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PREDICTING DISCOUNTS OF SECONDARY MARKET SOVEREIGN DEBTS

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I
INTRODUCTION

In the 10 years after the debt crisis began in 1982, many events transpired and among the most significant were the continued rescheduling of developing country debts and the emergence of a secondary market for these loans. More and more, free market "solutions" were being hailed as the means of finally resolving the debt burden of developing countries. From the onset of the debt crisis, financial markets produced a steady stream of instruments to deal with developing country debts in ways that reflected their market value. A secondary market for these sovereign debt papers has now become too obvious, prevalent and persistent to ignore.

Sovereign debt secondary market prices have, in fact, been used to evaluate the costs and benefits of the debt restructuring proposals of Sachs (1989) and Robinson (1989). These prices have also been employed as indicators of debt values in several of the individual country schemes being implemented under the umbrella of the Brady Plan. These applications of foreign loan market prices were based on the assumption that they are reliable indicators of debt values. However, if market imperfections draw a wedge between investor debt appraisals and reported prices, then the valuation of debt restructuring based on market quotes may not be capturing investor expectations (Stone 1991).

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What is interesting about the secondary market for sovereign debts is the fact that this "market" was not about a group of disinterested, faceless, passive or unsophisticated investors. The original holders of debt (i.e., the commercial banks that lent money in the first place) were themselves the principal participants in the market. The same banks were bailing out at huge discounts while trading among themselves.

In analyzing whether secondary market prices are reliable indicators of debt values, the extent to which various dimensions of country risk determine such values will be tested. It is argued that secondary market sovereign debt prices were significantly influenced by the same economic risk factors that explained debt rescheduling, as well as by bankers' perceptions of creditworthiness. The choice of variables reflecting a country's economic conditions is based on previous empirical country risk studies. These variables have been found to significantly influence a country's probability of rescheduling. Bankers' perceptions which could not be observed, on the other hand, is dealt with by utilizing the Institutional Investor Country Risk Rating (IICR).

The IICR is taken from a biannual (March and September) survey by the Institutional Investor, an international finance magazine based in New York. The survey, which started in the late 1970s, covers from 75 to 100 of the most active banks involved in international lending. Bankers are asked to assign a score, on a scale of 0 to 100, to different countries according to their perception of a country's chances of running into debt-servicing difficulties. A rating of zero represents the least creditworthiness with the highest probability of rescheduling while a grade of 100 represents the highest rating of creditworthiness with the least chance of having debt-servicing difficulties. The individual responses are averaged using a weighing procedure which gives more weight to banks with the largest worldwide exposure and the most sophisticated country risk analysis systems. This paper starts

with the conviction that these scores are a reasonable measure of bankers' perceptions of the creditworthiness of countries which influence their bid prices for sovereign debt papers traded in the secondary market.

II
THE SECONDARY MARKET FOR SOVEREIGN DEBT

The original premise, both in the restructuring process and of the bank advisers that ran it, was that the principal portion of the debt could be maintained at par value through debt rescheduling. The market rejected this premise right from the start. With every reduction in spread, every extension of grace period and/or maturity, and every advance of new money, the value of the debt declined in the secondary market. In fact, the relationship between the concessionary terms of rescheduling and the market value of sovereign debt is so direct that the rescheduling process can be used to help map the persistent decline in the market value of developing country debt over the years.

Initially, the secondary market for sovereign debt evolved to facilitate bank loan swapping aimed at reweighing portfolio exposure in preferred countries to reduce risk (Sand 1987). In addition to portfolio realignment, traders were also motivated by tax considerations. For example, the secondary market provided a profitable opportunity for commercial banks to reduce their tax liabilities by writing down developing countries' debts.

The introduction of formal debt conversion schemes in several major debtor countries (eg., Chile, Argentina, Brazil, Mexico and the Philippines) after 1984, stimulated the growth of the secondary market for sovereign debt, particularly in cash transactions. The schemes included the conversion of debt into equity and debt repurchases by countries at a discount. From $1 billion of assets traded in 1984, the market trading volume rose to around $6 billion in 1985

and 1986 and $12 billion the following year. Large-scale commercial bank selloffs contributed to a quadrupling of the volume to $50 billion in 1988 and $80 billion in 1989. In 1990, the volume reached $100 billion and was estimated by Salomon Brothers to have reached more than $120 billion in 1991. Trading in the debt obligations of Argentina, Chile and Colombia accounted for most of the volume. Secondary market transactions have also been facilitated by the emergence of market-makers (e.g., Salomon Brothers, Citibank, Libra Bank, J.P. Morgan, and Nederlansche Middensandsbank) who specialize in developing country debts by matching buyers and sellers and/or trading for their own accounts.

Table 1 shows the rescheduling history of 68 countries and the secondary market prices of debt claims against these countries. For the unobserved prices, it is assumed that they maintain a 100 percent face value. If the debt claims are unquoted, then presumably the commercial banks still value them at par in their books. Except in the case of Algeria and Hungary, all nonrescheduling countries' debts have remained untraded. Thus, their secondary prices are unobserved and assumed to have maintained their 100 percent face value. Both the debts of Algeria and Hungary have been quoted below par, despite the fact that these countries never formally signed a multilateral rescheduling agreement. For all the rescheduling countries in the sample, with the exception of El Salvador, the data clearly show that prices of the debt claims against them were significantly discounted against their face values.

In a sample of 20 Latin American and Caribbean countries, only Paraguayan, Guatemalan and Haitian debts maintained their value at par. Except for El Salvador, the rest which rescheduled at least once during the period 1978-1990 suffered large discounts. El Salvador's debt remained untraded, thus unquoted, and is assumed to have maintained its face value despite having been rescheduled in 1990. Latin American and Caribbean debt suffered large declines in

Table 1
RESCHEDULING HISTORY AND SECONDARY MARKET
SOVEREIGN DEBT PRICES*

Sample countries	Rescheduling history	1986	1987	1988	1989	1990	1991	1992
Latin America and the Caribbean								
1. Argentina	1983,1985,1987,1989	65.0	47.0	25.0	16.0	13.0	27.0	44.0
2. Barbados	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
3. Bolivia	1980,1981,1983,1986, 1988, 1990	6.0	9.0	11.0	11.0	11.0	11.0	11.0
4. Brazil	1983,1984,1986,1987, 1988	75.0	53.0	47.0	30.0	25.0	29.0	36.0
5. Chile	1983,1984, 1985, 1987, 1988, 1990	66.0	63.0	59.0	60.0	68.0	85.0	89.0
6. Colombia	1985, 1989	82.0	79.0	66.0	100.0	100.0	100.0	100.0
7. Costa Rica	1983,1985,1989	44.0	29.0	13.0	14.0	29.0	45.0	53.0
8. Ecuador	1983,1985,1987,1988, 1989	65.0	44.0	24.0	13.0	16.0	23.0	25.0
9. El Salvador	1990	100.0	100.0	100.0	100.0	100.0	100.0	100.0
10. Guatemala	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
11. Haiti	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
12. Honduras	1983,1984,1987,1989, 1990	40.0	34.0	23.0	17.0	20.0	20.0	27.0
13. Mexico	1983,1984,1985,1986, 1987,1988, 1989,1990	58.0	53.0	48.0	40.0	42.0	55.0	63.0
14. Morocco	1983,1985,1986,1987, 1988,1990	68.0	52.0	48.0	38.0	39.0	47.0	44.0
15. Nicaragua	1980,1981,1982,1984	4.0	4.0	2.0	1.0	3.0	5.0	8.0
16. Panama	1983,1985	69.0	56.0	25.0	100.0	100.0	100.0	100.0
17. Paraguay	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
18. Peru	1978,1980,1983,1984	19.0	11.0	6.0	4.0	4.0	8.0	14.0
19. Uruguay	1983, 1986, 1988	64.0	68.0	60.0	55.0	49.0	62.0	71.0
20. Venezuela	1986, 1987, 1988, 1990	76.0	64.0	51.0	37.0	44.0	61.0	62.0

