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Economic Determinants of Fund Financial Arrangements

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Abstract

This paper analyses empirically the economic factors that lead to approval of Fund financial arrangements. We account for both the economic variables that induce a country to seek an arrangement with the Fund ("demand-side" factors) and the macroeconomic policy commitments that the Fund considers when deciding whether to approve it ("supply-side" factors). Using a pooled sample of annual observations for 91 developing countries over 1973-1991, we obtain maximum likelihood estimates of bivariate and univariate probit equations to determine the probability of approval of a financial arrangement for a given country in a given year. A number of our chosen demand-side and supply-side variables are statistically significant determinants of the approval of a Fund arrangement, and the overall explanatory power of the equations is high.

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<u>Contents</u>	<u>Page</u>
Summary	iii
I. Introduction	1
II. Empirical Studies of Fund Arrangements	2
III. General Empirical Methodology	6
1. Formal framework for the probit analysis	6
2. Definition of variables	10
a. The endogenous variable	11
b. The timing of events in the empirical model	13
c. Demand for a Fund arrangement	14
d. The Fund's "supply" of an arrangement	17
e. Other variables	20
IV. Estimation Results	21
V. Concluding Remarks	30
Figures:	
1. Timing of events	14a
2. Histogram of predicted probabilities	30a
Text tables:	
1. Summary of Studies Analyzing the Demand for Fund Arrangements	3
2. Variable Definitions	12
3. Bivariate Probit Model (Maximum Likelihood Estimates)	23
4. Univariate Probit Model (Maximum Likelihood Estimates)	25
5. Approval of Arrangements: Actual and Bivariate Probit Predicted Frequencies of Outcomes in Country-Years	27
6. Approval of Arrangements: Actual and Univariate Probit Predicted Frequencies of Outcomes in Country Years	27
7. Fund Arrangements Approved, 1973-1991	36
Appendix	32
References	37

### Summary

This paper analyzes empirically the economic factors associated with the approval of a Fund financial arrangement with a member country. It specifies two alternative probit models that determine the probability that a financial arrangement will be approved for a given country in a given year. The analysis distinguishes between the observable factors likely to induce a country to seek financial assistance from the Fund and the government policy actions most closely associated with the Fund's decision whether to approve an arrangement. The estimates, based on the most comprehensive data set compiled to date for this purpose (a pooled sample of annual observations on major economic variables for 91 developing countries over 1973-1991), indicate a reasonably well-identified set of economic factors that are quantitatively important as determinants of the likelihood that a Fund financial arrangement will be approved for a country in any given year.

As regards the economic variables that induce a country to seek a Fund arrangement, the estimates corroborate earlier work suggesting that a low level of international reserve holdings or low per capita GDP are likely to be important determinants of the country's decision. In addition, however, the results provide a measure of the quantitative importance of other factors that have received less attention in earlier studies as determinants of a country's interest in seeking an arrangement. These include a high ratio of external debt service to export earnings, overvaluation of the real exchange rate, weak growth of real per capita GDP, a low rate of domestic investment, and experience in implementing an adjustment program under a previous Fund arrangement. The paper finds that policy measures to enhance fiscal revenues, to reduce government expenditures, to tighten domestic credit, and to adjust the exchange rate are significant in increasing the probability of Fund approval of an arrangement. The results appear to be empirically robust, since estimated equations that incorporate the factors outlined above are able to predict correctly a large proportion (over 80 percent) of the events of approval or non-approval of a Fund financial arrangement for the sample of 1,516 (country-year) observations.

The conclusions of the paper should not be interpreted to suggest that the event of approval of a financial arrangement is mechanically predictable on the basis of observable economic factors alone, since the discussions that lead up to a Fund arrangement with a country are often complex and time-consuming. But the empirical results indicate that approval is at least partly explainable by a limited number of the observable economic factors that the analysis posits as likely determinants of the "demand for" and "supply of" a Fund arrangement. Thus, although judgment and experience will remain essential ingredients in identifying countries that could potentially become candidates for a Fund arrangement, the empirical results suggest that systematic empirical analysis of probit equations along the lines considered here might provide useful supplementary information.



## I. Introduction

What are the economic factors that induce a country to seek financial assistance from the Fund? What are the sorts of government commitments on economic policy that are most closely associated with Fund approval of a financial arrangement? Although these are central aspects of the Fund's financial assistance to member countries, rigorous empirical analysis of them remains limited. Much of the existing empirical literature in this area concentrates on the macroeconomic effects of the macroeconomic adjustment programs that are implemented under Fund arrangements. <sup>1/</sup> Paradoxically, although there is widespread agreement among analysts on the typical constellation of macroeconomic problems that may induce a country to seek Fund assistance, there has been only scant empirical analysis that documents which of these are most closely associated with the approval of an arrangement. The present study is a preliminary attempt to fill this gap. To do so, we adopt an approach that differs from most of the existing literature. In particular, we focus on the factors that lead to the event of approval of a financial arrangement by the Fund for a given member country during a given year, rather than on the effects of the adjustment program that is implemented under an arrangement.

This paper extends past research in three ways. First, we attempt to estimate the quantitative effects of both the factors that lead a country to seek a financial arrangement with the Fund and the determinants of the Fund's decision to approve it. The data we use to obtain these estimates consist of annual observations on major economic variables for 91 Fund member non-oil developing countries over the whole period from 1973 to 1991. We believe that the data set we have assembled, which is based on quantitative information collected for the Fund's semi-annual World Economic Outlook exercises, is the most comprehensive of its type that has been compiled to date. <sup>2/</sup>

Second, our data set is designed to isolate a number of country-specific and time-specific characteristics and relate them to the periods when individual Fund financial arrangements were initiated with member countries. These country- and time-specific variables are defined in ways that reflect the observable economic factors that are likely to be determin-

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<sup>1/</sup> The papers by Khan (1990), Killick, Malik and Manuel (1992) and Killick and Malik (1992) are some of the more recent and comprehensive assessments of Fund programs, while the study by Doroodian (1993) analyzes the effects of economic policies commonly supported by the Fund. Khan (1990) also reviews the methodologies employed in earlier studies of the macroeconomic effects of Fund programs, such as the work of Reichmann and Stillson (1978), Connors (1979), Kelly (1982), Killick (1984), Zulu and Nsouli (1985), Pastor (1987), Donovan (1981, 1982), Gylfason (1987) and Beveridge and Kelly (1982).

<sup>2/</sup> This large data set has been constructed in a way that is intended to minimize the possibility of selection bias and to include as many Fund arrangements as possible. By focusing on developing countries we exclude only a small proportion of Fund members since the number arrangements approved for industrial countries was very limited during this period.

ants of either a country's decision to seek Fund financial assistance at a given time, or the macroeconomic policy actions by national authorities that are most likely to lead to Fund approval of a financial arrangement in support of the country's adjustment program. For simplicity, we refer to these as the determinants of the "demand for" and "supply of" a Fund arrangement, respectively.

Third, in order to draw empirical inferences from this very large data set we estimate both a bivariate probit model with partial observability and a simple univariate probit specification. We derive estimating equations in which the "supply" and "demand" factors simultaneously determine the probability that a Fund financial arrangement will be approved for a given member country in a given year. The initial estimation results of this analysis are encouraging in that they are largely consistent with our basic model of the economic determinants of the approval process for Fund arrangements.

The rest of the paper is organized as follows. Section II summarizes past empirical studies of Fund arrangements and relates our research to previous work in this area. In section III we describe the empirical methodology and discuss the proper measurement and timing of the included variables. Section IV presents the results of our probit estimations using the method of maximum likelihood. Section V summarizes our conclusions.

## II. Empirical Studies of Fund Arrangements

The empirical literature analyzing Fund financial arrangements is limited, and most of it is concerned with estimating the demand for Fund credit. This literature has been inspired by the analysis of Goldstein and Montiel (1986), who discuss some of the methodological pitfalls that arise in evaluating the effects of Fund programs using multi-country data. Goldstein and Montiel postulate that the probability that a country will enter into an arrangement with the Fund during a given period should depend on country-specific characteristics such as the deviation of some actual macroeconomic outcome in the previous period from a targeted level. However, they do not try to estimate this probability. Instead they find empirical evidence that during the period 1974-1981 macroeconomic outcomes for countries implementing adjustment programs supported by Fund arrangements--specifically, outcomes for the balance of payments, external current account, rate of inflation and real GDP--differed significantly from those for countries that did not have Fund arrangements. <sup>1/</sup>

Table 1 summarizes the salient features of studies that analyze the determinants of a country's demand for a Fund arrangement. The table reflects a great deal of variation in the selection of samples, dependent variables, and techniques of econometric modeling. In general, researchers

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<sup>1/</sup> Edwards and Santaella (1993) also find important differences between program and non-program countries using a sample of 48 devaluation episodes in developing countries during the Bretton Woods period.

Table 1. Summary of Studies Analyzing the "demand for" Fund Arrangements

Study	Sample	Dependent Variable	Estimation Method	Most Significant Regressors
Bird and Orme (1981)	31 Developing Countries (1976, 1977)	Drawings on the Fund	OLS	Current account, inflation, income per capita, Eurocurrency credit, imports, international reserves
McDonald (1986)	29 Countries (1972-1984)	Event: use of Fund credit	Logit	Inflation, export growth, international reserves, external debt, net direct investment, depreciation rate
Cornelius (1987)	11 Sub-Saharan Countries (1975-1977, 1981-1983)	Drawings on the Fund	OLS	Debt service, GNP per capita, imports, international reserves, external borrowing
Conway (1991)	73 developing countries (1976-1986)	Months per year under a Fund arrangement	Tobit	Participation in previous programs, rate of growth, terms of trade, foreign interest rates, year dummies for 1978-1982 and 1984.
Joyce (1992)	45 Countries (1980-1984)	Event: participation in a Fund-supported program	Logit	Government expenditure, international reserves, year dummies for 1980 and 1983.
Edwards and Santaella (1993)	48 devaluation episodes in developing countries (1948-1971)	Event: participation in a Fund-supported program	Probit	Relative GDP per capita, net foreign assets, index of political instability

have followed two different approaches: some have endeavored to estimate the demand for Fund credit, while others have used binary-choice models to analyze countries' involvement in Fund arrangements. Among the first group, Bird and Orme (1981) and Cornelius (1987) attempt to estimate the size of the drawings made under Fund arrangements. Based on a cross section of 31 developing countries for 1976, Bird and Orme find--not surprisingly--that the countries that draw more from the Fund are those that have a relatively weak external current account position, a high inflation rate, and/or a relatively low level of per capita income. Cornelius finds similar results for the sub-periods 1975-1977 and 1981-1983 using pooled cross-section time-series data for eleven Sub-Saharan African countries.

Attempts to estimate the demand for Fund credit have not yet uncovered a robust empirical relationship. The problems arise at least partly because most researchers have tended to ignore the fact that since the Fund's operational guidelines on the amount of credit to be extended to a member country are specified as fractions of the member's quota, the variable representing Fund credit needs to be properly scaled in both time-series and cross-section samples. The specific proportion of quota that the Fund approves as the borrowing country's access to financial resources under an arrangement is also limited by guidelines on access established by the Fund. For this reason the amounts of Fund credit extended as a percentage of quota, both annually and cumulatively over several years, tend to cluster below the maximum access limits rather than being simple monotonic functions of measurable variables. This complication suggests that, as in the other strand of the empirical literature, it may be more meaningful to treat a country's decision to seek an arrangement with the Fund as a binary choice leading to the event of approval of a Fund arrangement. 1/

Conway (1991), following the suggestion of Goldstein and Montiel, moves partially in the direction of studying the determinants of the event of approval. Using a censored-variable approach, he investigates the factors that determine the fraction of the year that a country spends under a Fund arrangement. According to his tobit estimates for 73 developing countries during the period 1976-1986, previous participation in a Fund arrangement, real GDP growth, and external factors explain his endogenous variable.

Recent papers by McDonald (1986), Joyce (1992), and Edwards and Santaella (1993) implement the full binary approach to the demand for Fund arrangements. 2/ Using a panel of annual data for 45 developing countries

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1/ This view is consistent with the suggestion made by a number of observers that developing countries seem to exhibit "threshold" behavior when approaching the Fund, in the sense that they will be reluctant to solicit a financial arrangement unless a given threshold of economic difficulties is reached.

