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LDC'S FOREIGN BORROWING AND DEFAULT RISK: AN EMPIRICAL INVESTIGATION 1976-1980

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ABSTRACT

This paper investigates to what extent the international financial community has taken into account the risk characteristics of borrowing less developed countries when granting loans. Specifically, this study analyzes the determinants of the spread between the interst rate charged to a particular country and the London Interbank Borrowing Rate (LIBOR). The empirical analysis uses data on 727 public and publicly guarantied Eurodollar loans granted to 19 LDC's between 1976 and 1980. The results obtained show that lenders in Eurocredit markets have tended to take into account (some of) the risk characteristics of borrowers. In particular it was found that the level of the spread will be positively related to the debt/GNP ratio and the debt service ratio. On the other hand, the spread will be negatively related to the international reserves to GNP ratio and the propensity to invest. The results obtained also show that an increase in the foreign debt coupled with an equivalent increase in international reserves will tend to leave the perceived probability of default unaffected. The empirical analysis presented in this paper also indicates that as late as 1980 the international financial community had not perceived any significant increase in the probabilities of defaulting in the countries that eventually run into serious debt problems (i.e., Argentina, Brazil, Mexico).

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1. Introduction

The recent foreign debt crisis faced by some less developed countries (LDC's) — i.e., Mexico, Brazil, Argentina — has generated concern among economists, bankers and politicians. In particular, the ability of the international banks to distinguish between "good" and "bad" risks has been questioned. It has even been suggested that the inability to restrict credit to countries with low "credit worthiness" has resulted in the overextension of some major banks and that, as a consequence, this has increased the probability of a global international financial collapse.[1]

The purpose of this paper is to investigate to what extent the international financial community has taken into account the risk characteristics of borrowing less developed countries when granting loans. Specifically, this study analyzes the determinants of the spread between the interest rate charged to a particular country and the London Interbank Borrowing Rate (LIBOR). If the financial community distinguishes between countries with different probabilities of default, these perceptions will be reflected in the spreads over LIBOR, with riskier countries (i.e., countries with a higher probability of default) being charged a higher risk premium or spread. When the perceived probability of default exceeds a given level, however, that particular country will be completely excluded from the credit market (Eaton and Gerowitz 1980, 1981a,b; Sachs and Cohen 1982, Folkers-Landau 1982.)

The empirical analysis of the determinants of the default risk premium is important for several reasons. First, an understanding of the factors that influence lending behavior, is useful for borrowing countries. With this knowledge LDCs can take positive steps towards managing their economies in a way such that the perceived default risk is kept at a level compatible with what lenders think is prudent. Second, additional information on how the

market assesses default risk will be helpful for determining the probability that the present repayment difficulties faced by some LDC's can be transformed into a major global crisis. Also, this analysis will provide insights on the international banks lending behavior, that will be helpful to assess to what extent they have been (partially) responsible for the present debt crisis. And third, empirical information on the relationship between the level of the foreign debt and its cost is useful for the analysis of optimal borrowing strategies and of the social rate of discount in an open economy.[2]

A number of papers have recently analyzed the theoretical determinants of default country risk.[3] Early studies (i.e., Bardhan, 1967) mainly focused on the relationship between the level of foreign debt and the cost of foreign borrowing, trying to define "optimal" borrowing strategies. More recent work, however, has expanded the analysis in several directions: First, the existence of credit ceilings, above which countries cannot borrow, has been explicitly introduced into the analysis (Eaton and Gersowitz, 1980, 1981a,b, Sachs and Cohen, 1982 and Folkerts-Landau 1982.) Second, variables other than the level of foreign debt have been explicitly considered as affecting the default risk premium. In particular, it has been argued that in a general equilibrium framework the level of international reserves will be related to the level of debt, and thus could affect the level of default risk (Feder and Just, 1979; Eaton and Gersowitz, 1980, 1981a). Also it has been pointed out that the propensity to invest will be negatively related to the risk premiums. The reason for this is that a higher propensity to invest will generally indicate a higher potential for future growth, and thus, a lower probability of default (Sachs and Cohen, 1982). Third it has been argued that the current account will affect the default premium (Sachs, 1981; Sachs and Cohen, 1982).

Recent theoretical analyses have also made a distinction between bond and bank foreign financing, and have explicitly introduced the possibility of rescheduling debt payments (Sachs and Cohen, 1982; Sachs, 1982).[4] Finally, it has been argued that if borrowers and lenders have different perceptions with respect to the probability of default, the analysis of optimal borrowing strategies would be substantially affected (Harberger, 1976a,b, 1980).

The empirical work on the subject has investigated several aspects of the problem, including the probability of a country rescheduling its payments (Frank and Cline, 1971; Sargen, 1977), and the probability that a particular LDC borrower has reached its credit ceiling (Eaton and Gersowitz, 1980, 1981a,b). Generally, those studies that have analyzed lending behavior in international financial markets have found that lenders tend to take into account the riskiness of borrowers in making their lending decisions (Frank and Cline, 1971; Feder and Just, 1977a,b; Feder and Ross, 1982; Sachs, 1981). In particular, it has been found that the interest rate spread, or risk premium, will be higher for countries with a higher foreign debt ratio (Frank and Cline, 1971; Feder and Just, 1977; Sachs, 1981). Moreover, in a recent paper, Feder and Ross (1982) used data from the Institutional Investor creditworthiness ranking to show that lenders risk perceptions are systematically reflected in the spreads charged in Euromarkets. Also, this study shows that the expected losses lenders expect to incur in case of default are quite low -- typically between 4 and 7 percent.

The analysis presented in this paper extends previous work on the subject in several directions. First, while most of the previous work used cross-section data for a particular year or quarter, the present study covers several years (1976-1980). Second, the sample considered in this paper only includes loans denominated in Eurodollars, thus avoiding the problem of

different currency composition of loans, mentioned by McDonald (1982, p. 630). Also this paper only includes public and publically guaranteed loans, thus restricting the analysis to the determinants of country risk, as distinct from financial risk.[5] Finally, the present study has considered a larger set of possible determinants of the probability of default than previous work.

