AN ADJUSTMENT MODEL OF RESERVE HOLDING BEHAVIOR: THE DEVELOPING COUNTRIES

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INTRODUCTION

THE POSTWAR period has witnessed governments of many developing countries[1] actively participating in the efforts at economic development through the use of the planning technique. However, these attempts are frequently constrained by the unavailability of "adequate" international reserves and external resources in general, because of the nature of the present international monetary arrangement. Yet, when international liquidity problems are discussed, either at the national or global level, the theoretical and empirical analyses seem to ignore such countries while the appendices invariably acknowledge them.[2] This is despite the fact that the modern communications media continue to place at the forefront of world concern, pronounced international disparities in reserve holdings of all countries. This is especially the case with the recent shift of reserves to major oil-producing areas, while a majority of developing countries still continue to be reserve deficient.

In this way, not only will a study of the reserve holding behavior of developing countries be especially relevant for parallelism in the context of discussions on world liquidity problems but also it can aid in appraising the general development problems of these countries. This paper is an attempt to bridge this gap by providing an apparatus for thinking about the way this behavior can be analyzed in the short run, and suggesting its implications for world monetary reform.

I. THE NATURE OF THE PROBLEM

Almost all the existing studies on reserve holding behavior differ widely in terms of methods and assumptions used, and even purposes; some intend to establish criteria for determining optimal levels of reserves for individual countries; others

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[1] The term, "developing countries," covers countries in all of Latin America, all of Africa (except the Union of South Africa), Middle and Far East (except Israel and Japan), and Asia. This is clearly an arbitrary classification since some countries in this group have higher levels of per capita income than a few in Europe.

[2] Refer, for example, to R. E. Caves [1], also [10] [4] [11].

attempt to discern a consistent behavioral pattern in the actual reserve holdings of developed countries in particular; while still others have been concerned with the adequacy of international liquidity in relation to growing world trade and payments.[3] Consequently, the literature exposes some unsettled questions. For example, there seems to be a controversy over the relevant explanatory variables that ought to be included in a demand function for reserves, whether from the point of view of the developed or the developing countries. Some economists stress, as the necessary determinants, the level of imports (exports) and the interest rate; others prefer the money supply, or the money supply and the interest rate. In either case, it is not even clear whether the short-term or long-term interest rate has greater explanatory value.

In addition, the inspection of the methods employed in the empirical investigations of the effects of the explanatory variables on reserve holding behavior of developing countries in particular leads one to doubt the final reliability of the results. In many of the studies often cited, it is not clear that the variables employed have been entered into the hypothesis in a theoretically defensible manner.[4] For example, it appears that in virtually all the statistical tests of the opportunity cost of holding reserves, the hypotheses tested were ecletic ones in which, although the proxy variables selected seemed to be relevant, there was no complete underlying theoretical model to support the choice.[5] In this paper, this "traditional" approach becomes irrelevant when we exclusively deal with the reserve holding behavior of the developing countries from the point of view of their efforts at economic development.

This exclusive concern is not completely a novelty. The approach has been implied in various hypotheses that seek to explain the liquidity crisis in these countries.[6] For example, the profligacy hypothesis explains the reserve holding behavior of these countries in terms of their "irresponsible" behavior. Others, such as the "state of growing pains," primitive rational choice, and the credit unavailability hypotheses, are suggestive in that they are examples which seek to explain the reserve holding behavior of these countries on rational grounds. However, they are all subject to one basic shortcoming in that they are not based on any coherent theoretical structure, being only scattered in "bits and pieces" throughout the literature. Neither are they empirically testable. It is possible, however, to use them as a basis for formulating a model of reserve holding behavior of developing countries, and to argue by such an approach

[3] Refer to J. Williamson [20, p. 685]. Also H. G. Grubel's article [7].

[4] Refer, for example, to M. June Flanders [5]. Also, Jacob A. Frenkel [6].

[5] An exception to this "traditional" approach is Kelly's study [13].

[6] The nature of this crisis is highlighted in International Monetary Fund, *Annual Report* [12, 1966, p. 13]. Also, Paul Streeten [18]. The drastic decline in reserve holdings of these countries has often been attributed to negligence and economic mismanagement on the part of the monetary authorities of these countries. However, Harrod claims evidence to the contrary. He maintains that, between 1958 and the second quarter of 1965, while the world as a whole let its reserves fall by 32 per cent in ratio to trade, the less developed countries let their reserves fall by 16 per cent only (or by 18 per cent if one includes the Middle East countries), "indicating that the less developed countries have not, after all, been so negligent about their reserves" [9, p. 200].

that the profligacy hypothesis is not valid. In the next section, a model is developed which takes these factors into account.

II. THE BASIC MODEL

The model of reserve holding behavior formulated in this paper is dominated by two major considerations: First, the investment in reserve accumulation is the result of a decision embedded in a general policy framework to accelerate economic development. Second, countries attempt to adjust their actual stocks of reserves to some desired level in a manner consistent with maximizing the goal of economic development. The procedure, then, is to specify the determinants of the desired stock of reserves for countries and to set forth the adjustment mechanism by which countries move from one equilibrium to another. Completion of these two tasks will provide us with a model that can be tested against historical data. To make such an approach applicable to the problem at hand, the following assumptions are made.

First, we assume that the average developing country is small in size so that it does not influence world prices of traded goods and services and that there are no foreign repercussions due to actions of such a country. We also assume that the country's balance of payments is in fundamental equilibrium, and the economy operates at less than the full employment level. These assumptions are modifiable under conditions of uncertainty.

Next, we suppose that the authorities of such a country can be regarded in the aggregate as wealth holders or spending units which make decisions at the margin on the different forms in which the country's social savings can be held. The authorities, it is assumed, have the power to implement their investment decisions through the adoption of a variety of direct and indirect controls. This includes controls over the country's balance of payments such that, at any given time, they can control a deficit or surplus in the payments position defined in an ex ante or autonomous sense. This may be achieved through trade, licensing and exchange restrictions, devaluation or through the manipulation of such economic variables as interest rates, government expenditures, tax rates, etc., via monetary and fiscal policies. Since these latter policies may be ineffective in a developing country for obvious reasons,[7] we shall assume that, if adopted at all, such policies will be supplemented by direct controls. We use the term "monetary authorities" as a pseudonym for all such aspects of government controls and decisions, since the government as a whole has these powers.