2/ Corbo and Rojas (1991) follow closely the methodology suggested by Goldstein and Montiel (1986) to evaluate World Bank-supported adjustment programs.



during 1980-1984, Joyce (1992) performs a series of logit regressions. His results indicate that countries with relatively high ratios of government expenditure to GDP and low ratios of international reserve holdings to imports are more likely to become involved in Fund arrangements. McDonald (1986) analyzes the factors that determine the use of Fund credit by member countries. From a series of logit regressions on quarterly panel data for 29 countries from 1972 through 1984, she finds that the most significant determinants of the use of Fund credit are the rate of inflation, export growth, the ratio of foreign exchange reserves to imports, the ratio of total external debt to GNP, the ratio of net direct investment to GNP, and the rate of depreciation of the country's nominal exchange rate. Edwards and Santaella (1993) estimate the probability that when a country devalues its currency it does so in the context of an IMF program. <sup>1/</sup> Their sample is a group of 48 devaluation episodes in developing countries during the Bretton Woods era, and they include in their regressors both economic and political indicators. They find that the most important determinants of a country's decision to approach the Fund are its GDP per capita relative to other countries and its ratio of net foreign assets to money supply, whereas the extent of the real exchange rate appreciation or external current account deterioration that occurred prior to the exchange rate action does not seem to be as important.

The results of this second strand of the literature are interesting, but suffer from several drawbacks. First, none of the studies in Table 1 recognize explicitly that the event of the Fund's approval of a financial arrangement with a country is the *joint outcome* of both the country's desire to seek an arrangement and the Fund's willingness to approve one on the basis of the economic program the authorities intend to adopt. Their specifications incorporate only the "demand-side" determinants of Fund arrangements and ignore the influence of "supply-side" factors.

Second, with the exception of Conway (1991), most of these studies fail to take into account the influence of a country's previous participation in IMF programs on its current decision to participate. This seems to us to be an important consideration: a country with external adjustment problems is more likely to enter into an arrangement with the Fund if it has had past experience in formulating an adjustment program that was supported by a Fund financial arrangement.

Third, it is interesting to analyze the factors that may determine the initiation of IMF financial arrangements *per se*, as in Joyce (1992), rather than the determinants of the amounts of Fund credit extended, as is the case in McDonald (1986). These are two different events, although admittedly they are closely related. The obvious difference is that the initial drawing of Fund credit upon approval of an arrangement is not always followed by further drawings during the life of the program. Furthermore

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<sup>1/</sup> In a similar study Santaella (1993) uses the European currency stabilizations of the 1920s as a sample and estimates a probit model of the decision to participate in a program involving some degree of external enforcement.

there are uses of credit, such as drawings under the Fund's Compensatory and Contingency Financing Facility (CCFF), that need not occur in the context of high conditionality arrangements.

Finally, using the precise initial date of an arrangement as the assumed starting point for implementation of its main adjustment policies can be misleading because policy measures that are essential to the program are often taken as "prior actions" before the approval of the arrangement by the Fund. For this reason, using a year rather than a quarter as the relevant basic time interval may tend to increase the likelihood of catching the appropriate period relevant to policy actions associated with approval of the arrangement. In this paper we attempt to deal with the shortcomings and difficulties of earlier studies, and to offer a new empirical analysis of the factors that lead to the approval of a Fund arrangement with a member country.

### III. General Empirical Methodology

#### 1. Formal framework for the probit analysis

One of the basic innovations of our analysis is the distinction between the "demand for" and the "supply of" a Fund financial arrangement: in our approach the event of approval of an arrangement is the outcome of a process in which both factors interact. On the demand side, a country must be facing certain economic conditions that will induce national authorities to request a financial arrangement. On the supply side, the Fund will determine whether the actions the country is prepared to implement address its external adjustment problem in a way that justifies Fund financial support.

We assume that the probability that a country will request an arrangement depends on a number of factors. Formally, we denote a country's demand for a Fund arrangement by a dichotomous variable  $I_c$ , where  $I_c$  is equal to unity if the country wants to enter into an arrangement with the Fund in a particular year and zero if it does not. Then the demand-side probability of an arrangement will be given by:

$$\begin{aligned} \text{Prob}(I_c=1) &= F_c(\beta_c' x_c) \\ \text{Prob}(I_c=0) &= 1 - F_c(\beta_c' x_c) \end{aligned} \tag{1}$$

where  $x_c$  is a vector of country-specific characteristics that give rise to the demand for an arrangement. As will become clear in the discussion below,  $x_c$  will generally include external-sector and other macroeconomic objectives--developments in the country's holdings of international reserves, external financing, the current account position, the rate of inflation, the growth of GDP, etc.--in the preceding period. The function  $F_c(.)$  is a generic cumulative distribution function and  $\beta_c$  is a vector of parameters.

We assume that the supply side of the system (that is, the set of determinants of the Fund's willingness to approve an arrangement) has a similar form. The probability that the Fund will be willing to approve a financial arrangement for a given country in a given year is:

$$\begin{aligned}\text{Prob}(I_f=1) &= F_f(\beta_f' \mathbf{x}_f) \\ \text{Prob}(I_f=0) &= 1 - F_f(\beta_f' \mathbf{x}_f)\end{aligned}\tag{2}$$

where now the dichotomous variable  $I_f$  indicates whether a given country meets the Fund's criteria for approval of an arrangement (if unity) or whether it does not (if zero). Hence the vector  $\mathbf{x}_f$  comprises variables that indicate whether the national authorities' intended stance of economic policies during the program period--such as the fiscal balance, the rate of growth of domestic credit, the level of the exchange rate, etc.--meet the Fund's criteria for approving an arrangement. The function  $F_f(\cdot)$  is another generic cumulative distribution function, and  $\beta_f$  is a new set of parameters.

In principle, a Fund arrangement will be put in place only when two conditions are met: (i) the situation in the country is such that it wants an arrangement with the Fund; and (ii) the Fund judges that the policy actions which the country is committed to take are adequate to achieve the objectives of its macroeconomic adjustment and structural reform program, and therefore warrant access to the Fund's financial resources. In practice, for each (country-year) observation in the sample we are only able to observe whether a Fund arrangement is approved or not. Although the event of approval of an arrangement will occur only if *both* the necessary supply-side and demand-side conditions are met, it is still desirable for us to try to disentangle empirically the demand and supply factors that result in the event by estimating separate coefficients for the variables in the  $\mathbf{x}_c$  and  $\mathbf{x}_f$  vectors. Define  $I$  as a new dichotomous variable that indicates the presence or absence of an arrangement for a country in a given year. It is determined according to

$$I = \begin{cases} 1 & \text{if } I_c = 1 \text{ and } I_f = 1 \\ 0 & \text{otherwise} \end{cases}\tag{3}$$

which can be captured more compactly by the following condition

$$I = \min[I_c, I_f].\tag{4}$$

Assuming for the moment that  $I_c$  and  $I_f$  are two independent events, it follows from this specification that the probability of observing the event of approval of an arrangement for a given country in a given period is:

$$\text{Prob}(I=1) = \text{Prob}(I_c=1)\text{Prob}(I_f=1) = F_c(\beta_c' \mathbf{x}_c)F_f(\beta_f' \mathbf{x}_f). \quad (5)$$

It should be noted that this framework is equivalent to the definition of a pair of latent variables  $I_c^*$  and  $I_f^*$  that are governed according to

$$I_c^* = \beta_c' \mathbf{x}_c + u_c ; \quad u_c \sim F_c(.) \quad (6)$$

$$I_f^* = \beta_f' \mathbf{x}_f + u_f ; \quad u_f \sim F_f(.)$$

where  $u_c$  and  $u_f$  are two independent random variables. The decision rules that determine a country's interest in a financial arrangement and the Fund's willingness to approve it are:

$$I_j = \begin{cases} 1 & \text{if } I_j^* > 0 \\ 0 & \text{if } I_j^* \leq 0 \end{cases} \quad j=c, f. \quad (7)$$

In this case the probability of observing approval of an arrangement is given by

$$\text{Prob}(I=1) = \text{Prob}(u_c > -\beta_c' \mathbf{x}_c) \text{Prob}(u_f > -\beta_f' \mathbf{x}_f) = F_c(\beta_c' \mathbf{x}_c)F_f(\beta_f' \mathbf{x}_f) \quad (8)$$

where we have assumed that both cumulative distribution functions are symmetric. Of course, this expression is equivalent to the one derived in equation (5).

If we relax the assumption of independence and allow the random variables  $u_c$  and  $u_f$  to be drawn from a symmetric joint cumulative distribution function  $F(.,.)$ , then we can rewrite the probability of observing a financial arrangement as

$$\text{Prob}(I=1) = \text{Prob}(u_c > -\beta_c' \mathbf{x}_c, u_f > -\beta_f' \mathbf{x}_f) = F(\beta_c' \mathbf{x}_c, \beta_f' \mathbf{x}_f). \quad (9)$$

In order to obtain maximum likelihood estimates of our parameters, we define the likelihood function to be equal to

$$L = \prod_{I=1} F(\beta_c' \mathbf{x}_c, \beta_f' \mathbf{x}_f) \prod_{I=0} [1 - F(\beta_c' \mathbf{x}_c, \beta_f' \mathbf{x}_f)]. \quad (10)$$

We maximize the natural logarithm of  $L$  with respect to  $\beta = (\beta_c, \beta_f)$  and the coefficient of correlation between the two disturbances.

The final assumptions concern the functional form of the joint distribution function  $F(\cdot)$ ; we assume that  $u_c$  and  $u_f$  follow a bivariate normal distribution. Let  $f(\cdot)$  be the density function corresponding to  $F(\cdot)$ . Then using standard notation we have:

$$f(u_c, u_f) = \frac{1}{2\pi\sigma_c\sigma_f\sqrt{1-\rho^2}} \exp \left[ -\frac{\left(\frac{u_c-\mu_c}{\sigma_c}\right)^2 + \left(\frac{u_f-\mu_f}{\sigma_f}\right)^2 - 2\rho\left(\frac{u_c-\mu_c}{\sigma_c}\right)\left(\frac{u_f-\mu_f}{\sigma_f}\right)}{2(1-\rho^2)} \right] \quad (11)$$

The parameters  $\mu_c$ ,  $\sigma_c$ ,  $\mu_f$  and  $\sigma_f$  are the means and standard deviations of the marginal distributions of  $u_c$  and  $u_f$  while  $\rho$  is their correlation. In particular, we assume that  $f(u_c, u_f)$  corresponds to  $\phi_2(u_c, u_f)$ , a bivariate standard normal density function, or in terms of the cumulative distribution function

$$F(u_c, u_f) = \Phi_2[u_c, u_f | \mu_c, \mu_f, \sigma_c^2, \sigma_f^2, \rho] = \Phi_2[u_c, u_f | 0, 0, 1, 1, \rho]. \quad (12)$$

The above specification corresponds to a *bivariate probit model* with joint-decision and partial observability. 1/ First, the normality assumption for the disturbances determines that the problem falls under the category of probit models. Second, the fact that we have assumed that both the country and the Fund take their decisions simultaneously makes this a joint-decision model, as opposed to a sequential model in which one of the parties would make a decision before the other. We think this is a reasonable assumption since during program negotiations the national authorities and the Fund staff follow parallel decision processes and a country's decision to formally request a Fund arrangement is normally simultaneous with the decision to present the arrangement to the Fund's Executive Board. Finally, this is a problem that exhibits partial observability; that is, we are not able to observe the individual variables  $I_c$  and  $I_f$ , but only the final outcome variable  $I$  defined by our equation (4).

As is evident from the above discussion, the bivariate probit with partial observability is a very demanding model. It attempts to extract a substantial amount of information--indeed it tries to disentangle two different components of randomness--from an event that is only incompletely observed. This feature of the model imposes severe limitations on the econometrician, for it creates difficult but surmountable identification problems and greatly limits the efficiency of the estimated parameters. 2/ For these reasons it is also useful to consider an alternative model, one in

1/ On the bivariate probit model with partial observability see Poirier (1980), Maddala (1983) and Meng and Schmidt (1985).

2/ Poirier (1980) shows that the parameters of the bivariate probit with partial observability can never be globally identified. On the efficiency cost of the model, see Meng and Schmidt (1985).

which we restrict the specification to a single source of randomness. In particular, we also consider the following *univariate probit model*:

$$I^* = \beta_c' x_c + \beta_f' x_f + u, \quad u \sim \Phi(0,1) \quad (13)$$

$$I = \begin{cases} 1 & \text{if } I^* > 0 \\ 0 & \text{if } I^* \leq 0 \end{cases} \quad (14)$$

where  $\Phi(0,1)$  is the standard normal distribution. This specification can be thought of as a reduced-form model that includes both demand and supply variables. 1/ Estimation of this alternative model will also serve as a check on the robustness of the results from the bivariate model.