In Section 2 of this paper a simple framework for analyzing the determinants of the (subjective) probability of default is presented. It is argued here that these determinants will basically depend on the nature of the present value of the expected cost of defaulting. From a modelling point of view, different assumptions regarding the specific form of this cost will yield different sets of determinants of this probability. In this section a specific example is presented, assuming that in a two periods world the cost of default can be represented as a fraction of the second period output (Sachs and Cohen, 1982). Section 3 presents results obtained from the empirical analysis of the determinants of the spread between LIBOR and the interest rate charged to different countries. The analysis uses data on 727 public and publically guaranteed Eurodollar loans granted to 19 developing countries between 1976 and 1980. The results obtained show that lenders in Eurocredit markets take into account some of the risk characteristics of borrowers. Even though the results obtained are quite robust they are, in some cases, somewhat surprising, leading us to conclude that even though international banks have taken into account some of the borrower's characteristics, they have tended to overlook others. In that sense, the results presented in this paper provide some basis to presume that the present crisis is <u>partially</u> a result of banks' lending practices. However, these results do suggest that by and large the main causes of the present foreign debt crisis have been the unexpected

external shocks of the late 1970s and early 1980s (i.e., the oil price shock of 1979-1980, the world recession of 1980 and the high interest rates that prevailed during this period). This section also presents estimates of the perceived probabilities of default implicit in the econometric estimates. Finally, in this section I present an analysis of the residuals obtained from the regression analysis. Section 4 contains some concluding remarks.

2. The Determinants of the Probability of Default

The principal distinction between a sovereign and a private borrower is that the former can repudiate its debt without (totally) losing control of the assets financed by it (see Buiter, 1980; Eaton and Gersowitz, 1980). Generally, however, the repudiation of the foreign debt will result in some costs to the borrower. These costs can take several forms, including the country's complete exclusion from future borrowing in the international capital market.

The decision to repudiate the debt will depend both on the level of the debt and the cost of repudiating it. Broadly speaking, a country will repudiate its debt if its value exceeds the present value of the (expected) cost of repudiating it. Assuming that this cost (C) is a continuous non-negative random variable, and denoting the value of the debt as D, the probability of default can be written as:

$$p = \text{prob}\{C < D\} \tag{1}$$

By a well known theorem it is possible to write (Mood, Graybill and Boes 1974, p. 71):

$$1 - p = \text{Prob}\{C \geq D\} \leq \frac{E(C)}{D} \tag{2}$$

where $E(C)$ is the expected value of C. Then, considering (2) with an equality sign, the probability of default can be written as:

$$P = 1 - \frac{E(C)}{D} \tag{3}$$

This expression has the following desirable properties: $\partial P/\partial D > 0$; $\partial P/\partial E(C) < 0$; and $\lim_{D \to \infty} p = 1$. Also, recognizing the p has to be bounded by 0 and 1 (i.e., $0 \leq p \leq 1$), we find that, $\lim_{E(C) \to \infty} P = 0$.

Equation (3) is a very general expression that simply states that the determinants of the probability of default will depend on the initial value of the debt and on the nature of the cost of repudiating it. From a modelling perspective, different sets of determinants of this probability can be derived depending on the nature of the expected cost chosen. In that sense then, it is not surprising that Sachs and Cohen (1982) find that the probability of default will be a decreasing function of the propensity to invest.[6] The reason for this is that they assume that the cost of default is a function of future output which, on its turn, will depend on the present propensity to invest.

In order to further illustrate this point, assume that the expected cost of repudiating the debt can be expressed as a proportion α of the present value of output. Furthermore, in order to simplify the exposition assume that the case of a two period world where output in period 2 (q_2) can be written as:

$$q_2 = q_1 + a_1 I_1 + a_2 n + X_2 \tag{4}$$

where q_1 is output in period 1; I_1 is net investment in period 1; n is

the rate of growth of the labor force; a_1 and a_2 are constant parameters; and X_2 is a random shock with mean μ and variance σ^2.[7] Then, the present value of the expected cost of repudiating the debt is (where r is the interest rate on the debt):[8]

$$E(C) = \frac{\alpha E(q_2)}{1+r} = \frac{1}{1+r}\{\alpha q_1 + \alpha a_1 I_1 + \alpha a_2 n + \alpha\mu\} \qquad (5)$$

and the probability of default p can be written as:

$$p = \{1 - \alpha[1 + a_1 f_1 + a_2 n/q_1 + \mu]\}\ [(1+r)d_1]^{-1} \qquad (6)$$

where f_1 is the average propensity to invest in period 1 ($f_1 = I_1/q_1$) and d_1 is the debt-output ratio ($d_1 = D_1/q_1$).

According to this expression then, if the cost of repudiating the debt is a fraction of future output, the probability of default will depend positively on the debt-output ratio d_1, and negatively on the propensity to invest (f_1) and the rate growth of population (n).

It can be further assumed that the cost of repudiating the debt will not be a constant function of future output, but that α will depend on some economic variables. In particular, it may be argued that α will depend positively on the level of internation reserves holdings. There are several ways to rationalize this assumption. On the one hand, an important proportion of international reserves are held in the form of financial instruments maintained in foreign banks which can easily be secured by the lender in case of default. Secondly, it may be assumed that the international financial community will impose harsher penalties on countries who, in spite of holding highly liquid reserves, decide to default on their debt. Then, if we include

these considerations and denote the ratio of reserves to output by R, it is possible to postulate that the probability of default can be written as:

$$p = p(\underset{(+)}{d}, \underset{(-)}{f}, \underset{(-)}{R}, \ldots; \beta) \tag{7}$$

where the signs in parentheses refer to the signs of the respective partial derivatives, and where β captures other possible determinants of p not explicitly considered by the previous analysis. In Section 3 below data on over 700 Eurodollar loans granted between 1976 and 1980 to LDC's are used to investigate the extent to which some of these variables (i.e., d, f, and R), among others, affect the spread between the LIBOR rate and the interest rate actually charged on these loans.