Table 1 *continued*

Sample countries	Rescheduling history	1986	1987	1988	1989	1990	1991	1992
North Africa and the Middle East								
21. Algeria	None	100.0	100.0	100.0	77.0	81.0	84.0	85.0
22. Egypt	1987	100.0	100.0	100.0	39.0	41.0	44.0	48.0
23. Iran	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
24. Iraq	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
25. Kuwait	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
26. Oman	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
27. Saudi Arabia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
28. Syria	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
29. Tunisia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
30. Yemen Arab Rep.	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Asia and the Pacific								
31. Afghanistan	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
32. Australia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
33. Myanmar (Burma)	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
34. China	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
35. Fiji	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
36. Hongkong	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
37. India	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
38. Indonesia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 1 *continued*

Sample countries	Rescheduling history	1986	1987	1988	1989	1990	1991	1992
39. Korea, South	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
40. Malaysia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
41. New Zealand	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
42. Pakistan	1981	100.0	100.0	100.0	100.0	100.0	100.0	100.0
43. Papua New Guinea	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
44. Philippines	1984, 1986, 1987, 1989, 1990	64.0	63.0	52.0	47.0	45.0	48.0	53.0
45. Singapore	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
46. Sri Lanka	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
47. Taiwan	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
48. Thailand	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Europe and the Mediterranean								
49. Cyprus	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
50. Greece	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
51. Hungary	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
52. Israel	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
53. Portugal	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
54. Spain	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Africa, South of Sahara								
55. Botswana	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
56. Ethiopia	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
57. Ghana	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 1 *continued*

Sample countries	Rescheduling history	1986	1987	1988	1989	1990	1991	1992
58. Ivory Coast	1984,1985, 1986, 1987, 1988, 1989	75.0	61.0	29.0	11.0	4.0	6.0	8.0
59. Kenya	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
60. Madagascar	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
61. Malta	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
62. Mauritania	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
63. Mauritius	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
64. Rwanda	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
65. Senegal	1981,1982,1983,1984, 1985, 1986, 1987, 1989, 1990	68.0	61.0	47.0	47.0	34.0	38.0	43.0
66. South Africa	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
67. Togo	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0
68. Upper Volta	None	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Average bid price for $100 of debt to financial institutions.

value from 1986 to 1990 but exhibited some recovery in 1991 and 1992.

The value of Nicaraguan debt was almost nil in 1989 (i.e., only 1 percent of its face value), and although it recovered slightly in the later years, it was still below 10 percent of its face value in 1992 (i.e., 8 percent). Bolivian debt was also valued for as low as 6 percent in 1986 but had recovered slightly to 11 percent in 1992. Also in 1992, the debts of Chile, Costa Rica, Mexico and Uruguay exhibited dramatic increases, registering values higher than their 1986 levels. For the rest of the Latin American and Caribbean countries, debt values exhibited some significant increases, but still had not regained their 1986 levels by 1992.

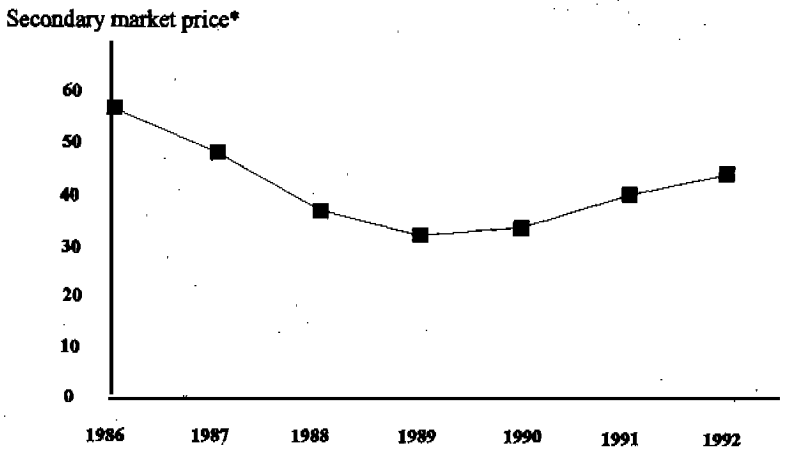
For the North African and Middle East regions, only Egyptian and Algerian debts traded below par, with the rest of the Middle East countries' debts remaining unquoted, implying that they retained 100 percent of their face values. As mentioned earlier, Algerian debts have been traded and quoted below par even though Algeria had not rescheduled any of its debts.

In the case of Asia and the Pacific region, only the debt of the Philippines was quoted below par from 1986 to 1992. Although the country's debt exhibited a slight improvement after 1990, it had not yet fully recovered from the 1986 level, and was still just over 50 percent of its face value in 1992.

Ivory Coast and Senegal were two of the African countries whose debts were quoted below par. Ivory Coast's debt showed a dramatic decline, from 75 percent of its face value in 1986 down to just 4 percent in 1989. Although its value increased slightly to 8 percent in 1992, it was still, practically, worthless. Consistent with the upward trend in secondary market sovereign debt prices in 1990, Senegal's debt also showed some improvement in 1991 and 1992, after a continuous decline from 1986 to 1990.

Figure 1 shows the price of sovereign debt computed as an unweighted mean of average monthly country quotes from 1986 through 1992. Four years after the Mexican debt crisis and the subsequent emergence of the secondary market, the figure clearly shows that the debts of countries which rescheduled are way below their face values. The secondary market sovereign debt prices experienced sharp and continuous declines from 1986 to 1988. In

Figure 1
SECONDARY MARKET SOVEREIGN DEBT PRICES



* Average bid price for $100 of debt to financial institutions.

the succeeding years, the market reflected a continued lack of confidence, with the movement still on a downward trend and reaching bottom in 1990. After 1990, however, the market started to exhibit an upward trend which reflected the restoration of some confidence in sovereign lending.

III
THE MODEL

It is presumed that objective risks arising from the economic, political and social conditions of a country and the bankers' subjective perceptions of that country's creditworthiness influence the prices of its sovereign debts which are traded in the secondary market. The selection of the risk factors is based on the study of Palac-Mcmiken (1995) as well as on other empirical work concerning country risk analysis. The full empirical model that will be tested can then be expressed as follows:

$$\begin{aligned} DISC = \Psi(&IICR, DSR, FDMP, \Sigma RSKX, INF, RESIMP, \\ &-\quad +\quad -\quad +\quad +\quad - \\ &OPNINDX, PCON, AGRGDP, GNPPC) \qquad (1) \\ &-\quad +\quad +\quad - \end{aligned}$$

where

DISC = percent discount on sovereign debt measured as the difference between the full face value of the debt (i.e., percent) and its secondary market average bid price;

IICR = a measure of the bankers' perception of country creditworthiness;

DSR	=	ratio of originally scheduled amortization and interest payments to total export receipts;
FDMP	=	ratio of noncompressible (food) imports to total imports;
ΣRSKX	=	cumulative rescheduling experience;
RESIMP	=	ratio of reserves (minus gold) to total imports
INF	=	rate of inflation
OPNINDX	=	measure of a country's degree of openness defined as half the sum of impoprts and exports divided by the sum of gross domestic product and imports;
PCON	=	share of private consumption in gross domestic product;
AGRGDP	=	share of agriculture in gross domestic product; and
GNPPC	=	per capita income.

The signs expected and the hypothesis for each of the explanatory variables follow.

Bankers' Creditworthiness Assessment (IICR)

A negative relationship is hypothesized between the Institutional Investor Country Risk (IICR) and the sovereign debt discounts. Since the principal participants in the secondary market are the same banks who are the original holders of debt, it is presumed that their subjective perceptions of country creditworthiness proxied by the IICR rating would guide their debt valuation, and that will be reflected in the discounts of sovereign debt traded in the secondary market. Debt claims on countries perceived as more creditworthy by these banks would tend to be quoted at lower discounts (or very close to par) while debt claims on countries perceived to be less creditworthy will tend to be quoted at higher discounts. In fact, a country perceived

to be high risk may be given limited access to voluntary commercial finance. This can contribute to its vulnerability to external shocks, thereby increasing that country's probability of debt rescheduling and making it more likely that its debt will be traded in the secondary market at a discount.