In principle we would like to take advantage of the fact that our sample consists of a panel for a large number of Fund member countries over a long period of time. This would mean specifying the model with subscripts  $i$  and  $t$  to index observations by country and time period. However, the probit model does not lend itself to a fixed-effects specification, and the random-effects treatment is feasible only for a panel with a small dimension time-wise. 2/ In these circumstances we have to assume that the pair  $(u_{c,it}, u_{f,it})$  is independent across countries and across time periods. Of course, this implies that we will not be able to control for unobserved country-specific or time-specific characteristics that might be present in the panel data.

## 2. Definition of variables

In order to deal with both demand and supply factors across countries as well as over time, it is necessary to use relatively simple and readily available empirical specifications for the economic determinants of the demand and supply of a Fund arrangement. In an effort to ensure a measure of consistency in the definitions of these variables, and to make the analysis as closely related as possible to the information that is actually

1/ As a first approximation the univariate model, and in particular the latent variable  $I^*$ , can be thought of as characterizing the outcome of a Nash bargaining game in which the Fund and the country decide whether or not to enter into an arrangement. More formally, let  $U_i$  be the payoff of party  $i$  in the case of a program and  $C_i$  be the payoff in the case of conflict or disagreement. Then it can be shown that there will be a program if  $U_f U_c - U_f C_c - U_c C_f > 0$ , which in turn will be satisfied if suitable individual rationality conditions hold on both parts.

2/ Technically speaking, there are no simple functions of the parameters of interest that are independent of the nuisance parameters introduced by the fixed-effects specification. As a consequence, there will not exist a consistent fixed-effects estimator for probit models. For more details see Hsiao (1986) and Greene (1993).

used by the national authorities and the Fund, we have obtained our data set from the World Economic Outlook (WEO) data bank. This data bank is the source of the data that have been made available in the statistical appendices of the semi-annual WEO publications for more than a decade.

In order to obtain a large homogeneously-defined sample, our choice has been to some degree limited to the common macroeconomic variables that are available for most countries in the WEO data set. As already noted, the basic sample of our study is a panel of 91 developing countries during the period 1973-1991. This sample comprises all the developing countries for which the relevant data are available, except for the major oil exporters. Table 2 introduces the notation of our empirical model and summarizes all the demand-side and supply-side variables in the estimating equation which determines the probability that a Fund arrangement will be approved for a given country in a given period. The Appendix provides detailed definitions of the variables and lists the countries and Fund arrangements that are included in the sample.

a. The endogenous variable

As already noted, the vector of observations on the dependent variable in our probit analysis is a dichotomous (zero-one) index that takes the value unity for a country and year when a Fund arrangement was approved, and zero otherwise. In this preliminary analysis we assign the index a value of unity for a country-year when any one of the following IMF financial arrangements was approved: a stand-by arrangement in the upper credit tranches, an Extended Fund Facility arrangement, a Structural Adjustment Facility arrangement, or an Enhanced Structural Adjustment Facility arrangement. <sup>1/</sup> Of the 1729 (country-year) observations in our basic sample, there are 301 that correspond to Fund approval of one of these four types of arrangements, while the remaining 1428 observations represent country-years when no arrangement was approved.

The purpose of the probit analysis is to estimate the underlying parameters of the models described by equations (6)-(12) and (13)-(14). Using these estimates we compute the probability of approval of a Fund arrangement based on the values taken by the right-hand-side "demand" and

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<sup>1/</sup> Although certain aspects of the adjustment programs in support of these arrangements may differ across countries and time periods, these four types of Fund arrangements also have a number of features in common. For example, since all Fund programs endeavor to restore balance of payments viability by reestablishing balance between domestic demand and supply, virtually all such programs involve an important element of demand restraint. For this reason, we argue that it is valid for the purpose of our estimations to group all four of them together. Furthermore, from an empirical point of view it is important to use a broad definition of Fund arrangements in order to obtain a sufficient number of observations relating to program approvals in our sample.

Table 2. Variable Definitions <sup>1/</sup>

Variable	Definition	Units	Expected Sign
<b>I. <u>Endogenous Variable</u></b>			
A2SESA	Approval of an IMF arrangement	Binary variable	
<b>II. <u>Demand Side</u></b>			
IR	Stock of International Reserves	Months of imports	-
CA	External Current Account	Percent of GDP	-
GCPI	Consumer Price Index	Percentage rate of change	+
EDS	External Debt Service	Percent of exports	+
ED	External Debt	Percent of GDP	+
FNED	Non-Fund Financing Flow	Months of imports	-
GGDPPC	GDP per Capita	Percentage rate of change	-
GTOT	Terms of Trade	Percentage rate of change	-
GXM	Export Markets	Percentage rate of change	-
I	Gross Fixed Capital Formation	Percent of GDP	-
BP	Overall Balance of Payments	Percent of GDP	-
REER	Real Effective Exchange Rate	Index, 1980=100	+/-
GDPPC	GDP per Capita	Current US\$	-
OLDPROG	Previous Fund Arrangement	Binary variable	+
<b>III. <u>Supply Side</u></b>			
DEPN	Nominal Depreciation exceeding 5 percent	Binary variable	+
DREV2	Two year change in Government Revenues	Percent of GDP	+
DEXP2	Two year change in Government Expenditures	Percent of GDP	-
DDCEW2	Two year change in Real Domestic Credit	Percentage rate of change	-
<b>IV. <u>Other Variables</u></b>			
ARREARS	Presence of arrears to the Fund	Binary variable	-
P2SESA	Presence of an IMF arrangement	Binary variable	-
D1979	Period 1979-1991	Binary variable	+

Source: World Economic Outlook Databank.

<sup>1/</sup> Annual Data for 91 non-oil developing countries over the period 1973-1991. The Appendix contains all the calculation details.



"supply" variables listed in Table 2 for each country and year of our sample. The two models have a critical value equal to zero for the latent variables (equations 7 and 13), which corresponds in a standard normal distribution to a probability of 0.5, above which we estimate a unitary value for the prediction of the "event" of approval for a particular country and year.

b. The timing of events in the empirical model

A careful consideration of the timing of events is very important in our analysis of the period leading up to the approval of a financial arrangement by the Fund. Since most right-hand-side variables in our analysis are available only at an annual frequency for the developing countries in our data set, the precise time at which these variables are measured relative to the left-hand variable (defined as time period  $t$  for country  $i$ ) creates some difficult problems of interpretation. The timing of the variables that appear in Table 2 is best explained by reference to Figure 1. As can be seen, we assume that the endogenous variable of our probit estimations (denoted A2SESA) takes a unitary value for country  $i$  in period  $t$  if an arrangement was approved for that country *during the first two quarters of year  $t$  or the last two quarters of the previous year (i.e.  $t-1$ )*. This way of defining the dependent variable reflects the fact that Fund approval of an arrangement is the culmination of an extended process of consultation and negotiation between the Fund and the national authorities. The time it takes from the point when the staff and the authorities reach tentative agreement on the macroeconomic adjustment program that is to be supported by an arrangement to the moment when the Executive Board approves the arrangement is normally several months. This means that programs approved by the end of the second quarter of a calendar year will normally have been designed on the basis of information about the macroeconomic picture for the preceding calendar year, while arrangements approved in the second half of the calendar year will generally be based on information that extends through the first half of the same calendar year. Therefore, given the way we have defined our endogenous variable we choose to use the calendar year  $t-1$  as the relevant time frame to consider the demand-side variables in Table 2 for our estimations of the event of approval or non-approval.

Empirical issues relating to the timing of the explanatory variables representing policy instruments that influence the probability of Fund approval of an arrangement (the "supply-side" variables discussed below), are perhaps even more problematic. This is because the Fund is interested in reaching agreement with the authorities on the basis of their projected future policy stance during the period of the arrangement. This generally means, for example, that a policy variable reflects a more restrained demand management stance in the calendar year *following* the year of approval of the arrangement than it did in the year preceding the year of approval. In order to capture this "forward-looking" feature of the variables that determine the Fund's offer of an arrangement, we again refer to Figure 1 where for each observation in our sample we compare the stance of various policy variables in a given country in year  $t$  with their stance in  $t-2$ . This approach has the advantage (compared with a simple comparison of  $t$  with  $t-1$ )

of better approximating the intended *shift* in the stance of policies under the macroeconomic adjustment program that is to be supported by the financial arrangement. However, as explained below, the problem of using calendar year *t* is that we are testing a joint hypothesis: (i) that these variables are relevant for the approval of an arrangement; and (ii) that policies are actually implemented as envisaged under the adjustment program.

c. Demand for a Fund arrangement

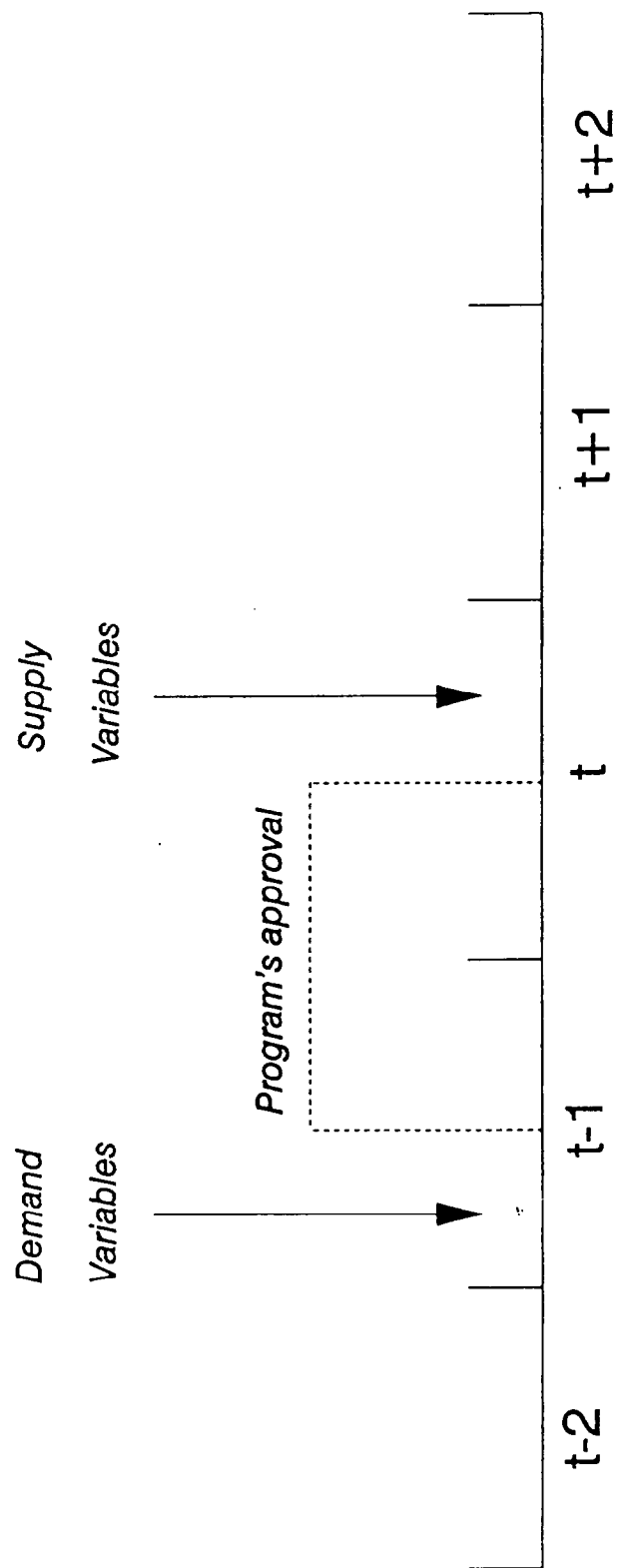
There are a number of important economic variables that are widely viewed as determinants of a country's interest in seeking a financial arrangement with the Fund. The observations on variables that typically enter into consideration on the demand side are the levels of major *policy target variables* in the period immediately prior to the year under consideration. Our choice of demand-side variables is fairly standard. 1/ First, a country that has a clear balance of payments need for financial resources will be more likely to solicit assistance from the Fund, and this need will be reflected in low holdings of international reserves, high external indebtedness, and a deficit in the overall balance of payments and/or its major components. In order to standardize these and other variables across countries and over time, we measure them as percentages of GDP or other relevant scale variables. In particular, our indicators for the overall balance of payments and the current account (BP and CA respectively) are measured as percentages of GDP. 2/ We also expect that, in addition to these flow variables, certain stock indicators are also relevant determinants of a country's interest in an arrangement. For example, countries with relatively low holdings of international reserves will be less able to meet balance of payments difficulties through reserve use and hence will be more likely to request an arrangement. We standardize the international reserves variable (IR) by expressing it in terms of the number of months of merchandise imports.