3. Estimation

Assume that, as postulated by Feder and Just (1977a,b), Eaton and Gersovitz (1980) and Sachs (1981) among others, the spread (s) over LIBOR charged on Eurodollar loans reflects the probability of default (p) of a particular country. Then, observed data on the spread can be used to formally analyze the way in which variables like the debt-output ratio, the propensity to invest, and others affect the level of this perceived probability. However, before empirically analyzing the determinants of the spread two important questions should be addressed: (1) What is the functional form of the probability of default (p); and (2) What is the exact form of the relationship between these two variables (s and p). A related question, that was partially answered in the previous section, has to do with the determinants of p.

Assuming that banks maximize the present value of profits, Feder and Just (1977a) developed a model where the spread (s) can be written in the following form:

$$s = [p/(1-p)]\ A \tag{8}$$

for $A = (\eta/\eta-1)\ \bar{h}\theta^{-1}$; and where η is the elasticity of demand for loans; $\bar{h}$ is the expected loss in case of default; and θ captures the cost of capital for the bank. Equation (8) is highly convenient for the empirical analysis, since by assuming that p has a logistic form it is possible to write the logarithm of the spread as a linear function of the determinants of p (Theil, 1971):

$$\log s = \alpha_o + \sum_{i=1}^{k} \alpha_i X_i + \log A \tag{9}$$

where the X_i's are the determinants of the probability of default (i.e., the debt-output ratio, the reserves-output ratio, the propensity to invest), and where the α's are the respective coefficients.

In this section the results obtained from the estimation of an equation of the type of (9) using data on 727 public and publically guaranteed loans granted to 19 LDC's during 1976-1980 are reported.

3.1 The Data

The analysis reported in this paper uses annual data for 19 LDC's, who received 727 public and publically guaranteed loans during 1976-1980. The spread variable for each country in a particular year was constructed as a weighted average of spreads actually charged for the individual public and

publically guaranteed loans granted to that particular country. The basic data were obtained from various issues of the world Bank's Borrowing in International and Capital Markets. Table 1 contains the data on loan characteristics, including the yearly average spread or "risk premium", for the countries used in this study.[9] The data presented in this table is quite interesting. In particular it may be noted that, within each year, the variation of the spreads across countries is not too high. For example, in 1979 the difference between the highest and lowest premiums are only 1.1 percentage points [1.603 for Ivory Coast and .517 for Greece.]

A number of variables were considered as possible determinants of the level of the spread, including those suggested by the model presented in the preceding section. Specifically, the following variables were included as possibly affecting s in the empirical analysis:

(1) The debt-output ratio. As the model developed in Section 2 indicates -- and has been argued by Frank and Cline (1971), among others — it is expected that this variable will have a positive coefficient in the regression analysis. (See, also, Hanson 1974.) The data on this variable refers to public and publically guaranteed debt and was obtained from the World Bank World Debt Tables;

(2) The ratio of debt service to exports. This indicator measures possible cash-flow problems faced by a particular country. This variable has been previously included by Frank and Cline (1971) and Feder and Just (1977a) in related studies, and it is expected that its coefficient will be positive. Data on this ratio was obtained from the World Debt Tables.

(3) Ratio of international reserves to GNP. This indicator measures the level of international liquidity held by a country and as suggested in

TABLE 1

EUROCURRENCY SYNDICATED LOANS AND AVERAGE PREMIUM 1976-1980

COUNTRY	YEAR	N LOANS	SUM OF LOANS	AVG LOAN	WEIGHTED AVG PREMIUM	WEIGHTED AVG TERM
ALGERI	1976	6	566.00	94.3000	1.62500	5.00000
	1977	10	488.00	48.8000	1.62500	6.14000
	1978	22	1158.30	52.7000	1.37300	8.02000
	1979	8	609.90	76.2000	1.22000	9.70000
	1980	0	N A	N A	N A	N A
ARGENT	1976	3	1038.00	346.000	1.88000	4.0400
	1977	7	602.00	86.000	1.65700	7.2800
	1978	16	1278.00	79.900	1.49000	8.8000
	1979	15	1480.00	98.700	0.75000	11.0300
	1980	13	1496.30	115.100	0.62700	8.1100
BOLIVI	1976	3	155	51.7000	2.02400	5
	1977	2	100	50.0000	1.78100	7
	1978	2	192	96.0000	1.55700	7
	1979	1	47	47.0000	1.37500	8
	1980	0	N A	N A	N A	N A
BRAZIL	1976	21	1376.70	65.600	1.91000	5.3000
	1977	15	1325.00	88.300	2.01500	5.9900
	1978	43	3122.80	72.600	1.57100	9.9800
	1979	37	4366.00	118.000	0.88400	11.6200
	1980	29	3257.80	112.300	1.25200	8.5300
CHILE	1976	0	0	0.000	N A	N A
	1977	5	222	44.400	1.98400	4.9000
	1978	8	960	120.000	1.45200	7.8000
	1979	3	293	97.700	0.86100	11.4300
	1980	5	153	30.600	0.92300	9.0700
COLOMB	1976	2	110.000	55.000	1.63600	6.8200
	1977	1	28.000	28.000	1.50000	7.0000
	1978	2	125.000	62.500	1.03800	10.0000
	1979	7	825.500	117.900	0.82500	10.0000
	1980	9	687.900	76.400	0.75800	9.9530
COSTAR	1976	0	0	0.0000	N A	N A
	1977	3	54	18.0000	1.75000	7.0000
	1978	4	215	53.8000	1.05400	9.6200
	1979	4	252	63.0000	1.12300	10.0000
	1980	2	90	45.0000	1.18000	6.6100
ECUADO	1976	1	90.000	90.000	1.43800	7.00000
	1977	11	378.000	34.400	1.40200	6.66000
	1978	2	100.000	50.000	0.97500	9.00000
	1979	7	826.500	118.100	0.94100	9.99000
	1980	9	694.000	77.100	0.74100	7.71000

Table 1 (continued)