Debt Service Ratio (DSR)

A positive relationship is hypothesized between debt service ratio (DSR) and sovereign debt discounts. For a debtor country to have uninterrupted access to external credit, it must be able to continue servicing its debt. It is postulated that the price of nonrescheduling is the necessity to honor scheduled debt service payments. It is the current and prospective payments required to service external debt that constitute the price of nonrescheduling. It can be proxied by the contractual debt service ratio or by the ratio of the originally scheduled amortization and interest payments to total export receipts (DSR). As a country's price of nonrescheduling rises directly with its debt service ratio, it should be positively correlated with its probability of rescheduling. This is supported by empirical studies of various authors (Frank and Cline 1971; Feder, Just, and Ross 1981; and many others). Since debt rescheduling implies that the original terms of the debt will no longer be honored, the implication is that the debt claim has lost its original value and will more likely be traded at a discount in the secondary market. Thus, the higher a country's debt service ratio, the more likely that its sovereign debt will be quoted at a higher discount.

Ratio of Noncompressible (Food) Import to Total Imports (FDMP)

A negative relationship is hypothesized between the ratio of noncompressible (food) import to total imports (FDMP) and sovereign debt discounts. The FDMP has been used as an indicator

to represent the price (opportunity cost) of rescheduling which reflects a country's vulnerability to a credit embargo (Solberg 1988; Palac-Mcmiken 1993). As a country's price of rescheduling rises with its FDMP, it should be negatively correlated with rescheduling. There is empirical evidence to support this (Solberg 1988; Palac-McMiken 1993). The argument is that a reduced access to external credit following a debt rescheduling results in foregone credit-based noncompressible imports (which are mostly food items). A country that is not self-sufficient and that has to rely on imports to provide the most basic needs of its population may not risk a decision (that is, rescheduling) that would lead to further diminution of its access to external finance. Thus, the higher a country's FDMP, the less likely that it will reschedule and the more likely that its sovereign debt would be quoted close to par.

Cumulative Rescheduling Experience (ΣRSKX)

A positive relationship is hypothesized between cumulative rescheduling experience (ΣRSKX) and sovereign debt discounts. Regardless of whether debt rescheduling may lead to a renegotiation which, in the final analysis, becomes favorable to a debtor country, rescheduling always tarnishes a country's reputation in the financial community. This will, in all likelihood, diminish a country's access to voluntary external financing. The rollover of that country's debt may no longer be possible as all its unpaid debts may even become due and demandable. Thus, the more frequent a country reschedules its debt, the stronger the signal that the debtor country is not able get out of the debt trap, and thus, the more likely that its sovereign debt would be discounted at a higher rate.

Ratio of Reserves (Minus Gold) to Total Imports (RESIMP)

A negative relationship is hypothesized between the ratio of reserves (minus gold) to total imports (RESIMP) and sovereign debt discounts. This variable has been frequently used as a measure of a

country's liquidity position. It is argued that a higher level of reserves serves as a buffer against foreign exchange earnings fluctuations while an inadequate level of reserves to pay for imports can lead to liquidity problems. Various authors have shown the negative effect of RESIMP on a country's probability of rescheduling (Frank and Cline 1971; Feder and Just 1977; Feder, Just and Ross 1981; Mayo and Barret 1978; and Cline 1984). Since, by implication, the higher a country's RESIMP the lower the probability of debt rescheduling, it is more likely that a country with a strong liquidity position will have its sovereign debt quoted close to par.

Inflation Rate (INF)

A positive relationship is hypothesized between the inflation rate (INF) and sovereign debt discounts. It is argued that, since exchange rates do not necessarily compensate, the international competitiveness of a country's exporters may be hampered if it has an above-average inflation differential with its major trading partners. High inflation implies higher labor costs and higher costs for domestically purchased intermediate goods. High inflation also reduces the relative price of imports. All these have negative effects on a country's foreign exchange operations and will consequently affect that country's debt-servicing capacity. The negative and significant influence of inflation on a country's probability of rescheduling has been found by various authors (Sargen 1977; Abassi and Taffler 1982). Thus, since the probability that a country would reschedule its debt rises with its rate of inflation, then it is more likely that a country exhibiting high rates of inflation will have its sovereign debt quoted at a higher discount if traded in the secondary market.

Openness Index (OPNINDX)

A negative relationship is hypothesized between openness index (OPNINDX) and sovereign debt discounts. It is argued that a more open economy can easily adjust to balance-of-payments constraints

because an aggregate demand policy will have a stronger impact on imports. Moreover, the more open an economy, the more likely that its domestic producers are experienced in world markets and the easier for them to shift from domestic markets to export markets. As a result of the greater flexibility enjoyed by more open economies, a greater degree of openness is expected to reduce the probability of rescheduling. There is empirical evidence to support this (Callier 1985). In the same vein, it can be argued that countries exhibiting a greater degree of openness would more likely have their sovereign debt quoted close to par.

Share of Private Consumption in GDP (PCON)

A positive relationship is hypothesized between the share of private consumption in GDP (PCON) and sovereign debt discounts. The PCON may be taken to represent the share of production allocated to consumption as opposed to the accumulation of real capital assets. It is argued that nonaccumulation of real capital assets may decrease a country's future productive capacity. This, in effect, decreases the amount of real resources that will be available for a country to service its debt in the future, hence, increasing its probability of rescheduling. Thus, since a country's probability of rescheduling rises with PCON, it is more likely that debt claims against countries allocating more of their resources to private consumption will be traded at a higher discount.

Share of Agriculture in GDP (AGRGDP)

A positive relationship is hypothesized between the share of agriculture in GDP (AGRGDP) and sovereign debt discounts. The AGRGDP may be taken as a variable to indicate a country's flexibility in allocating its resources, with a high ratio implying a highly rigid economy. This rigidity can greatly constrain a country's ability to adjust to balance-of-payments problems, and is thus expected to have a

positive effect on its probability of rescheduling. The argument for this is taken from the concept of "dualism" which is widely discussed in the economic development literature of developing countries. According to this concept, the economy is divided into two sectors: the rural agricultural sector and the modern industrial sector. Between these two sectors (i.e., agricultural and industrial), resources do not flow freely to maintain marginal conditions usually associated with conditions of efficiency in resource allocation. For a basically agricultural country, the tendency to cut production in the industrial sector to reduce imports may serve as the only mechanism available to restore current account balance. The possibility of an efficient reallocation of resources can therefore be very limited in such an economy. Moreover, a higher AGRGDP may also imply that the country is highly dependent on agricultural exports. Since world agricultural prices exhibit greater variance, then a basically agricultural country would be more vulnerable to foreign exchange fluctuations. Since the prospect of rescheduling increases with AGRGDP, it is also more likely that debt claims against countries exhibiting higher AGRGDP will be quoted below par.

GNP Per Capita (GNPPC)

A negative relationship is hypothesized between GNP per capita (GNPPC) and sovereign debt discounts. Assuming a declining marginal propensity to consume, poorer countries may have a stronger resistance than richer countries to reduce consumption following a debt rescheduling. The positive and significant relationship between a country's GNPPC and its probability of rescheduling had been established by various authors (Feder and Just 1977; McFadden et al. 1985; and Berg and Sachs 1988). Since countries with higher per capita GNP are less likely to reschedule, then it is more likely for debt claims against these countries to be quoted close to par.

IV
DATA AND METHODOLOGY

It will be assumed that the discount on the debt is a nonlinear function of country risk factors. This nonlinearity arises from the fact that the discount on the debt can be positive or zero but never negative. For countries that have rescheduled, the discount tends to be positive, while for countries that have not rescheduled, the discount is assumed to be zero (or close to zero). In practice, this latter assumption may be violated in very few cases. Cases of Algerian and Hungarian debt were cited earlier. For most nonrescheduling countries, however, the secondary market price of the debt is not publicly quoted. For these unobseved discounts, we can assume that the actual market discount is equal to zero. This is deemed to be a reasonable assumption because if the country's debt has in fact been traded at a discount, the secondary market price of the country's debt would have been quoted.

