A Country Risk Assessment Model and the Asian Crisis

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Abstract

This paper estimates country risk using an alternative method to commonly used country risk models by the rating agencies. The paper builds on earlier work and tries to identify empirically the important factors affecting debt service capacity of borrowing countries. In this study we assess the riskiness of 34 developing countries over the period 1986 to 1998 using a two-limit Tobit model. In the model a-year-ahead debt rescheduling ratios are used as the dependent variable. Using the debt rescheduling ratios, we emphasize the role of relative sizes of debt rescheduling in predicting external debt crisis. The model is tested for its predictability of the external debt crises and the results are compared with the rating of S&P and Moody's. A special emphasis is given to the recent Asian crisis and its predictability.

JEL Classification: F34
Keywords: Sovereign rating; Country risk; Debt crises

1. Introduction

The external debt crises faced by developing countries have been generating concern among creditors and borrowers particularly over the last two decades. After the Asian crisis, once again, the growing volume of private commercial loans to developing countries has increased concern about the ability of these countries to repay external obligations on time. However, it should be noted that debt service difficulties on the part of borrower countries are not a recent development. As a

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result, demand for sovereign credit ratings and popularity of rating agencies has increased dramatically.

Country risk assessment models or sovereign ratings are quite beneficial to all the parties if they are accurate and able to predict the debt crises in advance. Many studies exist to identify factors of country risk. These studies are separated into two types: descriptive studies and analytical studies. The first type of studies are used by banks and rating agencies to appraise risk and generally rank borrowers according to a large number of selected criterias. The second type of studies utilize statistical methods to understand debt rescheduling decision. Frank & Cline (1971), Dhonte (1974), Grinols (1976), Feder & Just (1977), Sergen (1977), Mayo & Barret (1977), Smith (1977), Saini & Bates (1978), Fisk & Rimlinger (1979), Feder, Just & Ross (1981), Cline (1984), Kharas (1984), Edwards (1984), Beltratti (1990), Ngassam (1991), Ozler (1992), Hajivassiliou (1987 and 1994), Hernandez-Trillo (1995), Gur (1998) are some of the studies of this type attempted to predict the debt crises and identify the factors responsible for the debt repayment problems.

This paper combines both approaches. The determinants of debt rescheduling for 34 developing countries over the period from 1986 to 1998 is examined by utilizing the two-limit Tobit model. After determining the macroeconomic variables and fundamental debt ratios affecting the debt repayment capacities and debt rescheduling of the sample developing countries, the estimated debt rescheduling ratios are used to determine the country grades similar to rating agencies. The model is tested for its predictability of the external debt crises a-year in advance with special emphasis given to the recent Asian crisis. In the model, contrary to the previous studies, the ratio of the amount of debt rescheduled to the total debt, *rescheduling ratio*, is used as a dependent variable in order to pay attention to the relative amount of debt reschedulings over total debt.

The paper is organized as follows: the first section explains the sample countries, their selection criteria, and the data set. Section two explains the explanatory variables used in the model. Section three presents the empirical results. Section four examines the trends of creditworthiness and accuracy of the model for the sample countries. In this section the estimated country risk grades are compared to some other available country risk ratings constructed by the rating agencies for 1997 and 1998 prior to the Asian crises. Section six provides conclusions.

2. The Sample Countries and Data

This paper studies thirty-four developing countries for the period between 1986 and 1998. The countries in our sample are Algeria, Argentina, Bolivia, Brazil, Chile, China, Colombia, Costa Rica, Cote D'Ivoire, Dominican Republic, Ecuador, Egypt, India, Indonesia, Jamaica, Kenya, South Korea, Malaysia, Mexico, Morocco, Nicaragua, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Sri Lanka, Sudan, Thailand, Tunisia, Turkey, Uruguay and Venezuela. The sample countries have been borrowing significant amounts of external loans from other governments, international institutions, commercial banks and other private sources over the years. The first criterion for country selection was the availability of compatible data for significantly long time periods. The second criterion was the amount of external debt stock and the level of external borrowing from commercial banks. As a result, many developing countries have been excluded from the analysis because either they do not have a significant amount of external debt, especially only in the form of small amounts of external loans obtained from the commercial banks, or data is unavailable.

Out of the thirty-four countries that are selected for this study, twenty-four are middle income countries and the remaining ten are low income countries as categorized by the World Bank country classification lists. In this study, eight African, nine Asian, one European, and sixteen Latin American and Caribbean countries have been selected for our data base to reduce the regional biases that may arise in this type of studies. This study also covers 15 severely indebted, 12 moderately indebted and 7 low debt countries. Table 1 gives the list of the countries included in this study and their group classifications according to The World Bank Tables.

This study uses the World Bank data sets. The annual values for each economic indicator are obtained mainly from the Global Development Finance data diskettes of the Bank. The database of this study has 408 observations. There are 110 rescheduling observations which make up 27 percent of total observations. This represents a relatively rich data set on country debt rescheduling. Out of thirty-four, six countries have not experienced any rescheduling in the time period of 1986 to 1998. These countries are India, Malaysia, Pakistan, Thailand, Tunisia, and Turkey. The remaining twenty-eight countries have experienced rescheduling in various degrees and years.