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1/ A good deal of experimentation could be done to define the demand-side variables. For example, one could consider the behavior of a variable in a given year for each country relative to past values of the same variable. This would provide a measure of the extent to which some target variable improved or deteriorated in the period prior to that for which the country's decision whether to enter into a Fund arrangement is to be taken. Similarly, the level of a given target variable in a country during some period could be compared to the average level of that variable in the same year for all countries that have similar characteristics (such as all primary-commodity exporters or all middle-income countries). In this preliminary analysis, however, we decided not to test these more sophisticated hypotheses and chose instead to use very simple and easily understood empirical definitions.

2/ Not surprisingly, given that we are using a panel data set we do not detect any substantial collinearity problems in the data. The largest correlation coefficient between any two right-hand-side variables in our sample is only 0.65, and most are much lower.

Figure 1. Timing of Events





One possible cause of balance of payments problems is a high level of external indebtedness. To capture its impact on the decision to request a Fund arrangement, we use both the stock of outstanding external debt as a percentage of GDP (ED) and the flow of external debt service as a percentage of exports of goods and services (EDS). The expectation is that high values of either of these variables will increase the probability that a country will request an arrangement.

Given a balance of payments need, not all of a country's external financing requirement would necessarily be covered by the Fund. In most cases the Fund operates either as lender of last resort or as a catalyst for external financing from other sources. Therefore we would expect that the lower is the available (and actual) external financing from non-Fund sources, the higher will be the probability that a country will request assistance from the IMF. To capture this factor, we assume that the higher is the flow of non-Fund external debt expressed in months of merchandise imports (FNED) in the preceding period, the lower is the probability that a country will seek Fund assistance in period  $t$ .

We also expect that countries experiencing a deterioration in their terms of trade and/or relatively slow growth in their export markets will be more likely to solicit an arrangement from the Fund. For the terms of trade, we use the percentage change in this index (GTOT). To capture the influence of developments in each country's export market we first construct an index of foreign demand for its exports using its trading partners' GDP levels weighted by the average share of each trading partner in the country's total exports in the period 1980-1982. We then assume that the rate of change of this export market index (GXM) is negatively associated with a country's demand for a Fund arrangement.

Whether caused by domestic or external factors, a persistent or growing overvaluation of a country's real exchange rate is likely to be an important factor that contributes to a weakening of its external position, increasing the likelihood that it will need to seek assistance from the Fund. Thus we need to include an empirical measure of exchange rate misalignment as a factor influencing a country's demand for a Fund arrangement. Following Fund convention we define a country's real effective exchange rate index (REER) as that country's price level divided by a trade-weighted average of the price levels of its partners converted into its domestic currency at the prevailing exchange rate. Accordingly, a *rise* in REER signals an appreciation of the domestic currency in real terms.

Define a misalignment index  $m$  as the difference between the actual REER and the sustainable or "equilibrium" real effective exchange rate  $REER^*$ :  $m = REER - REER^*$ . A country's external position tends to deteriorate whenever the actual level of REER is above the sustainable level, that is whenever  $m > 0$ . In principle, we would like to include  $m$  as a regressor in our estimating equations. The problem for empirical analysis, however, is that a country's sustainable real exchange rate  $REER^*$  is neither directly observable nor constant over time: it changes in response to a large number of domestic and external factors. Hence we need to find a simple empirical

representation of changes in REER that are likely to be correlated with these unobservable exchange rate misalignments.

Our approach to this problem is as follows. We use the actual level of REER in our estimating equations, which can be written as

$$I^* = \beta_0 \text{REER} + \text{other terms} = \beta_0 (m + \text{REER}^*) + \text{other terms} \quad (15)$$

It is clear from (15) that the use of the actual REER conceals two different and possibly conflicting forces: one is the effect of the misalignment,  $m$ , and the other is the effect of the sustainable or equilibrium real exchange rate. The misalignment term should affect positively the probability that a country will seek an arrangement with the Fund. For example, if the combination of a less than fully flexible nominal exchange rate and excessively expansionary demand management policies causes the domestic price level to rise, then the real value of a country's currency will appreciate. On the assumption that the country's sustainable real exchange rate  $\text{REER}^*$  remains unchanged, an observed rise in the REER results in a misalignment (a real overvaluation of the domestic currency). Other things equal, this will cause the balance of payments to deteriorate, increasing the likelihood that the country will seek financial assistance from the Fund. Therefore, to the extent that  $\text{REER}^*$  remains constant (and is thus incorporated into the intercept of the estimated equation),  $\beta_0$  would then capture only the effect of the isolated misalignment index; hence, we would expect the estimated parameter  $\beta_0 > 0$ .

However, it is also possible that variations in  $\text{REER}^*$  dominate the misalignment effect. It is easy to imagine situations in which the equilibrium real exchange rate changes while the actual real exchange rate remains unchanged. The typical case of a change in  $\text{REER}^*$  is where a shock necessitates a decline in the real value of a country's currency in order to restore its international competitiveness. Examples of such shocks are a sustained deterioration in the terms of trade or an increase in foreign interest rates (Edwards 1988). These are cases where the country's sustainable real exchange rate has declined as a result of depreciating factors. The country may need to seek a financial arrangement with the Fund while it implements a program of demand restraint to adjust to the new more adverse external environment. In this case a country's demand for a Fund arrangement in a given period will be correlated with a decline in its  $\text{REER}^*$  and we would expect the estimated value of  $\beta_0 < 0$ .

In this perspective, including REER as a demand-side variable in the estimating equation for a Fund arrangement provides a simple test of whether--for our broad sample of non-oil developing countries over 1973-1991--real exchange rate movements were associated, on average, with misalignment factors or changes in equilibrium real exchange rates. In other words, the sign of the estimated parameter of REER provides an *indicator of the nature of the shocks* that have given rise to demands for Fund arrangements by the countries included in our sample. Specifically, under our simplified empirical assumptions a significant positive

coefficient on REER indicates that *misalignment factors* predominate in the sample as a whole; conversely, a negative estimated coefficient indicates the predominance of *variations in the sustainable real exchange rate*, REER\*.

Not only external sector variables but also domestic factors may be important considerations leading a country to seek an arrangement with the Fund. For example, countries that are experiencing relatively weak growth in real GDP per capita (GGDPPC) and/or relatively high consumer price inflation (GCPI) in a given period are more likely to seek a Fund arrangement.

It is widely assumed that low income countries are more likely than more developed countries to seek assistance from the Fund to finance their macroeconomic adjustment programs, for two reasons. First, poor countries generally have only limited access to private international capital markets. Second, they may need the technical assistance to develop well-functioning institutions that is often provided in the context of a Fund arrangement. Since the variable that we use to represent non-Fund credit (described above) is unlikely to capture all the effects of the constraint that poorer countries face in credit markets, an additional proxy is needed. We assume that a country's likelihood of requesting a Fund arrangement is negatively correlated with the level of its GDP per capita (GDPPC). Similarly, we expect that countries with a relatively low ratio of total gross investment to GDP, defined as (I), will be more likely to request an arrangement. A low investment ratio may not only indicate limited access to international capital markets, but also limited imports of capital and intermediate goods as well as distorted domestic credit markets, reinforcing the country's low attractiveness for investors.

Finally it is also plausible that, other things equal, countries that have had arrangements with the Fund in the past will be more likely to enter into an arrangement in a subsequent period. The reason is simply that the authorities of a country are familiar with the Fund's operating procedures when they have negotiated a past arrangement and implemented the adjustment program that was supported by it. Hence, other things equal, it is likely to be easier for them to reach agreement on an arrangement on a subsequent occasion. We define a dummy variable (OLDPROG) that equals unity for a specific country in a given year if that country has entered into a Fund arrangement in any previous year.

d. The Fund's "supply" of an arrangement

An essential prerequisite for Fund approval of a financial arrangement is evidence that a given country is committed to undertake a comprehensive policy program to resolve its external adjustment problems. The factors that influence the Fund's willingness to approve a financial arrangement constitute what we here refer to as the "supply-side" factors underlying approval of an arrangement. In particular, the Fund requires an assurance of the authorities' willingness to carry out an agreed macro-economic stabilization and structural reform package. Furthermore, it may often expect a country to undertake some important policy actions prior to the approval of the financial arrangement in order to initiate adjustment

"up front", thereby justifying the use of Fund resources and simultaneously signalling the authorities' commitment to the program.

It is worth emphasizing that our empirical specification of the determinants of the Fund's offer of a financial arrangement focuses only on the core policy variables relating to the demand management aspects of a macroeconomic adjustment program. In recent years, the Fund has placed increasing emphasis on other areas of policy action, such as deregulation, privatization, and social safety nets. This emphasis has made the design of programs supported by Fund financial arrangements much more complex and comprehensive than it was in earlier years, but these elements are not dealt with explicitly in the empirical analysis presented here. Nevertheless, since a balance of payments deficit usually reflects an excess of aggregate domestic demand relative to domestic supply, Fund programs--which are dedicated to restoring a sustainable external position--must emphasize measures of demand restraint. The policy instrument variables included in our empirical model are therefore intended to reflect these essential demand-management elements of a stabilization program. In principle, it would be important to extend the list of variables that influence the Fund's willingness to approve an arrangement to include major structural and supply-side policy commitments. Unfortunately, the problem of finding simple empirical variables to represent commitments on structural policies in a pooled data set is likely to prove difficult.

The variables that will be important in determining the likelihood that the Fund will be prepared to offer an arrangement in support of a country's adjustment program will need to reflect the changes in the stance of economic policy variables that the authorities of a country are willing to implement under the program. Here three problems arise for the empirical analysis: a "timing problem", an "implementation problem", and an "observability problem". The timing problem occurs because, as we have already noted, some policy adjustments are taken as prior actions before a Fund arrangement is actually approved. We attempt to deal with this difficulty by distinguishing in time certain policy adjustments that are taken just prior to the period when an arrangement is approved, and other commitments on policy measures that are to be taken during the life of the arrangement. The implementation problem originates from the fact that the policy commitments which form the basis for the Fund's approval of an arrangement may not actually be fully implemented after approval--for example, the Fund could approve an arrangement on the basis of a policy commitment to a target path for fiscal deficit reduction that the authorities subsequently proved unable to achieve. The observability problem arises from the simple fact that we are only able to observe policy commitments for those countries and years when arrangements were approved and not the commitments that would have been agreed for those countries and years when no such approval took place.

Since balance of payments difficulties typically reflect excess aggregate demand, virtually all stabilization programs invoke a determined shift to a more restrained demand management stance. As regards money and credit policy, it is reasonable to suppose that the Fund is more likely to approve a financial arrangement with a country if it agrees to restrain domestic credit growth. Accordingly, one variable that is likely to



increase the probability of Fund approval of an arrangement is a commitment by the authorities to tighten credit under the program. <sup>1/</sup>

In order to ascertain directly whether such a commitment had been made, one would have to undertake a detailed analysis of the Fund's confidential program documents. However, such information would still not provide a solution to the observability problem; namely, to the hypothetical commitments that the authorities of a country would have been prepared to make in order to reach agreement on a program for countries and years where an arrangement was not approved (over 80 percent of the country-year observations in our population). Therefore we follow a simpler approach, which is to construct a variable that indicates whether the growth of total credit per unit of output is actually lower in the first period *after* the current one than it was in the period *immediately prior* to it (see Fig. 1). If so, then we hypothesize that it is more likely that the Fund would approve an arrangement in the period under consideration. Note that this simplification means we are actually testing the joint hypothesis that: (i) an arrangement is more likely to be approved if it involves the authorities' agreement to pursue a more restrained domestic credit policy, and (ii) the expected values of the policy instrument variables (both in the presence and in the absence of a program) can be accurately approximated by the *actual* policy performance. Accordingly, we assume that the Fund's willingness to approve an arrangement is negatively related to a policy commitment variable (DDCEW2), defined as the *change* in the annual rate of growth of total real domestic credit of the consolidated banking system in year *t*, relative to year *t-2*.