A Tobit model will be used to test for the factors that determine the size of the discounts on the debt. Let Y^*_i be a latent creditworthiness variable for country i, which is only observed if it is nonnegative and otherwise takes the value of zero. It is a function of the explanatory variables X_i and a random error ε_i distributed normally, so that

$$Y^*_i = \beta' X + \varepsilon_i \qquad (2)$$

where X is a vector of objective and subjective risk indicators and β a vector of coefficients. In general, Y^*_i may represent a threshold for rescheduling. Higher Y^*_i signifies lower creditworthiness. For Y^*_i less than or equal to zero, the actual discount Y_i is equal to zero, while for Y^*_i greater than zero, the actual discount is set equal to Y^*_i. That is,

$$Y_i = 0 \quad \text{for} \quad Y^*_i \leq 0$$
$$Y_i = Y^*_i \quad \text{for} \quad Y^*_i > 0 \tag{3}$$

In this case, the regression function can be written as:

$$E[Y_i / X_i, Y_i > 0] = \beta' X_i + E(\varepsilon_i / Y_i > 0), \; i = 1,...N\text{-}s \tag{4}$$

where of the total N observations, the last ΣY_i's are zero, but Y_i, i = 1,...,N-s are observable. There is no problem if the conditional expectation of the error term is zero since the least squares regression on N-s available observations provide an unbiased estimator of β. This is not the case, however, since ε_is is assumed to be an independent and normally distributed random variable, with mean zero and variance σ^2, hence,

$$E[\varepsilon_i / Y_i > 0] = E[\varepsilon_i / \varepsilon_i > -\beta' X_i] = \sigma\lambda_i \tag{5}$$

where

$$\lambda_i = f(y_i)/1\text{-}F(y_i), \; y_i = -\beta' X_i/\sigma$$

and f(.) and F(.) are, respectively, the density and CDF of a standard normal random variable. Thus, the regression function can finally be written as:

$$E[Y_i/X_i, Y_i > 0] = \beta' X_i + \sigma\lambda_i, \text{ for } i = 1,..., N\text{-}s. \tag{6}$$

In general, the least squares estimator of β is biased and inconsistent, using either the entire sample or the subsample of complete observations (Greene 1981; Golberger 1981). Maximum likelihood estimation using Newton's algorithm method will be used instead.

The empirical testing utilized a pooled sample of at most 56 countries within the period of 1986 to 1988. Data on secondary market prices were taken from the World Bank and Salomon Bros.' "Indicative Prices of Developing Country Debts." Monthly bids for a $100 debt to financial institutions are averaged to get the annual average bid price. Sovereign debt discount is simply the difference between the face value (i.e., 100 percent) and the annual average bid price. Data for the explanatory variables, on the other hand, were primarily taken from the *Institutional Investor, World Development Report, International Financial Statistics,* and *World Debt Tables.* In order to take account of the time lags involved in data availability, a one-year lag was chosen for the explanatory variables.

To test how the various dimensions of country risk affect the rate of discount on sovereign debt and to isolate the extent of influence of objective vis-á-vis the subjective risk factors, three regression equations were estimated. The results are discusssed in the succeeding section.

V
REGRESSION AND PREDICTION RESULTS

Subjective Model

The first regression equation may be referred to as a "subjective" model because it is estimated using only IICR as the explanatory variable. This allows the study to determine the extent to which bankers' creditworthiness assessments influence secondary market sovereign debt discounts. The sovereign debt discount predictions of this model can also shed light on the extent to which sovereign debt valuations in the secondary market deviate from bankers' (the principal participants in the secondary market who are themselves the original holders of debts) valuations on the basis of their assessment of countries' creditworthiness. The model was regressed

on a pooled sample of 168 observations (56 x 3 = 168), 32 percent (54/168) of which has a positive dependent variable (i. e., $Y^*_i > 0$) The estimated result is given below:

$$DISC = 63.49 - 2.55\ (IICR_{t-1}) \qquad (7)$$
$$(5.46)\ (-6.07)$$

$$R2 = 0.25 \quad \text{Log-likelihood} = -336.81$$

As expected, IICR has a negative and significant influence on sovereign debt discounts. Debt claims on countries perceived as more creditworthy tend to be quoted with lower discounts. The model can explain 25 percent of the variation in DISC.

Consider the within-sample prediction results of the above estimated equation listed in Table 2. P(D) - A(D) shows the absolute difference between the predicted discount and the actual discount quoted in the secondary market. On the basis of bankers' creditworthiness assessment alone, the debt papers of El Salvador, Ethiopia, Haiti and Guatemala should have been quoted at a discount of over 37 percent from 1986 to 1988, similar to those of other Latin American countries. But since debt claims against these countries remained untraded or unquoted at that time, their secondary prices were unobserved and presumed to have maintained their value at par (i.e., zero discount). The model almost correctly predicts the zero discounts for the debts of Canada, Australia, Singapore, China, Hong Kong, Kuwait, Malaysia, Saudi Arabia, Spain and Taiwan, with predicted discounts of less than 1 percent. On the average, the model overpredicts the unquoted sovereign debts by a little over 11 percent from 1986 to 1988.

In the case of quoted debt claims, except for Senegal's debt in 1986, the model underpredicts all of them. The model fails miserably in predicting discounts on Latin American debt, particularly for Peru,

Table 2
SUBJECTIVE MODEL SOVEREIGN DEBT DISCOUNT PREDICTIONS

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
1 Algeria	0.00	2.13	2.13	0.00	2.13	2.13	0.00	4.36	4.36
2 Australia	0.00	0.04	0.04	0.00	0.06	0.06	0.00	0.12	0.12
3 Barbados	0.00	12.29	12.29	0.00	13.26	13.26	0.00	11.04	11.04
4 Canada	0.00	0.02	0.02	0.00	0.02	0.02	0.00	0.02	0.02
5 China	0.00	0.43	0.43	0.00	0.37	0.37	0.00	0.44	0.44
6 Cyprus	0.00	10.26	10.26	0.00	8.10	8.10	0.00	7.18	7.18
7 El Salvador	0.00	47.66	47.66	0.00	47.99	47.99	0.00	45.51	45.51
8 Ethiopia	0.00	45.51	45.51	0.00	44.68	44.68	0.00	43.37	43.37
9 Greece	0.00	2.53	2.53	0.00	3.33	3.33	0.00	3.98	3.98
10 Guatemala	0.00	37.40	37.40	0.00	38.03	38.03	0.00	37.08	37.08
11 Haiti	0.00	43.20	43.20	0.00	43.53	43.53	0.00	42.38	42.38
12 Hongkong	0.00	0.48	0.48	0.00	0.33	0.33	0.00	0.32	0.32
13 Hungary	0.00	3.87	3.87	0.00	2.53	2.53	0.00	3.05	3.05
14 India	0.00	4.34	4.34	0.00	3.14	3.14	0.00	2.79	2.79
15 Indonesia	0.00	3.17	3.17	0.00	3.08	3.08	0.00	4.52	4.52
16 Iran	0.00	28.50	28.50	0.00	29.65	29.65	0.00	27.66	27.66
17 Iraq	0.00	27.10	27.10	0.00	28.22	28.22	0.00	31.71	31.71
18 Israel	0.00	16.16	16.16	0.00	16.27	16.27	0.00	12.29	12.29
19 Kenya	0.00	17.65	17.65	0.00	15.55	15.55	0.00	14.86	14.86
20 Korea, South	0.00	1.29	1.29	0.00	1.43	1.43	0.00	1.03	1.03
21 Kuwait	0.00	0.64	0.64	0.00	0.62	0.62	0.00	1.16	1.16
22 Malaysia	0.00	0.51	0.51	0.00	0.66	0.66	0.00	1.43	1.43
23 Mauritius	0.00	25.87	25.87	0.00	21.72	21.72	0.00	18.88	18.88