EUROCURRENCY SYNDICATED LOANS AND AVERAGE PREMIUM 1976-1980

COUNTRY	YEAR	N LOANS	SUM OF LOANS	AVG LOAN	WEIGHTED AVG PREMIUM	WEIGHTED AVG TERM
GREECE	1976	2	200.00	100.000	1.51600	6.6300
	1977	3	122.00	40.700	1.42000	8.4800
	1978	4	475.00	118.800	0.72900	9.4900
	1979	4	700.00	175.000	0.51700	10.2100
	1980	10	1004.40	100.400	0.58800	7.8800
INDIA	1976	0	0	0.0000	N A	N A
	1977	1	50	50.0000	1.00000	7.00000
	1978	2	55	27.5000	1.00000	7.10000
	1979	1	50	50.0000	0.56900	4.50000
	1980	3	70	23.3000	0.52500	7.85000
INDONE	1976	6	268.30	44.700	1.84000	5.7300
	1977	1	50.00	50.000	1.75000	7.0000
	1978	7	1190.30	170.000	1.12500	8.1200
	1979	3	805.00	268.300	0.71000	10.0000
	1980	8	604.50	75.600	0.76100	9.9800
IVORYC	1976	5	174.000	34.8000	2.00000	5.7800
	1977	3	60.000	20.0000	2.00000	5.2500
	1978	1	60.000	60.0000	1.75000	7.0000
	1979	2	68.200	34.1000	1.60300	9.6400
	1980	7	556.000	79.4000	1.24600	11.1900
JORDAN	1976	0	0	0.0000	N A	N A
	1977	4	197	49.3000	1.50000	6.00000
	1978	2	50	25.0000	0.94500	9.00000
	1979	3	93	31.0000	1.07900	7.75000
	1980	0	N A	N A	N A	N A
KOREA	1976	4	251.000	62.800	2.10600	5.16000
	1977	4	352.100	88.000	1.59500	7.45000
	1978	4	950.000	237.500	0.94900	9.68000
	1979	5	966.100	193.200	0.63700	9.98000
	1980	3	173.800	57.900	0.56400	9.27000
MALAYS	1976	1	200.000	200.000	1.42900	7.0000
	1977	4	230.000	57.500	1.09200	7.0000
	1978	4	658.400	164.600	0.76000	8.7800
	1979	1	100.000	100.000	0.56300	10.0000
	1980	3	750.000	250.000	0.41800	10.5300
MEXICO	1976	11	1863.70	169.400	1.55600	5.37000
	1977	6	2183.00	363.800	1.67800	6.93000
	1978	19	4461.00	234.800	1.15700	8.16000
	1979	30	6031.00	201.000	0.70400	8.45000
	1980	14	3340.00	238.500	0.44600	6.63000

Table 1 (continued)

EUROCURRENCY SYNDICATED LOANS AND AVERAGE PREMIUM 1976-1980

COUNTRY	YEAR	N LOANS	SUM OF LOANS	AVG LOAN	WEIGHTED AVG PREMIUM	WEIGHTED AVG TERM
MOROCC	1976	3	365	121.700	1.61600	5.0300
	1977	3	650	216.700	1.35300	6.8100
	1978	5	605	121.000	0.98100	8.0900
	1979	2	450	225.000	0.96300	10.0000
	1980	3	450	150.000	1.03600	8.1300
PANAMA	1976	2	80	40.000	1.75000	6.0000
	1977	5	138	27.600	1.84300	6.2800
	1978	3	498	166.000	1.59800	8.8100
	1979	2	155	77.500	0.87800	10.2600
	1980	2	225	112.500	1.25000	8.0000
PHILIP	1976	5	731.60	146.300	1.75000	5.9100
	1977	7	336.70	48.100	1.70700	6.7400
	1978	11	1310.00	119.100	1.04600	9.9200
	1979	5	575.00	115.000	0.77500	10.4400
	1980	7	456.20	65.100	0.77300	8.9700
PORTUG	1976	1	50	50.000	1.87500	5.00000
	1977	3	87	29.000	1.50400	5.59000
	1978	6	608	101.300	1.05100	6.87000
	1979	12	761	63.400	0.88600	8.61000
	1980	11	641	58.200	0.71800	8.04000
SPAIN	1976	10	1325.00	132.500	1.42200	5.10000
	1977	20	1126.70	56.300	1.31200	6.38000
	1978	18	1071.00	59.500	0.90700	8.48000
	1979	27	1988.20	73.600	0.65900	9.87000
	1980	38	2107.70	55.400	0.62600	8.60000
THAILA	1976	1	100.000	100.000	1.62500	5.00000
	1977	3	100.000	33.300	1.15000	7.30000
	1978	4	149.500	37.400	0.90600	8.90000
	1979	3	110.000	36.700	0.57900	8.01000
	1980	6	609.600	101.600	0.79900	8.29000
TUNISI	1976	0	0.000	0.000	N A	N A
	1977	1	125.000	125.000	1.12500	7.00000
	1978	2	170.000	85.000	0.89800	7.88000
	1979	4	131.700	32.900	0.82000	9.63000
	1980	1	11.700	11.700	0.50000	5.00000
URUGUA	1976	1	26.500	26.5000	2.37500	6.0000
	1977	1	60.000	60.0000	1.87500	5.0000
	1978	3	230.000	76.7000	1.29900	9.4100
	1979	2	40.000	20.0000	1.05000	10.0000
	1980	2	85.000	42.5000	0.97400	8.8200

Table 1 (continued)

EUROCURRENCY SYNDICATED LOANS AND AVERAGE PREMIUM 1976-1980

COUNTRY	YEAR	N LOANS	SUM OF LOANS	AVG LOAN	WEIGHTED AVG PREMIUM	WEIGHTED AVG TERM
VENEZU	1976	4	1039.00	259.800	1.14300	6.93000
	1977	6	1629.20	271.500	0.99900	6.92000
	1978	7	1558.10	222.600	0.75200	9.23000
	1979	10	1943.80	194.400	0.54200	6.66000
	1980	9	2417.00	268.500	0.69100	7.05000
YUGOSL	1976	1	60.000	60.000	1.75000	5.00000
	1977	4	74.600	18.700	1.68300	5.77000
	1978	3	84.000	28.000	1.39300	7.62000
	1979	2	239.000	119.500	0.98200	8.59000
	1980	10	949.000	94.900	1.19610	7.16800

Section 2, it is expected that its coefficient will be positive. Some previous work on the subject have also included some kind of international liquidity indicator. See, for example, Frank and Cline (1971). This variable was constructed from data obtained from the International Financial Statistics.

