IMPORT DEMAND AND IMPORT SUBSTITUTION IN BRAZIL

1953-1965

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To our knowledge past work on Brazilian imports has been either descriptive or interpretative, making a factual analysis of past import trends to support a point of view or complement a work on industrialization. Many fewer attempts have been made to analyse or quantify the determinants of import demand. Yet from the point of view of policy, what causes importation is the central question. This paper will give some preliminary results of our attempt to determine import demand function through regression analysis and sketch out some of their implications for future policy. We will be able to show that Brazilian imports are generally predictable by regression functions containing demand and substitution variables and relative prices. These regressions demonstrate that Brazilian imports are sensitive to both the rate of growth of national substitutes and changes in exchange rates and relative prices. This means that import demands can be modified by changes in the rate of growth of industry and in the relative price of imports, and our regression functions will allow us to estimate the effect of these changes.

The outline of the paper is the following. Section one puts the problem of import demand in the context of general price theory and discusses the general import record. Section two contains two alternative expressions of the import model in regression form. The econometric results of the regressions are discussed in section three. In section four we will examine some of the implications of the regression functions by showing the forecast changes in imports when the growth rates of domestic industry and relative prices are allowed to vary. Also we will include a discussion of the implication of the regressions in the light of "import substitution."

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Needless to say the errors remain my own responsibility.

SECTION ONE

One of our main efforts in this paper is to introduce prices back into the study of the determination of imports. Partly because of the difficulty obtaining reliable price information, it is easier to concentrate on the between imports and total income. But in a market economy demand for imports is nothing more than a standard problem in demand theory, where national and imported goods are substitutes. (They may in some cases be complements). Clearly the relative cost of the imported product and the national substitute is relevant to determining the proportion of total demand for the good satisfied by importation. The price that we are thinking of here for the imported good is the price of the good in the foreign currency expressed in cruzeiros at the actual rate fo exchange, plus tariffs and other costs such port charges, advance deposits and the like. The relative price is then the price just described, expressed as a fraction of the cost of a national substitute good.

Capital and intermediate goods are governed by final demand only indirectly and the analysis has to be adjusted accordingly. In the case of capital goods, the total demand for imports should depend upon total fixed domestic investiment, and as before the relative cost of imported and domestic capital goods. The demand of intermediate goods may generated either by fixed investment or production for consumption. The choice of a demand variable is somewhat uncertain, but given that choice, relative prices enter in the usual way to govern the proportion of total intermediate goods imported. For capital goods another relative price which is likely to be relevent is that between imported and national final goods. Suppose that imported final goods become relatively more expensive. This should lead to more domestic production, in turn requiring more fixed investiment and a greater demand for imported capital equipment. Thus domestic final products and imported capital goods are complements.

There are many goods for which the simple demand model just described is not entirely relevant. In the case of raw materials such as wheat and oil, national production is insufficient to meet total

demand regardless of relative prices. At the same time the Brazilian government has historically made a policy decision to encourage domestic production by providing a market for all national output. Thus relative prices may be expected to be uneffective either on the upside or downside. There are other goods such as asbestos, lead and coal for which imports are allowed so long as the national output of the same good is also used in the final products. Relative prices as we have defined them are going to be irrelevant in determining the demand for imports because the government does not allow substitution between foreign and Brazilian production.

Let us now have a brief look at the import record since 1953 that we will be attempting to "explain". Table one shows the changes in the shares of the various components of imports over the years since 1953. It shows an absolute and relative growth of imports of capital goods at the expense of consumer and intermediate goods up to 1960 followed by a steady decline which must be partly due to the decline in total investment. Since 1962 there has been a fundamental change in import behavior in the country with all components either falling absolutely or growing at a reduced rate.

Imports are in some sense a residual. Thus when the level of economic activity slows down, as it did after 1962, there is a sort of accelerator effect causing the demand for imports to fall faster than the fall in income. However, for goods not produced in great quantity in Brazil, such as wheat, oil, and metallic intermediate goods, the slowdown in growth does not enable Brazilian production to satisfy total demand. This can be verified in appendix table six which shows imports in constant dollars. What we observe is a levelling off in intermediate goods accompanied by an absolute decline in imports of capital and consumer goods which means a growth in the share of the former at the expense of the latter.

TABLE ONE

PERCENTAGE SHARE OF VARIOUS IMPORT GROUPS IN TOTAL IMPORTS

Base 1953 dollars

YEARS	Consumer Goods	Intermediate Goods	Capital Goods	Wheat	Total in millions
1953	10.1 %	39.9 %	36.3 %	13.7 %	1 316.6
1954	9.5	46.2	35.3	9.0	1 750.2
1955	9.9	46.5	30.3	13.4	1 408.2
1956	10.5	49.7	28.1	11.7	1 359.2
1957	9.0	42.2	38.7	10.0	1 610.0
1958	7.7	42.0	39.5	10.7	1 567.2
1959	6.9	38.6	42.5	11.9	1 714.8
1960	7.6	44.7	34.5	13.2	1 722.0
1961	8.8	45.7	33.5	12.0	1 750.2
1962	9.4	49.2	27.7	13.8	1 774.8
1963	9.0	52.7	25.3	12.9	1 877.1
1964	10.2	51.9	19.3	18.6	1 563.8
1965	11.5	56.0	17.0	15.4	1 361.1

Another interesting way of presenting the import data is as a proportion of the demand generating variable which will be investment for capital goods and total income for the rest. Table two shows these proportions. To my mind this is a striking set of numbers which suggests the extent of the substitution process which has gone on in Brazil during the last 15 years. While one cannot identify exactly what import substitution is without more information, as we will discuss below, the decline in the import function which occurs in every category is unmistakable and so gives a good indication of the import proportions which might be expected in the future.

TABLE TWO

IMPORTS AS A PROPORTION OF THE DEMAND GENERATING VARIABLE

Imports and demand generators in 1953 cruzeiros

YEARS	Consumer Goods	Intermediate Goods excluding wheat	Capital Goods
1953	.59%	2.34%	16.24%
1954	.69	3.55	17.08
1955	.54	2.54	13.17
1956	.54	2.57	10.96
1957	.52	2.42	15.94
1958	.40	2.29	14.93
1959	.37	2.06	15.85
1960	.38	2.25	11.99
1961	.42	2.17	12.56
1962	.43	2.25	9.24
1963	.43	2.40	8.79
1964	.39	2.00	6.22
1965	.37	1.79	5.35

Turning first to capital goods the data indicates a broad reduction in the ratio imported which is a result of the decline in investment coupled with the growth in the capacity of the national capital goods industry. Imports of capital equipment appear to act like a residual. When the domestic investment rate is high, the proportion imported is also high and vice-versa. At the same time, there is a downward trend in the import ratio for a given investment rate due to the growth of the Brazilian capital goods industry. Thus for example an investment rate of 15.2% in 1954 required an import fraction of 17% while in 1961 roughly the same rate induced import of only 12%. The same declining pattern can be found for the years of low investment rates. It will remain for us to demonstrate through regression analysis whether relative prices and substitution variables can explain this import pattern.

The overall pattern of declining import fraction noted for capital goods shows up equally for both consumer and intermediate goods imports as a fraction of PNB. The fraction declines almost continuously throughout the fifties followed by an increase to 1963, and then another rapid decline. The movement in the 1950's appears to have been the result of an attempt by the government to encourage the importation of capital equipment at the same time that it was facing a constraint in the total capacity to import. This was done by granting special tariff exemptions and lower exchange rates which kept the relative cost of foreign capital equipment below that of other types of imports. In 1958 and 1959 the relative price of capital imports was about 30% lower than either consumer or intermediate goods. The rise in the import fraction which occurred between 1959 and 1963 also appears to have been the result of changes in relative prices, at least for intermediate goods. By far the most significant component in the rise is the increase in metallic intermediate goods, which coincides exactly with significant decline in the import fraction. Relative prices were neutral, and the reduction in imports was undoubtedly due to the overall lower rate of economic activity and the balance of payments constraint.