Table 2 *continued*

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
24 New Zealand	0.00	0.27	0.27	0.00	0.33	0.33	0.00	0.43	0.43
25 Oman	0.00	2.74	2.74	0.00	2.10	2.10	0.00	2.82	2.82
26 Pakistan	0.00	19.10	19.10	0.00	17.11	17.11	0.00	14.66	14.66
27 Papua New Guinea	0.00	6.78	6.78	0.00	7.54	7.54	0.00	8.04	8.04
28 Paraguay	0.00	12.63	12.63	0.00	13.44	13.44	0.00	13.90	13.90
29 Portugal	0.00	3.14	3.14	0.00	2.82	2.82	0.00	1.91	1.91
30 Saudi Arabia	0.00	0.31	0.31	0.00	0.37	0.37	0.00	0.95	0.95
31 Singapore	0.00	0.08	0.08	0.00	0.11	0.11	0.00	0.15	0.15
32 South Africa	0.00	1.67	1.67	0.00	5.40	5.40	0.00	12.46	12.46
33 Spain	0.00	0.56	0.56	0.00	0.34	0.34	0.00	0.23	0.23
34 Sri Lanka	0.00	19.57	19.57	0.00	20.63	20.63	0.00	20.39	20.39
35 Syria	0.00	29.08	29.08	0.00	27.24	27.24	0.00	28.65	28.65
36 Taiwan	0.00	0.26	0.26	0.00	0.20	0.20	0.00	0.16	0.16
37 Thailand	0.00	2.40	2.40	0.00	2.24	2.24	0.00	2.06	2.06
38 Tunisia	0.00	5.49	5.49	0.00	6.51	6.51	0.00	9.45	9.45
absolute average under/overprediction *			**11.45**			**11.34**			**11.35**
39 Argentina	35.00	24.27	-10.73	53.00	23.36	-29.64	75.00	20.75	-54.25
40 Bolivia	94.00	45.01	-48.99	91.00	46.67	-44.33	89.00	46.00	-43.00
41 Brazail	25.00	13.44	-11.56	47.00	13.26	-33.74	53.00	10.26	-42.74
42 Chile	34.00	20.51	-13.49	37.00	20.99	-16.01	41.00	19.33	-21.67
43 Colombia	18.33	6.67	-11.66	20.92	8.23	-12.69	34.44	7.36	-27.08

Table 2 *continued*

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
44 Costa Rica	56.00	33.82	-22.18	71.00	33.21	-37.79	87.00	31.41	-55.59
45 Ecuador	35.00	21.60	-13.40	56.00	18.88	-37.12	76.00	19.10	-56.90
46 Honduras	60.00	42.55	-17.45	66.00	40.27	-25.73	77.00	37.87	-39.13
47 Ivory Coast	25.00	18.20	-6.80	39.00	18.54	-20.46	71.00	17.76	-53.24
48 Mexico	44.00	7.79	-36.21	50.00	9.60	-40.40	57.00	16.37	-40.63
49 Morocco	30.00	22.59	-7.41	37.00	22.85	-14.15	50.00	22.59	-27.41
50 Nicaragua	96.00	49.99	-46.01	96.00	50.49	-45.51	98.00	50.32	-47.68
51 Panama	31.25	12.63	-18.62	43.58	14.18	-29.40	75.19	14.37	-60.82
52 Peru	81.00	25.60	-55.40	89.00	32.91	-56.09	94.00	34.28	-59.72
53 Philippines	36.00	26.14	-9.86	37.00	28.79	-8.21	48.00	24.14	-23.86
54 Senegal	32.00	32.15	0.15	39.00	29.51	-9.49	53.00	28.79	-24.21
55 Uruguay	36.00	16.79	-19.21	32.00	17.65	-14.35	40.00	17.65	-22.35
56 Venezuela	24.00	9.24	-14.76	36.00	7.42	-28.58	49.00	9.24	-39.76
absolute average under/overprediction*			**20.22**			**27.98**			**41.11**

Note: A(D) - actual discount; P(D) - predicted discount; * - computed as average absolute difference between actual and predicted values

Nicaragua, Mexico and Bolivia. In 1986, the average underprediction of sovereign debt discounts registered at 20 percent and further increased to 28 percent and 41 percent in 1987 and 1988, respectively. As a whole, the model based on bankers' creditworthiness assessments tended to overpredict discounts of the unquoted sovereign debt of nonrescheduling countries and to underpredict those that have actually been traded in the secondary market. This may be an early indication that bankers, who are themselves the original holders of most of the traded sovereign debts, attempted to protect their exposure by overvaluing their portfolios. Although it appears that secondary market sovereign debt prices are determined in a more complex manner and cannot be directly generated just on the basis of bankers' creditworthiness assessment alone, the significance of IICR and its explanatory ability cannot be discounted.

Academic Model

The second regression equation may be referred to as an "academic" model because it is estimated using the frequently used variables in the country-risk literature to explain sovereign debt discounts. The equation includes nine economic risk factors as explanatory variables. Due to some missing data, only 144 observations were included, of which 37.5 percent (54/144) have discounts greater than zero. The estimated result is given below:

$$\begin{aligned} DISC = {} & 143.15 + 20.46\,(RSKX_{t-1}) - 2.07\,(FDMP_{t-1}) \\ & \textit{(3.78)} \qquad \textit{(8.39)} \qquad \textit{(-3.40)} \\ & - 0.19(DSR_{t-1}) - 30.2(RESIMP_{t-1}) + 0.12(INF_{t-1}) \\ & \textit{(-.51)} \qquad \textit{(-2.58)} \qquad \textit{(4.03)} \\ & + 6.63(OPNINDX_{t-1}) - 0.93(PCON_{t-1}) - 2.8(AGRGDP_{t-1}) \\ & \textit{(0.20)} \qquad \textit{(-1.86)} \qquad \textit{(-5.21)} \end{aligned} \tag{8}$$

$$- 14.08(GNPPC_{t-1}).$$
$$(-3.28)$$

$R^2 = 0.65$ Adjusted $R^2 = 0.63$ Log-likelihood= -285.18

Of the nine risk indicators, only DSR and OPNINDX do not significantly affect the sovereign debt discount. As expected, cumulative rescheduling experience (RSKX) exhibits a positive and highly significant coefficient. Note that it was only for two cases that nonreschedulers' debt was quoted below par, that is, traded at a discount. Debt claims on countries exhibiting a higher ratio of noncompressible (food) imports to total imports tended to be quoted at a lower discount, the estimated coefficient of FDMP being negative and highly significant at 1 percent level. This result is consistent with the idea that countries who use a major portion of their foreign exchange on food imports are less likely to reschedule, hence, debt claims against them would tend to retain their 100 percent face value. The negative and highly significant effect of a country's reserve position (RESIMP) is consistent with the hypothesis. The insignificant effect of the debt-service burden (DSR) may, however, imply that bankers who are themselves the primary investors in the secondary market tend to favor countries to which they have a large exposure by downplaying the importance of a country's external debt burden. One implication of these findings from the point of view of the borrowing country is that it might be shrewd to borrow internationally and use the proceeds to increase foreign exchange reserves.

The positive and highly significant coefficient of INF which reflects the country's price stability implies that secondary market investors place great importance on the country's monetary policy in the medium term. Debt claims on countries exhibiting high rates of inflation tend to be quoted at higher discounts.

The long-term structural variables PCON and AGRGDP have negative and significant coefficients. This result is in contrast with the earlier argument that countries which consume more (i.e., invest less) and whose outputs are derived mainly from the agricultural sector (high AGRGDP) are more likely to reschedule. Hence, they are expected to have a positive effect on sovereign debt discount. But presumably, countries with higher PCON and AGRGDP are the same countries to which bankers were largely exposed. The same countries eventually undertook rescheduling. In order to protect their assets, bankers tend to quote debt claims against these countries at very low discount rates to retain the full value of their debt claims. Finally, the negative effect of GNPPC implies that debt claims against richer countries would tend to be quoted at a lower discount.

As a whole, the objective risk factors explain over 65 percent of the variation in DISC. The model exhibits a higher explanatory power compared to the model which includes IICR as the only explanatory variable. This is supported by the increasing value of the adjusted R^2 and the log-likelihood function. This is likewise confirmed by the model's prediction results as shown in Table 3.

The model correctly predicted more unquoted debt claims. Togo's debt, on the other hand, was highly overpredicted, registering a predicted discount of 28.77 percent, 10.36 percent and 24.05 percent in 1986, 1987, and 1988, respectively, when it was in fact unquoted during those years. The average overprediction of unquoted debt claims is down to just over 3 percent in 1986 and 1987 and 4.6 percent in 1988.

