RMF} on X_1 than on Y, as in the case of most other import categories, was not due to import substitution since the average growth rate of X-1 was in both subperiods higher than that Y.

Equation (5): Imports of Capital Goods

Argentina, Chile and Peru appear to rely heavily on imported capital goods for their investment. Brazil and Mexico have instead gone a considerable way towards freeing themselves from this constraint. The case of Mexico is of particular interest since a high dependence of I on M_K during the forties was succeeded by a sensitivity of M_K which was much greater with respect to the import constraint than with investment in the fifties and sixties. The estimates for Colombia seem rather puzzling because of the greater dependence of M_K on

X_{-1} than on I. Any interpretation of this phenomenon should take account of the lack of any significant trend in X_{-1} during the period under examination.

Imports of Services: "Frontier Imports"

Imports of consumer goods into Mexico show a slight, if statistically insignificant, downward trend since 1950. We, therefore, regressed two other import categories for which data were available, namely, imports of services and frontier imports. The former include tourist expenditure abroad, foreign investment income and interest on government borrowing abroad, and are significantly correlated with GDY. Frontier imports consist of imports relating to the Mexican-U.S. border zone which escape classification by type of commodity. Since they probably consist mainly of consumer goods and since their value now exceeds that of M_C, it may be argued that their greater dependence on Y than on X_{-1} invalidates our previous conclusion of a highly successful import substitution in the consumer goods sector. It should, however, be borne in mind that the relevant causal variable is the type of income flow peculiar to this border region, a sizable component of which consists the income of Mexican migratory workers who find jobs in the U.S. Moreover, the fact that 'frontier exports' are almost twice as great makes it hard to reach conclusions on either the practicability or desirability of import substitution in this class of commodities.

Equation (2): Total Imports

On an overall basis the countries for which the import substitution process seems to have been least successful are Argentina and Chile, countries for which (especially the former) the sensitivity of total imports with respect to income is higher than with respect to the capacity to import. In Chile some improvement

is discernible in the second subperiod as compared to the first. Colombia appears to present an intermediate case, total imports being approximately equally sensitive with respect to X_{-1} and to GDY. The Peruvian results are once again idiosyncratic to that economy, since the need for import substitution has hardly been felt. Brazil and Mexico reflect the highest degree of adaptation to the import capacity constraint. This adaptive behavior for the Mexican economy is illustrated by the changing significance of the coefficients of M with respect to X_{-1} and GDY by subperiods.

Equation (8): Investment in Construction

Investment in construction has borne a fairly steady relationship to total gross fixed investment in most of the countries examined and particularly in Mexico. Those countries in which X_{-1} has on the average grow more slowly than GDY and for which M_K has been more sensitive to X_{-1} than to GDY are therefore, in general, those which have been able to develop their own capital goods producing industries. Mexico and probably Brazil (for which data on ICI were not available) fit this description. In analyzing the pattern of investment in Latin America it seems warranted to postulate a fairly rigid relationship of ICI to I but a flexible one of M_K to I (and therefore of IDK to I) in those countries for which sufficient market size and enlightened public policy have been instrumental in establishing an indigenous capital goods industry. In such countries IDK, the domestic output of machinery and equipment, is then obtained as a residual between I and the sum of ICI and M_K, the latter variable being closely related to the overall import constraint.

Equation (10): Increase in GDY

Ideally this equation is intended to establish a link between the GDY's of successive years and thus render the model truly dynamic. The model could then be used to simulate the growth of an economy subject to exogenously given time path of X.[1] Unfortunately, the results we obtained fell below expectation. Except for Mexico and Chile, the coefficients of $Y-Y_{-1}$, with respect to I_{-1}, were either insignificant or of the wrong sign. Subsequent experiments using the breakdown of investment into its component parts were more encouraging, but still unsatisfactory. The incorporation of a production function into the model is hampered by the widespread lack of reliable capital stock data, and warrants considerable further research because of its fundamental importance.