(4) Loan duration. This variable is measured in years, and measures the (weighted) average maturity of loans granted to a particular country. As has been shown by Feder and Ross (1982) its a priori sign in the regression analysis is ambiguous. The weighted average was constructed from data reported in Borrowing in International Capital Markets and is presented in Table 1.

(5) Loan volume. This variable shows the average value of each loan obtained by a particular country in a given year, and was obtained from Borrowing in International Capital Markets. Also, a priori, its sign is ambiguous.

(6) Propensity to invest. This variable, previously considered by Sachs (1981) in his empirical study on the determinants of the spread, will tend to capture the country's perspectives for future growth. As is shown in Section 2, and in Sachs and Cohen (1982), it will be negatively related to the level of the spread. This indicator was obtained from data reported in the World Tables and in World Development Report (various issues).

(7) Ratio of the current account to GNP. It has been argued by Sachs (1981) that this variable will be negatively related to the spread. The data on this variable was obtained from World Tables and various issues of the World Development Report.

(8) Average propensity to import. This indicator was constructed as the ratio of imports to GNP, and measures the degree of openness of a country. To the extent that this ratio captures the degree vulnerability of a country to foreign shocks, it is expected that it will be positively related to the probability of default (Feder and Just, 1977a). This variable was constructed from data obtained from the International Financial Statistics.

(9) Growth of per capita GDP. It has been argued that a higher rate of growth of output will result in a lower probability of default (see Avramovic, et al., 1964; Feder and Just, 1977a). Data on this indicator was obtained from World Tables and the World Development Report.

Other variables were also considered as possible determinants of the probability of default, including GNP per capita (Feder and Just, 1977a), the rate of inflation (McDonald, 1982), the variability of exports (Frank and Cline, 1970), and the ratio of government expenditure to GNP. However, due to space considerations, and since their inclusion did not affect the results in any significant way, the estimates obtained when they were included are not reported here.

3.2 Results

Equation (9) was estimated using pooled cross-section time-series data for 19 countries during five years (1976-1980). For a list of the countries see Table 3. For estimation purposes it was assumed that $\log A_{nt}$ was equal to a constant k plus a random element U_{nt} ($\log A_{nt} = k - u_{nt}$). It was further assumed that this random term U_{nt} was formed of a country-specific random error v_n, with zero mean and variance σ_v^2; a time-specific random element w_t, with zero mean and variance σ_w^2; and an independently

distributed random term ε_{nt}, with zero mean and variance σ^2_{ε}.[10] (See Feder and Just 1977b, for a similar assumption.) Then the equation to be estimated can be written as:

$$\log s_{nt} = \alpha_o + k + \sum_{i=1}^{k} \alpha_i X_{nt} + v_n + w_t + \varepsilon_{nt} \qquad (10)$$

where

$$E(v_n^2) = \sigma_v^2;\ E(w_t^2) = \sigma_w^2;\ E(\varepsilon_{nt}^2) = \sigma_\varepsilon^2$$

and

$$E(v_n w_t) = E(v_n \varepsilon_{nt}) = E(w_t \varepsilon_{nt}) = 0$$

$$E(v_n v_m) = 0 \quad \text{for} \quad n \neq m$$

$$E(w_t w_s) = 0 \quad \text{for} \quad t \neq s$$

$$E(\varepsilon_{nt} \varepsilon_{ns}) = E(\varepsilon_{nt} \varepsilon_{nt}) = E(\varepsilon_{nt} \varepsilon_{ms}) = 0$$

Expression (10) is a typical random-effect error components equation. The results presented in this paper were obtained using the technique suggested by Fuller and Batesse (1974) for estimating this kind of equation. In the estimation $(\alpha_o + k)$ was combined into a constant β_o.

One possible problem with the estimation of (10) is that, to the extent that banks determine the spread and loan duration at the same time, use of Fuller-Batesse's technique would be subject to a simultaneity bias. However, following Feder and Ross (1982), and Beim (1977) it was assumed that the duration of the loan is determined by banks prior to the determination of the spread. This indeed appears to be the case in the Eurocurrency credit markets (see Euromoney, September 1978).

Table 2 contains the results obtained from the estimation of equation (1) using Fuller-Batesse's technique.[11] These results are quite satisfactory,

TABLE 2

Estimation of Equation (10) Using Pooled Cross-Sections of Time Series: Fuller-Batesse Procedure

Independent Variabe	Equation (10.1)	Equation (10.2)	Equation (10.3)	Equation (10.4)
Constant	0.329 (1.422)	0.141 (0.726)	0.305 (1.216)	0.465 (2.043)
Debt/GNP	0.622 (2.512)	0.544 (2.251)	0.634 (2.461)	0.728 (2.905)
International Reserves/GNP	-1.155 (-2.164)	-1.211 (-2.253)	-1.079 (-1.632)	-1.152 (-2.107)
Debt Service/Exports	0.426 (1.688)	0.567 (2.344)	0.440 (1.797)	-
Loan Duration	-0.012 (-0.648)	-0.011 (-0.581)	-0.013 (-1.719)	-0.007 (-0.400)
Loan Value	-0.001 (-1.340)	-0.001 (-1.658)	-0.001 (-1.269)	-
Investment/GNP	-0.681 (-1.991)	-	-0.756 (-1.324)	-1.422 (-2.738)
Current Account/GNP	0.435 (1.966)	-	0.387 (0.970)	-
Growth	-	-	0.007 (0.377)	-
Imports/GNP	-	-	-0.004 (-0.105)	-
$\hat{\sigma}^2_v$	0.022	0.020	0.024	0.027
$\hat{\sigma}^2_w$	0.054	0.058	0.050	0.056
$\hat{\sigma}^2_\varepsilon$	0.019	0.021	0.019	0.020
MSE	0.021	0.023	0.021	0.021

Notes The numbers in parentheses are asymptotic t-statistics. MSE refers to the mean square error of the transformed regression.

both from the point of view of the mean square errors of the regressions, and from the perspective of the signs and level of significance of the coefficients.[12] Broadly speaking, the empirical evidence shows that international lending behavior to LDC's tends to take into account some of the economic characteristics of the specific borrowing countries. As may be seen, in all regressions the debt-output ratio is significantly positive, and smaller than one. This result suggests that a higher level of indebtedness will be associated with a higher probability of default and thus, a higher spread over LIBOR. With respect to the debt-service ratio, its coefficients are also positive, as expected, and significant either at the 5 or 10 percent level.