In the case of traded and quoted debt claims in 1986, Argentinian, Panamanian and Senegalese debts were significantly overpredicted by over 10 percent while the rest were underpredicted. Honduran debt was highly underpredicted at 15.14 percent when in fact it was traded at a discount of 60 percent. The average absolute difference between the actual and predicted discounts in 1986 was over 20 percent.

Table 3
ACADEMIC MODEL SOVEREIGN DEBT DISCOUNT PREDICTIONS

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
1 Algeria	0.00	7.04	7.04	0.00	0.45	0.45	0.00	0.49	0.49
2 Myanmar (Burma)	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01
3 China	0.00	1.85	1.85	0.00	4.73	4.73	0.00	6.60	6.60
4 El Salvador	0.00	0.76	0.76	0.00	1.49	1.49	0.00	5.49	5.49
5 Ethiopia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.13
6 Ghana	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7 Greece	0.00	0.45	0.45	0.00	0.28	0.28	0.00	0.06	0.06
8 Haiti	0.00	0.03	0.03	0.00	0.25	0.25	0.00	0.01	0.01
9 Hungary	0.00	6.36	6.36	0.00	3.25	3.25	0.00	5.36	5.36
10 India	0.00	0.51	0.51	0.00	0.55	0.55	0.00	1.41	1.41
11 Indonesia	0.00	6.22	6.22	0.00	4.27	4.27	0.00	5.30	5.30
12 Israel	0.00	8.45	8.45	0.00	3.15	3.15	0.00	2.46	2.46
13 Kenya	0.00	1.19	1.19	0.00	3.09	3.09	0.00	1.95	1.95
14 Korea, South	0.00	12.93	12.93	0.00	16.06	16.06	0.00	16.50	16.50
15 Madagascar	0.00	11.93	11.93	0.00	16.96	16.96	0.00	31.55	31.55
16 Malaysia	0.00	2.36	2.36	0.00	2.72	2.72	0.00	3.31	3.31
17 Mauritania	0.00	0.34	0.34	0.00	0.90	0.90	0.00	1.31	1.31
18 Mauritius	0.00	2.38	2.38	0.00	2.71	2.71	0.00	3.48	3.48
19 Oman	0.00	0.49	0.49	0.00	2.04	2.04	0.00	0.15	0.15
20 Pakistan	0.00	1.40	1.40	0.00	2.38	2.38	0.00	4.99	4.99

Table 3 *continued*

	Sample countries	1986 A (D)	1986 P(D)	1986 P(D)-A(D)	1987 A (D)	1987 P(D)	1987 P(D)-A(D)	1988 A (D)	1988 P(D)	1988 P(D)-A(D)
21	Papua New Guinea	0.00	0.13	0.13	0.00	0.05	0.05	0.00	0.06	0.06
22	Paraguay	0.00	0.08	0.08	0.00	0.13	0.13	0.00	0.08	0.08
23	Rwanda	0.00	0.01	0.01	0.00	0.03	0.03	0.00	0.04	0.04
24	Singapore	0.00	1.56	1.56	0.00	1.24	1.24	0.00	0.91	0.91
25	Sri Lanka	0.00	0.58	0.58	0.00	0.62	0.62	0.00	0.48	0.48
26	Syria	0.00	1.35	1.35	0.00	2.78	2.78	0.00	0.42	0.42
27	Thailand	0.00	13.89	13.89	0.00	14.07	14.07	0.00	15.70	15.70
28	Togo	0.00	28.77	28.77	0.00	10.36	10.36	0.00	24.05	24.05
29	Tunisia	0.00	5.28	5.28	0.00	5.67	5.67	0.00	5.69	5.69
	absolute average under/overprediction*			**4.01**			**3.46**			**4.76**
30	Argentina	35.00	48.90	13.90	53.00	39.51	-13.49	75.00	61.76	-13.24
31	Bolivia	94.00	56.88	-37.12	91.00	94.78	3.78	89.00	89.00	0.00
32	Brazil	25.00	33.32	8.32	47.00	47.10	0.10	53.00	81.99	28.99
33	Chile	34.00	28.70	-5.30	37.00	42.29	5.29	41.00	67.31	26.31
34	Colombia	18.33	5.83	-12.50	20.92	6.20	-14.72	34.44	7.58	-26.86
35	Costa Rica	56.00	20.70	-35.30	71.00	24.56	-46.44	87.00	33.33	-53.67
36	Ecuador	35.00	36.59	1.59	56.00	42.37	-13.63	76.00	64.71	-11.29
37	Honduras	60.00	15.14	-44.86	66.00	16.83	-49.17	77.00	48.10	-28.90
38	Ivory Coast	25.00	5.25	-19.75	39.00	12.35	-26.65	71.00	17.89	-53.11
39	Mexico	44.00	40.18	-3.82	50.00	73.52	23.52	57.00	73.54	16.54

Table 3 *continued*

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
40 Morocco	30.00	22.56	-7.44	37.00	31.10	-5.90	50.00	62.05	12.05
41 Nicaragua	96.00	63.40	-32.60	96.00	63.70	-32.30	98.00	69.59	-28.41
42 Panama	31.25	47.55	16.30	43.58	47.59	4.01	75.19	61.63	-13.56
43 Peru	81.00	48.06	-32.94	89.00	74.39	-14.61	94.00	80.79	-13.21
44 Philippines	36.00	5.48	-30.52	37.00	15.71	-21.29	48.00	36.55	-11.45
45 Senegal	32.00	55.67	23.67	39.00	77.13	38.13	53.00	72.79	19.79
46 Uruguay	36.00	21.00	-15.00	32.00	36.54	4.54	40.00	22.39	-17.61
47 Venezuela	24.00	0.27	-23.73	36.00	12.20	-23.80	49.00	16.26	-32.74
absolute average under/overprediction*			**20.26**			**18.96**			**22.65**

Note: A(D) - actual discount; P(D) - predicted discount:
*computed as the average absolute difference between predicted and actual discount.

In 1987, the model's overpredictions of quoted debt claims were all below 6 percent except that for Senegal which was overpredicted by 38.13 percent. The model almost correctly predicted Brazilian debt with a difference of just 0.10 percent. Honduran and Costa Rican debts were highly underpredicted by over 45 percent. But on the average, the model's absolute under- and overpredictions of quoted debt claims in 1987 stood at 18.96 percent.

Finally for 1988, the model correctly predicted Bolivian debt at 89 percent discount. Debt claims on Brazil, Chile, Mexico, Morocco, and Senegal were underpredicted by at least 12 percent while the rest of the quoted debt claims were overpredicted. On the average, the model's absolute under- and overpredictions of quoted debt claims registered at 22.65 percent in 1988.

The "academic" model appeared to show better predictive power than the "subjective" model. Average absolute under- and overprediction exhibited dramatic declines though the model still tended to overpredict unquoted claims and to underpredict quoted claims. What is obvious, however, is that sovereign debt discounts have an objective basis and cannot be entirely influenced by bankers' perceptions. But one should note that IICR itself may have an objective basis. This problem will be dealt with in a subsequent regression.