Given the above set of assumptions, we postulate that the developing country possesses a preference function relating its conception of the public's welfare to the uses to which it would put the country's stock of available foreign exchange at any particular period of time. We can distinguish between these uses: (a) accumulation of reserves—defined as the sum total of a country's official holdings of gold, convertible foreign exchange plus its net IMF position and (b)

[7] See, J. Handa [8, p. 334].

imports of capital goods and consumer goods for development purposes.[8]

With the application of a modified version of Tobin's theory of portfolio analysis of demand for money [19] to the international payments sphere, it can be shown that the preference function, when maximized both for conditions of certainty and uncertainty in an environment in which economic development is a goal of national policy, generates a demand function in which reserve holding behavior is determined not only by the current levels of the independent variables but also by the variations experienced and anticipated in them.[9] Such variations, we assume, can be measured by the standard deviation of these variables. More specifically, the demand function is in the following form:

$$R^* = R[r, S(r), X, S(X), AG, S(AG), LN, S(LN)] , \tag{1}$$

where R^* = desired level of reserves to hold,
r = opportunity cost of holding reserves,
$S(r)$ = standard deviation of r,
X = exports,
$S(X)$ = standard deviation of X,
AG = foreign aid and/or capital flows,
$S(AG)$ = standard deviation of AG,
LN = lines of credit,
$S(LN)$ = standard deviation of LN.

In a linear form, this desired demand function can be written as:

$$R^*_t = \beta_1 + \beta_2 r_t + \beta_3 S(r)_t + \beta_4 X_t + \beta_5 S(X)_t + \beta_6 (AG)_t + \beta_7 S(AG)_t + \beta_8 (LN)_t + \beta_9 S(LN)_t + U_t, \tag{2}$$

where t is a time subscript for a particular year, and U_t is a disturbance term.

Although a demand function such as the one in equation (2) can obviously serve as a basis for an empirical analysis, it only tells us about the possible variables which determine *desired* reserves if countries behaved according to an assumption of rationality to accelerate their efforts at economic development. It does not tell us how the *actual* stock of reserves should be. The desired stock of reserves cannot itself be directly measured because of the period of adjustment required though it is possible, as done by some studies,[10] to assume that actual reserve balances closely approximate desired balances if countries can adjust their reserve balances quickly to changes in economic and other conditions. On this assumption of instantaneous adjustment, the actual stock of reserves will be determined by the independent variables given in equation (1).

However, this assumption of instantaneity is unsuitable for developing countries. It is well known that these countries face several bottlenecks to rapid

[8] Only these two forms of holding wealth are distinguished to simplify the analysis, even though we could have complicated it by considering other financial assets.

[9] The derivation of this equation is made in my dissertation [16, pp. 104–63].

[10] Compare Kelly's article [13] whose study is implicitly based on this assumption.

economic development. Particularly, they have little or no control over the sources from which foreign exchange can be procured rapidly and in large quantities. Moreover, the real world is dynamic in the sense that time does not stand still. Production, for example, takes time; gathering and assessing information take time and countries, as well as individual economic decision-making units, are influenced in their current decision-making both by the legacy of the past and by expectations of the future. Economic development itself involves change; it is, therefore, a dynamic disequilibrium process.

For these reasons, we postulate a stock adjustment model by which countries would attempt to adjust their actual reserves to desired levels, according to a disequilibrium adjustment factor. We specify that the change in the actual stock of reserves experienced in a period t, is only a fraction of the amount that would be necessary for reaching the desired level in that period.[11] The change in reserves during period t, noting that R_t, as measured in the empirical analysis, reserves at the end of period t, is then written as:

$$R_t - R_{t-1} = \gamma(R^*_t - R_{t-1}) \,, \tag{3}$$

where R_t = the actual reserve stock at the end of year t,
R_{t-1} = the actual reserve stock at the end of year $t-1$,
R^*_t = the desired reserve stock at the end of year t, and
γ = the reaction or speed of adjustment coefficient.

Now, substituting equation (2) into equation (3) and simplifying, we get:

$$\begin{aligned} R_t = {} & \gamma\beta_1 + \gamma\beta_2 r_t + \gamma\beta_3 S(r)_t + \gamma\beta_4 (X)_t + \gamma\beta_5 S(X)_t \\ & + \gamma\beta_6 (AG)_t + \gamma\beta_7 S(AG)_t + \gamma\beta_8 (LN)_t + \gamma\beta_9 S(LN)_t \\ & + (1-\gamma) R_{t-1} + \gamma U_t, \end{aligned} \tag{4}$$

where U_t=the disturbance term and the other variables are as defined before.

From the point of view of estimating equation (3), it is assumed that $0 \leq \gamma \leq 1$. When $\gamma = 1$, the adjustment is instantaneous and immediate; so that the smaller in value the adjustment coefficient, γ, becomes, the longer it will take countries to adjust actual demands to their desired or equilibrium levels. That is to say, as the estimated value of γ falls, we may infer a more costly or slower adjustment process. Equation (4) provides us with a disequilibrium adjustment model

[11] For the application of this adjustment function to demand for money analysis, see, G. C. Chow [2]. Of course, alternative adjustment functions can be assumed so that our model is hardly unique. For example, one hypothesis about the adjustment function takes the following form:

$$R_t - R_{t-1} = \gamma(R^*_{t-1} - R_{t-1}) \,.$$

This hypothesis assumes that a fraction γ of $(R^*_{t-1} - R_{t-1})$ and not of $(R^*_t - R_{t-1})$ is adjusted to achieve equilibrium; in other words, countries adjust their actual stocks of reserves according to their past desired levels, rather than the most recent ones. Results of empirical estimations using this hypothesis show that our initial hypothesis has greater explanatory value.

of reserve holding behavior. In the following two sections, this model is tested against the historical data of eleven developing countries over the period from 1952 to 1965.

III. THE DATA AND THE MEASUREMENT OF THE VARIABLES

The data used in this study were drawn basically from two sources: (1) the *Yearbook of International Trade Statistics*; and (2) country pages of the monthly issues of the *International Financial Statistics*, published by the International Monetary Fund (1954, 1956, 1958, 1960, 1962, 1964, and 1966 issues). These collected data, it must be noted, are based on data submitted by individual member countries. The first problem, thus, is the accuracy of such data and their reliability, particularly in cases where the data on a certain variable are revised periodically and where the methods of collection of data might not be reliable.

All variables are valued in millions of U.S. dollars, except the two variables, (R/M) and (K/M), which are dimensionless numbers. Reserves (R) are measured according to the International Monetary Fund's definition which is official holdings of gold, convertible foreign exchange, and the country's net IMF position. This measure may not be obviously universally valid for all the countries covered in this paper. In this way, the above measure may be wrongly chosen since the policy makers may make their decisions concerning desired reserve holdings with a much broader definition of reserves in mind; that is, perhaps in terms of a broader concept of international liquidity. However, it is well known that such a wide definition of reserves raises a conceptual problem of measurement. Thus, if we use the narrow definition above, which is measurable, it must be recognized that such a measurement can adversely affect our statistical results.