We take a similar approach to specifying commitments on fiscal policy actions in the context of a Fund arrangement, but here there are additional problems. Unlike domestic credit policy, which can usually shift quickly to a more restrained stance, the overall fiscal position can only be changed gradually as policy measures are implemented to increase the flows of fiscal revenue and reduce spending. Furthermore, data on fiscal developments are normally only available on an annual basis, often for the fiscal year rather than the calendar year, and often only with a long lag. These data problems create difficulties for the measurement of the fiscal policy determinants of the Fund's offer of a financial arrangement. To capture the stance of fiscal policy we use the two-year differences of total fiscal revenues (DREV2) and total fiscal expenditures (DEXP2) as percentages of GDP. Note that we separate revenue and expenditure policies, rather than consolidating them into a single fiscal deficit ratio. This is because there is no reason to restrict the coefficients of these two variables to be of the same magnitude and opposite sign, since the Fund might exhibit a revealed preference for fiscal revenue enhancement over expenditure restraint (or vice versa) in deciding whether a given arrangement should be approved.

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<sup>1/</sup> It is very important to stress that these commitments are predetermined at the time of approval, and thus should not be viewed as simultaneously determined with the event of approval.

The final policy instrument variable that we consider here as a determinant of the Fund's "supply" of an arrangement is exchange rate policy. Often a devaluation of the exchange rate plus a tightening of domestic monetary policies is either a prior action of an adjustment program or an element of its early stages. Since the extent of the initial overvaluation depends on many factors, however, we should assume that the incidence of Fund approval relates to the event that the authorities take exchange rate action rather than assuming that the probability that the Fund will offer an arrangement rises monotonically with the size of the initial devaluation. Accordingly, we define a dummy variable (DEPN) that takes the value unity for any year when the nominal effective exchange rate experienced a depreciation that was equal to or greater than an arbitrary threshold value, which we take as five percent. This dummy variable therefore signifies a year when a country "takes exchange rate action", and is assumed to be positively associated with the approval of an arrangement in that year.

As already indicated, one important consideration that we must keep in mind is the problem created by the divergence between *ex-ante* and *ex-post* variables. In principle, the variables that should enter the Fund's offer function for an arrangement refer to the *agreed targets* for the policy variables that we have just described, including the counterfactual targets for cases where no arrangement was approved. These *ex-ante* variables would capture the stabilization effort that was foreseen at the moment of approval of the financial arrangement. However, all of our indicators have been constructed on an *ex-post* basis; to the extent that these actual values differ from the programmed targets some estimation problems may arise.

e. Other variables

In addition to the supply and demand variables discussed above that influence the likelihood of approval of an arrangement there are three others that need to be included in the estimating equations for technical reasons.

First, since our concern is with the event of approval of a financial arrangement with the Fund rather than with predicting all years when a country has a financial arrangement, we also need to dummy out years when a given country already has an arrangement with the Fund. We control for this event with an additional dummy variable (P2SESA).

Second, and potentially more important, the estimating equation must also take account of the fact that under the Fund's Articles of Agreement a country that has persistent arrears to the Fund becomes ineligible to use the Fund's resources--it cannot have an arrangement approved whatever the supply and demand variables may indicate. Since a country can have arrears to the Fund for brief periods without formally being declared ineligible, we reflect the presence of persistent arrears using a dummy variable (ARREARS) that takes the value of unity for any member country in any period when the Fund has made a determination that the country is in arrears, and zero otherwise. Although this variable must clearly be included in the estimating equations in order to avoid bias in the estimated parameters of other

variables, its effect is unlikely to dominate the empirical results. The reason is that, on our definition, ARREARS tends to be a *lagging indicator* of serious problems. By the time a country is declared ineligible (so that the value of ARREARS becomes unity) other observable economic factors already included in the model are likely to have been showing difficulties for some time.

Finally, it is widely recognized that the number of Fund arrangements approved each year has been significantly larger since 1979 than it was in the preceding period. This "clustering" of approvals from 1979 onward is very evident from Table 7 of the Appendix, and relates to the severe external financing problems experienced by a large number of developing countries beginning in that year. Accordingly, we have included a dummy variable (D1979) that takes the value unity for the period 1979-1991, and zero before then.

#### IV. Estimation Results

The analytical framework and choice of variables discussed in the previous sections indicate a number of observable economic factors that may be empirically important determinants of the approval of a Fund arrangement. In the empirical work described here we have included all variables suggested in the preceding section for which we have been able to find a reasonable empirical counterpart in our data set. The results obtained in this way would be suggestive of the most important determinants of Fund arrangements, but at the cost of including some variables that are found to be statistically insignificant. Hence the results reported below should be viewed only as a first step in the empirical analysis of the question we address.

Nevertheless the empirical results are very interesting and in our view lend support to our general approach. We first describe the estimates for the *bivariate probit* model corresponding to equations (6)-(12) and then the estimates for the *univariate probit* specification of equations (13)-(14). <sup>1/</sup> In principle, the bivariate probit analysis has certain advantages over the simpler univariate probit. In particular, while the latter is easier to estimate, the bivariate probit is capable of isolating separately the demand and supply equations, provided one is prepared to bear the cost imposed by the partial observability in the joint determination of the "event" of approval of a financial arrangement. By contrast, the univariate probit specification can only be interpreted as a reduced form, but its advantage is that it has a simpler stochastic specification--and hence a simpler likelihood function--which greatly facilitates estimation of the model. Accordingly, there may be a trade-off here between analytical rigor and empirical tractability. Although the estimated coefficients from

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<sup>1/</sup> The sample in the final specifications varied slightly from the basic sample because of some missing values for certain (country-year) observations.

both estimation procedures are quite similar this point is noteworthy since, as we will see below, the two specifications yield a striking difference with respect to their predictions for approvals of arrangements.

Table 3 presents the estimation results for the bivariate probit procedure assuming that the disturbances are independent. 1/ Overall, the estimates are very good in the sense that most of the economic factors enter the estimated equations with the expected signs, and many are significant at conventional significance levels. 2/ We are able to reject strongly the null hypothesis that all the coefficients except the constants are jointly equal to zero: the likelihood ratio tests, distributed as a  $\chi^2$ , are equal to 469.0 and 285.7 for the demand and supply equations respectively (critical values are equal to 34.3 and 20.3 for 17 and 7 degrees of freedom at the 0.5 percent confidence level). In the *arrangement-demand equation* estimated from the bivariate probit analysis we find that the stock of international reserves, the real effective exchange rate, the external debt service ratio, the growth rate of per capita GDP, the investment ratio, the level of per capita GDP, and the dummies for previous Fund arrangements and the period 1979-1991 are empirically significant with the expected signs (at the 6 percent level or better) as determinants of a member country's decision to seek an arrangement with the Fund. In the *arrangement-supply equation*, the variables that reflect programmed adjustments in government revenues and expenditures as well as the variable indicating recourse to exchange rate action and the dummy D1979, are the most empirically significant variables; their estimated parameters also have the expected signs.

It is important to recall that since probit models are highly non-linear the estimated coefficients that one obtains are not equal to partial effects that would indicate the increase in the probability when one of the regressors is increased by one unit, holding the rest constant. Using equation (8), it is clear that these partial effects are equal to

$$\frac{\partial \Phi_2(\beta_c' x_c, \beta_f' x_f)}{\partial x_j} = \Phi(\beta_c' \bar{x}_c) \phi(\beta_f' \bar{x}_f) \beta_{f,j} + \Phi(\beta_f' \bar{x}_f) \phi(\beta_c' \bar{x}_c) \beta_{c,j} \quad (16)$$

where these marginal effects are evaluated at the means of the regressors. These effects are shown in the last column of Table 3. All these effects are very small for the bivariate probit because most of the variables affect either the supply or the demand equations but not both, therefore limiting the impact on the probability of approval.

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1/ The maximum likelihood estimates of the bivariate model did not converge when we relaxed the assumption of independence. This seems to be a common problem with this model, and was also encountered in Connolly (1983), the only other application of the bivariate probit with partial observability that we are aware of.

2/ The significance level of each estimated parameter (i.e., probability of rejecting in a two-tailed test the null hypothesis of  $\beta_i = 0$  when it is true) is given in the penultimate column of Tables 3 and 4.

Table 3. Bivariate Probit Model (Maximum Likelihood Estimates) 1/

Dependent variable Country-year observations		A2SESA <sub>t</sub> 1516		I. Demand equation		II. Supply equation	
Log Likelihood				-492.312		-583.933	
Restricted (Slopes=0) Log-Likelihood				-726.799		-726.799	
Chi-squared (17 and 7 d.f. respectively)				468.974		285.731	
Significance Level				0.000		0.000	

Variable	Expected Sign	Coefficient	Standard Error	t-ratio	Prob t ≥x	Partial Effects at the means (percentage points)
I. Demand equation:						
Constant		-0.4243	0.286	-1.49	0.14	--
IR <sub>t-1</sub>	-	-0.1285	0.020	-6.47	0.00	-0.0251
CA <sub>t-1</sub>	-	-0.0040	0.009	-0.46	0.64	-0.0008
GCFI <sub>t-1</sub>	+	0.0000	0.000	0.36	0.72	0.0000
EDS <sub>t-1</sub>	+	0.0061	0.002	2.47	0.01	0.0012
ED <sub>t-1</sub>	+	0.0009	0.001	0.85	0.40	0.0002
FNED <sub>t-1</sub>	-	0.0076	0.013	0.58	0.56	0.0015
GGDPPC <sub>t-1</sub>	-	-0.0321	0.009	-3.47	0.00	-0.0063
GTOT <sub>t-1</sub>	-	0.0031	0.003	1.15	0.25	0.0006
GXM <sub>t-1</sub>	-	-0.0221	0.031	-0.71	0.48	-0.0043
I <sub>t-1</sub>	-	-0.0113	0.006	-1.90	0.06	-0.0022
BP <sub>t-1</sub>	-	-0.0047	0.010	-0.45	0.65	-0.0009
GDPPC <sub>t-1</sub>	-	-0.0001	0.000	-3.00	0.00	-0.0000
REER <sub>t-1</sub>	+/-	-0.0080	0.001	-5.34	0.00	-0.0016
OLDPROG <sub>t-1</sub>	+	0.7766	0.120	6.49	0.00	0.1514
P2SESA <sub>t</sub>	-	-5.3684	32.550	-0.17	0.87	-1.0466
ARREARS <sub>t</sub>	-	-5.7015	73.280	-0.78	0.94	-1.1116
D1979 <sub>t</sub>	+	0.8250	0.117	7.06	0.00	0.1609
II. Supply equation:						
Constant		-1.5669	0.095	-16.43	0.00	--
DREV2 <sub>t</sub>	+	0.0346	0.012	2.79	0.01	0.0062
DEXP2 <sub>t</sub>	-	-0.0204	0.008	-2.50	0.01	-0.0036
DEPN <sub>t-1</sub>	+	0.4754	0.088	5.43	0.00	0.0850
P2SESA <sub>t</sub>	-	-4.8678	33.180	-0.15	0.88	-1.0466
ARREARS <sub>t</sub>	-	-4.8614	74.90	-0.07	0.95	-1.1116
DDCEW2 <sub>t</sub>	-	-0.0001	0.000	-0.97	0.33	-0.0000
D1979 <sub>t</sub>	+	0.9123	0.103	8.85	0.00	0.1609

1/ See Table 1 and main text for variable definitions.

The estimation results from the alternative univariate probit are presented in Table 4. Overall, the estimation results of this model confirm a number of the findings of the previous estimation. As in the bivariate probit, in the univariate probit most of the economic factors enter the estimated equation with the expected signs, but in this case many more are significant at conventional significance levels (12 percent or better). The overall fit of the estimation is good, since the null hypothesis that all of the coefficients excluding the constant are jointly equal to zero is firmly rejected (the  $\chi^2$  statistic is 497.5, versus a critical value of 41.4 for 21 degrees of freedom at a 0.5 percent confidence level).