"Subjective-cum-Academic" Model

Finally, the third regression equation may be referred to as a "subjective-cum-academic" model because it includes all the economic and subjective risk factors as explanatory variables of sovereign debt discounts. In this model, however, one is confronted with the problem that if both the IICR, and the several objective indicators of country risk are included as independent variables, major multicollinearity will result because IICR itself is a function of the same economic risk factors. This therefore complicates the individual variables' effect on secondary market sovereign debt discounts. The inclusion of the

ostensibly all-inclusive IICR and the objective risk indicators will dilute the validity of the estimated coefficients. To avoid this problem, a two-step procedure was used. First, IICR was regressed against country-risk indicators. These variables reflect solvency proxied by the ratio of total debt to GNP (TDGNP), liquidity proxied by the ratio of total reserves minus gold to total imports (RESTDSMP), loan duration (AVGMTY), inflation (INF), share of exports to GDP (EXPGDP), share of investment in GDP (INVGDP), share of agriculture in GNP (AGRGDP), and GNP per capita (GNPPC). The residuals from the first step (RIICR), (i.e., the unexplained portion of the IICR) were saved. In the second step, the objective indicators of country risk and the residuals from the first regression were used as independent variables to explain the secondary market sovereign debt discount. While the IICR equation was estimated on a set of 255 observations, due to missing data, the Tobit DISC model was estimated using only 108 observations, of which 50 percent (54/108) have a positive dependent variable. The estimated results are given below.[1]

$$\begin{aligned} IICR = {} & 15.89 - 7.76(TDGNP_{t-1}) + 19.38(RESTDSMP_{t-1}) \\ & \textit{(3.75)} \quad \textit{(-5.69)} \qquad\qquad \textit{(4.61)} \\ & - 0.32(AVGMTY_{t-1}) - 0.79(INF_{t-1}) \\ & \qquad \textit{(-3.79)} \qquad\quad \textit{(-1.06)} \\ & + 2.82\ (EXPGDP_{t-1}) + 1.00(INVGDP_{t-1}) \\ & \qquad \textit{(0.91)} \qquad\quad \textit{(10.42)} \\ & - 0.03(AGRGDP_{t-1}) + 0.67(GNPPC_{t-1}). \\ & \qquad \textit{(-0.31)} \qquad\quad \textit{(.76)} \end{aligned} \tag{9.1}$$

$R^2 = 0.63$ Adj. $R^2 = 0.62$ Log-likelihood = -937.37

1. For further discussion of the IICR results, see Palac-McMiken (1993).

$$
\begin{aligned}
DISC = {} & 60.43 - 0.86\ (RIICR) + 17.18\ (RSKXt\text{-}1) \qquad (9.2)\\
& \quad (3.45) \qquad (-3.40) \qquad (12.27)\\
& + 25.78\ (LATIN\ AMERICA) + 0.64\ (ASIA)\\
& \qquad (3.03) \qquad\qquad (0.06)\\
& - 3.33\ (AFRICA)\\
& \quad (-0.35)\\
& - 1.22\ (FDMP_{t-1}) - 0.04\ (DSR_{t-1})\\
& \quad (-3.21) \qquad (-.18)\\
& - 23.86\ (RESIMP_{t-1})\\
& \quad (-3.10)\\
& + 0.06\ (INF_{t-1}) - 0.87\ (PCON_{t-1})\\
& \quad (3.71) \qquad (-3.54)
\end{aligned}
$$

$R^2 = 0.88$ Adj. $R^2 = 0.87$ Log-likelihood = -238.43

The first equation indicates that bankers' creditworthiness assessments are likewise influenced by economic risk factors. The latter account for over 60 percent of the variation in IICR. Hence, about 40 percent of bankers' creditworthiness assessments may be accounted for by nonquantifiable perceptions of a country's political, social, legal and environmental risks otherwise not captured by the included explanatory variables.

For the Tobit model determining the influence variables of DISC, some of the economic risk factors were dropped because of multicollinearity problems. Now consider the RIICR. It is highly significant at the 1 percent level. This implies that the unexplained portion of IICR which presumably embodies political and other noneconomic dimensions of country risk not encompassed by the "objective" risk indicators is an important determinant of sovereign debt discount. In fact, this already excludes any perceived geographical risk because the equation separately includes geographical dummies to isolate their influence. The sample countries were classified into four geographical regions. To avoid the dummy

variable trap, Europe and the Mediterranean region were dropped. It appears that the Latin American and Caribbean debt tended to be quoted at a discount which is at least 25 percent higher than that for European and Mediterranean debt. The dummy for the former region is the single most important determinant of sovereign debt discount. This may be attributed to the fact that, except for the Philippines and two other African countries, the secondary market was dominated by trading of Latin American debts. With very few exceptions, all Latin American debts have been quoted at a discount. Dummy variables for Sub-Saharan Africa and for the Asian and the Pacific regions on the other hand, do not exhibit any significant effect. Cumulative rescheduling experience (RSKX) still exhibits a very strong positive and significant effect second only to the dummy variable for Latin America.

All the economic risk factors retained their signs. The insignificant effect of DSR further verifies the earlier finding that bankers who are the original holders of debt presumed to be the principal investors in the secondary market, tended to ignore and, in effect, downplay the risk of heavy debt burden in their attempt to protect their own lending exposures. FDMP and RESIMP have both negative and insignificant effects while INF has a positive effect, all of which are consistent with earlier findings. PCON, on the other hand, exhibits a negative effect which is inconsistent with what is expected. This negative effect is too strong to ignore, and it was noted that the same effect was generated in an earlier regression equation, which only included the objective determinants of risk as explanatory variables. As has been argued, the most likely explanation for this is the fact that countries with a lower propensity to invest are most likely the same countries to which bankers' exposures eventually turned sour. Bankers would try to protect their portfolios by continuing to retain their debt claims against these countries at a 100 percent face value.

Looking at the predictive performance of the model estimated in Table 4, it is apparent that this model has the best predictive ability

Table 4
SUBJECTIVE-CUM-OBJECTIVE MODEL SOVEREIGN DEBT
DISCOUNT PREDICTIONS

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
1 Algeria	0.00	7.04	7.04	0.00	0.45	0.45	0.00	0.49	0.49
1 Algeria	0.00	1.80	1.80	0.00	0.08	0.08	0.00	0.25	0.25
2 China	0.00	1.18	1.18	0.00	2.84	2.84	0.00	4.73	4.73
3 El Salvador	0.00	5.06	5.06	0.00	6.80	6.80	0.00	10.95	10.95
4 Ethiopia	0.00	0.00	0.00	0.00	0.01	0.01	0.00	2.52	2.52
5 Haiti	0.00	1.66	1.66	0.00	4.70	4.70	0.00	0.98	0.98
6 India	0.00	0.08	0.08	0.00	0.09	0.09	0.00	0.24	0.24
7 Indonesia	0.00	1.88	1.88	0.00	1.16	1.16	0.00	1.63	1.63
8 Kenya	0.00	0.53	0.53	0.00	3.65	3.65	0.00	1.11	1.11
9 Korea, South	0.00	1.46	1.46	0.00	1.51	1.51	0.00	1.60	1.60
10 Malaysia	0.00	0.16	0.16	0.00	0.38	0.38	0.00	0.75	0.75
11 Mauritius	0.00	0.20	0.20	0.00	0.16	0.16	0.00	1.28	1.28
12 Oman	0.00	1.26	1.26	0.00	0.80	0.80	0.00	0.23	0.23
13 Pakistan	0.00	0.28	0.28	0.00	0.32	0.32	0.00	0.70	0.70
14 Papua New Guinea	0.00	0.19	0.19	0.00	0.10	0.10	0.00	0.09	0.09
15 Paraguay	0.00	1.83	1.83	0.00	3.20	3.20	0.00	4.11	4.11
16 Sri Lanka	0.00	0.22	0.22	0.00	0.16	0.16	0.00	0.18	0.18
17 Thailand	0.00	0.34	0.34	0.00	0.34	0.34	0.00	0.45	0.45
18 Tunisia	0.00	0.57	0.57	0.00	0.50	0.50	0.00	1.00	1.00
absolute average under/overprediction *			**1.04**			**1.49**			**1.82**