SECTION TWO
TWO ALTERNATIVE REGRESSION MODELS

Our first regression model is taken directly from the discussion of the import mechanism in section one. There was showed how imports should be a function of total demand and relative prices. For goods where national production cannot satisfy total demand, or where that production is being stimulated by special government measures, imports were shown to be a residual which depended on the difference between total demand and national production and not on relative prices. For such goods an additional variable, to be called a substitution variable, can be introduced into the model. Since such goods are in fact spread throughout the import list, we used the substitution variable along with prices and total demand in most of the regressions. Our first model had the following form:

(1) $$\text{Log } M = a_0 + a_1 \log Y + a_2 \log P + a_3 \log T$$

M = imports in millions of 1953 dollars

Y = demand generating variable in millions of 1953 cruzeiros

P = a relative price index

T = a production index of comparable Brazilian products (except for fuels)

Y represents the determinant of total demand for the good in question. For consumer and intermediate goods Y will be PNB, while for capital goods it represents gross fixed investment. P, the price variable, is composed of three different parts. One is the cost of acquiring foreign exchange and paying associated tariffs and extras. A second is the price in the exporting country. Multiplied together these two give the cost of buying a foreign good in cruzeiros. The third price is the price of the comparable national substitute. To

arrive at the final price, the product of the first two elements is deflated by the third. Because these separate elements are not without some interest in their own right, and especially because the tariff and exchange calculations have never been done before, each is shown separately in tables in the appendix for all import classes. The substitution variable T represents the output of domestic wheat, for that regression and an index of the output of Brazilian industry for all the rest of the functions except fuels. While it is probably not theoretically defensible to use this variable in all cases, it is an extremely interesting one for planning purposes. It can take the place of the price variable, and it shows explicity the balance of payments effect of alternative strategies of industrial development. For the coefficient of this variable tells us the percentage changes in imports which will result from a given percentage rate of growth of domestic capacity.

Econometrically the regression form that we have proposed is liable to problems of multicollinearity between the income and the production variables making it extremely difficulty to separate their influences. As is usual with multicollinearity, one needs additional information. Lacking that, we introduce the assumption that the elasticity of imports with respect to the demand generating variable is equal to unity. Equation one then becomes:

$$(2) \qquad \text{Log} \frac{M}{Y} = n = b_0 + b_1 \log P + b_2 \log T$$

If the true elasticity of demand with respect to income is different from one, than we are probably introducing some bias into our regression coefficients. For example, if the true elasticity is greater than one, then the regression estimates of b_1 and b_2, will be biased downward in absolute magnitude. Technically we are accepting some bias in our coefficients in order to reduce their sample variance, and this bias should be borne in mind when interpreting the regression results. To determine the importance of this, we will in the future rerun the regressions using various alternative assumption about the demand elasticity and observing the sensitivity of the other coefficient to changes in it.

SECTION THREE
REGRESSION RESULTS

Probably the most significant conclusion to be drawn from the regression analysis is that the technique can be used successfully to approximate import behavior in Brazil. Both the price and substitution variables entered negatively and significantly in almost all relations and their coefficients have the right order of magnitude. However it proved difficult to show the effect of the demand variable directly, for it was so highly correlated with the substitution variable that it did not even enter the regression significantly in most cases. Assuming unitary elasticity of potential demand and changing the dependent variable to the fraction imported proved to be far more successful, though we still need to investigate the importance of the unitary elasticity assumption by testing alternative elasticitie In general the results confirm the previous work of EPEA in showing a strong influence of domestic investment on the level of imports. This is not surprising in the imports of capital goods, but its occurrence in intermediate goods other than fuels as well deserves some investigation. The net result of the investment relationship from the planning point of view is that projected imports in the future will be highly sensitive to the choice of a national rate of growth because of the relationship between it and investment.

In this study imports have been divided into nine so called use classes plus wheat which can be grouped as consumer, intermediate products and capital goods. Regressions were run for both the ten individual categories and the aggregate groups. Wheat was separated out to see whether its special treatment and nature would affect the regressions. Because of some doubt about the authenticity of the import deflators, most of the regressions were run in both current and constant dollars. In almost every case the constant dollar results were superior, and the deflators have therefore been accepted. In reporting the results we will discuss first the aggregate and then the individual import categories for each of the three broad import classes

Intermediate or Producers Goods

Imports of producers goods have in the past been significantly influenced by the relative price of imports, the growth in national industrial production, and the level of domestic investment. However there remains an unexplained residual influence, probably related to unmeasurable policy constraints on importation which tends to make actual imports less than estimated in the 1957/1960 period and the opposite thereafter.

The estimated price elasticities, while significant in all cases, are consistently low. For all the regressions tried, there is no significant difference in the estimates, which range from -0.28 to -0.64. This is only another way of saying that the introduction of different variables or different regression forms does not significant affect the estimated price elasticity. Thus one can have a good deal of confidence in the conclusion that for producer goods the true shortrun price elasticity is around .4. The fact that this is a short run elasticity may go a long ways towards explaining why it is so low. One would expect that if Brazilian substitute goods were available, the price elasticity would be relatively high, while if they weren't, that the regression estimate would be insignificant. But in a developing country, the high relative cost of importing only stimulates the production of national substitutes with a lag, for one first must create the capacity. Thus in a developing country the short and long run price elasticities may well differ significantly. When further observations are available it would be extremely interesting to test this hypothesis by splitting the sample, and seeing whether the elasticity was higher in the later period when there was more installed capacity. In the absence of a differential effect over time this low elasticity implies that Brazilian imports in this important category are likely to be rather insensitive to exchange policy.

TABLE THREE

REGRESSION RESULTS INTERMEDIATE GOODS *

1. $M_{53} = 4.20 + .71\ I - .10\ T - .47\ P$ $\quad R^2 = .78$
(.27) (.16) (.14)

2. $M_{53} = 12.4 - 2.25\ Y + 1.73\ T - .64\ P$ $\quad R^2 = .74$
(1.04) (.68) (.19)

3. $m = .75 + .90\ I - .85\ T - .38\ P$ $\quad R^2 = .81$
(.30) (.18) (.15)

4. $m = 2.25 - .37\ T - .29\ P$ $\quad R^2 = .61$
(11) (.21)

(1) * excluding wheat
(2) all variables in logs
(3) M in million of 53 dollars
(4) Y is PNB in billions of 53 cruzeiros
(5) T is index of output of transformation industry
(6) P is relative price of imports
(7) I is gross fixed investment in billions of 53 cruzeiros
(8) m = M/Y

The influence of domestic industrial capacity while somewhat harder to capture than that of prices appear also to be lower than would be expected. In table three, one sees a range of - .10 to - .85 and this spread includes all the other estimates derived without the influence of prices and income. In part this is due to the nature of the products included in this import group. By and large these are raw materials some of which are not readily available in Brazil. The index of industrial output, far from being an index of the availability of substitutes for such products, is an index of increases in demand. Therefore in aggregating over the whole product class one is lumping together products with a positive and a negative relationship to domestic capacity, and the net result is a low aggregate coefficient. This does not affect the predictive ability of the equations however, so long as the general structure of Brazilian raw materials supplies does not change drastically.

One interesting relationship which all of our work has confirmed is the rather strong positive influence of investment on imports of intermediate goods. One can see this by comparing equations (3) and (4) in table three. Investment is an index of the level of domestic activity, indeed the Keynesians would say that it is the primary determinant of domestic activity through the multiplier. Imports to a great extent are a residual, determined by total demand and domestic capacity. Given the relatively fixed level of domestic capacity at any moment, a higher level of investment leads to higher fraction of imports through the multiplier effect on total demand. This arguement is equally valid when investment falls, and indeed a Tinbergen chart will show that investment is primarily responsible for the explanation of the rapid fall in imports of producers goods after 1963. It should be noted that there may well be a difference between the behavior of imports when investment is rising or falling. The arguement we have made assumes that there is no idle capacity, where there is, the assumption of fixed capacity breaks down, and a much lower relation between investment and imports should be expected.

In table three we showed equation (2) simply to demonstrate the difficulty of measuring the income elasticity of demand for intermediate goods directly. It is of course not possible to work with income alone, since we are interested in potential demand and there has been a good deal of import substitution. But when one introduces a substitution variable such as the industrial output index, the high multicollinearity between it and income gives nonsense results. This is the reason for our adding the assumption of unitary elasticity of potential demand. Clearly an interesting direction for further research would be to refine this assumption by the use of elasticities obtained independently such as through international cross-sections. If these elasticities were greater than one, this would make the elasticity of imports with respect to industrial output more negative, and for predictive purposes the two effects would probably cancel each other out. On the one hand, one would be assuming a greater potential demand, but on the other, a greater ability by domestic industry to supply it.

Fuels

In the explanation of the imports of fuels the problem of multicollinearity once again forced us to resort to the fraction of imports to income, for which the chief explanatory variable is the fraction of total oil consumption produced in Brazil. Relative prices were insignificant in all the regressions run in this sub group and generally had the wrong sign. To explain this failure of the price variable one must remember the nature of the petroleum industry in Brazil. Directly stimulated and controlled by the government, it at no time ever supplied more than one-third of the total demand for oil. Thus it neither had the capacity to respond to high relative prices for imports, nor were low relative prices permitted to interfere with the government program for expansion. Apparently domestic investment plays little part in the demand for imported oil. Its explanatory power as a demand variable is inferior to income as can be seen from regressions (1) and (2), and it is insignificant in the import fraction regression (4). This is a reasonable result since one would not expect much of a fuel component in fixed capital formation.