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[1] A discussion of the econometric analysis of dynamic models is found in (5, pp. 373-378) and F. Fisher (3).

V. Interpretation of the Results for Peru, Chile, and Mexico

In this section we have selected for brief examination Peru as an illustration of the pattern of trade-induced growth in a traditional export economy, Chile as an unsuccessful attempt at import substitution, and Mexico as a successful one.

Peru A simple trade-growth model fits the behavior of this economy better than any other. When the capacity to import displayed a rising rate of growth between periods one and two (the decades overlap), so did savings and investment, the domestic marginal savings rate rising sharply between the early fifties and early sixties. Capital goods imports were closely related to investment demand. Little or no import substitution occurred, nor was it necessary since the rate of growth of exports rose to average 10.2% between 1956 and 1965, leading that of income by a considerable margin. One must look beyond the model for an explanation of the factors leading to this pattern of growth. Certainly, the pro-trade bias of public policy in recent years, the limited national market resulting from unequal family and regional income distribution, the small size of the economy and exceptionally good fortune in the export market have been contributing factors. The resulting growth pattern has closely resembled that of the traditional export economy in the 19th century. Whether it is a viable pattern in the longer run is an open question. It is certainly hard to derive any policy prescriptions without paying due consideration to the "fallacy of composition".

Chile In many respects Chile is similar to Peru, having a small population, income, and considerable inequality of wealth. It does possess a significant urban "middle class" by Latin American standards, reflecting a public policy to reduce the inequality in the pattern of income distribution without radically altering that of asset ownership.

Although in the forties both Peru and Chile attempted a policy of import substitution, Peru had reversed this policy by the fifties while Chile continued it. The Chilean capacity to import showed no significant trend for the first period but rose gradually in the second, thus giving the country the possibility of intensifying the import-substitution process after emphasizing the need for it. Yet the economy has not shown any difference in its rate of growth of GDY in the two subperiods.(Table 1). Our results indicate that the economy's marginal savings rate has been low and declining over the two periods, and capital goods imports have remained highly related to investment demand indicating little or no import substitution in this sector. The incremental output-capital ratio which was low and almost significant in the forties fell though becoming insignificant in the fifties. Intermediate goods, raw material and fuel imports remained closely related to income in the fifties. Even in the consumer goods sector, which is often the first to undergo a process of import substitution, this did not occur to any significant extent after the early fifties.

The apparent failure of the import substitution policy in Chile, along with a slow rate of growth of exports, must partially explain both the failure to increase the rate of savings and investment and the relatively low rate of growth of income. It is possible that the structure of comparative advantage was so distorted by forced import-substitution in the forties that export growth itself suffered from the policy. Chile is perhaps a case in which a small country, in attempting to free itself from a trade constraint on growth, lost rather than gained in the process in terms of the actual import substitution achieved.

Mexico Mexico enjoyed a rapid rate of growth of income over the entire period from 1940 to 1962, despite the fact that the growth of import capacity declined substantially over time. This was due to a successful long-run process of import substitution which eventually included consumer goods, raw materials, fuels and even capital goods. Our results clearly illustrate the nature of this process, which permitted the rate of investment to rise sharply in the forties and stabilize at a high level during the fifties and early sixties.

Import substitution occurred initially in the consumer goods sector, consumer goods imports showing a slight downward trend with respect to income in the second subperiod. It already started to take place for raw materials and fuels in the forties, and by the fifties included producers goods as well. Independent research on the Mexican economy[1] suggests that the rapid rise in savings, investment, and output during the forties was due in large part to the increasing inequality of income distribution arising from export expansion. Meanwhile public investment in social and economic infrastructure had been occurring which by the fifties had slowed or even reversed the trend of income inequality, expanded the rate of urbanization, and permitted import competing industries to realize scale economies. Had it not been for the distributive and allocative effects of public policy, and especially those leading to improved factor mobility, it is unlikely that import substitution would have been as successful as the model indicates. Under different circumstances the growth rate during the fifties would have been much slower, and much more dependent upon the capacity to import, than was actually the case.