3. Indicators of the Country Risk Assessment Model

Like many other empirical studies, this study also adopts the view that the demand for debt rescheduling, or alternatively, debt restructuring, represents a debt repayment problem for a country and, therefore, a risk for lenders. Since country defaults no longer exist, we attempt to measure country default risk by using country debt rescheduling risk as a proxy. In other words, since country default is not an observable variable, debt rescheduling is substituted in the estimation of debt servicing capacity. Place (1989) points out some problems with such a change. First, debt servicing difficulty need not result in a rescheduling agreement. Second, some rescheduling agreements are not made public, so that we may face hidden information. Third, there may be a considerable length of time between the problem of debt servicing and the announcement of a rescheduling agreement. Nevertheless, debt rescheduling, or structuring, indicates that a country is experiencing severe difficulties in servicing its external debt. As a result, rating sovereign borrowers, according to their debt rescheduling risk makes sense for lenders who do not want to be involved in the long and extremely painful process of debt rescheduling.

As we mentioned earlier, a year-ahead ratio of total debt rescheduling to total external debt, **TR(+1)EDT**, is the dependent variable used in this study. It will be called the *rescheduling ratio* in the remaining text. In the existing literature, the analyses focuses only when rescheduling took place; thus the rescheduling event is a binary dependent variable taking the values of zero and one. However, this study extends the literature by modeling the actual *rescheduling ratios* that are negotiated so that a two percent rescheduling ratio is actually treated as a different event from a ten percent ratio. As a result, this study focuses on the total amount of debt rescheduled in estimation of country risk and estimates the relative size of debt rescheduling.

In order to determine the factors responsible for debt rescheduling, that in turn, determine country rescheduling risk in external borrowing, this study uses a total of six economic variables. These variables are defined in table 2 and listed in table 3 with their expected signs.

The first variable, the interest payment to export ratio, (INT XGS), is a traditional indicator of creditworthiness, which is used in many country risk studies. This ratio, also called the interest service ratio, is obtained by dividing the total interest payments to exports of goods and services, including worker's remittances,

in a given year. Together with amortization, the interest service ratio itself is sometimes used as a rule of thumb for country risk assessments and seen as a single most important factor driving sovereign borrowers into debt rescheduling process. Therefore, a high interest service ratio indicates a heavy burden on the economic resources of a country and increases rescheduling risk.

The second indicator in determining the debt capacity of sovereign borrowers or country rescheduling risk is the ratio of concessional loans to total debt stock, (CEDT). Concessional long-term loans are defined by the World Bank as loans with a grant element of 25 percent or more. The grant element of a loan is the grant equivalent expressed as a percentage of the amount committed, and it is used to measure the overall cost of borrowing. The grant equivalent of a loan is its commitments (present) value, less the discounted present value of its contractual debt service; conventionally, future service payments are discounted at 10 percent. So, the ratio of concessional long-term loans to total debt stock is a significant variable to measure the effect of borrowing cost on total rescheduling demand of borrowers. The expected sign of this variable is negative.

The third indicator is the total reserves to total debt ratio, (RES EDT). Foreign reserves serve as a buffer against sudden adverse shocks and indicates the liquidity capacity of a sovereign borrower. Reserves are the sum of a country's monetary authority's holdings of special drawing rights (SDRs), its reserve position in the IMF, its holdings of foreign exchange, and gold. A strong international reserve position shows the ability to respond to foreign currency demands in cases of adverse shocks. So with a larger ratio of reserve to total debt, one excepts higher debt servicing capacity and less need to demand a rescheduling over external obligations. Therefore, the expected sign of this coefficient is negative.

The fourth indicator used to explain rescheduling behavior in the model is the ratio of total debt stock to gross national product, (EDT GNP). This indicator represents the debt burden on a sovereign borrower. We expect a positive correlation between debt burden and debt rescheduling. If a country's debt stock increases relative to its GNP, the likelihood of debt rescheduling increases. In such situations debtor countries would have difficulties in servicing external obligations according to a payment schedule.

The fifth variable of the study is the private debt to total debt ratio (PRV EDT). Presumable a country with well established private sector and high ratio of private

debt to total debt is less likely to default or ask for debt rescheduling than otherwise. This indicator has a negative expected sign.

The last variable is the one-period lagged dependent variable, (TR EDT), the ratio of debt rescheduling to total external debt. Once a debtor plunges into the debt crisis and reschedules her debt, she will probably find itself in difficulty to service the future debt obligations in the following years. In such situations debtors will also have difficulties to obtain new credits from international creditors. This seems to be the main reason why most governments remain extremely reluctant to dishonor their external debts. The recent Asian crisis is a good example of such behavior. Only two countries out of many severely affected, made rescheduling.

Hence, the model to estimate is

$$TR_{(t+1)}EDT = INT\,XGS_{(t)} + CEDT_{(t)} + RESEDT_{(t)}$$
$$+ EDTGNP_{(t)} + PRVEDT_{(t)} + TREDT_{(t)} \qquad (1)$$

Since the dependent variable takes a value of only between zero or one, the appropriate model to estimate is a two-limit Tobit model (described in Appendix 1).

The purpose of using one-period lagged values of the explanatory variables is to make the model serve as a early-warning model of country riskiness. As a result of such setup, the estimates of rescheduling ratio for the next year (t+1) are obtained by utilizing values of the explanatory variables in the present year (t). In another words, the model is aimed to predict future debt servicing capacity of the selected countries a-year in advance.