TABLE FOUR
REGRESSION RESULTS FUELS

1.	$M = 1.34 + .71\ Y - .07\ s + .12\ P$ $(.17)\quad (.04)\quad (.11)$	$R^2 = .81$
2.	$M = 3.57 + .50\ I - .003\ s - .10\ P$ $(.23)\quad (.04)\quad (.13)$	$R^2 = .65$
3.	$m = - .42 - .13\ s + .20\ P$ $(.02)\quad (.10)$	$R^2 = .84$
4.	$m = - .33 + .10\ I - .12\ Q + .16\ P$ $(.20)\quad (.03)\quad (.10)$	$R^2 = .85$
5.	$m = - .04 - .10\ s$ $(.027)$	$R^2 = .78$

all variables in logs

$a = \frac{\text{national production of oil}}{\text{national consumption of oil}}$

I = gross fixed investment in billions of 53 cruzeiros

Q = index of output of crude oil in Brazil

P = Relative price index

Y = PNB in billions of 53 cruzeiros

m = imports as a fraction of PNB

There is nothing surprising about the nature of the [illegible] variable, natural production or a function of [illegible] oil. The relationship between it and the import function is [illegible] by definitional, differing only in coverage and in the fact that [illegible] and not total oil consumption is in the denominator of the [illegible]. The reason for using this variable rather than say the index of weight of Brazilian oil in that could be called the percentage [illegible] ton. For a national industry which is very small compared to [illegible] may have very high rates of growth, especially at the beginning [illegible] which including a point requirements very much in absolute terms. It is one main reason the substitution element although [illegible] and this can only be overcome by using absolution or [illegible] as we have done here.

Metallic and Non Metallic Producer Goods

Since metals and non metals have the same general dependence on investment, low price elasticity, and multicollinearity between the substitution and demand variable, they can be usefully discussed together. For both, the same regression form gives the best results; mainly predicting the import fraction as a function of domestic investment, price, and the industrial output index. This function, for each being examined over time has had substantial fluctuations especially in metals imports.

TABLE FIVE

REGRESSION ON RESULTS FOR METALLIC AND NON-METALLIC PRODUCER GOODS

Metallic

1. $m = 2.66 + 2.19\ I - .99\ P - 1.75 \log T$ $\quad R^2 = .74$
   (.64) (.26) (.41)

2. $M = 7.93 + .15\ Y - .82\ P$ $\quad R^2 = .47$
   (.45) (.38)

3. $M = 9.21 - .89\ P$ $\quad R^2 = .47$
   (.30)

Non-Metallic

4. $m = -.01 + 1.10\ I - .29\ P - 1.04\ T$ $\quad R^2 = .86$
   (.29) (.15) (.17)

5. $M^{\circ} = 5.22 + .39\ Y_2 - .23\ P$ $\quad R^2 = .56$
   (.12) (.30)

° includes wheat

all variables in logs

M = imports in millions of 1953 dollars

Y = PNB in billions of 1953 cruzeiros

m = M/Y

P = relative price index

T = index of Brazilian industrial output

Y_2 = income outside agriculture in billions of 1953 cruzeiros

As one can see from the table, it again proves impossible to measure the demand elasticity for imports directly, and the import fraction form is an acceptable way of overcoming this. The comparison of equations (2) and (1) and (5) and (4) shows the improvement in fit which comes from this alternative as well as the consistency of the price elasticity estimates. As there is no significant difference between the various price coefficients, the estimates of -.99 and -.29 for metals and non metals respectively can be accepted as unbiased and reasonable. The metals elasticity is undoubtedly higher because the substantial fluctuations in yearly relative prices were greater and they were followed to a much larger extent than in non metals.

Investment, as we discussed earlier in reference to the aggregate of producers goods, seems to be an index of capacity utilizations. Its turn down in 1963 is an important element in the explanation of the steep decline in the import fraction for both these groups, especially since the price variable is not moving up rapidly enough to explain such a reduction in imports. This general reduction in investment may have been related to a broad reduction in the relative price of imported goods which occurred in most categories. That price movement is an important explanatory factor in the rise in imports of intermediate goods especially metals after 1960. But the increased international competition that it implies may have been one reason for the reduction in domestic capital formation which started in 1963. The net effect of all this was that while the movement in relative prices pointed in the direction of import expansion, the reduction in aggregate demand caused by the decline in investment after 1963 caused a more than proportional fall in imports which spread through practically all categories.

Wheat

One of the more surprising results of this study was the ability to find an explanatory relation for imports of wheat. Like fuel, imports appear to be determined by the demand generating variable less domestic production, but not by changes in relative price. The most interesting regression is the following:

$$M = 5.46 + .39\,Y - .41\,Q \qquad R^2 = .82$$
$$(.13) \quad (.11)$$

Prices did not enter significantly in any of the regressions and generally had a positive sign. This insensitivity to relative prices in the short run is to be expected in a product such as wheat. Planted in advance, the domestic supply cannot respond to yearly changes in relative prices.

In addition, the substitution index we are using is extremely specific, unlike the industrial transformation index that is being used in most other regressions. The relevant magnitude in the short run is the national supply of wheat on hand, not price changes. For domestic and foreign wheat are close if not perfect substitutes, and imports are the simple difference between total demand and domestic supply. Note that even if national production reacts to a price stimulus, where the imported and national good are homogeneous domestic supply may be a better predictor than relative price. In this general characteristic of homogeneity between imported and national products oil and wheat are similar, and it is therefore interesting to note that in both of these categories the chief explanatory variable is a domestic production index. Even more striking is the fact that they are the only two categories in which relative prices are not significant.

Aggregated Capital Goods

The general results for the capital goods sector are highly satisfactory both in regards to the overall fit of the regressions and to the sign and significance of all the variables. However the high multicollinearity between several of the explanatory variables makes the absolute size of some of the individual coefficients suspect. In table six we present some of the regression results.

TABLE SIX

REGRESSION RESULTS FOR CAPITAL GOODS

1. $M = .65 + 2.84\ I - 1.52\ T - .45\ P + .92\ P_C$ $\quad R^2 = .96$
$\qquad\qquad (.37) \quad (.32) \quad (.19) \quad (.33)$

2. $M = 3.52 + 3.02\ I - .58\ P - 1.47\ T$ $\quad R^2 = .91$
$\qquad\qquad (.50) \quad (.25) \quad (.44)$

3. $M = -2.35 + 3.54\ I - 2.27\ T$ $\quad R^2 = .85$
$\qquad\qquad (.54) \quad (.32)$

4. $M = 5.90 + 1.58\ I - 1.27\ P$ $\quad R^2 = .80$
$\qquad\qquad (.37) \quad (.22)$

5. $m = 7.25 - 1.05\ P + .01\ T$ $\quad R^2 = .77$
$\qquad\qquad (.37) \quad (.39)$

all data in logs
M = imports in millions of 1953 dollars
I = gross fixed investment in billions of 1953 cruzeiros
T = index of output of Brazilian transformation industry
P = relative price index
P_C = relative price index for final goods. (use classes 1-5)
m = M/I

As one can see from the table all the variables enter significantly and with the proper sign in all of the regressions. However a closer look reveals some large changes in the sizes of the regression coefficients over the four equations that needs to be explained. Equation (4) shows the system without the substitution variable, and one can see that elasticity of imports with respect to investment is significantly different from the first three regressions in which substitution is entered specifically. The same thing is true to a lesser degree with prices where the price elasticity of imports appears to be much higher in (4) than either (1) or (2). Of course the reason for this is the high correlation between I, T and P shown below.

$$R_{IT} = .89$$

$$R_{IP} \quad .66$$

$$R_{TP} \quad .86$$

When one thinks about the process of import substitution, this is not a surprising relationship. Indeed it is exactly the evidence we would expect, if the process is taking place. For we assert that substitution takes place in response to a rise in the relative cost of imports. Domestic industry is built when imports become more expensive, implying that R_{TP} should be positive which it is. Similarly fixed investment is required in order to build domestic industry leading one to expect a positive correlation between investment and the substitution index. It is impossible to choose among the regression estimates without additional information. If one knew, for example, that the estimates of (4) were the true ones, then one could regress the substitution variable on the difference between actual imports and imports estimated through (4). But we do not have such information, and it is therefore preferable to use our best estimate, equation (1). Even though its individual coefficients may be untrustworthy, the total estimator is, providing the relationship between the explanatory variables does not change drastically.

Such an equation has to be used with care in prediction however. If for example one had an investment program which increased only agricultural capacity, one could not predict imports with (1). For in this case the relationship between I and T upon which (1) is based in not being held unchanged and one should use an alternative form.

Another interesting result of the regressions shown in table six is the positive and significant role of P_C, the relative price of final goods. P_C is an index of the relative price of foreign and Brazilian consumer and intermediate goods. When the index goes up, it means that there is an incentive for import substitution requiring investment. The P_C index should therefore be positively related to both investment imports of investment goods. This means that changes in relative prices for final goods may simply change the composition of imports in the short run. While imports of the final goods in question may fall, imports of capital equipment to build the substitutes increases. Ideally the P_C variable should probably be introduced with a lag. The degrees of freedom problem precluded this but when more observations are available, it will be interesting to introduce a lag system to see whether this variable has even more significance.