Experienced and anticipated variations in exports (X) are measured by the moving standard deviation of exports over the current and preceding three years, designated as $S(X)$. Since data are not sufficiently available both for all the countries in the sample and over the period covered with regard to such independent variables as lines of credit (LN), aid and capital flows (AG), they are omitted from the estimation equations. This is another limitation of the statistical analysis, since the omitted variables may be crucial for certain individual countries.

The opportunity cost of holding reserves, r, and the uncertainty attached to it, which generate the risk of inadequate reserves, is the most difficult variable to handle. It is usually measured by the rate of interest such as the yield on long-term government bonds. However, data on rate of interest are not readily available for many of the developing countries included in the sample over the relevant period. Courchene and Youssef's study employs this proxy which they found statistically significant. However, the underdeveloped nature of the money and capital markets of most developing countries partially provide evidence of the unreliability of the use of this proxy in the estimation of our model. As a matter of fact, one can easily argue that the negative correlation found in some studies between reserves and interest rates may be due simply to the fact that

restrictive measures (tight monetary policy for example) and, therefore, higher interest rates are used to correct a payments deficit which is, of course, associated with a lower level of reserve holdings.

The difficulties involved in properly specifying the opportunity cost variable which, in most cases, may be essential for studies related directly to the developing countries lead some economists to leave it out completely in their estimating equations. For example, P. B. Clark maintains that, "although the opportunity cost of [holding] reserves, r, is part of the model, the obvious difficulties inherent in obtaining comparable estimates of this variable for thirty-eight countries militated against any attempt in using it to explain variations in reserve holdings" [3, p. 589]. Other economists, however, prefer to use proxies for the opportunity cost variable. In this study, we shall follow the latter approach of using proxies. The problem here is whether our proxy is a properly chosen one.

Our theoretical analysis explains that, given the independent variables and the variations in them, a country with a high degree of preparedness to speed up the development process will want to utilize a large part of its accumulated foreign exchange for development purposes. In other words, the higher the opportunity cost of holding reserves, ceteris paribus, the lower the demand for reserves will be since a large proportion of available funds will be allocated to the financing of imports of development goods. Thus, we can approximate the cost variable by using a proxy, the ratio of capital goods imports to total imports of a particular country in a certain year, K/M. The variations in this opportunity cost variable are measured by the standard deviation of our proxy variable, calculated as the moving standard deviation of the current plus the preceding three years ratios, $S(K/M)$. The difficulty here was the construction of a reliable and consistent annual series for our proxy variable, particularly with regard to materials for incorporation into the capital goods category. The appropriate calculations were made from the relevant issues of the *Yearbook of International Trade Statistics*, which list the figures for the capital goods category.

Since the available data are limited in scope as well as in reliability, reasonably valid results can be expected for only a limited number of countries. Moreover, in estimating the equations, it is assumed that the preference functions of the countries remained stable over the period. This may not be true since certain political and noneconomic factors can cause these functions to shift over the period. Finally, since it is a cross-country study, dummy variables we have introduced may take inadequate account of the preferences between countries—the dummy variables take account of differences in the constants of the equations but the parameters themselves may differ among countries.

However, abstracting for a moment from potential data problems and errors that may be involved in the measurement of the variables, and in the absence of empirical reasons to specify alternative forms of a functional relationship, it is postulated that, for estimation purposes, reserve holdings (R) in a period are related in a linear fashion to both the levels of exports (X) and its standard deviation $S(X)$, and to the level of the capital goods import ratio (K/M) and

its standard deviation $S(K/M)$. More specifically, these variables are substituted into our distributed lag equation (4) to obtain:

$$R_t = \gamma\beta_1 + \gamma\beta_2 X_t + \gamma\beta_3 S(X)_t + \gamma\beta_4 (K/M)_t + \gamma\beta_5 S(K/M)_t + (1-\gamma)R_{t-1} + \gamma\xi_t, \tag{5}$$

where the variables are defined as before.

It is not clear in most cases whether the absolute level of reserves in a particular year t (R_t) or the ratio of reserves to total imports in a particular year $(R/M)_t$, is the relevant decision variable for a country. The latter variable tries to relate the magnitude of reserve demand to the magnitude of the economy to which it belongs. Such an operation seems useful because it permits the elimination of some differences in size among countries, although it does not obviously eliminate institutional differences (traditions included) which exist between them. Consequently, another equation of the form:

$$(R/M)_t = \gamma\beta_1 + \gamma\beta_2 X_t + \gamma\beta_3 S(X)_t + \gamma\beta_4 (K/M)_t + \gamma\beta_5 S(K/M)_t + (1-\gamma)(R/M)_{t-1} + \gamma\xi_t \tag{6}$$

is tested against the historical data. The variables are as defined before, and ξ is a stochastic disturbance term.

Equations (5) and (6) are our estimation equations that are tested against the historical data of eleven developing countries. The results of these tests are analyzed in the next section.

IV. THE EMPIRICAL RESULTS

Taking into consideration the myriad of methodological and statistical problems which might adversely affect our results, the adjustment model in equations (5) and (6) is tested by the use of ordinary least squares against the historical data of eleven developing countries—Argentina, Brazil, Ceylon, Costa Rica, Ghana, India, Iraq, Pakistan, Sudan, United Arab Republic, and Venezuela for the period 1951–65.[12]

[12] There are two basic criteria for selecting these eleven countries which form the original sample. The first is based on how the International Monetary Fund has divided the developing countries in general into (a) major oil exporters, (b) countries with initial high reserves, and (c) other less developed countries. See [12, 1966, p. 13]. The countries in group (b) are Ceylon, Ghana, India, Pakistan, Sudan, and United Arab Republic. In 1951, reserves as percentage of imports for this group was 118 per cent but, by 1965, this ratio had dwindled to 22 per cent. As pointed out in the IMF report, the decline in the reserve-import ratio for all developing countries combined appears to be influenced mainly by this group (64 per cent in 1951 to 42 per cent in 1965). Consequently, it is a matter of interest to develop a hypothesis capable of explaining their reserve holding behavior.

As a check on the hypothesis used to explain the reserve holding behavior of the above countries, the other developing countries are included in the sample. Argentina, Brazil, and Costa Rica are taken from group (c) and Iraq and Venezuela from group (a). The selection of these other countries is based solely on a second criterion—the relative

Various tests of equations (5) and (6) were undertaken, using both the linear and log-linear forms of the equations first, for the data of all the countries pooled together, second, for the data of the individual countries considered separately. The statistical results are reported in Appendix Tables I–X. Following an elimination procedure to choose the specification which yields the most significant coefficients—i.e., the highest "*t*" statistics—unless that specification produced some other economic or econometric problem such as the coefficients with the wrong signs or serially correlated residuals, the log-linear forms of the equations are chosen for analysis.[13] Along similar lines, the equation with (R/M) performed better than with (R) as the decision variable.