4. Estimation Results

The parameter estimates of the two-limit Tobit model are shown in Table 4. All the variables used to estimate the debt rescheduling are found to be statistically significant at 10 percent level. Excluding EDTGNP, the variables are even significant at 5 percent level. Out of six variables, private debt ratio, PRVEDT, and previous debt rescheduling ratio, TREDT, have high coefficient values that indicate effectiveness on coming year rescheduling size and behavior. The signs of the parameters are also in line with model predictions. Concessional terms on loans, high international reserves, and high degree of private sector establishment in debtor country are factors reducing the debt rescheduling likelihood and the amount of the proportion of rescheduled debt in the following year. On the contrary, interest

payment burden over exports of goods and services, accumulated debt burden over GNP and previous debt service difficulties increase the likelihood of debt rescheduling risk a year later.

In order to construct a credibility index which is similar to indexes of the rating agencies, for the sample countries, the predicted rescheduling ratios are grouped into 10 subgroups according to their size. Also, in constructing a risk index, current ratings are made sensitive to the previous debt reschedulings. As a result, both the estimated size and the period of previous reschedulings are taking into account. These subgroups and their assigned weights are given in Table 5.

Each country has a total scores of 100 at the beginning of each year and any increase in their estimated rescheduling ratio make them lose some points depending upon the size of the rescheduling ratio. This is an adaptive weighting method and only the last four years are weighed in the scoring for a given year. In order to calculate the creditworthiness score and grade, both the year coefficients and the rescheduling range coefficients are used. The year coefficients range between 1 and 4, and the rescheduling ratio coefficients range between 0 and 10.

The grades assigned are similar to Standard & Poor's and Moody's and range between (AAA), which represents extremely strong capacity to service external obligations and (C) the lowest payment capacities and almost certain likelihood of debt payment problems and (F), a definite default probability.

5. Estimated Country Risk and Grades

In this section we test the accuracy and the predictability of our model. For this reason no-rescheduling and major rescheduling cases are examined between 1990 and 1998. If the model is able to identify high-risk countries and low-risk countries correctly, then one may conclude that the model is successful in assessing country risk.

Table 6 shows accuracy levels reached in our estimates for eleven countries, which have never exercised a debt rescheduling in the period 1988-1998. For these countries, the size of estimated rescheduling reaches up to only 4 percent in the cases of India in 1993 and Turkey in 1994. Malaysia, Pakistan, Sri Lanka, Thailand and Tunisia are the other no-rescheduling countries and their highest estimated rescheduling ratios are less than 3 percent in our model. So, the differences between the estimated ratios and actual rescheduling ratios are very small and these low-risk

countries are successfully identified in our country-risk system. As a result, we can argue that our method of country-scoring has been successful in estimating the high credibility of some countries and has produced very low type II errors.

Table 7 presents the major debt reschedulings of the sample countries and the in-sample predictions of our model. In predictions, both estimated rescheduling ratios and the country credit scores for the last three years before the rescheduling are considered for eleven sample countries. The table basically checks type I errors for fourteen major rescheduling cases. The results indicate that many major reschedulings are predicted very well in advance in our model. Considering the predictions in a one-year horizon for more than 10 percent rescheduling, our model fails to assign correct grades only in the Korean case in 1998. In this case, the estimated rescheduling ratio is only 1 percent and grade BB is given to Korea in 1997, 1996, 1995. In fact, Korea exercised a major rescheduling in 1998.

As we will discuss the Korean case later in detail, our model still seems to predict the rescheduling risk of Korea better than the others since her grade is downgraded from BBB in 1994 and kept in a speculative grade BB until 1998. However, the model correctly estimates all other major-reschedulings with two-year lead time in general. In many cases, B or lower grades, indicating extremely high risk, are given to some sample countries, which actually succumbed into the debt payment crises in later years. The estimates are even more precise considering the credit scores with one-year lead time. Out of fourteen major rescheduling cases, the model assigns six C grades and eight B grades indicating extremely high risk and warning creditors one-year in advance. So, our credit-scoring method is very accurate and easily identifies the future debt-service problems in the sample countries in advance with only few exceptions. We can conclude that our credit-scoring method has also been very successful in reaching low type I error ratio. In some exceptional cases, these countries had good economic conditions until sudden changes. The very sudden adverse external shocks and some political factors might be responsible for these developments.

Table 8 and Table 9 include the Institutional Investors, the Euromoney, Standard & Poor's, and Moody's long-term foreign currency risk ratings before and during the Asian crisis to compare the accuracy of our credit-scoring method. In fact, note that the scores are not directly comparable due to different sample sizes and scoring techniques. However, the ranking of the sample countries from low-risk to high-risk by the agencies are comparable.

As table 8 indicates, our scores assess the debt rescheduling risk reasonably well for many countries including nine Asian countries. Thailand, Sri Lanka, Paraguay, Malaysia and Chile ranked with the highest grade in the sample with BBB according to our methodology. These countries did not exercise any debt rescheduling as predicted by the model. But, Egypt and China with the same grade BBB had a very minor rescheduling with the magnitude of debt restructuring ranging between 0.002 and 0.06 percent, in 1997 or 1998. According to Moody's and Standard & Poor's rating, Korea, Malaysia, China, Chile, Thailand and Indonesia were the lowest-risk countries in 1997 with grades AA or BBB. However, Korea, Indonesia, China rescheduled in 1998.