Capital Goods by Individual Use Classes

The work on individual classes of capital equipment is as yet quite incomplete, and the results reported here should be regarded as preliminary. No domestic substitution variable was used in these regressions which lowered the overall goodness of fit substantially. Nonetheless, the same negative and significant relationship between imports and the relative price variable can be seen, and, as in the aggregate results, investment always has a positive and significant import elasticity.

TABLE SEVEN

REGRESSION RESULTS - CAPITAL GOODS

Class 6 - Construction Material

1. $M = 3.63 + 2.01\ I - 1.34\ P$ $\qquad R^2 = .68$
$\qquad\qquad (.62) \qquad (.31)$

Class 7 - Agricultural Equipment

2. $M = 7.89 + .92\ I - 1.27\ P$ $\qquad R^2 = .39$
$\qquad\qquad (.75) \qquad (.54)$

Class 8 - Industrial Equipment

3. $M = 2.64 + 1.53\ I - .86\ P$ $\qquad R^2 = .59$
$\qquad\qquad (.46) \qquad (.28)$

Class 9 - Transportation Equipment

4. $M = 10.02 + 1.28\ I - 1.57\ P$ $\qquad R^2 = .79$
$\qquad\qquad (.73) \qquad (.28)$

I = gross fixed investment in billions of 1953 cruzeiros
P = relative price variable

Comparing equation (4) of table six with these results, one sees that there is apparently little aggregation bias, as the weighted average of the investment and price elasticities shown in table seven is roughly equal to the coefficients in that equation. As might be expected imports of agricultural equipment are poorly related with gross fixed capital formation probably because that magnitude is not particularly correlated to investment in agriculture. Unfortunately this statistic is not available. Another comparison that comes from tables seven and six is that aggregation substantially improves the results. The equivalent equation (4), of the first table has a fit greater than that of any of the disaggregated functions. This is undoubtedly due to the poor investment measure being used in the latter regressions. While total investment is relevant to explain

the total importation of capital equipment, there may have been changes in its internal composition which make it a good deal less useful in explaining the component parts of capital goods importation. While at the present state of Brazilian statistics the aggregate demand function is probably sufficient, an interesting line for further work would be to refine the measures of the demand generator for the individual import classes. Also of interest would be the addition of a substitution variable more specific than aggregate industrial output.

Consumer Goods

Our work on consumer goods is still preliminary, in the sense that we do not yet have a dependable prediction equation either for the aggregate group or the individual classes. Our best equation, (2), does well up to 1960, but then bears little or no relation to the actual amount of importation. Table eight shows some of our results.

TABLE EIGHT

REGRESSION RESULTS FOR CONSUMER GOODS

Aggregate Class

1. $m = -3.32 - .53\ T$ (.12) $\quad R^2 = .67$

2. $m = .80 - .43\ T - .47\ P$ (.12) (.25) $\quad R^2 = .76$

Non Durable Consumer Goods

3. $M = 6.04 + .64\ Y^o - 1.03\ P$ (.25) (.43) $\quad R^2 = .51$

4. $M' = 5.32 + .96\ Y^o - 1.30\ P$ (.36) (.26) $\quad R^2 = .76$

Durable Consumer Goods

5. $m = 1.94 - 1.00\ T + .03\ P$ (.40) (.55) $\quad R^2 = .49$

all variables in log
M = imports in millions of 1953 dollars
T = index of output of Brazilian transformation industry
P = relative price index
Y^o = PIB adjusted for the terms of trade, in billions of 1953 cruzeiros
m = M/PIB

As the table shows all the coefficients have the proper sign and they are all significant. However, even our best equation (2) does well only up to 1960. From that date to 1963 there was a rapid rise in imports and then an equally steep decline which our equation cannot explain. In fact our price variable has practically the opposite movement. The rise in imports is doubly difficult to handle considering that the rate of growth of total demand during these years also was declining.

To shed more light in this group one should use disaggregated regressions because of the great disparity between non durable and durable consumer goods. The second class, composed mostly of manufactures, has been steadily reduced in both absolute and relative terms as Brazilian industry has reached maturity. This is reflected in the strong negative coefficient for T in equation (5). In contrast, imports are of non durables composed mainly of foods and foreign books, two types of commodities which cannot be replace by domestic industry. This class has been growing in absolute amounts, at a rate almost equal to that of income, especially since 1957. Thus one is able to use imports as a direct function of income with reasonable results. But the net result of the disimilarity between the two classes is that the coefficients in the aggregate regression do not correspond well those of the individual classes.

SECTION FOUR
IMPLICATIONS OF THE REGRESSION RESULTS

From the point of view of planning, the chief use of the regression results that we have obtained is to project the demand for imports. The estimates that we will present below are approximations of the yearly rate of growth of imports between 1967 and 1972 based on the best equations from the three aggregate sectors and wheat. They show clearly the position influence on imports of the growth in income, and the negative effect of rises in relative prices and domestic capacity. To make the projection a specific production function had to be assumed to obtain a relationship between investment and the growth in income. This choice will be defended elsewhere, but its limitations should be borne in mind in interpreting our results. Also a set of values for each import category had to be derived for the year 1967 based on assumed investment and income values. These are the following:

Total Imports in 1967

Imports	Growth of Income
$ 1,547	5.0%
1,911	5.5
2,678	6.0

(in millions of 1965 dollars)

Table 9 shows the yearly geometric rates of growth predicted by the model under a variety of different policy assumptions. To construct the table we calculated the five year compound average rate of growth for each import category, applied this to the base level of imports for 1967 to get an absolute amount for 1972, summed across the four categories and then derived the aggregate yearly rate of growth. The column headings refer to the projected rates of growth of domestic industrial capacity and the output of wheat. The left hand column shows the three aggregate rates of growth of the economy, 5, 5.5, and 6 percent. The next column shows various changes in relative prices, with the same change assumed for all four import categories. Thus for example the number 4.3% in the upper left hand corner of the table is the predicted rate of growth of total imports if the economy as a whole grows at 5%, relative prices fall at 10% per year, and both wheat and manufacturing are growing at 6% per year.

TABLE NINE

ANNUAL GEOMETRIC RATES OF GROWTH OF IMPORTS: 1967 - 1972*

$\frac{\Delta Y}{Y}$	$\frac{\Delta P}{P}$ $\frac{\Delta T}{T}, \frac{\Delta H}{W}$	6.0%	7.0%	8.0%	9.0%
5.0%	- 10.0	4.3	3.3	2.4	1.5
	0.0	4.1	3.2	2.3	1.3
	5.0	3.5	2.6	1.6	0.7
	10.0	3.1	2.1	1.1	0.1
5.5%	- 10.0	6.5	5.5	4.5	3.5
	0.0	6.5	5.5	4.4	3.4
	5.0	6.2	5.2	4.2	3.1
	10.0	6.2	5.1	4.0	3.0
6.0%	- 10.0	9.2	8.1	7.0	5.9
	0.0	9.2	8.1	7.0	5.9
	5.0	9.3	8.2	7.1	5.8
	10.0	9.4	8.5	7.3	6.2

* The assumptions underlying the table are the following.
Output has a zero rate of growth in 66, and the policy rate of growth thereafter.

Fixed investment is assumed to be related to output and its rate of growth in the following manner:

$\dot{Y}/Y$	$\dot{I}/I$	I/Y (in 1967), 1953 prices
5.0%	5.25%	12.9%
5.5	6.50	15.3
6.0	7.75	17.7

This relation is derived from a Cobb Douglas production function in which investment is proportional to capital. Hence it grows at the same rate as capital, the rate being equal to the ratio of net investment to capital at the beginning of the period.

The index of wheat output is assumed to be 693 thousand tons, which implies a six percent rate of growth during both 1966 and 1967.

The transformation index number 15 of the Conjuntura Economica is assumed to be 265 in 1967.

Relative prices in 1967 are assumed to be equal to their 1965 levels.

Based on Eq. (3) of table 3
Eq. (1) of table 6
Eq. (2) of table 8

The display brings out clearly the great sensitivity of imports to the choice of the rate of growth.

Other things equal the move from 5% to 6% in aggregate growth more than doubles the rate of growth of imports. The output of domestic manufacturing industry also has a significant influence, with every one point increase in the growth of domestic capacity accompanied by an equivalent decline in the rate of growth of imports. Prices appear to have much less effect, as one might expect from their low individual price elasticities. One can reduce imports more by increasing the growth of domestic industry by one percentage point than he can be raising rel.tive prices by ten.