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[1] One of the authors is preparing a monograph on the structure and growth of the Mexican economy from 1900 to 1960 in which the process of import substitution receives special attention.

Conclusion

The model and the results presented above have attempted to quantify the pattern of import substitution or reveal the lack of its existence (possibly due to the lack of a need for it, as in the case of present-day Peru) in some of the most important Latin American countries. We cannot emphasize the limitations inherent in an aggregative model of this kind. More satisfactory results, particularly as regards production relationships, would be obtained by disaggregation of the economy into several sectors, or at least into industry, agriculture and services. A more detailed study of each country's economy is needed to indicate in each case the reasons for success or failure in the chosen import substituting strategy.

By disaggregating imports into various categories, however, we hope to have shown that the rigidity of import coefficients with respect to domestic income or to investment found in many open-economy growth models can be a dangerous oversimplification and can result in vastly overstated foreign exchange needs when the models are used for projection purposes. By this we do not wish to imply that an escape from such rigidity is an easy process, or that it can be accomplished at all if either an adequate market size or an adequate political will are missing. A radical alteration in the pattern of income distribution may be a necessary, though not sufficient, precondition for this political will to exist and ensure the continuation of the import substitution process once it has been launched by an initial concentration of income accompanied by high rates of saving and investment.

(1) Banco de México, Alternativas de Estimación de la Inversion Bruta Fija en México, 1939 - 1962, prepared by Louis Cossío

(2) CONADE-CEPAL, Cuentas Nacionales de la República Argentina, Buenos Aires, 1964.

(3) Fisher, F.M., Dynamic structure and estimation in economy-wide econometric models, in The Brookings Quarterly Econometric Model of the United States (edited by J. S. Duesenberry, G. Fromm, L. R. Klein and E. Kuh), Rand McNally & Co., Chicago, 1965.

(4) Furtado, C. and A. Maneschi, "A Programming Interpretation of Development and Stagnation in Latin America" (mimeographed).

(5) Goldberger, A.S., Econometric Theory, John Wiley & Sons, Inc., 1964.

(6) McKinnon, R., "Foreign Exchange Constraints in Economic Development and Efficient Aid Allocation, Economic Journal, June, 1964.

(7) Malinvaud, E., Statistical Methods of Econometrics, Rand McNally & Co., Chicago, 1966.

(8) Reynolds, C. W., "Notes on the Gains from Trade and Growth," to appear in El Trimestre Económico.

(9) Seers, Dudley, "The Stages of Economic Development of a Primary Producer in the Middle of the Twentieth Century," The Economic Bulletin of Ghana, Vol. VII, No. 4, 1963.

(10) Thorbecke, E., Macroeconomic Growth and Development Models of the Peruvian Economy (mimeographed).

(11) Zellner, A. and H. Theil, "Three-Stage Least-Squares: Simultaneous Estimation of Simultaneous Equations," Econometrica, January, 1962.

(12) United Nations, The Economic Development of Latin America in the Postwar Period, 1964.

Table 1

	Mexico			Chile		
Period	1940-62	1940-50	1951-62	1941-63	1941-50	1951-63
SAVINGS						
Coefficient of						
1	-4044. (-4.712)	-8652. (-4.321)	599.0 (0.3376)	174.5 (2.588)	-21.38 (-0.1304)	-32.36 (0.2024)
YE	0.2346 (29.28)	0.3032 (9.968)	0.2000 (14.86)	0.07186 (4.526)	0.1379 (2.664)	0.09923 (3.053)
IMPORTS OF RAW MATERIALS AND FUELS (MRMF)						
Coefficient of						
1	-469.5 (-1.557)	-1118. (-1.969)	-423.7 (0.3550)	27.54 (1.769)	98.03 (1.695)	-25.62 (-0.7780)
X-1	0.5799 (10.26)	0.2924 (3.054)	0.6359 (5.704)	0.04564 (0.9122)	0.003720 (0.04015)	0.02159 (0.2846)
YE	-0.01598 (-2.681)	0.03207 (2.345)	-0.02296 (-3.165)	0.01899 (4.302)	0.002433 (0.2448)	0.03177 (3.295)

The figures in parentheses are the ratios of the estimates to their asymptotic standard errors and are hence analogous to t-ratios.