One of the most interesting findings of this analysis is that the coefficient of the reserves to GNP ratio is consistently negative, as expected, and with the exception of equation (10.3) it is always significant at the 5% level. Also, the estimated values of these coefficients are high, indicating that the behavior of the reserves ratio has played an important role in the determination of the perceived probability of default. The main importance of this result is that, from a policy point of view, countries that want to reduce the probability of being excluded from the international financial market due to an increase in the perceived probability of default, should be particularly careful in managing their international reserves. Also, these results suggest that the analysis of the demand for international reserves should incorporate the level of foreign indebtedness as an additional determinant of the desired level of international liquidity. It is also interesting to note that coefficient of the reserves ratio is quite high in absolute terms, exceeding in all cases the estimated value of the coefficient of the debt to GNP ratio.

The coefficients of loan duration and loan value are negative, but insigificant, as are the coefficients of the imports-output ratio and growth. In all regressions the estimated coefficient of the gross investment/GNP ratio was negative, as expected. Also in all cases, except in equation (10.3), it was significant, indicating that, as the model in Section 2 suggests, a higher propensity to invest reflects higher expected output in the future, and as a consequence a lower perceived probability of default.

The coefficients of the current account ratio is positive in the two regressions where it was included (10.1) and (10.3), being significant in only one of the cases. This is a somewhat puzzling result, since it indicates that a lower deficit (or higher surplus) will result in a higher and perceived probability of default and spread. The problem with this is that, with other things given -- especially the investment ratio -- a higher current account deficit means that the same investment is being financed with a higher proportion of foreign savings, and one would generally expect that in this case (i.e., lower domestic savings ratio) the perceived probability of default would be higher.

It is interesting to note that in all cases the estimated variance of the time-specific element $\hat{\sigma}_w^2$ exceeds the estimated country-specific variance σ_v^2, indicating that during the period under consideration differences across time in the country risk premium were more important than differences across country. This result is capturing the fact that throughout the period under consideration (1976-1980) the level of world liquidity varied significantly. On the whole, however, the low value of the mean square error of the regressions (MSE) show a quite satisfactory fit.

From the results presented in Table 2 it would be interesting to investigate how the perceived probability of default will be affected if a

country increases its foreign debt to finance the accumulation of international reserves.[13] In order to answer this question it is important to realize that in this case, three right hand side variables from our default risk equation (10) will be affected: (1) the debt/GNP ratio will increase, tending to raise the spread; (2) the international reserves/GNP ratio will rise, exercising a downward pressure on the spread, since its estimated coefficient is negative; and (3) the debt service/exports ratio will also go up, generating additional positive pressure on the spread. The final effect of this policy, aimed at financing the accumulation of reserves with new foreign debt, on the spread will depend on the sum of these three effects, and can be written in the following form:

$$d \log s = [\hat{\alpha}_1 + \hat{\alpha}_2 + \frac{\hat{\alpha}_3 (\gamma+i)}{XR}] d\ DR \qquad (11)$$

where $\hat{\alpha}_1$, $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are the estimated regression coefficients of the debt/GNP, reserves/GNP and debt service/exports ratios respectively; γ is the fraction of the debt's principal that has to be amortized every year (i.e., one over the duration of the debt); i is the interest rate actually charged (LIBOR plus the spread); XR is the exports/GNP ratio; and DR is the debt/GNP ratio. In order to illustrate the total impact of this policy, on the spread, consider the case where $\gamma = 0.125$ (i.e., the duration of the loan in 8 years), $i = 0.12$ and $XR = 0.225$.[14] The expression in square brackets in (10) will have a value of -0.069 for the α's obtained from equation (10.1) in Table 2; a value of -0.050 for the α's obtained from equation (10.2); and for the α's obtained in equation (10.3) this expression in square brackets has a value of 0.034.

For all practical purposes, then, the results presented in Table 2 indicate that an increase in the foreign indebtedness ratio by 10%, coupled with an increase of the international reserves ratio by 10% will tend to leave the spread (and the perceived probability of default) unaffected. This could be considered to be somewhat surprising, since international reserves are a short-term highly volatile asset, which can be equickly depleted, while foreign debt is a long term liability. (This case corresponds closely to the recent experiences of Argentina and Chile.)

Summarizing, the evidence presented in this section shows that during the recent past, lending behavior by international banks in Eurocurrency markets has taken into account (some of) the economic characteristics of borrowers. Even though some of the coefficients were sensitive to the specification of the estimated equations, the general results tend to be consistent with what was expected.

3.3 The Perceived Probabilities of Default

The econometric estimates reported in Table 2 can be used to compute the estimated banks' perceived probabilities of default as:

$$p_{nt} = \frac{\exp\left\{\tilde{\alpha}_{on} + \sum_{i=1}^{k} \hat{\alpha}_{in} X_{nti}\right\}}{1 + \exp\left\{\tilde{\alpha}_{on} + \sum_{i=1}^{k} \hat{\alpha}_{in} X_{nti}\right\}} \qquad (12)$$

where $\tilde{\alpha}_o = \hat{\beta}_o - k$ is the imputed value for α_o in equation (9) (for $\hat{\beta}_o$ the estimated value of the constant in the regression analysis).[15] Table 3 presents estimated probabilities of default for each year obtained from equation (10.1) under the assumption that k equals 2.50. Table 4, on the other hand, contains the estimated perceived probabilities of default under the assumption that $k = 1.75$.[16] A number of interesting characteristics of

TABLE 3

Estimated Perceived Probabilities of Default

From Equation (10.1) Assuming $k = 2.5$

(Percent)