As regards *demand-side* variables, the results appear to be very robust. As expected, the estimates confirm that the most important factors leading to the approval of a Fund financial arrangement are those that relate to the overall balance of payments: the stock of international reserves, the real effective exchange rate, and the external debt service ratio. But other domestic variables are also important: the growth of GDP per capita, the rate of investment, the level of GDP per capita and the dummy for previous Fund arrangements; as in the bivariate model, these variables enter with coefficients that have the expected signs and are significant at conventional levels. The fact that the real effective exchange rate again has a coefficient that is negative and highly significant suggests that, on average, what we have called "equilibrium real exchange rate factors" have been more important than "misalignment factors" for the non-oil developing countries in our sample.

Partial effects appear in the last column of Table 4. They have been computed as

$$\frac{\partial \Phi(\beta' x)}{\partial x_j} = \phi(\beta' \bar{x}) \beta_j \quad (17)$$

In general, these effects are larger in magnitude than those computed for the bivariate specification. For example, according to our calculated marginal effects a reduction of international reserves by an amount equal to one month of imports will, *ceteris paribus*, increase the estimated probability of a Fund arrangement by 0.6 of a percentage point.

The fact that according to Table 4 countries with higher external debt service ratios are more likely to seek a Fund arrangement is hardly surprising. What is indeed revealing and interesting is the fact that the real effective exchange rate has a negative coefficient and that a low rate of investment is an important determinant of the demand for a program. This result is consistent with the view that the ultimate reason for seeking a Fund arrangement is to improve a country's longer-term investment and growth prospects. The estimates also confirm our priors that a lower rate of real GDP growth or a lower level of per capita GDP increase the likelihood that a country will seek a Fund arrangement. Moreover, another result that confirms our priors is the fact that the dummy indicating that a country has previously had an arrangement with the Fund also exhibits substantial explanatory power. In addition to the major external sector variables noted

Table 4. Univariate Probit Model (Maximum Likelihood Estimates) 1/

Dependent variable		A2SESA <sub>t</sub>				
Country-year observations		1516				
Log Likelihood		-478.027				
Restricted (Slopes=0) Log-Likelihood		-726.799				
Chi-squared (21 d.f.)		497.544				
Significance Level		0.000				

Variable	Expected Sign	Coefficient	Standard Error	t-ratio	Prob t ≥x	Partial Effects at the means (percentage points)
Constant		-0.4768	0.290	-1.64	0.10	--
I. Demand side:						
IR <sub>t-1</sub>	-	-0.1324	0.020	-6.48	0.00	-0.5990
CA <sub>t-1</sub>	-	-0.0102	0.009	-1.14	0.26	-0.0461
GCPI <sub>t-1</sub>	+	-0.0001	0.000	-0.68	0.50	-0.0002
EDS <sub>t-1</sub>	+	0.0040	0.003	1.55	0.12	0.0181
ED <sub>t-1</sub>	+	0.0010	0.001	0.93	0.35	0.0047
FNED <sub>t-1</sub>	-	0.0092	0.001	0.69	0.49	0.0414
GGDPFC <sub>t-1</sub>	-	-0.0319	0.009	-3.41	0.00	-0.1445
GTOT <sub>t-1</sub>	-	0.0019	0.003	0.66	0.51	0.0085
GXM <sub>t-1</sub>	-	-0.0415	0.032	-1.30	0.19	-0.1878
I <sub>t-1</sub>	-	-0.0112	0.006	-1.85	0.06	-0.0506
BP <sub>t-1</sub>	-	0.0003	0.010	0.03	0.97	0.0015
GDFPC <sub>t-1</sub>	-	-0.0002	0.000	-3.28	0.00	-0.0007
REER <sub>t-1</sub>	+/-	-0.0073	0.002	-4.82	0.00	-0.0332
OLDPROG <sub>t</sub>	+	0.7456	0.122	6.11	0.00	3.3725
II. Supply side:						
DREV2 <sub>t</sub>	+	0.0432	0.149	2.91	0.00	0.1953
DEXP2 <sub>t</sub>	-	-0.0237	0.009	-2.50	0.01	-0.1071
DEPN <sub>t-1</sub>	+	0.3907	0.102	3.82	0.00	1.7673
DDCEW2 <sub>t</sub>	-	-0.0002	0.000	-1.54	0.12	-0.0009
III. Other variables:						
P2SESA <sub>t</sub>	-	-5.6273	32.580	-0.17	0.86	-25.4539
ARREARS <sub>t</sub>	-	-5.9672	72.930	-0.08	0.93	-26.9915
D1979 <sub>t</sub>	+	0.7948	0.119	6.67	0.00	3.5951

1/ See Table 1 and main text for variable definitions.

above, the coefficients of the external current account, the external debt ratio, and growth of export markets also enter the probit equation with the correct estimated sign although their coefficients are not significantly different from zero at least at the 15 percent level; on the other hand, in our sample the coefficients of the overall balance of payments, the inflation rate, the terms of trade and non-Fund financial resources are insignificant and have the wrong signs.

With respect to the *supply-side variables*, our univariate probit estimates confirm the importance of taking into account the factors that affect the Fund's willingness to approve a financial arrangement in the joint determination of approval of an arrangement. The most important supply-side variable in both estimations turns out to be that which indicates whether there has been a nominal depreciation of more than 5 percent ( $DEPN_{t-1}$ ) in the preceding period. In fact, our point estimates imply that if a country has implemented a nominal depreciation of 5 percent or more in the preceding period the probability that an arrangement will be approved is increased by 1.77 percentage points.

Interestingly, the estimated coefficients of changes in the stance of fiscal policies that affect both government revenues and government expenditures are also statistically significant with the expected signs at a very high significance level (one percent). According to our estimated partial effects an increase in government revenues of one percentage point of GDP, *ceteris paribus*, increases the probability that an arrangement will be approved by 0.19 percent, while a reduction in government expenditures is estimated to increase it by a smaller amount, 0.11 percent. This suggests that in deciding whether to support economic policy packages with financial arrangements the Fund has, in practice, placed slightly more emphasis on commitments to implement measures to raise fiscal revenues than on commitments to constrain public expenditure. This result is understandable since many non-oil developing countries start out with relatively low ratios of fiscal revenue to GDP, and since commitments to alter tax policy and administration may tend to be more 'credible' than promises to cut fiscal spending.

With respect to our indicator of the stance of monetary policy, as expected the estimation results indicate that the change in the rate of growth of real domestic credit has a coefficient that is negative and significant at the 12 percent confidence level in the univariate probit model; that is, a country's willingness to increase its degree of domestic credit restraint raises the probability that an arrangement will be approved. Finally, the dummy variable for the period 1979-1991 enters with a positive and significant sign, reflecting the fact that the incidence of Fund arrangements has been much higher since 1979 than it was in the earlier period.

We now proceed to compare the empirical results of the bivariate probit analysis with those for the univariate. From this perspective the estimates for the bivariate probit exhibit an undesirable feature, as is



Table 5. Approval of Arrangements: Actual and Bivariate Probit  
Predicted Frequencies of Outcomes in country-years (A2SESA)

(Predicted outcome has maximum probability)

Actual	Predicted		Total
	No Approval (A2SESA=0)	Approval (A2SESA=1)	
No Approval (A2SESA=0)	1229	6	1235
Approval (A2SESA=1)	262	19	281
Total	1491	25	1516

Table 6. Approval of Arrangements: Actual and Univariate Probit  
Predicted Frequencies of Outcomes in country-years (A2SESA)

(Predicted outcome has maximum probability)

Actual	Predicted		Total
	No Approval (A2SESA=0)	Approval (A2SESA=1)	
No Approval (A2SESA=0)	1170	65	1235
Approval (A2SESA=1)	158	123	281
Total	1328	188	1516

illustrated in Table 5. Here we cross-tabulate the number of approvals predicted by this model against the actual frequency of Fund approval of an arrangement, as indicated by our endogenous variable (A2SESA). Table 5 shows that of the 1516 country-year observations the estimated bivariate probit equation predicts 1248 correctly, an accuracy ratio of 82.3 per cent. <sup>1/</sup> In fact, it is able to predict 1229 of the events in which there was no program approval. Furthermore, it shows only six "false positives"; that is cases where the estimated bivariate probit predicts the approval of an arrangement for a given country and year when no such arrangement was actually approved. On the other hand, it is also noteworthy that the estimates from the bilateral probit specification fail to predict a considerable number of cases of approval of arrangements. Indeed, these estimates correctly predict only 19 such events in our sample, while they show 262 "false negatives": they predict no approval when in fact an arrangement was put in place.

It is possible that the high ratio of "false negatives" in the bivariate probit estimation reflects economic factors. As noted above, Fund stabilization and reform programs are designed to reduce excess demand and balance of payments pressures through both financial policies to restrain aggregate domestic demand and structural measures to enhance domestic supply. Nevertheless, mainly owing to the difficulty of finding simple quantitative indicators of structural policies that can be applied consistently across countries and time, our empirical analysis has concentrated on changes in the stance of a country's demand management policies that may increase the likelihood that the Fund will approve a financial arrangement. This means that to the extent that countries have been willing to commit to undertake supply-enhancing structural policies in the context of adjustment programs, the emphasis on demand management in our estimated equation might tend to result in a higher proportion of "false negatives" for the in-sample predictions. Thus this result might be taken as a possible indication of the importance of structural supply-side policies in economic reform programs supported by Fund financial arrangements.

However, it is also important to understand the methodological reasons why the estimated bivariate probit specification fails to predict sufficient approvals of arrangements. As explained above, this model will only predict an approval for a given country in a given year when both the demand for and the supply of an arrangement, taken independently, predict an arrangement. This feature of the model is captured in the minimum condition specified in equation (4). It turns out that this "double hurdle" condition imposes a very stringent criterion on the prediction of the joint event of an arrangement approval; in consequence, it is perhaps not surprising that the bivariate probit estimates fail in the prediction of approvals.

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<sup>1/</sup> This accuracy ratio is suggested as one of the possible statistics that are analogous to the traditional  $R^2$ .

These results lead us to the conclusion that for our purposes the estimates of the univariate probit model are superior to those of the bivariate specification. This broad conclusion is illustrated in Table 6, where we tabulate predicted against actual outcomes. Of the 1516 observations, the univariate probit predicts 1293 correctly, an accuracy ratio of 85.3 percent and an improvement over the bivariate probit. The univariate probit is similar to the bivariate in that it correctly predicts most of the country-years when arrangements were not approved. Of the 1235 country-years when the event of an approval did not occur, the univariate probit is able to predict with an accuracy of 94.7 percent, and it only predicts 65 "false positives"; that is, approvals predicted by the model that did not actually occur. However, although it is less successful in predicting approvals than non-approvals, our simple univariate model does a much better job than the bivariate model in predicting these approvals. Specifically, the univariate probit is able to predict correctly 123 out of the 281 such events in our sample, leaving us with 158 "false negatives".

Further details of our univariate probit's prediction of approvals can be observed in Figure 2. Here we plot the histogram for the predicted probabilities of approval of a Fund financial arrangement. As can be inferred from Figure 2, the sample is disproportionate in the sense that it is strongly dominated by (country-year) observations in which no arrangement was approved, and the univariate probit estimates do relatively well in capturing this feature of the data. The ratio of false negatives to true negatives increases with the predicted probability indicating that, as expected, most of the prediction errors occur in the neighborhood of the 0.5 threshold for predicting approval of an arrangement. This ratio is particularly high when the predicted probability is between 0.4 and 0.5, where the sample contains 45 approvals that we are not able to predict. With respect to the cases in which we predict arrangement approvals, it is interesting to see in Figure 2 that the number of false positives drops dramatically for approval probabilities greater than 0.6: we are able to predict accurately 76 approvals, and only in 26 cases do our predictions fail to correspond to actual approvals of Fund financial arrangements.

These results indicate that, relative to the estimates from the bivariate probit model, those of the univariate probit specification are more sensitive in detecting the event of approval of a financial arrangement (i.e., a lower proportion of false negatives). On the other hand, the estimates from the univariate probit seem to be less specific in predicting approvals than the bivariate probit (a higher proportion of false positives). Nevertheless, the univariate probit can still be regarded as a rather specific detection model: in the cases where the levels of the explanatory variables are such that it predicts an approval, it is likely--the estimated odds are roughly 2 to 1--that a financial arrangement was indeed approved. Of course, these results reflect the well known trade-off between sensitivity and specificity that is analogous to the distinction between Type I and Type II errors in statistical inference.