Argentina	Brazil	Colombia	Peru	Peru	Peru
1953-63	1950-63	1951-62	1951-65	1951-60	1956-65
SAVINGS					
-89.47	17.68	1857.0	303.8	7537.	1529.
(-1.197)	(5.059)	(2.662)	(2.288)	(2.236)	(0.9375)
0.2904	0.06525	0.1160	0.157	0.06695	0.1780
(3.588)	(6.583)	(3.416)	(7.501)	(1.046)	(7.699)
IMPORTS OF RAW MATERIALS AND FUELS (MRMF)					
-30.22	93.68	-58.60	711.5	255.8	698.8
(-0.9141)	(0.8353)	(-1.249)	(1.723)	(0.3476)	(1.036)
-0.06170	15.62	0.02395	0.3822	0.2986	0.4084
(-0.3376)	(4.771)	(2.513)	(6.347)	(2.160)	(5.574)
0.1038	1.191	0.01068	-0.001987	0.02112	-0.007062
(2.406)	(4.841)	(7.021)	(-0.1208)	(0.8210)	(-0.3182)

Table 2

	Mexico			Chile		
Period	1940-62	1940-50	1951-62	1941-63	1941-50	1951-63
IMPORTS OF CAPITAL GOODS (MK)						
Coefficient of						
1	-230.7	-371.1	497.1	-54.59	-78.36	-9.455
	(-0.3859)	(-0.8235)	(0.8415)	(-2.501)	(-3.577)	(-0.2068)
X-1	0.3078	-0.01826	0.3127	0.04529	-0.02040	-0.003208
	(2.866)	(-0.3219)	(5.437)	(-1.901)	(-1.289)	(-0.06075)
JE	0.06030	0.3443	0.02826	0.6872	0.7179	0.5700
	(1.323)	(21.52)	(1.317)	(14.30)	(9.766)	(6.359)
IMPORTS OF CONSUMER GOODS (MC)						
Coefficient of						
1				-87.49	179.6	-196.2
				(-3.296)	(4.316)	(-3.710)
X-1				0.2693	-0.1457	0.1634
				(2.858)	(-2.119)	(1.051)
YE				0.01839	-0.01578	0.05041
				(2.329)	(-2.065)	(2.636)

Argentina	Brazil	Colombia	Peru	Peru	Peru
1953-63	1950-61	1951-62	1951-65	1951-60	1956-65
IMPORTS OF CAPITAL GOODS (MK)					
-15.01	51.42	747.6	-0.003338	-1833.	-4063.
(-4.481)	(2.743)	(1.106)	(-3.121)	(-3.644)	(-3.375)
-0.02898	7.425	0.1456	-0.1266	0.2692	-0.2212
(-1.043)	(1.029)	(3.787)	(-1.080)	(2.693)	(-3.076)
0.2262	-3.053	0.1229	0.6600	0.2204	0.7993
(12.70)	(-1.921)	(0.7769)	(3.774)	(2.704)	(6.199)
IMPORTS OF CONSUMER GOODS (MC)					
7.935	207.2	62.51	663.8	1017.	-0.2823
(2.036)	(2.521)	(1.233)	(1.755)	(1.909)	(-0.05036)
-0.004189	3.101	0.01715	0.1466	0.3611	0.08401
(-0.1992)	(1.068)	(1.831)	(2.719)	(3.557)	(1.260)
-0.002834	-0.3851	-0.002634	.002457	-0.03845	0.02426
(-0.5619)	(-2.512)	(-1.560)	(0.1653)	(-2.024)	(1.261)