In case of Korea which rescheduled 15 percent of total debt in 1998, S&P and Moody's assigned AA- and A1 ratings respectively, the highest grades among 34 sample countries in 1997 right before the Asian crisis. On contrary, receiving BB and B grades respectively, Korea and Indonesia are found to be moderate and high-risk countries by our model in 1997. As we mentioned earlier, Korea was downgraded in 1994 from BBB to BB and put into the risky category. The difference between risk assigned to Korea by us and the rating agencies indicates that the East-Asian countries are clearly overrated by the rating agencies despite the fact that political variables as well as many economical variables are examined regularly by the rating agencies. However, our model is constructed on the basis of fundamental debt ratios and do not consider political factors in its grading system. Despite the lack of political risk, our scoring system reflects country risk very accurately even in a three-year horizon. Especially major debt reschedulings and their relative sizes are anticipated and pointed out in earlier years.

On the other hand, the majority of the high-risk countries assigned with C grades in our model, Nicaragua, Panama, Argentina, Ecuador, Peru and Algeria made reschedulings in either 1997 or 1998 or both years as predicted a-year earlier by us. For example the countries graded with CC, Algeria and Nicaragua, rescheduled debt in both 1997 and 1998. Peru and Ecuador are the two other countries assigned with CCC rescheduled their debt as predicted correctly by our model. Five out of nineteen countries in our sample assigned with B grade made debt rescheduling at various degrees. The most striking result founded in comparing country grades of the major rating agencies with ours is the grades assigned to Korea and Indonesia during the Asian financial crisis which resulted in major debt rescheduling. In 1998, Korea is rated with BB+ by S&P and Ba1 by Moody's which are better grades than

many no-rescheduling countries. Similarly, Indonesia's grade is determined as CCC+ and B3 by S&P and Moody's respectively. On the other hand, Turkey, which is one of the few countries that has not faced any debt repayment problems over the last twenty years is wrongly undergraded with B and B1 by S&P and Moody's. Comparing with the grades given to Korea and Indonesia by these agencies, the grades assigned to Turkey is the lowest grades among the sample countries in 1998, a year of Asian crisis.

Peru is another example of overrating. In our model, Peru properly received CCC in 1997 and made a 15 percent rescheduling in 1998. However, both S&P and Moody's rated Peru with BB and Ba3 respectively. With such grades Peru is rated over Turkey, Paraguay, Venezuela, India, Indonesia and many other countries. In addition to Turkey, some other countries Paraguay, Venezuela, India, Indonesia receive relatively low scores, although no rescheduling, or very small size reschedulings are exercised in 1997 and 1998. Such examples of over and underrating have not yet found explanations to anybody's satisfaction.

The difference between credit scores can be attributed to political concerns. The political risk has not been our particular concern; while, the country scores of the rating agencies assigned weights to political observations. Therefore, some ratings and country scores of the popular agencies are basically the reflection of political concerns of the Western financial institutions toward some countries.

Despite the high level of accuracy reached in our credit-scoring method, overall results also verify the fact that any credibility index should be accompanied with expert opinions. The highest level of accuracy can be reached in country risk analysis if the most efficient quantitative methodology is used in conjunction with the qualitative scoring methodology, in which political and social-economical factors are considered in sovereign rating. Our index scores are broad, therefore, country-specific and time-specific conditions in sovereign scoring should be evaluated by country experts in order to revise scores and grades. Such final touches will definitely improve the prediction quality. Nonetheless, the index has worked very well for many countries in our sample with only few exceptions for some specific years.

6. Conclusion

The goal of this paper was to create a better method for estimating the risk that a country might reschedule the payments on its external debt. The increasing uncertainties in the borrowers capacity to repay their loans have raised the risk awareness of lenders in the past two decades. This paper examines the existing literature on country risk analysis, and develops an efficient, alternative risk assessment model by using a panel data set for the 1986 - 1998 period for 34 nations.

In the existing literature, the majority of the analyses focus on the rescheduling event. However, this study extends the literature by modeling the actual *rescheduling ratios* that are negotiated so that a two percent rescheduling ratio is actually treated as a different event from a twenty percent ratio. In fact, rescheduling and rescheduling ratios have a very high correlation, but, since the size of debt rescheduling conveys more information about sovereign borrowers risk, the rescheduling ratio is obviously found to be a better proxy than binary rescheduling values in the assessment of country risk. Therefore, the country risk table developed in this study reflects more a accurate credit scorings for the sample countries since it ranks the sovereign borrowers according to the amount of debt reschedulings.

It is found that not all the debt payment difficulties resulted in a rescheduling agreement. The best example of such situation is the recent Asian crisis. Despite severe economic conditions and debt service difficulties, Thailand, Sri Lanka, Philippines, Malaysia did not exercise any rescheduling as Korea and Indonesia did. For some countries, with relatively low rescheduling ratios, the cost of rescheduling is much more formidable than the benefits they accrue. However, the countries that do reschedule their debt in small size generally face chronic economic difficulties.

This study compares the estimated country creditworthiness obtained from an econometric model with other risk indexes constructed by the rating institutions. It is found that our credit scores reflect creditworthiness more accurately than some others since borrowers are correctly ranked and graded as a result of the emphasis given to the relative size of debt rescheduling. However, in order to measure the effects of sudden changes and turning points and to reflect them in country risk table, a successful quantitative model should be supported by country- expert opinions.