	1976	1977	1978	1979	1980
Greece	8.0	8.0	7.7	7.2	7.9
Portugal	8.4	8.3	8.5	8.9	8.6
Spain	7.8	8.1	8.1	7.8	7.9
Yugoslavia	7.6	7.6	7.8	7.0	7.4
Argentina	8.4	8.7	8.8	7.2	6.1
Brazil	8.9	8.8	8.9	9.1	9.6
Colombia	8.7	8.3	7.8	7.5	7.3
Ecuador	7.8	8.0	8.4	8.6	8.6
Mexico	9.9	10.1	10.5	10.5	9.2
Panama	10.4	11.6	11.9	11.3	11.5
Uruguay	10.6	10.2	10.5	8.6	8.5
Venezuela	5.9	5.8	6.3	7.1	7.9
Indonesia	9.6	9.6	9.3	8.4	8.7
Korea	8.9	8.5	7.7	7.7	8.5
Malaysia	7.0	7.4	7.0	7.1	6.3
Phillipines	7.4	7.9	7.7	7.7	7.7
Thailand	7.4	7.4	7.4	7.6	7.8
Ivory Coast	9.9	10.0	9.4	9.9	10.0
Morocco	8.0	8.1	9.4	9.2	10.3

Table 4

Estimated perceived Probabilities of Default From Equation (10.1) Assuming k = 1.75

(percent)

	1976	1977	1978	1979	1980
Greece	15.5	15.5	15.0	14.2	15.3
Portugal	16.3	16.1	16.4	17.1	16.6
Spain	15.2	15.6	15.7	15.2	15.3
Yugoslavia	14.8	14.8	15.2	13.7	14.4
Argentina	16.3	16.8	16.8	14.1	12.0
Brazil	17.1	16.9	17.2	17.4	18.2
Colombia	16.8	16.1	15.1	14.6	14.3
Ecuador	15.3	15.6	16.5	16.6	16.6
Mexico	19.0	19.2	19.8	19.8	17.6
Panama	19.7	21.8	22.3	21.2	21.6
Uruguay	20.1	19.3	19.9	16.6	16.5
Venezuela	11.7	11.4	12.4	14.0	15.4
Indonesia	18.5	18.3	17.8	16.3	16.8
Korea	17.1	16.4	15.0	15.0	16.4
Malaysia	13.4	14.5	13.8	13.9	12.4
Phillipines	14.4	15.4	15.0	15.1	15.1
Thailand	17.9	17.8	17.8	18.3	18.6
Ivory Coast	22.9	23.2	22.0	22.9	23.2
Morocco	19.1	19.4	22.1	21.6	23.7

these probabilities can be observed. First, it can be seen that, within each year, there is a fairly wide variation in the perceived probability across countries. For example, the results in Table 3 show that in 1976, p ranges from a lower value of 5.9% (Venezuela) to 10.6% (Uruguay). Second, for each country, these probabilities of default show some variation through time. For example, for the case of Ecuador the probability increases steadily between 1976 and 1979. On the other hand, for the case of Brazil, one of the countries that eventually ran into serious foreign debt problems, there is an increase in the perceived probability of default of approximately one full percentage point. Surprisingly, however, Argentina's probability declined throughout the period.

The computations presented in Tables 3 and 4 suggest that even as late as 1980 the international financial market had not predicted in any important way the future payment difficulties faced by Argentina, Mexico, Uruguay and Venezuela. At the present time a number of these countries are facing foreign debt crisis that have forced them to renegotiate a rescheduling of their payments. Table 5 presents a picture of the rescheduling negotiations underway as of March of 1983.

One possible explanation for the fact that the implicit probabilities in Tables 3 and 4 don't seem to capture the 1981-1982 payments difficulties faced by some countries, is that these problems were basically triggered by unexpected events. In fact, according to some experts, including the International Monetary Fund, these payments difficulties are (basically) the result of external events that took place in the late 1970s, including the increase in the price of oil in 1979-1980, the world recession that began in 1980 and the huge increase in world interest rates. Even though these external factors indeed have had a role in the present crisis, it is important

TABLE 5

Countries Presently Negotiating Foreign Debt Rescheduling

(Millions US$)

Country	Amount of Debt Being Renegotiated	Terms (in years) of Renegotiation	Grace Period	Spread Over LIBOR	Amount In Arrears
Argentina	8,000/10,000	7	3	2.125	-
Brazil	4,700	8 1/2	2 1/2	2.25/2.5	-
Chile	2,600	8	5	-	
Costa Rica[b]	228	-	-	-	112
Cuba	1,000	10	3	-	-
Ecuador[c]	970	6	1	2.25	-
Madagascar	195	-	-	-	70
Mexico	14,900	8	4	1.875	100
Romania	515	6	4	1.750	-
Yugoslavia	1,400	3 to 5	-	-	-

[a]Also, Poland and Togo are, at the present time renegotiating their debts. However there is no detailed data on these cases.

[b]Agreement reached in December 1982 (in Principle)

[c]Agreement reached in January 1983.

Source: IMF

not to minimize the role of domestic policies. In particular, the fact that in most cases a large proportion of the new indebtedness was used to finance consumption should be pointed out (see Kindleberger, 1977). For example, this was the case of Chile 1979-1981 where the foreign debt almost doubled, with domestic savings falling (see Edwards 1983).

3.4 Residuals Analysis and Other Possible Determinants of Country Risk

The analysis presented in the preceding sections has focused exclusively on the economic determinants of the premium over Libor charged by the financial community to sovereign borrowers. However, it is highly likely that this premium is also affected by the lenders perception of political stability in a particular country (see, for example, Buiter, 1980). In order to investigate this possibility the residuals from the regressions were analyzed, and an average (for 1976-1980) residual for each country was computed.

$$RES_n = \sum_{t=1}^{5} [\log s_{nt} - \Sigma \beta_h^{GLS} X_{nth}]/5 \qquad (13)$$

where s_{nt} is the spread actually charged in period t to country n, and where $\Sigma \beta_h^{GLS} X_{nth}$ is the estimated log of the spread using Fuller-Batesse's GLS procedure. Then, a positive value of RES_n will indicate that, on average, the spread being charged to that particular country exceeds the model's prediction. If the residuals are capturing the effect of omitted variables related to political stability, countries with positive RES should be considered as being politically more risky than the average.