Table 3

Mexico

Period	1940-62	1940-50	1951-62
FRONTIER IMPORTS* (MFR)			
Coefficient of			
1	-541.2 (-4.701)	-125.8 (-1.128)	-847.0 (-1.298)
X-1	0.01143 (0.4551)	0.03808 (1.380)	0.04844 (0.7599)
YE	0.02040 (7.704)	0.01016 (2.196)	0.01832 (4.625)

* Data unavailable for countries other than Mexico

IMPORTS OF SERVICES* (MS)			
Coefficient of			
1	308.5 (3.230)	269.7 (2.239)	468.2 (0.8918)
X-1	-0.04204 (-2.092)	-0.07081 (-5.673)	-0.03545 (-0.7024)
YE	0.02239 (10.50)	0.02653 (10.06)	0.02049 (6.504)

* Data unavailable for countries other than Mexico

Table 4

	Mexico			Chile		
Period	1940-62	1940-50	1951-62	1941-63	1941-50	1951-63
			TOTAL IMPORTS (M)			
Coefficient of						
1	-53.09	-4479.	3123.	-309.1	-43.56	-475.8
	(-0.07142)	(-2.688)	(2.051)	(-6.800)	0.6376	(-4.810)
X-1	1.008	0.6356	0.7975	0.6317	0.01978	0.6711
	(8.540)	(3.181)	(6.270)	(4.012	(0.1785)	(2.422)
YE	0.02185	0.1416	0.02267	0.1099	0.07397	0.1385
	(1.851)	(7.939)	(2.593)	(8.254)	5.992	4.025

Argentina	Brazil	Colombia	Peru	Peru	Peru
1953-63	1950-63	1951-62	1951-65	1951-60	1956-65
-99.72	80.00	381.6	-4369.	-6709.	-70.01
(-2.896)	(2.800)	(0.4135)	(-3.518)	(-2.957)	(-0.04125)
-0.2614	25.65	0.5608	0.3793	1.046	0.7679
(-1.130)	(2.468)	(3.203)	(2.093)	(2.288)	(4.153)
0.2276	0.4830	0.007443	0.2274	0.1674	0.09194
(4.718)	(1.087)	(2.705)	(4.628)	(2.059)	(1.654)

Table 5

	Mexico			Chile		
Period	1940-62	1940-50	1951-62	1941-63	1941-50	1951-63
INVESTMENT IN CONSTRUCTION (ICI)						
Coefficient of						
1	229.1	1026.	-2218.	59.75	73.23	15.84
	(0.7876)	(2.533)	(-3.694	(3.126)	(3.072)	(0.3685)
IE	0.5228	0.4581	0.6104	0.2997	0.2692	0.3774
	(38.99)	(13.17)	(27.84)	(6.967)	(3.298)	(4.679)
INCREASE IN GDY						
Coefficient of						
1	2981.	2108.	5420.	29.50	-157.7	66.37
	(2.419)	(1.737)	(1.347)	(0.3516)	(-0.9824)	(0.4729)
I-1	0.1403	0.2156	0.05026	0.2988	0.9457	0.2387
	(2.335)	(1.952)	(0.3271)	(1.499)	(1.698)	(0.8542)

Argentina	Brazil	Colombia	Peru	Peru	Peru
1953-63	1950-63	1951-62	1951-65	1951-60	1956-65
		INVESTMENT IN CONSTRUCTION (ICI)			
51.70		-648.8	2592.	1078.	2022.
(12.33)		(-1.243)	(4.256)	(1.204)	(2.580)
0.1652		0.6657	0.2955	0.4407	0.3312
(7.353)		(5.156)	(6.399)	(5.567)	(6.146)
		INCREASE IN GDY			
118.1	2.608	1642.0	552.4	8012.	664.7
(3.231)	(0.1942)	(2.424)	(0.1978)	(3.034)	(0.2425)
-0.5396	0.2705	-0.2285	0.2437	-0.5245	0.2495
(-2.733)	(0.9436)	(-1.336)	(1.071)	(-2.204)	(1.258)

SOURCES OF DATA

(1) CONADE-CEPAL, Cuentas Nacionales de la República Argentina, Buenos Aires, Abril de 1964.