Finally, it is worth noting that the estimation results of our analysis are very robust. This is noteworthy since we have not excluded variables from our basic list in order to obtain better significance levels in the estimated coefficients. Nor have we eliminated any countries or observations that are not well explained by the estimated model. In spite of the absence of such "regression strategies" a close look at the residuals from the estimated equation shows that there is no apparent cross-country or cross-year pattern that may indicate serious problems of autocorrelation or heteroskedasticity. <sup>1/</sup> It is also noteworthy that lagging the arrangement-demand variables by one additional period would not affect our estimates in any important way. This result would be relevant to any operational work that used the estimated arrangement-demand equation as an element in the process of projecting member countries' possible future need for access to Fund financial resources.

#### V. Concluding Remarks

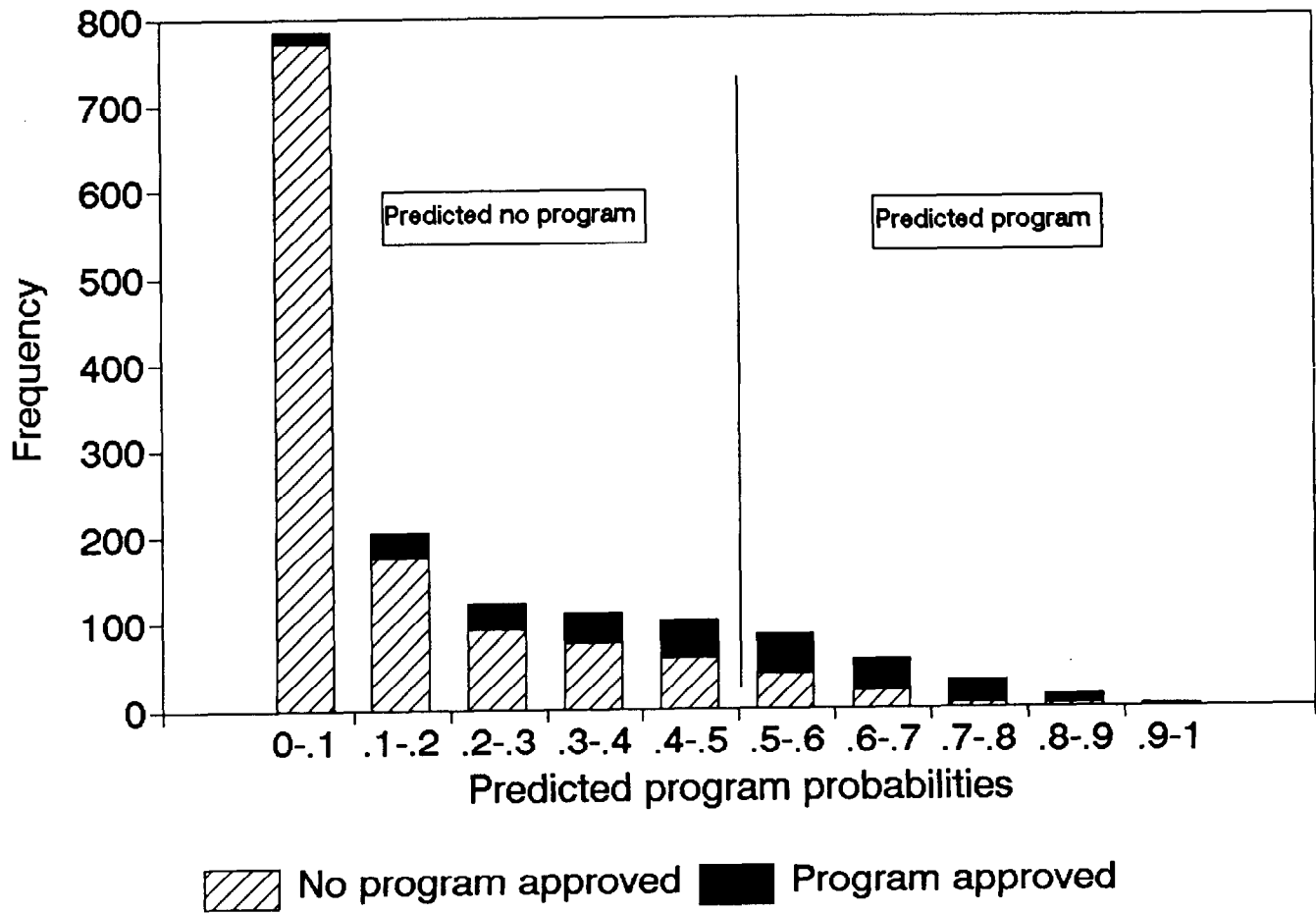
This paper has specified and estimated two probit models in an attempt to identify empirically the economic factors that may induce countries to seek financial assistance from the Fund, as well as the observable determinants of the Fund's decision whether to approve an arrangement. Such an analysis, of course, confronts many difficult empirical problems. These include the fact that the endogenous variable is dichotomous (it measures the event of Fund approval or non-approval of an arrangement for a given country in a given year); the fact that this event is the result of two not necessarily independent decisions resulting from the demand for an arrangement by a country and the Fund's willingness to offer an arrangement; the difficulty of choosing appropriate timing effects using annual data; and many other considerations. Accordingly, the results of the present analysis must be considered preliminary.

Nevertheless, our initial empirical results are encouraging. They confirm the intuition of Goldstein and Montiel (1986) that the event of entering into an arrangement is not purely random: in fact, based on estimates with the very comprehensive sample that we have put together we are able to show that there is a clear set of observable economic factors that are strongly correlated with the event of approval of a financial arrangement. In our view they support our hypothesis that it is important to consider both the "demand-side" and the "supply-side" factors leading to approval of a financial arrangement with the Fund. As regards the economic variables that induce a country to seek an arrangement, our estimates corroborate earlier work suggesting that a low level of international reserve holdings or low per capita GDP are likely to be important determinants of its decision. In addition, however, our results provide a measure of the quantitative importance of other factors which have received less attention in earlier studies as determinants of a country's interest in seeking an arrangement. These include a high ratio of external debt service to export earnings, overvaluation of the real exchange rate, weak growth of real per capita GDP, a low rate of domestic investment, and previous

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<sup>1/</sup> All these results are available upon request.

Figure 2  
Histogram of predicted probabilities





experience in implementing an adjustment program under a Fund arrangement. As regards the factors that the Fund takes into account in deciding whether to approve an arrangement, we find that policy measures to enhance fiscal revenues, to reduce government expenditures, to tighten domestic credit, and to adjust the exchange rate are significant in increasing the probability of approval. Our results appear to be empirically robust, since estimated equations that incorporate the factors outlined above are able to predict correctly a large proportion (over 80 percent) of the events of approval or non-approval of a Fund financial arrangement for our sample of 1,516 (country-year) observations.

We do not mean to suggest that the event of approval of a financial arrangement is mechanically predictable on the basis of observable economic factors alone, since the discussions that lead up to a Fund arrangement with a country are often complex and time-consuming. But our empirical results suggest that this event is at least to a degree explainable and predictable in terms of a limited number of the observable economic factors that our analysis posits as likely determinants of the demand for and supply of a Fund arrangement. Thus although judgement and experience will remain essential ingredients in identifying countries that could potentially become candidates for a Fund arrangement, our empirical results suggest that systematic empirical analysis of probit equations along the lines considered here might provide useful supplementary information.

### Appendix

Data sources: The basic data set used in this study consists of annual observations of data for 91 non-oil developing countries over the period 1973-1991. All the variables were taken from the World Economic Outlook (WEO) data base. The variables to obtain the empirical estimates in this study were constructed in the following way:

#### I. Endogenous variable

$$A2SESA_t = \begin{cases} 1 & \text{if country } i \text{ had an arrangement approved during the} \\ & \text{first or second quarters of year } t \text{ or third or fourth} \\ & \text{quarters of year } t-1 \\ 0 & \text{otherwise} \end{cases}$$

#### II. Determinants of the Demand for an Arrangement

$$BP = \frac{\text{Overall Balance of Payments (US\$)}}{\text{Nominal GDP (US\$)}} * 100$$

$$CA = \frac{\text{Current Account (US\$)}}{\text{Nominal GDP (US\$)}} * 100$$

$$IR = \frac{\text{Stock of International Reserves (US\$)}}{\text{Value of Merchandise Imports (US\$)}} * 12$$

$$GGDP = \left( \left( \frac{\text{Real GDP}_t}{\text{Real GDP}_{t-1}} \right) - 1 \right) * 100$$

$$GCPI = \left( \left( \frac{\text{CPI}_t}{\text{CPI}_{t-1}} \right) - 1 \right) * 100$$

$$EDS = \frac{\text{External Debt Service (US\$)}}{\text{Value of Goods and Services Exports (US\$)}} * 100$$

$$ED = \frac{\text{External Debt (US\$)}}{\text{Nominal GDP (US\$)}} * 100$$

$$FNED = \frac{\text{Flow of Total Debt (US\$)} - \text{Flow of Net Fund Credit (US\$)}}{\text{Value of Merchandise Imports (US\$)}} * 12$$

$$GDPPC = \frac{\text{Nominal GDP (US\$)}}{\text{Population}}$$

$$GGDPPC = \left( \left( \frac{(\text{GGDP}/100) + 1}{(\text{POP}_t/\text{POP}_{t-1})} \right) - 1 \right) * 100$$

$$TOT = \frac{\text{Export Unit Value Index (US\$)}}{\text{Import Unit Value Index (US\$)}} * 100$$



$$GTOT = \left( \left( \frac{TOT_t}{TOT_{t-1}} \right) - 1 \right) * 100$$

$$w_{ij} = \text{country } i\text{'s share in the exports of country } j$$

$$XM_j = \exp \left\{ \sum_{i=1}^N w_{ij} \ln \left( \frac{\text{Real GDP}_{it}}{\text{Real GDP}_i 1980} \right) \right\}$$

$$GXM = \left( \left( \frac{XM_t}{XM_{t-1}} \right) - 1 \right) * 100$$

REER = Real Effective Exchange Rate Index, defined as the real price of a country's domestic currency in terms of its trade partners' currencies.

$$I = \frac{\text{Investment}}{\text{Nominal GDP}} * 100$$

$$OLDPROG_t = \begin{cases} 1 & \text{if } A2SESA_{t-j} = 1 \text{ for any } j \geq 1 \\ 0 & \text{otherwise} \end{cases}$$

### III. Supply-side variables

NEER = Nominal Effective Exchange Rate Index, defined as the price of a country's domestic currency in terms of its trade partners' currencies.

$$GNEER_t = \left( \left( \frac{NEER_t}{NEER_{t-1}} \right) - 1 \right) * 100$$

$$DEPN_t = \begin{cases} 1 & \text{if } GNEER_t \leq -5 \text{ percent} \\ 0 & \text{otherwise} \end{cases}$$

$$GDCW_t = \left( \left( \frac{\text{Domestic Credit}_t}{\text{Domestic Credit}_{t-1}} \right) - 1 \right) * 100$$

$$DDCEW2_t = (GDCW_t - GCPI_t) - (GDCW_{t-2} - GCPI_{t-2})$$

$$REV = \frac{\text{Government Revenue}}{\text{Nominal GDP}} * 100$$

$$EXP = \frac{\text{Government Expenditure}}{\text{Nominal GDP}} * 100$$

$$DREV2_t = REV_t - REV_{t-2}$$

$$DEXP2_t = EXP_t - EXP_{t-2}$$

IV. Other variables

$$P2SESA_t = \begin{cases} 1 & \text{if arrangement was in place for country } i \text{ in period } t \\ 0 & \text{otherwise} \end{cases}$$

$$ARREARS_t = \begin{cases} 1 & \text{if country } i \text{ is in arrears with the Fund in period } t \\ 0 & \text{otherwise} \end{cases}$$

$$D1979_t = \begin{cases} 1 & \text{if year } t \geq 1979 \\ 0 & \text{otherwise} \end{cases}$$