The aggregate im ort figures conceal a continuation of the trend toward the reduction in the relative importance of consumer goods, including wheat, in the future. Capital goods are highly sensitive to the projected rate of growth of total output because of their high elasticity with respect to investment. Other things equal, moving from a five to six percent growth rate increases the rate of growth of capital goods imports in absolute terms by around 7%. On the other hand imports of wheat and consumer goods should remain practically constant. For the strategies that we tried, the highest annual rate of growth in these categories was a little in excess of 1% per year. Thus an ambitious development program will increase the proportion of development goods in total imports. For example if fixed investment were raised to 17.7% of product in 1967, our estimate of the amount required to produce 6% growth, and this was distributed so that manufacturing industry grew at 8%, relative prices held constant, then imports of consumer goods and wheat should fall from 14% of imports in 1967 to 10.5% in 1972.

Import Substitution

In view of the interest in the concept of import substitution and its measurement, it is useful to add a section to this paper discussing our results in that light. This section can be by passed by those interested only in the regression analysis. We are going to define import substitution over a period as the difference between actual and potential import for the given level of income. Where demand is growing the crucial thing will be to measure the change in potential imports, or in other words, to decide what proportion of the change in demand could have been supplied competitively by importation. Where demand does not grow, potential imports will be defined equal to imports in the previous period, by which we are assuming that once domestic capacity has been created to supply demand, it is no longer possible to supply it through importation. Our definition highlights the essential feature of the process, namely, that an increase in national production can only be a substitution of imports if is possible to substitute imports for that domestic production. For example in transportation it is not possible to import roads and not feasible to import coffee. One could not therefore call the domestic expansion of the highway network or coffee production import substitution. In the opposite case if all of an increase in demand in a certain sector could have been supplied by importation, then any increase in domestic output is import substitution. Obviously therefore the central problem is the measurement of potential imports. For simplicity let us assume that demand rises over time and consider the range of possibilities.

The largest measure of substitution is where all increases in demand could be potentially supplied through imports. By our definition

$$(1) \qquad IS = D_1 - S_e - (D_1 - S_1)$$

$$= S_1 - S_e$$

where

IS = import substitution
D_1 = total demand in the present period
S_1 = actual domestic supply in the present period
S_e^1 = potential domestic supply when imports are as large as possible. We are assuming $S_e \gg S_{t-1}$ where S_{t-1} = domestic supply in the previous period.

Import substitution is exactly equal to the increase in domestic capacity.

Now suppose that a proportion, k, of the total change in demand has to be provided domestically. Then (1) becomes:

$$(2) \qquad IS = S_1 - S_0 - k(D_1 - D_0)$$

There is no substitution when $k = \frac{S_1 - S_0}{D_1 - D_0}$, that is when the necessary proportion of demand supplied domestically equals the actual proportion.

The most common definition of import substitution asserts that it is equal to the decline in the fraction of total demand supplied by importation. Putting this in our terms we have:

$$(3) \qquad IS = S_1 - S_0 - S_0 \frac{(D_1 - D_0)}{D_0}$$

This amounts to assuming that $k = S_0/D_0$, or in other words that at least the original proportion of total demand supplied domestically must continue to be so supplied. This is an arbitrary assumption which would be violated if relative prices changed. Further it is a lower bound estimate of substitution since it assumes that it is impossible for domestic supply in the sector in question to grow slower than total demand.

To quantify import substitution perhaps the easiest way is to define the change in maximum potential imports as the maximum amount by which the capacity to import could be expanded through exports, assuming that this level is compatible with total income. Since no country is free to increase its exports without limit, it follows that its ability to import also is limited. Thus one might define substitution as the difference between the maximum amount of imports, derived through the maximum feasible growth in the capacity to import, and actual imports. Assuming balance of payments equilibrium initially this works out to be:

$$(4) \qquad IS = M_0 (1 + j) - M_1$$

where

- j is the maximum feasible percentage rate of growth in the capacity to import
- M_0 is base period imports
- M_1 is present period actual imports

Evidently this definition will give a low estimate of import substitution in a country where the capacity to export is stagnant. In fact import substitution will be zero by definition if the maximum capacity to export is constant. This is the situation of an economy isolated from the world market. Its internal growth is in response to increases in domestic demand, not import substitution.

It is clear that the problem in the measurement of import substitution boils down to that of measuring the constant k. For Brazil we do not have the information at hand to make that measurement, and must be content to present upper and lower estimates based on definitions (3) and (4). (1) gives the uninteresting upper limit that 100% of growth was due to import substitution). Starting first with (3), in the period 1953-1965 import substitution was equal to 23.7 billion 1953 cruzeiros which is 6.2% of the growth in PIB over that period. This is the lower bound estimate. For an upper bound estimate suppose that we assume that the maximum possible rate of growth in the capacity to export was 10% per year. Then import substitution is roughly 61 billion cruzeiros or 15.9% of the growth in national income over the period *. Tentatively we can therefore conclude that less than one-fifth of the growth in national income since 1953 could be called import substitution.

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* The numbers on which these estimates are based are the following:

S_1 = PIB '65 = 810.4 billions of 53 cruzeiros
S_0 = PIB '53 = 427.1 " " " "
M 53 = 28.8 " " " "
M 65 = 29.3 " " " "

$D_0 = S_0 + M_0$

$D_1 = S_1 + M_1$

M 65 is calculated on the basis of the IBGE estimate of the real quantity of imports shown in Appendix table 5.

This measure of substitution does not tell us much about any particular sector however. For this one would need to know how much of the increases in the output of that sector could have been supplied by importation. The overall limitation on the growth in the capacity to export will not be so much a constraint. For example, suppose that the growth of Brazil had been such that exports had been able to grow at 10% and the foreign exchange had been used solely to satisfy the demand for industrial products. This would certainly give us an upper bound estimate of substitution in industry, since it is based on a maximum estimate of potential imports. If we assume that nonindustrial imports are unaffected by the change in import capacity, then industrial import substitution can be defined as the difference between total potential exports and actual total imports, or as we just calculated in the previous paragraph, 61 billion 1953 cruzeiros. This number must be compared with the growth in industrial value added, since we do not know what the markup on imported industrial good is. Using the total output index of the Conjuntura Economica and an absolute base year figure based on the national accounts, the change in value added in the transformation industries between 1953 and 1965 can be estimated at about 107 billion 1953 cruzeiros. This makes import substitution account for no more than 57% of the growth in Brazilian manufacturing in the last 12 years *.

One gets a significantly lower estimate if one uses total value, and an assumed markup for tariffs and profits of importers. If the latter is assumed to be 100%, then import substitution can be estimated as 45% of the total increase in the value of manufacturing production. These estimates are highly sensitive to the choice of the hypothetical maximum rate of growth of exports. If our ten percent figure is reduced to seven, then the contribution of import substitution to industrial growth falls from 57% to 30%.

All these calculations suggest that the growth in internal demand not import substitution was the chief stimulant to the growth of Brazilian industry. This is certainly not true in particular sectors such as capital equipment or automobiles where domestic production hardly existed in 1953, but in the overall picture of industrial growth the conclusion is warranted.

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* To get this estimate we assumed that 80% of total industrial value added was that of the transformation industries based on an observation of 88.4% in 1950 and 90.1% in 1960.

To put the conclusion another way, the conscious choice to industrialize through import substitution that appears to have been a policy of the Brazilian government was probably less important than its decision to promote growth. For if it had been possible to achieve equivalent growth through a path of expanding exports instead of domestic industry, by 1965, Brazilian manufacturing would still be at least 80% of its present size*. The growth in aggregate demand is a far more important stimulus to total industry than the replacement of goods previously imported. While import substitution had a significant effect in altering the internal structure of industry, its effect was less important in determining the total size of the sector within Brazilian economy.

Conclusion

In this report on work in progress at IPEA on the demand for imports, we have tried to show that a model based on economic rationality, and estimated through regression analysis gives primising indications of the ability to understand and predict levels of imports in the future. Domestic investment rates were the single most important determinant of both the rate of growth and level of imports although the growth of industry and relative prices also had a significant effect. While the results are promising, we are still in an initial phase of the research, and in the future should be able to improve our estimates through further disaggregation. This will allow us to refine the relative price indexes and the measures of domestic substitute goods, and should enable us to show in much greater detail the import implications of different investment strategies.

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* This is calculated by assuming that potential exports grow at 7% and subtracting the import substitution estimate of 35.5 billion cruzeiros from our estimate of 1965 industrial value added of 185 billion 1953 cruzeiros.

TECHNICAL APPENDIX B FOR CLARK EPEA IMPORT STUDY

This report is a description of the data sources and adjustment methods used in obtaining a set of import statistics and relative prices for regression analysis to determine the demand for imports in Brazil. As such it should be read in conjunction with the Clark and Weisskoff papers [1]

For our purposes, the data problems followed from our interest in investigating the effect of relative prices and import substitution on the demand for imports. We had therefore four fundamental tasks, first to choose a consistent set of import statistics, second to determine the cost of imported goods over the time period of the sample, third to measure the price movements of Brazilian substitutes and complements to imported goods and fourth to find a variable which might express import substitution.