References

Amemiya, T. (1984): "Tobit Models : A Survey," *Journal of Econometrics*, 24, 3-61.

Belratti, A. (1990): "*Empirical Estimates of the Debt Capacity to Repay a Foreign Debt: A Vector Autoregressive Methodology*," in: H. O'Neil, ed., *Third World Debt: How Sustainable are Current Strategies and Solutions?*, Frank Cass, London.

Cline, W.R. (1984): *International Debt: Systematic Risk and Policy Responses*, Institute of International Economics, Washington , DC.

Dhonte, P. (1974): "Quantitative Indicators and Analysis of External Debt Problems," IMF mimeo, Washington DC.

Edwards, S. (1984): "LDC Foreign Borrowing and Default Risk: An Empirical Investigation 1976-80," *American Economic Review*, Vol.74, No4.

Euromoney, Country Risk League Tables.

Feder,G. and R.E. Just (1977): "A Study of Debt Servicing Capacity Applying Logit Analysis," *Journal of Development Economics*, 4.

Feder, G.,R. Just and K. Ross (1981): "Projecting Debt Service Capacity of Developing Countries," *Journal of Financial and Qualitative Analysis*, vol. 16, no 5.

Fisk, C. and Rimlinger, F. (1979): "Nonparametric Estimation of LDC Repayment Prospects," CIA mimeo, Washington DC.

Frank, C.R. Jr. and W. R. Cline (1971): "Measurement of Debt Servicing Capacity: An Application of Discriminant Analysis," *Journal of International Economics*, Vol.1, 327-44.

Grinols, E. (1976): *International Debt Rescheduling and Discrimination Using Financial Variables*, US Treasury Department mimeo, Washington , DC.

Gur, T. H. (1998): *External Debt and Empirical Models for Country Risk Assessment*, Capital Markets Board of Turkey (SPK), Pub. Number 117, Ankara, (1995) Ph.D. Dissertation, State University of New York at Albany, Department of Economics.

Hajivassiliou, V. A. (1987): "The External Debt Repayment Problems of LDC's: An Econometric Model Based on Panel Data," *Journal of Econometrics*, 205-230.

——— (1994): "External Debt Crises of Developing Countries," *Journal of Applied Econometrics*, 109-131.

Heffernan, S.A. (1986): *Sovereign Risk Analysis*, Allen & Unwin, London.

Hernandez-Trillo, F. (1995): "A Model-Based Estimation of the Probability of Default in Sovereign Credit Markets," *Journal of Development Economics*, Vol. 64, 163-179

Institutional Investor, Country Credit.

Kharas, H. (1984): "The Long-run Creditworthiness of Developing Countries: Theory and Practice," *Quarterly Journal of Economics*, August.

Krayenbuelhl (1988), *Country Risk: Assessment and Monitoring*, NYIF Corp., NY.

Mayo, A.L. & A.G. Barret (1977): "An Early-Warning Model for Assessing developing Country Risk in Developing Countries," in: S.H. Goodman, ed.

Moody's Investor Services, www.moodys.com

Ngassam, C. (1991): "Factors Affecting the External Debt-Servicing Capacity of African Nations: An Empirical Investigation," *The Review of Black Political Economy*.

Ozler, S. (1992):"The Evaluation of Credit Terms," *Journal of Development Economics*, 38.

Place, F.M. (1989): “Information Quality, Country Risk Assessment, and Private Bank Lending to Less-Developed Countries,” Ph.D. Dissertation, Dept. of Economics, University of Wisconsin-Madison.

Rosett, R. N. & F. D. Nelson (1975): “Estimation of the Two-Limit Probit Regression Model," *Econometrica*, Vol 43, No 1, 141-146.

Saini, K. & P. Bates (1978): "Statistical Techniques for Determining Debt-Service Capacity for Developing Countries," *Federal Reserve Bank of New York Research Paper*, no 7818.

Sergen, N. (1977): "Economic Indicators and Country Risk Appraisal," Economic *Review of the Federal Reserve Bank of San Francisco*.

Smith, G.W. (1977): *The External Debt prospects of the Non-oil Exporting Developing Countries: an Econometric Analysis*, Overseas Development Council NIEO Series, no 10, Washington, DC.

Standard & Poor’s, www.dri.mcgrow-hill.com

Tobin, J. (1958): “Estimation of Relationship for Limited dependent Variables," *Econometrica*, 26, 24-36.

The World Bank , "World Debt Tables," Washington.