Countries in the basic sample

- |                         |                        |
|-------------------------|------------------------|
| 1 Afghanistan           | 47 Madagascar          |
| 2. Algeria              | 48 Malawi              |
| 3 Argentina             | 49 Malaysia            |
| 4 Bahrain               | 50 Mali                |
| 5 Bangladesh            | 51 Malta               |
| 6 Barbados              | 52 Mauritania          |
| 7 Benin                 | 53 Mauritius           |
| 8 Bolivia               | 54 Mexico              |
| 9 Botswana              | 55 Morocco             |
| 10 Brazil               | 56 Myanmar             |
| 11 Burkina Faso         | 57 Nepal               |
| 12 Burundi              | 58 Nicaragua           |
| 13 Cameroon             | 59 Niger               |
| 14 Central African Rep. | 60 Nigeria             |
| 15 Chad                 | 61 Pakistan            |
| 16 Chile                | 62 Panama              |
| 17 China, People's Rep. | 63 Paraguay            |
| 18 Colombia             | 64 Peru                |
| 19 Congo                | 65 Philippines         |
| 20 Costa Rica           | 66 Romania             |
| 21 Cote d'Ivoire        | 67 Rwanda              |
| 22 Cyprus               | 68 Senegal             |
| 23 Dominican Republic   | 69 Sierra Leone        |
| 24 Ecuador              | 70 Singapore           |
| 25 Egypt                | 71 Somalia             |
| 26 El Salvador          | 72 South Africa        |
| 27 Ethiopia             | 73 Sri Lanka           |
| 28 Fiji                 | 74 Sudan               |
| 29 Gabon                | 75 Swaziland           |
| 30 Gambia, The          | 76 Syrian Arab Rep.    |
| 31 Guatemala            | 77 Tanzania            |
| 32 Guinea               | 78 Thailand            |
| 34 Guyana               | 79 Togo                |
| 35 Haiti                | 80 Trinidad and Tobago |
| 36 Honduras             | 81 Tunisia             |
| 37 India                | 82 Turkey              |
| 38 Indonesia            | 83 Uganda              |
| 39 Israel               | 84 Uruguay             |
| 40 Jamaica              | 85 Venezuela           |
| 41 Jordan               | 86 Western Samoa       |
| 42 Kenya                | 87 Yemen Arab Rep.     |
| 43 Korea                | 88 Yemen, P.D. Rep.    |
| 44 Lebanon              | 89 Yugoslavia          |
| 45 Lesotho              | 90 Zaire               |
| 46 Liberia              | 91 Zambia              |

Table 7. Fund Arrangements Approved, 1973-1991.

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Afghanistan	UCT																		
Algeria																			
Argentina				UCT	UCT						UCT	UCT			UCT		UCT		UCT
Bahrain																			
Bangladesh			UCT				UCT	BFF			UCT		UCT		SAP			BSAP	
Barbados										UCT									
Benin																			
Bolivia	UCT							UCT						UCT, SAP		BSAP	SAP		
Botswana																			
Brazil											BFF					UCT			
Burkina Faso																			SAP
Burundi														UCT, SAP		UCT			BSAP
Cameroon																			UCT
Central African Rep.								UCT	UCT		UCT	UCT	UCT		UCT, SAP				
Chad																			
Chile		UCT	UCT								UCT		BFF		SAP				
China, People's Rep.																			
Colombia																			
Congo							UCT							UCT				UCT	
Costa Rica								UCT	BFF	UCT			UCT	UCT	UCT	UCT	UCT		UCT
Cote d'Ivoire									BFF				UCT	UCT		UCT	UCT		UCT
Cyprus								UCT											
Dominican Republic											BFF		UCT	UCT	UCT	UCT	UCT		UCT
Ecuador					UCT	BFF					UCT		UCT	UCT	UCT	UCT	UCT		UCT
El Salvador										UCT	UCT							UCT	UCT
Ethiopia									UCT										
Guinea																			
Ghana						UCT		BFF						UCT	UCT, SAP		UCT		UCT
Gambia, The										UCT		UCT		UCT, SAP		BSAP			
Ghana							UCT				UCT	UCT		UCT	BFF, SAP	BSAP			
Guatemala																			
Guinea														UCT	UCT, SAP	UCT			BSAP
Guinea						UCT	BFF	BFF			UCT	UCT						UCT, BSAP	
Haiti			UCT	UCT		BFF													
Honduras							BFF												
India																			
Indonesia	UCT								BFF										UCT
Israel			UCT	UCT															
Jamaica	UCT				UCT	BFF	BFF		BFF			UCT	UCT		UCT	UCT		UCT	UCT
Jordan																			
Korea			BFF				UCT	UCT	UCT	UCT	UCT		UCT			UCT, SAP	UCT	BSAP	
Korea			UCT					UCT	UCT	UCT	UCT		UCT						
Lebanon																			
Lesotho																			
Liberia								UCT	UCT	UCT	UCT	UCT				SAP			BSAP
Madagascar								UCT	UCT	UCT	UCT	UCT		UCT					
Malawi						UCT		UCT		UCT	BFF			UCT		UCT, BSAP			
Malaysia																			
Mali										UCT	UCT		UCT			UCT, SAP			
Malta																			
Mauritania								UCT	UCT				UCT	UCT, SAP	UCT		BSAP		
Mauritius							UCT	UCT	UCT				UCT						
Mexico					BFF														
Morocco								BFF	BFF	UCT	UCT		UCT	UCT					
Morocco																			
Myanmar		UCT			UCT	UCT													
Nepal																			
Nicaragua							UCT								SAP				UCT
Niger												UCT	UCT	UCT	UCT, SAP				
Nigeria																			
Pakistan	UCT	UCT			UCT		UCT	BFF	BFF	UCT	UCT		UCT			UCT, SAP	UCT		UCT
Pakistan						UCT	UCT	UCT											
Panama																			
Paraguay																			
Peru					UCT	UCT	UCT	UCT		BFF	UCT	UCT		UCT				BFF	UCT
Philippines	UCT			BFF	UCT		UCT	UCT			UCT	UCT							UCT
Romania			UCT						UCT										UCT
Rwanda																			SAP
Senegal								BFF	UCT	UCT	UCT		UCT	UCT, SAP	UCT	BSAP			
Sierra Leone							UCT		BFF			UCT		UCT, SAP					
Singapore																			
Somalia								UCT	UCT	UCT						UCT, SAP			
South Africa				UCT															
Sri Lanka		UCT			UCT			BFF	BFF		UCT	UCT							BSAP
Sudan	UCT	UCT						BFF			UCT	UCT	UCT			SAP			
Swaziland																			
Syrian Arab Rep.																			
Tanzania			UCT					UCT						UCT	SAP				BSAP
Thailand									UCT	UCT									
Togo							UCT		UCT		UCT	UCT	UCT	UCT		UCT, SAP	BSAP	UCT	UCT
Trinidad and Tobago																			
Tunisia																			
Turkey						UCT	UCT	UCT	UCT	UCT	UCT	UCT							
Uganda								UCT	UCT	UCT	UCT	UCT			SAP		BSAP		
Uruguay																			
Venezuela																			
Western Samoa							UCT				UCT	UCT							
Yemen Arab Rep.																			
Yemen, P.D. Rep.																			
Yugoslavia					UCT			UCT	UCT		UCT	UCT	UCT			UCT		UCT	
Zaire				UCT	UCT		UCT		BFF		UCT	UCT	UCT	UCT	UCT, SAP		UCT		
Zambia						UCT			BFF		UCT	UCT		UCT					

UCT: Stand-by in upper credit tranches BFF: Extended Fund Facility SAP: Structural Adjustment Facility BSAP: Enhanced structural Adjustment Facility

### References

- Beveridge, W.A. and Margaret R. Kelly, "Fiscal Content of Financial Programs Supported by Stand-By Arrangements in the Upper Credit Tranches, 1969-1978", Staff Papers, International Monetary Fund, Vol. 27 (June 1980), pp. 205-49.
- Bird, Graham and Timothy Orme, "An Analysis of Drawings on the International Monetary Fund by Developing Countries", World Development, Vol. 9 (1986), pp. 563-68.
- Connolly, Marie D. "The Impact of Final Offer Arbitration on the Bargaining Process and Wage Outcomes", unpublished Ph.D. dissertation, Michigan State University, 1983.
- Connors, Thomas A., "The Apparent Effects of Recent IMF Stabilization Programs", International Finance Discussion Paper 135, Board of Governors of the Federal Reserve System, April 1979.
- Corbo, Vittorio and Patricio Rojas, "World Bank-Supported Adjustment Programs: Country Performance and Effectiveness", Policy, Research, and External Affairs Working Papers No. 623, The World Bank, 1991.
- Cornelius, Peter, "The Demand for IMF Credits by Sub-Saharan African Countries", Economic Letters, Vol. 23 (1987), pp. 99-102.
- Conway, Patrick, "IMF Lending Programs: Participation and Impact", mimeo, University of North Carolina, 1991.
- Donovan, Donal J., "Real Responses Associated with Exchange Rate Action in Selected Upper Credit Tranche Stabilization Programs", Staff Papers, International Monetary Fund, Vol. 28 (December 1981), pp. 698-727.
- \_\_\_\_\_, "Macroeconomic Performance and Adjustment Under Fund-Supported Programs: The Experience of the Seventies", Staff Papers, International Monetary Fund., Vol. 29 (June 1982), pp. 171-203.
- Doroodian, Khosrow, "Macroeconomic Performance and Adjustment under Policies Commonly Supported by the International Monetary Fund", Economic Development and Cultural Change, Vol. 41 (July 1993), pp. 849-64.
- Edwards, Sebastian, Exchange Rate Misalignment in Developing Countries, The World Bank, Occasional Paper Number 2, Johns Hopkins, 1988.
- \_\_\_\_\_, and Julio A. Santaella, "Devaluation Controversies in the Developing Countries: Lessons from the Bretton Woods Era", in A Retrospective on the Bretton Woods System, ed. by Michael D. Bordo and Barry Eichengreen, University of Chicago Press, 1993.

- Goldstein, Morris and Peter J. Montiel, "Evaluating Fund Stabilization Programs with Multicountry Data: Some Methodological Pitfalls", Staff Papers, International Monetary Fund, Vol. 33 (June 1986), pp. 304-344.
- Greene, William H., Econometric Analysis, Second Edition, Macmillan, 1993.
- Gylfason, Thorvaldur, "Credit Policy and Economic Activity in Developing Countries with IMF Stabilization Programs", Princeton Studies in International Finance, No. 60, Princeton University, Princeton, New Jersey, 1987.
- Hsiao, Cheng, Analysis of Panel Data, Cambridge University Press, 1986.
- Joyce, Joseph P., "The economic characteristics of IMF program countries", Economic Letters, Vol. 38 (1992), pp. 237-42.
- Kelly, Margaret R., "Fiscal Adjustment and Fund-Supported Programs", Staff Papers, International Monetary Fund, Vol. 29 (December 1982), pp. 561-602.
- Khan, Mohsin S., "The Macroeconomic Effects of Fund-Supported Adjustment Programs", Staff Papers, International Monetary Fund, Vol. 37 (June 1990), pp. 195-231.
- Killick, Tony, ed., The Quest for Economic Stabilization: The IMF and the Third World, New York, St. Martin's, 1984.
- \_\_\_\_\_ and Moazzam Malik, "Country Experiences with IMF Programmes in the 1980s", The World Economy, Vol. 15 (September 1992), pp. 599-632.
- \_\_\_\_\_, Moazzam Malik and Marcus Manuel, "What Can We Know About the Effects of IMF Programmes?", The World Economy, Vol. 15 (September 1992), pp. 575-97.
- Maddala, G. S., Limited-Dependent and Qualitative Variables in Econometrics, Cambridge University Press, 1983.
- McDonald, Judith, "Factors Influencing Countries' Decision to Use Credit from the International Monetary Fund", Ph.D. dissertation, Princeton University, 1986.
- Meng, Chun-Lo and Peter Schmidt, "On the Cost of Partial Observability in the Bivariate Probit Model", International Economic Review, Vol. 26 (February 1985), pp. 71-85.
- Pastor, Manuel, "The Effects of IMF Programs in the Third World: Debate and Evidence from Latin America", World Development, Vol. 15 (February 1987), pp. 249-62.
- Poirier, Dale J., "Partial Observability in Bivariate Probit Models", Journal of Econometrics, Vol. 12 (1980), pp. 209-17.

Reichmann, Thomas M. and Richard T. Stillson, "Experience with Programs of Balance of Payments Adjustment: Stand-By Arrangements in the Higher Credit Tranches, 1963-72", Staff Papers, International Monetary Fund, Vol. 25 (June 1978), pp. 293-309.

Santaella, Julio A., "Stabilization Programs and External Enforcement: Experience from the 1920s", IMF Working Paper WP/93/3, International Monetary Fund, 1993. Forthcoming Staff Papers.

Zulu, Justin B. and Saleh M. Nsouli, Adjustment Programs in Africa: The Recent Experience, Occasional Paper 34, International Monetary Fund, 1985.