1.) Import Statistics

Out of the many alternative sources of import data we decided to use the IBGE Laboratorio sample because of the useful way that imports are classified, and because the data are reported both in current and constant dollars and in cruzeiros which allows one to calculate average exchange rates and dollar price indices. Also the sample has all been punched on cards which were kindly made available to us by the staff of the IBGE Lab. The interested reader should refer to Weisskoff's Technical appendix for a more complete description of all the alternative sources available.

2.) Relative Cost of Imports

The analysis of the relative cost of imports [illegible] three separate analysis one, the cost of buying for[illegible]

[illegible] in [illegible]

[illegible]

[illegible] were calculated [illegible] that [illegible] and [illegible] Weisskoff in this [illegible] average [illegible] the published [illegible] Manual.[2] [illegible] of the [illegible] in [illegible] exchange [illegible] (Clark estimate [illegible]). For they [illegible] both in dollars and [illegible] basic exchange [illegible] of the two series by [illegible]

[illegible] For the years since 1957 when the new Tariff Law, Lei Nº 3244, was passed, we were faced with the problem of getting an estimate of the average tariff rate for each of the nine use classes in our sample. Since the tariff collections are only shown according to a non-comparable classification of imports, this involved an averaging procedure of the published tariffs on the individual products within each import category. Weisskoff and De Angelis made a complete record of the goods in the IBGE sample by their tariff code classification, and then recorded the tariff rate for each one. For any import item with more than one good and consequently more than one tariff rate, they took a simple average to get a single tariff rate. For the nine import categories, the average tariff rate was then defined to be the weighted average of tariff rates for the products in the class, where the weighting was according to the import share in 19[illegible].

However, the estimated tariff collections according to this scheme were far too high. There appeared

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2 - Abilio Corrêa, Lacira Nobre, J.C. Magalhães, *Manual de Atualização de Tarifa das Alfândegas* (Rio, 1964).

to be several different reasons for this. First, many items were exempt from tariffs on a quota basis because the national production is still deemed insufficient to meet internal demand. Thus imports of rubber, wheat and coal paid no tariffs.[3] A second group of products iron, asbestos, aluminum, are exempt providing that a certain proportion of national production is used along with the imported product.[4] Still a third broad category of goods, namely those imported by state enterprises, or those judged to be beneficial to Brasil were granted special exemption from tariff payment. Chiefly capital goods were granted such exemptions. In order to adjust the published rate for exemptions, I reclassified the IBGE sample into the tariff code and calculated the estimated collections by section. Where there were wide divergences stemming from this cause such as in the capital goods and metal sections, 15-17, the tariff was reduced proportionally to make 1962 estimated and actual collections equal.

A third major area of divergence lay in the averaging procedure used for the import items with different tariff rates. What was needed was a weighted rather than a simple average of the several tariff rates included because it generally is the case that the high tariff levels discourage imports. Since our index will be the price of goods actually imported, a simple average would overstate the level of tariff protection. Wherever the adjustment between the simple and the weighted average tariff appeared to significantly change the overall average, I used weighted average, based on the proportion of foreign exchange bought for each product for the year 1962.[5]

When the correction procedures described above were

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3 - See the testimony of Dr. Margis in Câmara dos Deputados "Comissão Parlamentar de Inquérito para investigar os resultados da reforma pela Lei Nº 3.244" (Brasilia, April 20, 1965), p. 27.

4 - See note 39 and 162 as published in the Tariff Manual.

5 - The difficulty with this weighting procedure is that there are no data of imports by the tariff classification. However, I approximated this by observing the Certificado de Cobertura Cambial (CCC) purchases for each item and weighted accordingly. The books with this information are found in Cases with Dr. Paulo Monteiro Araújo.

[illegible] tariff rates had been [illegible], it [illegible] the variation in actual [illegible] collection [illegible] [illegible] still substantial [illegible] drugs, transport-ation [illegible] other which calc-ulated [illegible] collections [illegible] by less than [illegible] the average rate in each [illegible] too much devi-ation [illegible] to make a [illegible] value of [illegible].

[illegible] actual aver-[illegible], for each [illegible] tariff rate [illegible] adjusted downward by the difference between total estimated and total actual collection.

[illegible] Port Charges and other additional taxes

As Paul Clark has pointed out,[6] the importer is faced with several additional direct charges: 5% on CIF value for the "taxa de despacho aduaneiro", 5% on CIF value for the port assessment tax, 2% on CIF value for the dispatcher's comission, 5% of net ocean freight charges for the merchant marine improve-ment tax, and finally 1% on customs charges as a ware-housing fee. If one assumes that freight costs about 20% of the CIF value of the import, then the total extras amount to 13% of CIF value plus 1% of tariff charges. However, these extras cannot simply be added to the average tariffs because they are not charged to goods which are exempt from tariff payments.[7] As an estimate I reduced the 13% by the proportion of tariff-paying goods to total imports in each class and then added 1% of the previously determined average tariff rate. These total taxes were then added to the ad-justed average tariff and the total converted to cru-zeiros using the fiscal rate for each year. For each class this calculation gives the number of cruzeiros per dollar that must be paid in import taxes to buy one dollar of exchange.

6 - Clark, "Import Demand" p. B 2.

7 - Interview with Dr. Joaquim Mangia

2.1.4 Financial Charges - From 1961 until mid 1965, SUMOC required importers to make an advance deposit whose cost in terms of interest foregone must be added into the other costs of importation. To do this I relied upon the work of the Foreign Trade Sector of EPEA except for the year 1965 when they appear to have seriously understated the interest cost.

The total desagios per dollar are:

1961	39.52
1962	105.66
1963	192.65
1964	404.74
1965	300.16[8]

2.1.5 Brazilian Price Indices[8a] - The Brazilian price indices that were used are intended to represent the price movements of Brazilian goods capable of being substituted for imports. They are subject to at least two objections on this score, first the very rough nature of the correspondence between the composition of the imports in any class and the domestic index, and second that many domestic price indices are influenced or include a substantial imported component. Where this is true the final price index will not show the divergence between domestic and imported prices which it is intended to measure. In any case, the indices were constructed using various indices from the Conjuntura Econômica. In every case the weighting was according to the percentage of the corresponding imported good in the IBGE sample in 1962.

Non-durable consumer goods is a weighted average of 13 subindices including drugs, textiles, books and various foods.

Durable consumer goods is index 5, Furniture and

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8 - For 1965 I assumed that the financial charge for advance deposits must have risen at the same rate as the implicit deflator, that is at an annual rate of 50%. This has to be adjusted for the removal of the system at the end of October, 1965, and for the change in the advance deposit requirement from an average of 76% in 1964 to 50% in 1965. I took the desagio for 1964, Cr$ 75.47, inflated by 1.5 for the rise in the cost of living, deflated it by .667 for the lowering of the deposit requirement, and deflated it again by .83 to reflect the cancellation of the system before the end of the year. This gives Cr$ 146.00 to which I added the estimated encargo financeiro of Cr$ 154.16 to give the result shown above.

8a - These price indices were taken directly from the work of Clark and Weisskoff.

and Utensil, from the Cunnahan cost of living index.

Fuels is a weighted average of the price of national coal, gasoline and oil.

Metallic intermediate goods is a weighted average of seven metals indices.

Non-metallic intermediate goods is a weighted average of 13 products including paper, sulphur, caustic soda, grains, rubber, leather and alcohol.

Construction materials is index 64 from the Conjuntura Econômica.

The index for all other capital goods is index 63, metals and metal products from the Conjuntura Econômica.

2.1.6 Import Price Indices (P^1) - To obtain a measure of the changes in the price of the goods Brazil imports I used the indices of the IBGE Statistical Laboratory.[9]

2.1.7 The final Price Variables P^2 and P^F

Due to the fact that Weinshoff and Clark assumed that the price index P^1 did not change over the period, I separately calculated a final price variable with this assumption (P^2) and one without it, (P^F).

P^2 is defined to be:

$$\frac{E_{1_t}}{E_{1_{53}}} \Big/ \frac{P^B_{1_t}}{P^B_{1_{53}}}$$

E_{1_t} = basic exchange rate plus tariff and port and financial charges, in cruzeiros per dollar, for category 1 in year t.

P^B_1 = the price of those Brazilian products which correspond to the imports in category 1 in year t.

The final price variable $P^{(F)}$ is defined as:

$$P^F_{1t} = P^2_{1t} \cdot P^1_{1t}$$

To obtain the aggregated final price variables for consumer, intermediate and capital goods, I weighted the individual P^2 and P^F by the value of imports in

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9 - IBGE Laboratório Estatístico - Números Índices Anuais etc. dos Preços e das Quantidades no Comércio Exterior e de Cabotagem. (Rio, 1965), p. 15.