Table 1
Sample Countries

	COUNTRIES	By Income	By Location	By Indebtedness
1	ALGERIA	Middle	Africa	Severely Indebted
2	ARGENTINA	Middle	America	Severely Indebted
3	BOLIVIA	Middle	America	Severely Indebted
4	BRAZIL	Middle	America	Severely Indebted
5	CHILE	Middle	America	Moderately Indebted
6	CHINA	Low	Asia	Low Debt
7	COLOMBIA	Middle	America	Moderately Indebted
8	COSTA RICA	Middle	America	Moderately Indebted
9	COT'S IVORY	Middle	Africa	Severely Indebted
10	DOMINICAN REP.	Middle	America	Moderately Indebted
11	ECUADOR	Middle	America	Severely Indebted
12	EGYPT	Low	Africa	Severely Indebted
13	INDIA	Low	Asia	Moderately Indebted
14	INDONESIA	Low	Asia	Moderately Indebted
15	JAMAICA	Middle	America	Severely Indebted
16	KENYA	Low	Africa	Severely Indebted
17	KOREA, SOUTH	Middle	Asia	Low Debt
18	MALAYSIA	Middle	Asia	Low Debt
19	MEXICO	Middle	America	Severely Indebted
20	MOROCCO	Middle	Africa	Severely Indebted
21	NICARAGUA	Low	America	Low Debt
22	NIGERIA	Low	Africa	Severely Indebted
23	PAKISTAN	Low	Asia	Moderately Indebted
24	PANAMA	Middle	America	Severely Indebted
25	PARAGUAY	Middle	America	Low Debt
26	PERU	Middle	America	Severely Indebted
27	PHILIPPINES	Middle	Asia	Moderately Indebted
28	SRI LANKA	Low	Asia	Low Debt
29	SUDAN	Low	Africa	Severely Indebted
30	THAILAND	Middle	Asia	Low Debt
31	TUNISIA	Middle	Africa	Moderately Indebted
32	TURKEY	Middle	Europe	Moderately Indebted
33	URUGUAY	Middle	America	Moderately Indebted
34	VENEZUELA	Middle	America	Moderately Indebted

Source: The World Bank, World Debt Tables.

- Classification of the sample countries are made according to World Bank Classification Tables given in World Bank Debt Tables.

- The low-income countries in this study are those in which 1992 GNP per capita was no more than $ 675, and middle income countries are those in which GNP per capita was more than $ 675 and less than $ 8,359.

- According to the Bank, a country will be in the severely indebted country's group if one of the key is above critical level. These ratios and their critical levels are present value of debt service to GNP and present value of debt service to exports of goods and all services. Their critical levels are 80 percent and 200 percent respectively. The critical levels of the same ratios are 48-80 percent and 132-220 percent for moderately indebted countries.

Table 2
Variables and Definitions

Variables	Definitions
EDT Total debt stock	Sum of public and publicly guaranteed long term external debt, private non-guaranteed long term debt, the use of IMF credit, and short-term debt (estimated).
INT Interest payments	Actual amounts of interest paid in foreign currency, goods, or services in the year specified.
XGS Exports	Exports of goods and services in the year specified.
C Concessional loans	Total long-term loans with an original grant element of 25 percent or more.
RES International reserves	the sum of a country's monetary authority's holdings of special drawing rights (SDRs), its reserve position in the IMF, its holdings of foreign exchange, and its holdings of gold (valued at year-end London prices),
PRV Private sector LDOD	the distribution of long-term debt by private debtors including private banks
TR Debt Stock Rescheduled	amount of debt outstanding rescheduled in any given year

Table 3
Indicators of Country Rescheduling Risk and Expected Coefficient Signs

Ratio of interest payments on external debt to export	**INT XGS**	+
Ratio of concesional loans received to total debt	**C EDT**	-
Ratio of reserves to total debt	**RES EDT**	-
Ratio of total debt stock to GNP	**EDT GNP**	+
Ratio of private long term debt to total debt stock	**PRV EDT**	-
Ratio of Previous Total Rescheduling to total debt stock	**TR EDT**	+

Table 4
Parameter Estimates of the Two-Limit Tobit Model of Debt Rescheduling Risk

Variable	Coefficient	Std.Error	b/St.Er.	P[|Z|>z	Mean of X|
INTXGS	**0.0065**	0.0014	4.728	.0000	11.15
CEDT	**-0.0014**	0.0056	-2.577	.0100	21.35
RESEDT	**-0.0015**	0.0006	-2.324	.0201	19.17
EDTGNP	**0.0001**	0.00007	1.619	.1054	87.18
PRVEDT	**-0.2478**	0.1238	-2.001	.0453	0.078
TREDT	**0.2497**	0.0897	2.783	.0054	0.038
Constant	**-0.0751**	0.0296	-2.532	.0113	
Sigma	0.15	0.0087	17.171	.0000	
Observations	408				
Log-likelihood	-27.60				

Table 5
Grading and Scoring

Rescheduling		*0.40*	*0.35*	*0.30*	*0.25*	*0.20*	*0.15*	*0.10*	*0.05*	*0.01*	*0.00001*
Ratios Range		-	-	-	-	-	-	-	-	-	-
		Over	*0.39*	*0.34*	*0.29*	*0.24*	*0.19*	*0.14*	*0.09*	*0.04*	*0.0099*
Coefficients		**-10**	**-9**	**-8**	**-7**	**-6**	**-5**	**-4**	**-3**	**-2**	**-1**
Years											
t-3	**1**	*-10*					*-5*				*-1*
t-2	**2**	*-20*					*-10*				*-2*
t-1	**3**	*-30*					*-15*				*-3*
t	**4**	*-40*					*-20*				*-4*
Total Points to be Deducted		-100					-50				-10
Score		*0*	*61*	*66*	*71*	*76*	*81*	*86*	*91*	*96*	*100*
Range		-	-	-	-	-	-	-	-	-	
		60	*65*	*70*	*75*	*80*	*85*	*90*	*95*	*99*	
Grade		**F**	**C**	**CC**	**CCC**	**B**	**BB**	**BBB**	**A**	**AA**	**AAA**

Table 6
No Rescheduling Countries and Their Highest Estimated Rescheduling Ratios, 1990-1998

COUNTRIES	Estimated Highest Rescheduling Ratio * 1972-1991	Year
INDIA	0.04	1993
MALAYSIA	0.01	1998
PAKISTAN	0.02	1998
SRI LANKA	0.01	1997
THAILAND	0.01	1998
TUNISIA	0.03	1994
TURKEY	0.04	1994

* The actual rescheduling ratios for these countries are zero obviously.