In looking at the log-linear forms of equations (5) and (6) (see Appendix Table II), the results indicate that the variables $(X)_t$ and $S(X)_t$ are statistically insignificant. The poor performance of these export variables may be explained by the fact that exports and its standard deviation may be more of long-run than short-run determinants of current reserve holdings. Moreover, for many countries they seem to follow the cobweb theorem so that current exports may not enter significantly in influencing current reserve holdings.[14]

The most significant feature of the results is the performance of our proxy variable $(K/M)_t$ for the opportunity cost of holding reserves. It is statistically significant at the 99 per cent probability level in three cases and nearly so in a fourth case. It has the correct negative sign in all cases. These results attest to the fact that, on the average, reserve holding behavior of the developing countries could be explained in terms of their objective to accelerate economic development through development imports. However, the $S(K/M)$ variable which was assumed to measure the risk of inadequate reserves proved statistically insignificant. This is a crucial result because it indicates that some countries may think of balance of payments problems as an inevitable part of the development process in the short run and therefore may not enter them into calculations about reserve policy.

Another plausible outcome of the statistical results concerns the lagged dependent variables in all the equations tested. The coefficients for these variables are statistically significant even at the 99 per cent probability level, affirming the relative impact of past reserve holdings on current holdings. The lagged dependent variable can be viewed as a weighted average of all past reserve

availability of data on all the relevant variables for the whole period of 1951–65. This makes the countries in our sample very heterogeneous from the outset in terms of their reserve growth or decline. This is one possible source of bias for our statistical results.

[13] This procedure seems justified since we are not necessarily concerned with producing an equation which yields the best predictive estimates but with choosing between hypotheses which can be used to explain reserve holding behavior of developing countries.

[14] See [14]. On this presumption, other tests in which the lagged dependent variables were omitted from the estimation equations showed that the export variables are more of long-run than short-run determinants. Also see, M. G. Kelly's article [13]. On the cobweb phenomenon, see P. Samuelson [17, p. 339]. (See Appendix Table IV.)

holdings of the particular countries concerned.[15] It can also be interpreted more simply as a measure of past reserve holdings which encompasses a host of variables that mould the habits of monetary authorities.

The value of the adjustment or reaction coefficient (γ), which is calculated from the coefficient of either the lagged dependent variable, R_{t-1} or $(R/M)_{t-1}$, is statistically significant. If we consider the logarithmic forms of the equations tested, its value is approximately 0.35. From equation (6), it is calculated as $(1-0.667)$ or 0.333 which is close to $(1-0.646)$ or 0.354 in the case of equation (5). These low values imply a very costly or slow adjustment process on the part of the developing countries. That is to say, on the average, these countries take a long time to adjust actual levels of demand for reserves to their desired or equilibrium levels. For example, within a year, they may be able to cover only about 35 per cent of the actual adjustment burden.[16] Such a result indicates that, in the case of the developing countries, it may be inappropriate to assume instantaneous adjustment in the short run to changes in the independent variables precipitated by changing market conditions or other factors of inertia. In other words, when analyzing annual movements in developing countries' reserves for the period 1951–65, models that incorporate the assumption of instantaneity will yield biased estimates of the short-run effects of the determinants of their reserve holding behavior.

An inspection of equations (5) and (6) show that the true coefficients of the independent variables are all multiplied by the value of the adjustment coefficient (γ). The coefficients which are therefore estimated from these equations may be considered as "short-run" coefficients. To obtain true or long-run coefficients, we only have to divide the short-run coefficients by the value of (γ). This is a relatively easy task since the estimation of the equations including the lagged dependent variable provides a consistent estimator of the adjustment coefficient (γ). For example, taking the log-linear forms of equations (5) and (6), the short-run coefficients of the oppotrunity cost variable (K/M) are respectively -0.149 and -0.273. Since the true coefficient β_4 is equal to $\gamma\beta_4/\gamma$, the above short-run coefficients have to be divided by the respective values of the adjustment values in each equation. These values as calculated above are respectively 0.354 and 0.333 for equations (5) and (6). Thus, to obtain the long-run or true coefficient for the K/M variable, for example, we divide -0.149 by 0.354 in the case of equation (5) and -0.273 by 0.333 in the case of equation (6). This operation yields respective values of 0.421 and 0.819.

These calculated coefficients for the logarithm of the K/M variable give an idea of the relative elasticity of reserve demand with respect to this "development" variable. From the above calculations, we may consider the partial

[15] This is almost similar to the Friedman permanent income hypothesis and some studies on the consumption function which view past income levels as determinants of current consumption. See also P. B. Clark [3].

[16] The value of the adjustment coefficients for individual countries are provided in Appendix Table V, and as can be seen significant differences exist between the countries in their degree of adjustment from actual to desired levels.

elasticity of reserve demand with respect to this "development" variable to approximate 0.15 in the case of equation (5) for the short run and 0.42 for the long run. In the case of equation (6), the respective estimates are from 0.27 in the short run to 0.82 in the long run.[17] These low values for the elasticity of demand can be taken as an indication of how reserves as a commodity is a "necessity" in the development process of these countries, both for the short run and the long run. This result will obviously negate attitudes of profligacy on the part of such countries.

From the above results, we may write the chosen equation and its regression estimates taken from Appendix Table II, as:

$$\ln(R/M)_t = 2.081 + 0.667 \ln(R/M)_{t-1} - 0.082 \ln(X)_t$$
$$t \text{ values} \qquad (10.555) \qquad (0.655)$$
$$+ 0.043 \ln S(X)_t - 0.273 \ln(K/M)_t + 0.024 \ln S(K/M)_t \, .$$
$$(0.970) \qquad (-3.172) \qquad (0.533)$$
$$R^2 = 0.81. \qquad \text{DWS} = 2.21.$$

The use of the ratio of reserves to imports as a dependent variable rather than the level of reserves (i.e., $[R/M]_t$ instead of R_t) tends to conflict with Flanders's study, the empirical results of which were considered by her to be "a dismal failure" because the chosen independent variables failed to explain the variations in the reserve-import ratio [5, p. 7]. The above equation states that, in terms of statistical significance, past reserve-import ratios and current level of the capital goods—import ratios—a proxy for the opportunity cost of holding reserves—determine the reserve holding behavior of the developing countries. As can be seen from Appendix Table VI, this general conclusion, however, breaks down when separate tests are performed for each of the individual countries. It is observed that the countries respond differently to the significance of the explanatory variables in explaining variations in their reserve holdings; the form of the equation tested, the nature of the dependent variable used, the cost of adjustment, and the type of adjustment hypothesis employed, all vary in their significance for the individual countries and in their effects upon the relative performance of the model.[18]