1962. (This differs slightly from Clark and Weisskoff who weighted by the value of imports in the sample in 1962). These final price variable can be interpreted as an expression of the relative cost of imported vis-a-vis national products. They cannot be regarded as an index of protection however, since the import element measures only the cost of goods which actually were imported. Any good whose tariff and exchange level is high enough to prohibit importation will not enter into this index, which therefore understates the level of effective protection.

3.1 Substitution Variables

Three different substitution variables were used in the regression analysis. The first was the variable of Clark and Weisskoff. This is an artificially constructed measure of the potential import demand which is supplied domestically. For details of its construction the reader is referred to the Clark report p.C-3. As an alternative measure, I introduced the index of the output of the transformation industries.[10] In the fuels sector I used an index of the output of crude oil in Brazil.[11]

10 - Index 15 of Conjuntura Econômica, as adjusted by EPEA for the years after 1961.

11 - EPEA "Diagnóstico Preliminar de Petróleo", p.41

TABLE 1

TARIFF AND FINAL EFFECTIVE EXCHANGE RATES, in CR$/$

Years	Use 1		Use 2		Use 3(a)		Use 4		Use 5(b)	
	T	E	T	E	T	E	T	E	T	E
1953		20.6		19.1		18.8		18.9		19.3
1954		36.4		45.2		28.8		37.2		35.4
1955		49.2		72.0		46.7		56.7		48.1
1956		61.2		95.7		49.2		74.7		63.7
1957		67.7		97.6		52.4		68.2		56.7
1958	36.7	136.8	73.9	200.7	50.6	113.1	18.8	132.3	26.7	125.4
1959	54.1	216.1	111.8	281.8	76.5	179.4	21.1	207.8	32.2	179.9
1960	55.1	250.4	109.6	331.7	75.0	182.6	24.3	223.0	38.1	201.0
1961	149.1	390.2	191.1	448.6	103.9	313.3	52.6	290.9	86.3	269.0
1962	212.3	572.3	314.7	664.8	142.5	476.5	100.5	442.5	169.8	432.1
1963	349.3	901.0	494.7	1 052.7	203.5	697.6	167.7	675.8	274.3	654.1
1964	698.8	1 710.6	967.8	1 975.7	376.4	1 360.7	332.9	1 240.6	530.7	1 465.4
1965	816.5	2 608.1	1 256.2	3 079.5	646.3	2 442.5	459.1	2 185.1	678.7	2 198.3

Years	Use 6		Use 7		Use 8		Use 9		Wheat	
	T	E	T	E	T	E	T	E	T	E
1953		18.9		19.0		18.9		19.0		18.8
1954		34.2		31.2		32.6		46.0		24.8
1955		45.0		46.4		45.7		50.9		25.8
1956		59.3		63.0		59.9		64.7		30.5
1957		56.7		56.8		55.7		63.1		51.7
1958	34.8	116.5	14.1	96.0	21.0	92.6	16.1	93.4		64.6
1959	36.6	158.0	17.0	152.3	23.6	127.2	15.8	104.8		99.9
1960	44.7	181.8	18.4	177.5	28.9	146.0	18.8	149.8		100.0
1961	84.5	265.7	45.7	234.8	58.3	243.4	63.0	236.0		222.7
1962	155.5	515.0	89.9	419.8	109.9	449.9	134.4	509.5		357.5
1963	246.1	784.9	151.2	660.2	173.9	707.5	221.4	755.0		560.5
1964	465.0	1 443.4	303.4	1 125.2	329.0	1 329.4	404.6	1 293.3		1 109.1
1965	719.1	2 481.9	354.2	2 108.6	474.0	2 183.5	636.5	2 259.4		1 866.6

NOTES: (a) with "impôsto único"

(b) excludes wheat

TABLE 2

PRICE INDEX OF IMPORTED GOODS

(P_1)

Years	Use 1	Use 2	Use 3	Use 4	Use 5	Use 6	Use 7
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	97.0	91.6	91.7	94.3	85.7	91.0	97.5
1955	89.2	93.8	91.7	103.7	85.9	94.0	99.3
1956	79.5	82.6	98.9	114.4	80.5	114.0	94.7
1957	91.0	87.6	103.8	99.6	78.7	131.8	104.8
1958	69.3	87.1	95.9	82.2	75.1	107.9	100.1
1959	63.5	64.7	89.7	69.6	71.3	105.8	86.1
1960	59.9	78.7	81.6	98.0	68.8	93.8	95.3
1961	57.8	61.0	77.3	90.1	70.0	115.4	109.2
1962	60.5	66.6	72.0	80.0	69.0	131.1	110.6
1963	63.2	72.7	70.1	69.9	70.2	65.8	102.6
1964	63.4	96.3	66.3	77.8	74.4	122.9	119.6
1965	58.2	101.8	64.8	91.7	71.5	114.2	129.3

Years	Use 8	Use 9	Consumer Goods	Intermediate Goods	Capital Goods	Wheat	Total
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	105.4	31.4	95.5	92.5	96.6	80.0	92.9
1955	104.6	33.4	90.2	95.1	97.5	75.6	93.6
1956	98.1	71.4	80.2	98.3	90.5	68.4	90.8
1957	103.6	70.8	90.3	98.0	93.6	64.9	92.2
1958	112.6	63.2	74.2	90.1	90.0	66.5	86.4
1959	109.1	53.5	66.4	83.0	84.2	64.3	80.3
1960	107.4	94.0	63.6	75.6	102.4	62.9	83.7
1961	104.3	95.8	58.5	77.9	89.1	66.2	79.6
1962	114.7	128.3	61.6	73.6	115.5	65.8	83.1
1963	119.4	108.0	71.2	71.0	104.5	67.6	83.6
1964	128.4	111.3	67.4	71.1	121.8	72.0	90.5
1965	138.9	120.0	62.9	73.5	129.3	64.9	93.4

TABLE 3

RELATIVE EFFECTIVE RATES OF EXCHANGE

(P_2)

Years	Use 1	Use 2	Use 3	Use 4	Without Wheat Use 5	Use 6	Use 7
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	141.7	179.2	118.1	149.8	146.3	138.2	131.4
1955	165.6	203.8	132.3	183.8	165.9	177.7	170.0
1956	179.0	245.6	124.3	163.2	177.7	178.3	181.2
1957	183.4	225.1	105.8	175.8	142.0	143.5	154.9
1958	266.3	428.9	206.1	226.0	256.3	231.0	181.8
1959	294.6	407.6	224.3	231.2	240.8	236.2	200.9
1960	270.6	343.2	210.5	214.6	229.5	239.3	220.9
1961	292.7	364.1	204.5	208.6	195.5	244.1	225.5
1962	291.3	367.9	246.6	179.2	207.4	330.7	260.0
1963	288.4	302.8	200.4	156.2	167.2	252.4	210.1
1964	244.5	279.7	203.3	134.0	197.6	281.9	201.5
1965	242.1	266.1	195.1	138.8	180.4	298.0	221.9

Years	Use 8	Use 9	Wheat	Consumer Goods	Inter-mediate Goods	Capital Goods	Total
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	138.0	193.7	109.7	148.7	136.5	148.3	139.0
1955	167.9	186.0	87.1	172.8	156.6	172.4	156.2
1956	172.9	186.1	80.7	191.5	155.3	176.7	157.9
1957	152.7	172.1	135.3	191.2	134.5	155.9	146.8
1958	176.2	176.8	149.6	296.9	232.4	181.3	208.1
1959	168.7	138.2	231.3	315.8	233.2	171.2	214.8
1960	182.6	186.4	231.6	284.0	220.0	191.5	214.7
1961	235.0	226.7	247.6	306.1	201.4	233.2	225.9
1962	280.0	315.5	397.4	305.7	217.4	289.2	270.8
1963	226.3	240.2	248.4	291.1	177.9	229.6	213.4
1964	239.3	231.6	253.5	251.1	188.8	237.7	219.0
1965	231.0	237.7	220.9	246.6	178.8	236.9	210.5

NOTES a) $P_2 = \frac{\text{INDEX of Effective Exchange Rate}}{\text{Brazilian Price Index}}$

b) Aggregation weights are 1962 import proportions

Consumer Goods	6.9%
Intermediate Goods	43.6%
Capital Goods	38.6%
Wheat	10.9%

TABLE 4

FINAL PRICES

Years	Use 1	Use 2	Use 3		Use 4	Use 5 (d)	Use 6	Use 7
			b	c				
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	137.4	164.1	108.3	108.3	141.3	137.7	125.7	128.1
1955	147.7	191.2	121.3	121.3	190.6	161.1	167.0	168.8
1956	142.3	202.9	122.9	122.9	186.7	163.8	203.3	171.6
1957	166.9	197.2	109.8	109.8	175.1	130.9	189.1	162.3
1958	184.5	373.6	197.6	110.8	185.8	216.6	249.2	182.0
1959	187.1	263.7	201.1	116.3	160.9	182.3	249.9	172.8
1960	162.1	270.1	171.8	102.0	210.3	173.7	224.5	210.5
1961	169.2	222.1	158.1	106.3	187.9	146.2	281.7	206.2
1962	176.2	245.0	177.6	125.2	143.4	153.3	433.5	287.6
1963	182.3	220.1	140.5	99.9	109.2	125.1	166.1	215.6
1964	155.6	268.8	134.8	97.8	104.3	149.6	346.4	241.0
1965	140.9	270.9	126.4	93.1	127.3	141.8	340.3	286.9