Table 7
Major Reschedulings and Accuracy of Country Grades *

COUNTRIES	Year t	Actual Rescheduling Ratio	Estimated Rescheduling Ratio	Grade t-1	Grade t-2	Grade t-3
ALGERIA	1994	0.16	0.06	CC	CC	CC
	1995	0.17	0.07	CC	CC	CC
	1996	0.11	0.08	CC	CC	CC
ARGENTINA	1993	0.39	0.11	CC	CC	N.A
BRAZIL	1992	0.11	0.04	CCC	CC	B
COT'S IVORY	1997	0.13	0.04	B	B	CCC
DOMINICAN REP.	1994	0.11	0.03	B	B	B
ECUADOR	1995	0.39	0.05	B	CCC	CC
KOREA, S	1998	0.15	0.01	BB	BB	BB
NICARAGUA	1996	0.08	0.07	C	F	F
PANAMA	1996	0.53	0.05	B	B	B
PERU	1996	0.19	0.03	B	B	CCC
	1998	0.15	0.07	B	CCC	B
PHILIPPINES	1992	0.14	0.04	B	CCC	N.A

* The grades A, B, and C indicate the low risk, speculative risk, and extremely high, almost certain, likelihood of debt reschedulings respectively. Any country with grade BB or lower should be considered to be risky in the system.

Table 8
1997 Credit Ratings: Gur, The Institutional Investor, S&P, Moody's

	COUNTRIES	GUR * 1997	INS. INV. 1997	S&P 1997	MOODY'S 1997	Act. Resc. Ratio 1997	Act. Resc. Ratio 1998
1	ALGERIA	CCC	24.5			0.07	0.02
2	ARGENTINA	CCC	41.3	BB	Ba3	0	0
3	BOLIVIA	B	26.2	BB-		0.06	0
4	BRAZIL	B	39.5	BB-	B1	0.002	0.001
5	CHILE	BBB	63.5	A-	Baa1	0	0
6	CHINA	BBB	57.8	BBB+	A3	0.06	0
7	COLOMBIA	B	47.2	BBB-	Baa3	0	0
8	COSTA RICA	B	36.0	BB	Ba1	0	0
9	COT'S IVORY	B	20.1			0.13	0.02
10	DOMIN. REP.	B	24.8	B+	B1	0.03	0.014
11	ECUADOR	B	26.3		B1	0.004	0
12	EGYPT	BBB	39.7	BBB-	Ba1	0.005	0.002
13	INDIA	B	46.9	BB+	Baa3	0	0
14	INDONESIA	B	51.8	BBB-	Ba1	0	0.03
15	JAMAICA	B	29.7			0	0
16	KENYA	B	28.6		Ba3	0	0
17	KOREA, S.	BB	69.7	AA-	A1	0	0.15
18	MALAYSIA	BBB	66.7	A+	A2	0	0
19	MEXICO	B	43.5	BB	Ba2	0	0
20	MOROCCO	B	40.9			0	0
21	NICARAGUA	CC	13.5			0.08	0.02
22	NIGERIA	B	15.3			0	0
23	PAKISTAN	B	27.5	B+	B2	0	0
24	PANAMA	CCC	33.6	BB+	Baa1	0	0
25	PARAGUAY	BBB	33.5	BB-		0	0
26	PERU	B	33.7	BB		0.03	0.15
27	PHILIPPINES	B	44.3	BB+	Ba1	0	0
28	SRI LANKA	BBB	32.1			0	0
29	SUDAN	B	9.1			0	0
30	THAILAND	BBB	59.9	A		0	0
31	TUNISIA	B	47.9	BBB-	Baa3	0	0
32	TURKEY	B	38.6	B	B1	0	0
33	URUGUAY	B	43.4	BBB-	Baa3	0	0
34	VENEZUELA	B	35.4	B+	Ba2	0	0