Given the methodological problems associated with the estimation procedure mentioned earlier, it is felt that the investigation attempted in this paper does provide some positive and significant results; some less clear-cut, and a few rather negative ones which raise more questions than they answer. For example,

[17] The elasticities differ, as we would expect, both for the two "runs." Because of the time period required to change plans, break habits, disseminate information, generate new projects, etc., economic functions grow more elastic as the time period over which they are defined lengthens. Our results seem consistent with this economic criterion. It must be noted however that such estimates may be subject to the simultaneous equation bias because of the estimation procedure employed in our statistical tests, i.e., the lease squares linear regression method. For a discussion of this problem, see [15, p. 501].

[18] The results of these tests can be obtained on request or found in Chapter 7 of my dissertation [16]. Some of these are reproduced in Appendix Tables VI–X.

the fact that the export variables become statistically significant when they are all lagged one year (see Appendix Tables) but they perform badly when their current levels are used in our working hypothesis, poses some problems about generalizing on the applicability of one hypothesis on reserve holding behavior of developing countries. Indeed, it is hard to tell precisely what importance should be attached to our negative findings particularly with regard to the performance of the $S(K/M)$ variable which was supposed to measure the risk of inadequate reserve holdings. We are not prepared to accept this as conclusive evidence that the demand for international reserves by a developing country is not related to this variable even though, in the short run, there may be some reasons to expect some countries to disregard the influence of this variable in making decisions on what amount of reserves they should hold. We are rather inclined to interpret negative findings as a result of our inability to uncover significant effects reflecting in good part the serious shortcomings of the statistical procedure employed in this study. From this point of view, further investigations into the reserve holding behavior of developing countries are required.

V. CONCLUSIONS AND POLICY IMPLICATIONS

The purpose of this paper is to construct an adjustment model capable of explaining the reserve holding behavior of developing countries. In spite of deficiencies of data and statistical limitations of the estimation procedure, the results are very encouraging. They demonstrate some support for the observation that, in the short run, developing countries on the average have a low precautionary demand for reserves because of the pressure to accelerate economic development—a paradoxical result indeed. This result emerges from the statistical insignificance of the risk of inadequate reserves variable, $S(K/M)$, and all of the export variables, i.e., the current levels of the (X) and the $S(X)$ variables. This result partially implies an acceptance on the part of these countries that in the short run, balance of payments problems are an inevitable part of the development process itself.

The principal findings of this paper are that, on the average, developing countries are able to complete less than half of the adjustment in desired reserve holdings in each year; that is, the speed of adjustment of actual to desired or equilibrium levels is low; that reserves as a percentage of imports in a particular year is a more reasonable decision variable than that of the absolute level of reserves; that the log-linear forms of the equations tested performed better than the ordinary linear forms of the equations. Finally, it is found that, in the short run, the critical determinants of reserve holding behavior of these countries are not only past reserve holdings (a wealth variable) but also the current level of the ratio of capital goods imports to total imports, a surrogate to measure the degree of preparedness of a developing country to accelerate economic development. The statistical significance of this development variable measuring the opportunity cost of holding reserves tends to indicate that studies

on developing countries which eliminate this variable from the empirical estimations because of the difficulties associated with its proper measurement, may be very biased.

The above generalizations, however, broke down when tests were conducted separately for the individual developing countries. It was noted that, as one would expect, the developing countries responded differently to the significance of the explanatory variables in explaining variations in their reserve holdings. In particular, it was observed that the form of the equation tested, the nature of the decision variable used, the speed of adjustment and the nature of the adjustment hypothesis employed varied in their significance for the individual countries and in their impact upon the relative performance of the model. In general, the model performed fairly well for those countries with an initial high reserves in 1951—Ceylon, India, Ghana, Sudan, United Arab Republic, and only moderately for Pakistan. It also performed moderately well for the two oil-producing countries—Iraq and Venezuela—but very poorly for all the Latin American countries—Argentina, Brazil, and Costa Rica.

The fact that the model seems to be a crude representation of the actual reserve holding behavior of the Latin American countries is interesting because, paradoxically, these were the countries in which there were relatively more political upheavals and frequent use of multiple rates and devaluation during the period under consideration.

Thus, while the results at the individual country level tend to indicate that it is hard to generalize on the applicability of a particular model to all developing countries alike, the results at the aggregate level are especially interesting in that they tend to support the portfolio balance idea that the decision to invest in reserve accumulation cannot be made independently of the decision to accelerate economic development. Although, this paper has been exploratory and its conclusions tentative, the results could be taken to imply that some developing countries might have deliberately drawn down their reserve holdings to finance development expenditures, thus involving them in possible liquidity problems. The question, however, is: What can be done about these liquidity problems?

One of the major reasons that we seek an explicit operational framework with which to view the workings of the economic system is that the propositions forthcoming from such a framework allow us to evaluate the usefulness of various policy decisions, thereby promoting our ability to control and direct the economy. In this regard, this paper has obvious policy implications. First, the fact that the speed of adjustment of actual to desired levels is low tends to heighten the old argument of the need for an international policy to effect a system whereby more foreign resources will flow into the reserve deficient countries than it is at present. Such a policy might be to have a proposal that links a reform of the international monetary system (be it reallocation of SDRs) as has been suggested by many economists before, to the creation of a permanent development fund from which development assistance can be effected at rela-

tively low rates and favorable terms to reserve deficient countries. Such a system may have a built-in mechanism to let any surplus countries (at the moment it could be the rich oil-producing countries) bear the heavier part of this burden of financing the permanent fund's operations. Unless such a policy or a similar proposal, which takes into account the facts of inequitable distribution of international income and adjustment costs, is considered seriously, it is likely that the present development expenditure behavior of most of these countries will continue for several decades—a behavior which will most likely also impair the continued efficiency of any reformed international monetary arrangement. For example, there could be formed in the Third World countries and elsewhere, major trading blocs functioning on a bilateral rather than multilateral basis, each, of course, attempting to increase its relative bargaining position in trade. Soon, the world monetary system, beset also with accompanying inflationary pressures, would be reduced to a highly sophisticated system of barter.