Years	Use 8	Use 9	Consumer Goods	Capital Goods	Pondered (b)	Wheat	Total
1953	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1954	145.5	157.7	142.0	143.3	126.3	87.8	129.7
1955	175.6	155.1	155.9	168.1	148.9	65.9	147.7
1956	169.6	132.8	153.6	159.9	152.7	55.2	144.9
1957	158.2	121.8	172.6	145.9	131.8	87.8	135.3
1958	198.4	111.7	220.3	163.2	209.4	99.5	180.3
1959	200.9	73.9	209.7	144.2	193.6	148.7	170.7
1960	196.1	175.2	180.6	196.1	166.3	145.7	176.5
1961	245.1	217.2	179.1	242.8	156.9	163.9	178.8
1962	321.2	404.8	188.3	334.0	160.0	261.5	240.2
1963	270.2	259.4	207.3	239.9	126.3	167.9	180.3
1964	307.3	257.8	169.2	289.5	134.2	182.5	201.8
1965	320.9	285.2	155.1	306.3	131.4	143.3	201.8

NOTE

a) $P^F = P_2 \circ P_1$

b) with "impôsto único"

c) without "imposto unico"

d) excludes wheat

TABLE 4

PRICE INDICES OF BRAZILIAN WOODS COMPARABLE TO IMPORTS

Years	Use 1	Use 2	Use 3	Use 4	Use 5
1953	100,0	100,0	100,0	100,0	100,0
1954	124,7	132,0	129,7	131,4	125,3
1955	144,2	185,0	187,8	163,7	150,2
1956	166,0	204,0	210,6	242,1	185,8
1957	178,7	227,0	263,4	205,2	206,9
1958	249,4	245,0	292,4	309,7	253,5
1959	356,1	362,0	420,2	475,5	387,1
1960	449,2	506,0	462,1	549,7	453,9
1961	647,1	645,0	816,0	737,7	713,1
1962	953,7	946,0	1 029,5	1 306,3	1 079,3
1963	1 516,8	1 820,0	1 854,2	2 289,3	2 027,2
1964	3 396,4	3 698,0	3 565,2	4 899,6	3 843,2
1965	5 225,8	6 059,0	6 669,4	8 326,9	6 314,5

Years	Use 6	Use 7	Use 8	Use 9	Wheat
1953	100,0	100,0	100,0	100,0	100,0
1954	131,0	125,0	125,0	125,0	120,2
1955	134,0	144,0	144,0	144,0	157,5
1956	176,0	183,0	183,0	183,0	201,0
1957	209,0	193,0	193,0	193,0	203,3
1958	267,0	278,0	278,0	278,0	229,7
1959	354,0	399,0	399,0	399,0	229,7
1960	402,0	423,0	423,0	423,0	229,7
1961	576,0	548,0	548,0	548,0	478,5
1962	824,0	850,0	850,0	850,0	478,5
1963	1 645,0	1 654,0	1 654,0	1 654,0	1 200,3
1964	2 709,0	2 939,0	2 939,0	2 939,0	2 327,5
1965	4 407,0	5 002,0	5 002,0	5 002,0	4 495,4

TABLE 6

IMPORTS AND QUANTUM INDICES

YEARS	CONSUMER GOODS				INTERMEDIATE GOODS					
	Non durable	Index	Durable	Index	Fuel	Index	Metallic	Index	Non Metallic	Index
1953	105.5	100.0	27.9	100.0	244.4	100.0	80.9	100.0	199.5	100.0
1954	123.9	117.4	41.4	148.4	290.4	118.8	152.2	188.1	359.2	180.1
1955	115.9	109.9	23.8	85.3	298.0	121.9	77.1	95.3	277.2	138.9
1956	119.4	113.2	23.8	85.3	297.3	121.6	84.6	104.6	296.2	148.5
1957	114.6	108.6	31.5	112.9	271.0	110.9	109.3	135.1	299.1	149.9
1958	85.1	80.7	35.4	126.9	298.0	121.9	81.8	101.1	284.9	142.8
1959	82.7	78.4	40.8	146.2	288.3	118.0	84.6	104.6	295.7	148.2
1960	105.5	100.0	25.0	89.6	321.8	131.7	106.9	132.1	343.3	172.1
1961	113.9	112.7	35.2	126.2	324.2	132.7	118.3	146.2	355.7	178.3
1962	137.2	130.0	29.0	103.9	334.3	136.8	140.3	173.4	391.7	196
1963	152.4	144.5	33.7	120.8	346.2	141.7	218.0	269.5	411.0	206.0
1964	143.2	135.7	17.8	63.8	363.3	148.6	121.3	149.9	319.4	160.1
1965	141.6	134.2	16.1	57.7	327.5	134.0	117.1	144.7	306.7	153.7

YEARS	CAPITAL GOODS							
	Construction Material	Index	Agriculture	Index	Industry	Index	Transport	Index
1953	72.5	100.0	46.0	100.0	245.5	100.0	114.2	100.0
1954	87.9	121.2	108.0	234.8	273.8	111.5	152.3	133.4
1955	51.1	70.5	45.6	99.1	200.0	81.5	135.4	118.6
1956	21.1	29.1	44.2	96.0	178.3	72.6	146.9	128.6
1957	28.8	39.7	73.3	159.0	255.3	104.0	291.8	255.5
1958	29.2	40.3	57.4	124.8	224.0	91.2	341.8	299.3
1959	40.8	56.3	35.9	78.0	253.0	103.1	445.6	390.2
1960	42.3	58.3	84.7	184.1	239.1	97.4	246.1	215.5
1961	61.9	85.4	57.5	125.0	322.1	131.2	142.1	124.4
1962	35.0	48.3	47.7	103.7	312.0	127.1	86.4	75.7
1963	92.7	127.9	45.9	99.8	248.2	101.1	85.6	75.0
1964	23.8	32.8	35.3	76.7	176.5	71.9	61.8	54.1
1965	26.4	36.4	32.1	69.8	153.6	54.4	35.4	31.0

Imports in millions of 1953 dollars
Class 5 excludes wheat

TABLE 7

IMPORTS BY MAJOR USE CLASS

Years	Consumer Goods	Quantum Index	% Total imports	Inter-mediate Goods	Quantum Index	% Total imports
1953	133.4	100.0	10.1	524.8	100.0	39.8
1954	165.3	123.9	9.5	801.8	152.8	45.9
1955	139.7	104.7	9.9	652.3	124.3	46.2
1956	143.2	107.3	10.4	678.1	129.2	49.5
1957	146.1	109.5	8.9	679.4	129.5	41.6
1958	120.5	90.3	7.5	664.7	126.7	41.4
1959	123.5	92.6	7.0	668.6	127.4	37.7
1960	130.5	97.8	7.5	772.0	147.1	44.2
1961	154.1	115.5	8.8	793.2	152.1	45.7
1962	166.2	124.6	9.5	866.3	165.1	49.3
1963	186.1	139.5	9.9	975.2	185.8	52.0
1964	161.0	120.7	10.4	804.0	153.2	51.8
1965	157.7	118.2	11.7	751.3	143.2	55.8

Years	Capital Goods	Quantum Index	% Total imports	Wheat	Quantum Index	% Total imports	Total imports
1953	478.2	100.0	36.3	180.2	100.0	13.7	1 316.6
1954	622.0	130.1	35.6	157.3	87.3	9.0	1 746.4
1955	432.1	90.4	30.6	188.0	104.3	13.3	1 412.1
1956	390.5	82.7	28.5	158.8	88.1	11.6	1 370.6
1957	547.2	135.3	39.6	160.6	89.1	9.8	1 [illegible]
1958	652.4	136.4	40.6	168.1	93.3	10.5	1 605.7
1959	775.3	162.1	43.8	204.5	113.5	11.5	1 771.9
1960	612.2	128.0	35.1	226.9	125.9	13.0	1 741.6
1961	583.6	122.0	33.4	209.8	116.4	12.0	1 745.7
1962	485.1	100.6	27.4	244.7	135.8	13.9	1 758.3
1963	472.4	98.8	25.2	242.6	134.6	12.9	1 876.3
1964	297.4	62.2	19.1	291.1	161.5	18.7	1 553.5
1965	227.5	47.6	16.9	209.4	116.2	15.6	1 345.9

Imports in millions of 1957 dollars