Table 6 contains the estimated average residuals obtained from equation (10.1). These results are quite interesting.[17] In general, however, they don't seem to provide an obvious ordering of countries, according to a priori

TABLE 6

Redisual Analysis From Equations

(10.1)

	Equation (10.1)
Greece	-0.172
Portugal	-0.002
Spain	-0.118
Yugoslavia	0.333
Argentina	0.133
Brazil	0.190
Colombia	0.049
Ecuador	-0.032
Mexico	-0.314
Panama	-0.097
Uruguay	0.094
Venezuela	-0.068
Indonesia	-0.066
Korea	-0.061
Malaysia	-0.160
Phillipines	0.112
Thailand	-0.036
Ivory Coast	0.246
Morocco	-0.030

information on their relative stability. This suggests that other effects are also being captured by residuals.[18]

4. Concluding Remarks

This paper has analyzed the relationship between foreign debt and default country risk. The analysis presented suggests that, the probability of default will depend on the relationship between the cost of defaulting and the value of the debt. Once a particular function for the cost of default has been chosen, the determinants of the country risk can be easily found.

The empirical analysis has used data on 727 public and publically guaranteed loans granted to 19 LDCs during 1976 and 1980. The result obtained suggest that banks lending behavior has tended to consider (some of) the economic characteristics of countries when determining the spread they charge. However, the results also suggest that, at least during this period, banks might have overlooked some aspects of the developing countries' economies. In particular, the finding of a large negative value for the coefficient of the international reserves ratio suggests that banks might have given excessive weight to this value in their lending decisions.

Footnotes

[1]See, for example, Time (January 10, 1983), The Economist, (5-11 March 1983), Martin Feldstein (1983), Folkerts-Landau (1982). The indebtedness situation is particularly critical regarding Latin American debtors. For example, U.S. private banks have "extended credit of more than U.S. $50 billion to Mexico, Brazil and Argentina, an amount that exceeds 80 percent of the banks equity" (Feldstein, 1983, p. 2). The extent of the indebtedness crisis is reflected by the fact that in 1982 twenty countries undertook debt renegotiations, while in the second half of the 1970s an average of only 4 countries per year renegotiated their debts.

[2]See, for example, Harberger (1976, 1980).

[3]See McDonald (1982) for an excellent and exhaustive survey on the subject. See also the analysis in Buiter (1980).

[4]From a historical perspective, it is interesting to notice that in the recent time the number of defaults have been dramatically reduced, with the number of debt rescheduling increasing substantially. For a historical analysis of LDCs debt rescheduling and defaults, see Sachs (1982).

[5]In a previous paper (Edwards, 1981) I used data that included both publicly guaranteed and private loans. Using data for the second quarter of 1980 it was found that the government guarantee resulted, on average, in a reduction of the spread of one quarter of a percentage point.

[6]This is only true in their case "without" renegotiation.

[7]It is useful to think of equation (4) as being derived from a Cobb-Douglas aggregate production function.

[8]In (5) the interest rate on the debt (r) was used to compute the present value of the expected cost of repudiation. More generally, however,

the domestic rate of time preference (ρ) should be used. In (5), then, it is implicitly assumed that $r = \rho$. It should be noted, however, that the main results are not altered if $r \neq \rho$.

[9]Actually, Table 1 contains data for 23 countries. However, the results reported in this paper refer to those 19 countries that have data for all five years (1976-1980). It is important to note that these averages were constructed using data on publicized loans only. To the extent that, on average, the characteristics of non-publicized loans do not differ from that of publicized, the results will not be affected.

[10]In pooled time-series cross-section analysis it is usually assumed that the error term has this form. For detailed discussions see Anderson and Hsiao (1981) and Nerlove (1971). In the present case it is possible to think that the country-specific term v_n will capture some characteristics specific to each country, while the time-specific element (w_t) will capture, among other things, different liquidity situations in the market in every year. Equation (9) was also estimated assuming fixed-effect country-specific and time-specific terms. The results obtained, however, did not alter in a significant way those reported in Table 2.

[11]Also, in the analysis presented in this paper, as in previous work (i.e., Feder and Just 1977a,b; Sachs 1981; and Feder and Ross 1982), the possible role of fees and commissions has not been incorporated.

[12]These results were obtained using contemporaneous values of the spread determinants (as in Feder and Just, 1977b). Sachs (1981), however, used lagged values of the spread determinants. When lagged values of these variables are used in the estimation of (10) some of the results reported in Table 2 (i.e., the levels of significance) are affected.

[13]A recent case where this type of policy was deliberately persued is Chile 1979-1981. During this period the increase in the level of foreign debt was used almost in a one-to-one basis to accumulate international reserves. See, for example, Harberger (1982) and Edwards (1983).

[14]These are reasonable values for these parameters. As may be seen from Table 1, most of the loans considered in this study had a duration of around 8 years. On the other hand the LIBOR rate had the following values during this period: 1976 = 7.12%; 1977 = 7.42%; 1978 = 10.35%; 1979 = 13.15%; 1980 = 17.98%. Finally, the average value of the exports/GNP ratio for these countries was 0.233 in 1976 and 0.248 in 1980.

[15]The reason for the presence of $\tilde{\alpha}_o$ in (12) is that in order to estimate the perceived probability of default we need estimated values for all the α's from equation (9), including α_o. Since our estimations only give us the value of $\hat{\beta}_o = \alpha_o + k$ we need to find plausible values for k, and of α_o, in order to find these probabilities.

[16]Since $k = \log A - u_{nt}$ and $A = [\eta/(\eta-1)]\bar{h}\theta^{-1}$, a reasonable range for k can be obtained under alternative assumptions regarding η, $\bar{h}$ and θ. For example, if $\eta = 1.2$, $\bar{h} = 0.10$ and $\theta = 0.08$, $\log A = 2.01$.

[17]For example, according to these results, Mexico, Malaysia, Spain and Greece appear to be the "more stable" countries, with Yugoslavia, Ivory Coast, Argentina and Brazil the less stable ones.

[18]One possibility is that these residuals are capturing the fact that some of these countries are oil-producers. However, when a dummy for oil-producing countries was included its coefficient was insignificant, and the main results were not affected.

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