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APPENDIX TABLE I

POOLED REGRESSION ESTIMATES OF RESERVES FOR ELEVEN DEVELOPING COUNTRIES, 1952–65

Estimated equations without dummies:

(5) $R_t=\gamma\beta_1\pm\gamma\beta_2X_t\pm\gamma\beta_3S(X)_t\pm\gamma\beta_4(K/M)_t\pm\gamma\beta_5S(K/M)_t\pm(1-\gamma)R_{t-1}\pm\gamma\xi_t$.

(6) $(R/M)_t=\gamma\beta_1\pm\gamma\beta_2X_t\pm\gamma\beta_3S(X)_t\pm\gamma\beta_4(K/M)_t\pm\gamma\beta_5S(K/M)_t\pm(1-\gamma)(R/M)_{t-1}\pm\gamma\xi_t$.

Form of Equation \ Independent Variables		Inter-cept	R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)*	DWS	F-value
Linear	(5)	0.330	0.840	0.001	0.158	0.575	2.360	0.90	1.67	274.97
		(0.014)	(23.830)	(0.054)	(1.888)	(0.581)	(0.621)	(111.80)		
Linear	(6)	8.064	0.832	−0.002	0.023	−0.108	−0.022	0.82	2.20	133.13
		(1.433)	(23.261)	(−1.019)	(1.630)	(−0.579)	(−0.032)			
Log-linear	(5)	0.044	0.928	0.019	0.025	0.024	0.008	0.93	2.26	409.68
		(0.242)	(33.504)	(0.580)	(0.737)	(0.504)	(0.033)	(0.30)		
Log-linear	(6)	0.843	0.830	−0.047	0.065	0.071	0.012	0.79	2.33	109.11
		(2.774)	(19.777)	(−1.207)	(1.617)	(−1.120)	(−0.306)	(0.35)		

Note: Eleven developing countries are: Argentina, Brazil, Costa Rica, Ceylon, Ghana, India, Pakistan, Sudan, United Arab Republic, Iraq, and Venezuela.
* Standard error of estimate.

APPENDIX TABLE II

POOLED REGRESSION ESTIMATES OF RESERVES FOR ELEVEN DEVELOPING COUNTRIES, 1952–65

Estimated equations with dummy variables:*

(5) $R_t=\gamma\beta_1\pm\gamma\beta_2X_t\pm\gamma\beta_3S(X)_t\pm\gamma\beta_4(K/M)_t\pm\gamma\beta_5S(K/M)_t\pm(1-\gamma)R_{t-1}\pm\gamma\xi_t$.

(6) $(R/M)_t=\gamma\beta_1\pm\gamma\beta_2X_t\pm\gamma\beta_3S(X)_t\pm\gamma\beta_4(K/M)_t\pm\gamma\beta_5S(K/M)_t\pm(1-\gamma)(R/M)_{t-1}\pm\gamma\xi_t$.

Form of Equation \ Independent Variables		R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)†	DWS	F-value
Linear	(5)	0.761	−0.003	0.128	−2.155	4.835	0.91	1.71	97.09
		(16.821)	(−0.094)	(1.465)	(−1.594)	(1.061)	(109.26)		
Linear	(6)	0.774	0.010	0.020	−0.565	0.402	0.83	2.09	45.36
		(15.175)	(1.564)	(1.337)	(−2.190)	(0.482)	(20.14)		
Log-linear	(5)	0.646	−0.083	0.021	−0.149	0.016	0.95	2.04	157.44
		(10.318)	(0.814)	(0.562)	(2.189)	(0.441)	(0.28)		
Log-linear	(6)	0.667	−0.082	0.043	−0.273	0.024	0.81	2.21	39.49
		(10.555)	(0.655)	(0.970)	(−3.172)	(0.533)	(0.34)		

* Coefficients for dummy variables are shown in Appendix Table III.
† Standard error of estimate.

APPENDIX TABLE III

REGRESSION COEFFICIENTS FOR DUMMY VARIABLES

Country	Linear (5)	Linear (6)	Log-linear (5)	Log-linear (6)
Argentina	67.076 (1.093)	18.903 (1.582)	2.394 (3.054)	2.786 (3.045)
Brazil	152.707 (3.175)	25.363 (2.416)	2.617 (5.139)	3.005 (4.761)
Ceylon	91.705 (1.542)	20.673 (1.753)	2.078 (1.019)	2.809 (3.182)
Costa Rica	0.265 (0.084)	7.902 (0.538)	1.422 (0.004)	2.210 (1.357)
Ghana	41.350 (0.591)	22.699 (1.937)	2.241 (2.259)	2.810 (3.145)
India	431.213 (3.275)	60.631 (2.940)	2.841 (5.171)	3.249 (4.879)
Iraq	40.448 (0.708)	21.457 (1.885)	2.320 (2.477)	2.927 (3.909)
Pakistan	81.164 (1.387)	21.591 (1.876)	2.327 (2.514)	2.903 (3.823)
U.A.R.	48.531 (0.736)	13.063 (0.995)	2.342 (2.820)	2.610 (2.390)
Venezuela	236.815 (4.211)	32.746 (2.958)	2.756 (5.862)	3.196 (5.637)

Note: t-ratios are in parentheses below the coefficients.

APPENDIX TABLE IV

POOLED REGRESSION ESTIMATES OF DEMAND FOR RESERVES, 1952–65

Dummy variables are included in equations but lagged dependent variables are excluded.

Form of Equation \ Independent Variables	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2(SEE)*	DWS	F-value
Linear (5)	−0.081 (−1.347)	0.645 (4.517)	−4.481 (−1.914)	13.748 (1.746)	0.74 190.13	0.74	27.68
Linear (6)	−0.003 (−0.305)	0.053 (2.156)	−1.645 (4.079)	0.858 (0.632)	0.55 32.78	0.64	12.14
Log-linear (5)	−0.114 (−0.846)	0.104 (2.208)	−0.342 (−3.939)	0.087 (1.822)	0.90 0.370	0.88	91.60
Log-linear (6)	−0.273 (−1.633)	0.126 (2.155)	−0.597 (−5.554)	0.106 (1.800)	0.66 0.46	0.90	19.15

Note: t-ratios are in parentheses below the regression coefficients.

* Standard error of estimate.