(2) Consejo Nacional de Desarrollo, Plan Nacional de Desarrollo, 1965-1969 Buenos Aires 1965.

(3) Economic Bulletin for Latin America, Vol. IV, No. 2 Oct. 1959, Statistical Supplement. CEPAL.

(4) Boletín Económico de América Latina, Vol. V, Suplemento Estadístico, Nov. 1960. CEPAL.

(5) Statistical Bulletin for Latin America, Vol. II, No. 1, March 1965. CEPAL.

(6) Past Trends of Structural Relationships in the Economic Evolution of Brazil 1920-1965, Statistical Appendix, prepared by Octavio A. Dias Carneiro, Center for International Affairs, Harvard University, Cambridge, Massachusetts, May 1966.

(7) Corporación de Fomento de la Producción, Cuentas Nacionales de Chile, 1940-1962, Santiago, Junio de 1963.

(8) Corporación de Fomento de la Producción, Cuentas Nacionales de Chile, 1958-1963, Santiago, Junio de 1964.

(9) Banco Central de Chile, Balanza de Pagos de Chile: (a) Año 1963, Santiago, 1965; (b) Año 1964, Santiago, 1966.

(10) Banco de la República, Cuentas Nacionales (Colombia) 1950-1961.

(11) Banco de la República, Cuentas Nacionales (Colombia) 1962-1963.

(12) VII Asamblea Nacional de Afiliados de la Cámara Colombiana de la Construcción, "Situación Económica y Social de Colombia", Bogotá, D.E., Noviembre de 1964

(13) Banco de México, Alternativas de Estimación de la Inversión Bruta Fija en México, 1939-1962, prepared by Luis Cossío.

(14) Grupo Secretaría de Hacienda, Banco de México, Estudios sobre Proyecciones "Manual de Estadísticas Básicas para el Analisis y Proyecciones del Desarrollo Económico de México", Julio de 1964; rev. Dic. de 1964.

(15) Banco Central de Reserva del Perú, Cuentas Nacionales del Perú, 1950-1965, Lima, 1966

Argentina: All data in millions of 1960 pesos were derived from (2), with the exception of the terms-of-trade effect, given in (1).

Brazil: Total Imports and their breakdown by commodity group in millions of 1955 US $ were obtained from (3), (4) and (5). All remaining figures, in billions of 1950 cruzeiros, were found in(6). The real GNP figures are those proposed by the Conselho Nacional de Economía

Chile: Figures in millions of 1961 escudos were obtained from (7) and (8), including those for M and for M_K. The remaining import categories are quantum indices (1947 = 100) found in (9).

Colombia: Figures in millions of 1958 pesos were obtained from (10) and (11), with the exception of (i) M_K, which came from (12); and (ii) other categories of imports, which came from (3), (4) and (5).

Mexico: Figures in millions of 1960 pesos were obtained from (14) with the exception of the breakdown of I into M_K, ICI and IDK, which came from (13).

Peru: All figures are in millions of 1963 soles and were derived from (15).

The following should be noted:

(1) Figures for inventory investment were not available for Brazil and Mexico, so that the exogenous variable I_{inv} was omitted from the model relating to these countries;

(2) The income figure available for Peru was GNP (adjusted for the terms-of-trade effect) rather than GDY;

(3) The breakdown of imports for Argentina and Peru was obtained by multiplying the percentage composition of each category in current US $ to the total import figure in constant domestic prices for the corresponding year.