Table 9
Credit Ratings 1998: Gur, The Euromoney, S&P, Moody's

	COUNTRIES	GUR 1998	EUR MON. 1998	S&P 1998	MOODY'S 1998	Act. Resc. Ratio 1997	Act. Resc. Ratio 1998
1	ALGERIA	CC	26			0.07	0.02
2	ARGENTINA	CCC	45	BB	Ba3	0	0
3	BOLIVIA	B	35	BB-	B1	0.06	0
4	BRAZIL	B	36	BB-	B2	0.002	0.001
5	CHILE	BBB	59	A-	Baa1	0	0
6	CHINA	BBB	48	BBB+	A3	0.06	0
7	COLOMBIA	B	46	BBB-	Baa3	0	0
8	COSTA RICA	B	40	BB	Ba1	0	0
9	COT'S IVORY	B	30			0.13	0.02
10	DOMIN. REP.	B	22	B+	B1	0.03	0.014
11	ECUADOR	CCC	28		B3	0.004	0
12	EGYPT	BBB	43	BBB-	Ba1	0.005	0.002
13	INDIA	B	39	BB+	Ba2	0	0
14	INDONESIA	B	27	CCC+	B3	0	0.03
15	JAMAICA	B	43		Ba3	0	0
16	KENYA	B	25			0	0
17	KOREA, S.	BB	64	BB+	Ba1	0	0.15
18	MALAYSIA	BBB	42	BBB-	Baa3	0	0
19	MEXICO	B	45	BB	Ba2	0	0
20	MOROCCO	B	41	BB	Ba1	0	0
21	NICARAGUA	CC	24		B2	0.08	0.02
22	NIGERIA	B	17			0	0
23	PAKISTAN	B	19	CCC-	Caa1	0	0
24	PANAMA	CCC	50	BB+	Baa1	0	0
25	PARAGUAY	BBB	31	BB-	B2	0	0
26	PERU	CCC	40	BB	Ba3	0.03	0.15
27	PHILIPPINES	B	40	BB+	Ba1	0	0
28	SRI LANKA	BBB	28			0	0
29	SUDAN	B	7			0	0
30	THAILAND	BBB	41	BBB-	Ba1	0	0
31	TUNISIA	B	46	BBB-		0	0
32	TURKEY	B	39	B	B1	0	0
33	URUGUAY	B	46	BBB-	Baa3	0	0
34	VENEZUELA	B	30	B+	B2	0	0

Apppendix 1

Censored and Truncated Regression Models: The Tobit Model

This section presents the censored regression model (or the Tobit model). Suppose that we consider a sample size *n* and record only those values of the dependent variable greater than a constant *c*. The resulting sample based on such criterion is called a censored sample. However, if the sample is truncated before actual selection is made, then, a sample from this truncated normal distribution is called a truncated sample. Amemiya (1984) surveys the Tobit models by classifying them into five basic types according to the form of the likelihood function, and states that basic estimation methods can be applied to any of the five types with a slight modifications. In the next sections, two-limit Tobit model are reviewed. If dependent variable is subject to both an upper limit and a lower limit two-limit Tobit model is used rather than standard Tobit model.

Two-Limit Tobit (Probit) Model

In the next section of this study, the debt rescheduling ratios are estimated with use of alternative models. In analyzing the debt repayment crises, we estimate the relative size of debt rescheduling and use the debt rescheduling ratio which is bounded with 1 and zero as a dependent variable. Two-limit Tobit is the most appropriate framework in the cases that economic variables are restricted by an upper and lower limit but are continuous between the two limits. The two-limit Tobit (Probit) regression model and its estimation method is given in Rosett & Nelson (1975). In this section, we follow this paper closely. According to the model, the dependent variable Y is determined by

$$Y_t = L_{t1} \quad \text{when } \mathrm{Y}_t^* - e_t \le L_{1t},$$

$$Y_t = L_{t2} \quad \text{when } \mathrm{Y}_t^* - e_t \ge L_{2t},$$

$$Y_t = \mathrm{Y}_t^* - e_t \quad \text{when } L_{t1} \le \mathrm{Y}_t^* - e_t \le L_{2t},$$

where Y_t^* is a linear function of the independent variables X_t . The aim is to estimate the unknown parameters,

$$Y_t^* = \sum_{i=1}^{k} \beta_i X_{it}$$

where the subscript, *t*, distinguishes observations and its application to the limits L_1 and L_2 means that these limits are permitted to vary among observations. The random variable ***e*** is assumed to be normally distributed with a zero mean and

standard deviation σ. If the non-limit values are known, the maximum likelihood estimates can be obtained from the following likelihood function,

$$L = \prod_{S_1} Q\left(\frac{Y^* - L_1}{\sigma}\right).\prod_{S_2} P\left(\frac{Y^* - L_2}{\sigma}\right).\prod_{S3}\frac{1}{\sigma}Z\left(\frac{Y^* - Y}{\sigma}\right),$$

where P is the normal cumulative probability distribution, Q = 1-P, and Z is the normal density function. The sample has been partitioned into three parts, S_1, S_2,and S_3, for lower limit, upper limit, and non-limit observations respectively. After some simplifications, the likelihood function becomes

$$L = \prod_{S_1} Q\left(I^* + \alpha_0 L_1\right).\prod_{S_2} P\left(I^* + \alpha_0 L_2\right).\prod_{S3}\left(-\alpha_0 Z\left(I^* + \alpha_0 Y_1\right)\right),$$

where

$$\alpha_i = \beta_i \sigma,$$

$$\alpha_0 = -\frac{1}{\sigma},$$

$$I^* = Y^* / \sigma.$$

Taking the natural log of L gives

$$\phi = \sum_{S_1} \ln\ Q\left(I^* + a_0 L_1\right) + \sum_{S_2} \ln\ P\left(I^* + a_0 L_2\right)$$

$$+ \sum_{S_3}\left[\ln\left(-a_0\right) - \frac{1}{2}\ln 2\Pi - \frac{1}{2}\left(I^* + a_0 Y\right)^2\right]$$

and the unknown parameter can be obtained by maximization of this function.

Differentiating this likelihood function yields non-linear normal equations so that the solutions for the estimates are not obtainable. Thus, some iterative maximization procedure must be employed. The ordinary least square estimates are biased but in many cases they may provide adequate initial values where the values of Y for the non-limit observations are known. In such cases, applying the OLS to just non-limit observations yields better estimates. Alternatively, Tobin suggests a process to linearizing the normal equations. Tobin (1958), and Rosett & Nelson (1975) discuss the process in details.