Table 4 *continued*

Sample countries	1986			1987			1988		
	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)	A (D)	P(D)	P(D)-A(D)
19 Argentina	35.00	47.26	12.26	53.00	43.54	-9.46	75.00	61.65	-13.35
20 Bolivia	94.00	74.13	-19.87	91.00	93.17	2.17	89.00	87.45	-1.55
21 Brazil	25.00	39.63	14.63	47.00	50.57	3.57	53.00	87.87	34.87
22 Chile	34.00	33.29	-0.71	37.00	40.41	3.41	41.00	65.82	24.82
23 Colombia	18.33	15.32	-3.01	20.92	15.64	-5.28	34.44	19.04	-15.40
24 Costa Rica	56.00	57.08	1.08	71.00	62.35	-8.65	87.00	59.47	-27.53
25 Ecuador	35.00	45.34	10.34	56.00	50.06	-5.94	76.00	73.78	-2.22
26 Honduras	60.00	53.68	-6.32	66.00	50.82	-15.18	77.00	71.18	-5.82
27 Ivory Coast	25.00	10.69	-14.31	39.00	23.70	-15.30	71.00	33.77	-37.23
28 Mexico	44.00	51.94	7.94	50.00	77.62	27.62	57.00	76.22	19.22
29 Morocco	30.00	19.07	-10.93	37.00	26.54	-10.46	50.00	47.58	-2.42
30 Nicaragua	96.00	92.22	-3.78	96.00	90.75	-5.25	98.00	91.31	-6.69
31 Panama	31.25	44.75	13.50	43.58	48.75	5.17	75.19	57.41	-17.78
32 Peru	81.00	64.64	-16.36	89.00	83.94	-5.06	94.00	92.90	-1.10
33 Philippines	36.00	6.24	-29.76	37.00	13.44	-23.56	48.00	31.55	-16.45
34 Senegal	32.00	37.90	5.90	39.00	63.97	24.97	53.00	63.58	10.58
35 Uruguay	36.00	20.88	-15.12	32.00	37.63	5.63	40.00	30.69	-9.31
36 Venezuela	24.00	0.59	-23.41	36.00	20.32	-15.68	49.00	34.69	-14.31
absolute average under/overprediction *			**11.62**			**10.69**			**14.48**

Note: A(D) - actual discount; P(D) - predicted discount

* computed as average absolute difference between predicted and actual discount.

compared to the ones discussed earlier. Except for El Salvador, the model's underpredictions of unquoted debt claims were all below 5 percent.

The average underpredictions during the period covered were just over 1 percent. These can be interpreted as almost correct predictions.

For 1986, in the case of quoted debt claims, Philippine debt was highly underpredicted, registering a predicted discount of only 6.25 percent when in fact it was traded at a discount of 36 percent. It appears that the secondary market may have reacted to the political turmoil in the country at that time, even when the objective determinants themselves were not significantly affected. Except for Venezuela, all the other underpredictions were below 20 percent. Chilean debt was almost correctly predicted; on the average, the model's absolute under- and overprediction was just over 10 percent.

The predictive performance of the model with respect to unquoted debt claims for 1987 registered an absolute average under- and overprediction of 10.69 percent. Philippine debt is still highly underpredicted by about 23.56 percent while Mexican and Senegal debts were overpredicted by 27.62 and 24.97 percent, respectively.

Finally for 1988, the model's predictions showed an absolute average under- and overpredictions of quoted debt claims by 14.48 percent. Brazilian and Chilean debts were highly overpredicted by 34.87 and 24.82 percent, respectively, while Ivory Coast's debt is underpredicted by 37.23 percent. Bolivian and Peruvian debts were almost correctly predicted with a difference of just over 1 percent.

For this model, Table 5 lists the out-of-sample predictions for 1989. The prediction results do not deviate significantly from the within-sample predictions exhibiting comparably similar performance. Although with respect to unquoted debt claims, the average absolute difference between actual discounts (assumed to be zero) and the predicted registered for this equation appears to be slightly higher,

Table 5
SUBJECTIVE-CUM-OBJECTIVE MODEL OUT-OF-SAMPLE SOVEREIGN DEBT DISCOUNT PREDICTIONS

Sample countries	Rescheduling history	1989		
		A(D)	P(D)	P(D)-A(D)
1 China	None	0.00	11.98	11.98
2 Ethiopia	None	0.00	11.60	11.60
3 Haiti	None	0.00	13.25	13.25
4 India	None	0.00	-1.05	-1.05
5 Indonesia	None	0.00	3.95	3.95
6 Kenya	None	0.00	2.83	2.83
7 Korea, South	None	0.00	4.27	4.27
8 Malaysia	None	0.00	2.40	2.40
9 Mauritius	None	0.00	8.01	8.01
10 Pakistan	None	0.00	8.22	8.22
11 Papua New Guinea	None	0.00	-1.33	-1.33
12 Paraguay	None	0.00	17.80	17.80
13 Sri Lanka	None	0.00	0.39	0.39
14 Thailand	None	0.00	-2.06	-2.06
15 Tunisia	None	0.00	-5.46	-5.46
absolute average under/overprediction *				**6.31**

Table 5 *continued*

Sample countries	Rescheduling history	1989		
		A(D)	P(D)	P(D)-A(D)
16 Algeria	None	23.00	1.75	-21.25
17 Argentina	1983, 1985, 1987,1989	35.00	61.40	26.40
18 Bolivia	1980,1981,1983, 1986, 1988,1990	94.00	87.83	-6.17
19 Brazil	1983. 1984,1986,1987, 1988	25.00	83.94	58.94
20 Chile	1983,1984, 1985, 1987, 1988, 1990	34.00	69.29	35.29
21 Costa Rica	1983, 1985, 1989	56.00	60.48	4.48
22 Ecuador	1983, 1985, 1987, 1988, 1989	35.00	70.41	35.41
23 Honduras	1983, 1984, 1987, 1989, 1990	60.00	64.57	4.57
24 Mexico	1983, 1984,1985,1986, 1987, 1988, 1989, 1990	44.00	83.09	39.09
25 Morocco	19083, 1985, 1986, 1987, 1988, 1990	30.00	55.14	25.14
26 Peru	1978,1980, 1983, 1984	81.00	89.27	8.27
27 Philippines	1984, 1986, 1987,1987, 1990	36.00	42.13	6.13
28 Senegal	1981, 1982, 1983, 1984, 1985, 1986, 1987, 1989, 1990	32.00	61.01	29.01
29 Uruguay	1983, 1986.1988	36.00	33.67	-2.33
30 Venezuela	1986. 1987. 1988, 1990	24.00	50.98	26.98
absolute average under/overprediction *				**14.58**

A(D) - actual discount
P(D) - predicted discount
* computed as average absolute difference between predicted and actula discount.

registering at 6.31 percent. The model overpredicts two Latin American debts, that of Paraguay and Haiti at 17.8 and 13.25 percent, respectively. None of these debt claims were traded; hence, presumably their face values retained their 100 percent face values in the lenders' books. It appears that the secondary market failed to reflect the obvious decline in the face values of debt claims against Latin American countries.

While the model seems to capture the political turmoil in China by registering a discount of almost 12 percent, the secondary market failed to also reflect this development. The same goes for Ethiopian debt with a predicted discount of over 10 percent. The model registers some negative discounts for Thailand, Tunisia and Indonesia, probably due to some linear approximation, but they could just as well be taken as zero discounts. As for the quoted debt claims, except for three Latin American countries and Senegal, the model underpredicts most of the sovereign debt discounts. The debts of Brazil, Chile and Mexico were traded at 70, 40 and 64 percent discounts, respectively; the model, however, estimates the discount to be higher at 84, 70 and 83 percent, respectively. Senegal's debt is also overpredicted by 8 percent. For the traded sovereign debts, the model's average absolute difference between the actual discounts and predicted discounts stood at 14.5 percent. The model almost correctly predicts discounts on Bolivian and Moroccan debt with underpredictions of less than 2 percent.

VI
CONCLUSION

As a whole, results show the importance of both bankers' "subjective" creditworthiness perceptions and "objective" economic dimensions of country risk in the determination of secondary market sovereign debt discounts. Although a model based on bankers' creditworthiness

assessment alone cannot entirely predict sovereign debt discounts, it could exhibit reasonable predictive performance if coupled with various economic dimensions of objective country risk. From the absolute differences in the actual and the predicted discounts, the model appears to be more efficient in predicting unquoted debt claims. Within sample, the average absolute under- and overprediction of unquoted debt claims registered at less than 2 percent compared to average absolute over- and underprediction of quoted debt claims of about 12 percent. Out-of-sample observations exhibited a similar trend.

The secondary market is still highly illiquid. Traded debt papers consist mainly of sovereign debts from heavily indebted countries. Moreover, the principal participants remain to be the original holders of debt, swapping debt papers among themselves in their desire to restructure their portfolio. Thus, the subjective bias of these principal investors are likely to remain. Nonetheless, the performance of the "subjective-cum-objective" model does provide evidence that secondary market sovereign debt prices largely reflect their true economic values, despite the subjective biases of bankers who eventually participate as investors in the secondary market.

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