APPENDIX TABLE V

ESTIMATED ADJUSTMENT COEFFICIENTS FOR ELEVEN DEVELOPING COUNTRIES, 1952–65

A. Statistically Significant

Country	Linear (5)	Linear (6)	Log-linear (5)	Log-linear (6)
Ceylon	0.254	0.370	0.180	0.258
Ghana	0.415	0.536	0.305	0.423
India	0.407	0.526	0.256	0.256
Iraq	0.922	0.858	0.882	0.559
United Arab Rep.	0.270	0.133	0.140	0.935
Venezuela	0.001	0.607	0.328	0.724

B. Statistically Not Significant

Country	Linear (5)	Linear (6)	Log-linear (5)	Log-linear (6)
Argentina	0.750	0.950	0.861	0.979
Brazil	1.061	1.143	1.042	1.263
Costa Rica	0.938	1.282	1.015	1.322
Pakistan	1.024	0.910	1.029	0.375
Sudan	1.024	1.075	0.882	1.82

APPENDIX TABLE VI

LINEAR REGRESSION ESTIMATES OF RESERVES: INDIVIDUAL COUNTRIES, 1952-65

Estimated equation: $R_t=\gamma\beta_1\pm\gamma\beta_2X_t\pm\gamma\beta_3S(X)_t\pm\gamma\beta_4(K/M)_t\pm\gamma\beta_5S(K/M)_t\pm(1-\gamma)R_{t-1}\pm\gamma\xi_t$.

Country \ Independent Variables	Inter-cept	R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)*	DWS	F-value
Argentina	480.049 (1.786)	0.250 (0.891)	−0.098 (−0.394)	0.675 (0.974)	−3.839 (−1.034)	−11.741 (−0.998)	0.60 (118.56)	2.27	2.40
Brazil	99.129 (0.260)	−0.061 (−0.144)	0.404 (1.681)	0.111 (0.156)	−6.099 (−0.851)	6.299 (0.286)	0.46 (103.16)	1.56	1.37
Ceylon	252.530 (2.091)	0.746 (3.007)	−0.053 (−0.700)	−0.382 (−1.838)	−9.464 (−2.004)	7.499 (2.420)	0.84 (30.03)	1.56	8.45
Costa Rica	27.255 (1.302)	0.062 (0.164)	0.065 (0.348)	0.327 (0.626)	−0.855 (−0.983)	−0.431 (−0.130)	0.34 (4.59)	1.49	0.83
Ghana	289.652 (1.115)	0.585 (2.581)	−0.462 (−0.897)	0.984 (0.481)	−6.995 (−0.803)	11.802 (0.385)	0.89 (68.39)	2.29	13.03
India	−93.340 (−0.140)	0.593 (4.054)	0.053 (0.690)	0.338 (1.650)	−9.685 (−1.028)	86.662 (2.489)	0.97 (134.40)	3.08	44.42
Iraq	354.260 (2.206)	0.078 (0.227)	−0.166 (−1.626)	−0.936 (−1.619)	2.258 (0.853)	−1.573 (−0.292)	0.32 (55.25)	2.23	0.77
Pakistan	308.659 (3.306)	−0.024 (−0.159)	−0.025 (−0.701)	0.034 (0.369)	−1.179 (−0.978)	5.257 (0.975)	0.267 (36.047)	2.12	0.58
Sudan	261.836 (3.667)	−.024 (−0.080)	−1.845 (−2.494)	0.410 (0.124)	0.392 (0.189)	−11.280 (−1.643)	0.73 (26.72)	1.99	4.40
U.A.R.	451.199 (1.908)	0.730 (6.862)	−0.561 (−0.769)	−1.832 (−0.798)	−8.226 (−1.493)	−31.093 (−1.837)	0.96 (52.88)	2.16	38.70
Venezuela	571.977 (1.445)	0.999 (3.763)	0.093 (0.527)	−1.515 (−3.186)	−23.437 (−2.130)	98.861 (2.843)	0.82 (150.40)	2.05	7.10

Note: t-ratios are in parentheses below the regression coefficients.

* Standard error of estimate.

APPENDIX TABLE VII

LOG-LINEAR REGRESSION ESTIMATES OF RESERVES: INDIVIDUAL COUNTRIES, 1952-65

Estimated equation: (5) as in Table VI.

Country \ Independent Variables	Inter-cept	R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)*	DWS	F-value
Argentina	7.579 (1.131)	0.139 (0.481)	−0.239 (−0.244)	0.245 (1.058)	−0.531 (−1.054)	0.168 (−0.649)	0.45 (0.49)	2.15	1.32
Brazil	−0.958 (−0.190)	−0.042 (−0.109)	1.175 (1.541)	0.009 (0.057)	−0.360 (−0.773)	0.072 (0.680)	0.47 (0.22)	1.54	1.40
Ceylon	14.075 (2.284)	0.820 (3.877)	−2.332 (−2.536)	0.568 (2.641)	0.737 (2.041)	−0.221 (−0.900)	0.88 (0.21)	1.29	1.46
Costa Rica	3.093 (0.849)	−0.015 (−0.038)	0.909 (0.665)	0.210 (0.537)	−1.553 (−0.996)	0.112 (0.333)	0.31 (0.36)	1.41	0.71
Ghana	5.670 (1.706)	0.695 (2.947)	−0.513 (−1.186)	0.010 (0.069)	−0.461 (−1.481)	0.057 (0.358)	0.91 (0.23)	2.52	16.33
India	−0.179 (0.022)	0.744 (3.186)	0.150 (0.190)	0.152 (−0.109)	−0.112 (−0.392)	0.056 (0.592)	0.91 (0.20)	2.87	16.07
Iraq	5.889 (2.072)	0.118 (0.312)	−0.170 (−1.232)	−0.138 (−0.868)	0.212 (0.621)	−0.030 (−0.425)	0.18 (0.23)	1.89	0.35
Pakistan	7.406 (2.217)	−0.029 (−0.110)	−0.214 (−0.731)	0.009 (0.122)	−0.044 (−0.492)	0.025 (0.260)	0.17 (0.15)	1.88	0.33
Sudan	7.430 (3.074)	0.118 (0.374)	−0.796 (−2.501)	0.032 (0.152)	0.088 (0.311)	−0.333 (−1.865)	0.76 (0.23)	1.81	4.95
U.A.R.	2.914 (1.248)	0.896 (7.135)	−0.261 (−0.859)	−0.039 (−0.719)	−0.283 (−1.046)	−0.140 (−1.952)	0.96 (0.13)	2.71	42.91
Venezuela	3.625 (1.185)	0.672 (2.471)	−0.073 (−0.152)	−0.183 (−1.932)	−0.107 (−0.435)	0.362 (−1.746)	0.75 (0.21)	1.85	4.82

* Standard error of estimate.

APPENDIX TABLE VIII

LINEAR REGRESSION ESTIMATES OF RESERVES: INDIVIDUAL COUNTRIES, 1952–65

Estimated equation: (6) $(R/M)_t = \gamma\beta_1 \pm \gamma\beta_2 X_t \pm \gamma\beta_3 S(X)_t \pm \gamma\beta_4 (K/M)_t \pm \gamma\beta_5 S(K/M)_t \pm (1-\gamma)(R/M)_{t-1} \pm \gamma\xi_t$.

Country \ Independent Variables	Inter-cept	R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)*	DWS	F-value
Argentina	58.022 (1.887)	0.049 (0.158)	−0.016 (−0.599)	0.119 (1.542)	−0.430 (−1.233)	−1.607 (−1.440)	0.69 (11.66)	2.52	3.62
Brazil	−9.021 (−0.213)	−0.143 (−0.284)	0.050 (1.975)	−0.053 (−0.545)	−0.567 (−0.678)	0.563 (0.215)	0.40 (11.44)	1.22	1.08
Ceylon	99.235 (2.307)	0.630 (2.160)	−0.026 (−0.952)	−0.118 (−1.632)	−2.975 (−1.652)	2.206 (0.360)	0.79 (10.67)	1.74	5.99
Costa Rica	25.892 (1.700)	−0.282 (−0.756)	−0.032 (−0.212)	0.668 (1.372)	−0.604 (−1.009)	3.875 (1.087)	0.77 (3.60)	2.14	5.51
Ghana	147.262 (1.019)	0.464 (1.757)	−0.237 (−0.894)	1.202 (1.245)	−2.145 (−0.508)	−10.996 (−0.756)	0.90 (32.38)	3.16	14.03
India	41.612 (−0.803)	0.474 (3.190)	0.015 (2.189)	0.012 (0.671)	−2.294 (−3.252)	11.463 (3.232)	0.96 (12.05)	0.77	43.67
Iraq	55.083 (1.675)	0.142 (0.533)	−0.047 (−1.564)	−0.086 (−0.506)	1.429 (1.989)	1.635 (1.003)	0.67 (16.35)	2.19	3.28
Pakistan	62.261 (0.617)	0.090 (0.168)	−0.009 (−0.229)	0.067 (1.159)	−1.217 (−1.755)	1.604 (0.464)	0.55 (21.29)	1.67	1.97
Sudan	216.488 (3.046)	−0.075 (−0.230)	−1.734 (−1.963)	−0.404 (−0.122)	−0.189 (−0.122)	−10.178 (−1.454)	0.70 (26.76)	1.60	3.70
U.A.R.	44.586 (0.598)	0.867 (5.239)	0.143 (0.627)	−0.660 (−1.000)	−1.659 (−1.033)	−7.918 (−1.627)	0.93 (13.18)	2.10	22.17
Venezuela	46.312 (1.719)	0.393 (1.437)	0.004 (0.354)	−0.052 (−2.088)	−0.593 (−1.070)	3.305 (1.342)	0.52 (10.50)	2.27	1.71

* Standard error of estimate.

APPENDIX TABLE IX

LOG-LINEAR REGRESSION ESTIMATES OF RESERVES: INDIVIDUAL COUNTRIES, 1952–65

Estimates equation: (6) as in Table VIII.

Country \ Independent Variables	Inter-cept	R_{t-1} or $(R/M)_{t-1}$	X_t	$S(X)_t$	$(K/M)_t$	$S(K/M)_t$	R^2 (SEE)*	DWS	F-value
Argentina	7.446 (1.064)	0.021 (0.076)	−0.493 (−0.470)	0.337 (1.355)	−0.515 (−0.985)	−0.326 (−1.209)	0.55 (0.52)	2.31	1.99
Brazil	−7.591 (−1.162)	−0.263 (−0.648)	1.911 (2.083)	−0.253 (−1.071)	−0.257 (−0.414)	0.147 (−0.997)	0.48 (0.28)	1.29	1.46
Ceylon	17.632 (2.012)	0.742 (2.413)	−3.017 (−2.297)	0.775 (2.535)	1.069 (1.945)	−0.423 (−1.122)	0.80 (0.29)	1.87	6.30
Costa Rica	4.089 (1.523)	−0.322 (−0.833)	0.538 (0.493)	0.350 (1.006)	−1.225 (−1.072)	0.543 (1.639)	0.69 (0.28)	1.71	3.52
Ghana	7.194 (1.486)	0.577 (1.983)	−0.676 (−1.053)	0.101 (0.502)	−0.655 (−1.531)	−0.113 (−0.476)	0.90 (0.32)	3.18	14.10
India	−4.833 (−0.497)	0.744 (3.862)	0.733 (0.707)	0.090 (0.513)	−0.439 (−1.331)	0.104 (0.841)	0.94 (0.25)	2.74	23.10
Iraq	2.240 (1.340)	0.441 (1.459)	−0.153 (−1.036)	−0.086 (−0.496)	0.435 (1.333)	0.056 (0.727)	0.54 (0.25)	2.13	1.90
Pakistan	−3.306 (−0.296)	0.625 (1.199)	0.602 (0.498)	0.205 (1.252)	−0.448 (−2.476)	0.241 (1.169)	0.72 (0.33)	1.84	4.11
Sudan	11.727 (3.080)	−0.182 (−0.495)	−1.450 (−2.601)	0.062 (0.231)	−0.206 (−0.537)	−0.550 (−2.179)	0.83 (0.29)	1.75	7.65
U.A.R.	−1.648 (−0.620)	1.065 (9.019)	0.372 (1.027)	−0.050 (−0.796)	−0.137 (−0.432)	−0.157 (−1.909)	0.98 (0.14)	2.47	63.49
Venezuela	3.672 (1.279)	0.276 (0.820)	−0.031 (−0.071)	−0.101 (−1.150)	−0.030 (−0.148)	0.134 (0.650)	0.35 (0.20)	1.98	0.88

* Standard error of estimate.

APPENDIX TABLE X

CLASSIFICATION OF COUNTRIES INTO FITS OF MODEL

A. Countries That Fit the Model

Linear Equation (5)	Linear Equation (6)	Log-linear Equation (5)	Log-linear Equation (6)
Ceylon	Ceylon	Ceylon	Ceylon
Ghana	Ghana	Ghana	Ghana
India	India	India	India
Sudan	Sudan	Sudan	Sudan
United Arab Republic	U.A.R.	U.A.R.	U.A.R.
Venezuela	Venezuela	Venezuela	—
	Pakistan	—	Pakistan

B. Countries That Do Not Fit the Model

Linear Equation (5)	Linear Equation (6)	Log-linear Equation (5)	Log-linear Equation (6)
Argentina	Argentina	Argentina	Argentina
Brazil	Brazil	Brazil	—
Costa Rica	Costa Rica	Costa Rica	Costa Rica
Iraq	—	Iraq	Iraq
Pakistan	—	Pakistan	—