Country Risk Analysis: A Survey of the Quantitative Methods

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SHSU ECONOMICS WORKING PAPER

Country Risk Analysis: A Survey of the Quantitative Methods[*]

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JEL Classifications: F3; G2

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1.   INTRODUCTION

Country risk can be defined and measured in many different ways. In general, it refers to the risk associated with those factors which determine or affect the ability and willingness of a sovereign state or a borrower from a particular country 'to fulfill their obligations towards one or more foreign lenders and/or investors'[1]. Shapiro (1999) defines country risk as the general level of political and economic uncertainty in a country affecting the value of loans or investments in that country. Thus country risk analysis consists of the assessment of political, economic, and financial factors of a 'borrowing country' or an FDI host country which may interrupt timely repayment of principal and interest or may adversely affect returns on foreign investment[2]. To the extent that the borrowers have little control over these factors, country risk may represent a 'nondiversifiable systematic risk'[3]. This would particularly be the case when the borrowers are mostly private parties.

Note that the above definition of country risk encompasses the so-called sovereign risk which is defined as a risk that arises 'from events which are substantially under the control of a foreign sovereign government' (Ghose, 1988). Sovereign risk is direct when a foreign government is unwilling or unable to fulfill its overseas debt obligations. Indirect sovereign risk arises when a sovereign government influences the ability of the private borrowers in its territory to fulfill their debt obligations to foreign

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[1] See Hoti and AcAleer (2004). Earlier, the definition of country risk was narrowly focused on international lending, thus leaving aside the risk associated with foreign direct investment (FDI). For example, Kim (1993) defines country risk as `the credit risk of borrowers in a country as a whole viewed from a specific country perspective' (Kim, T.1993, pp. 382). Since the country specific factors affecting the success and failure of FDIs are not different from those affecting repayment of debt, the scope of this definition has been expanded to cover country specific risk factors that affect FDI decisions as well.

[2] In case of loans, the risk of loss may arise from several future actions of the borrowers including repudiation of debt, default, renegotiation, rescheduling, moratorium, technical default, and transfer risk. See Ghose (1988) for a detailed discussion,

[3] The relationship between the country risk and expected returns is examined by Erb *et al.* (1997)

lenders/investors. In both cases the risk exposure of foreign lenders or investors is amply influenced by sovereign risk and therefore the assessment of sovereign risk is a very important component of country risk analysis[4].

Political risk, a non-business risk arising out of political events and conditions in a country that could cause loss to international business, has been an important component of country risk analysis. Political events and conditions such as wars, internal and external conflicts, government regime change, terrorist attacks, and political legitimacy may seriously affect the profitability of international businesses and therefore constitute crucial elements in assessment of country risk[5]. Sometimes external factors also influence the political environment in a country and therefore the political risk[6]. For example, if a neighboring country is at war, it may increase the political fluidity of a country and may adversely affect its country risk assessment. Political risk is also intertwined with sovereign risk.

In contrast, economic and financial risks are associated with conditions and performances of the overall economy and the financial system[7]. However, they cannot be completely isolated from the political system or the political process in the country. The economic and financial factors that affect these risks are the outcomes of government's economic policies. For example, sound monetary and fiscal policy that promote low inflation, low unemployment, and low budget deficit or even surplus contribute to lower

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[4] See Ghose (1988) for a discussion on the importance of sovereign risk in country risk analysis.
[5] Brewer and Rivoli (1990) conclude that political instability as reflected by the frequency of regime change has significant explanatory power for perceived creditworthiness of a country.
[6] See Shanmugam (1990)
[7] In an early survey of country risk evaluation systems of major international banks, Burton and Inoue (1985) classify the economic factors into 'domestic economy-related variables', external economy-related variables' and 'external debt-related variables'.

country risk. Policies that are aimed at stabilizing the financial system also have positive impact on country risk assessment.

The country risk analysis results have been used as pre-lending as well as post-lending decision tools. Prior to lending, decisions such as whether or not to lend, how much to lend, and how much risk premium it should charge, are based on the measured risk. After lending, periodic country risk analysis serves as a monitoring device, providing a pre-warning system. The result of the analysis is also used to determine the need for bank loan portfolio adjustment and the discount prices of loans when they are sold in the secondary market. With increased capital mobility across the globe, particularly into the developing countries, the country risk analysis results have also been important for foreign direct investment. Further, as emphasized by Hayes (1998), the enhanced speed of contagion facilitated by this capital mobility and expanded international trade underlines the need for expanding the scope of country risk analysis[8].

This main objective of this paper is to present a survey of major quantitative methods used for evaluating country risk[9]. It also reviews selected empirical studies that use these quantitative techniques. Neither the survey of the methods nor the review of empirical studies is exhaustive in its coverage. Nevertheless, it provides an overview of the existing techniques and treatments and is expected to pave the way for further improvements in techniques used in country risk analysis.

The rest of this paper is organized as follows. Section 2 gives a brief historical background of country risk analysis and a brief description of current practices. Section 3 describes various techniques used for the analysis, with detailed discussion of the

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[8]The Tequila Crisis of 1994-95 that started in Mexico and the Asian Flu of 1997-98 that started in Thailand illustrate this enhanced speed of contagion.
[9] Saini and Bates (1984) provide an early survey of some of these techniques.

quantitative methods. A brief review of selected empirical studies is presented in section 4. Section 5 concludes the discussion.

2. HISTORICAL BACKGROUND OF COUNTRY RISK ANALYSIS

The history of country risk analysis goes back to the late sixties when Avramovic (1968) at the World Bank undertook a systematic examination of the factors that affect a country's balance of payments and, hence, its ability to service external debt. They suggested a combination of short-term and long-term indicators for evaluating a country's debt servicing capacity. They considered the following short-term indicators which are related to liquidity aspects of a country's ability to service its external debt: (1) growth rate of export volume, (2) the ratio of debt service payments to exports, and (3) the ratio of foreign exchange reserves to imports. The long-term indicators which were considered mainly to determine the conditions under which economic growth financed in part by foreign capital can succeed and thus provide for continuous servicing of external debt, included: (1) growth rate of GDP, (2) the ratio of investment to GDP, (3) the ratio of exports to GDP, and (4) the rate of price increases.

Prior to the first oil price shock (1973-74), most developing countries received foreign funds largely in the form of long-term, mostly concessional and project-related, loans from multilateral and bilateral official sources. After the first oil price shock, the resources of the official institutions proved insufficient to meet the large external imbalances developing countries began to experience and the commercial banks had to step in to meet these increasing needs. After the second oil price shock of 1979-80, most countries with large external debts experienced debt servicing problems. Since then the country risk analysis has increasingly become the focus of attention of not only banks and

international institutions, but also governments and the general public. At present most international banks and several independent agencies undertake country risk analysis[10]. These banks and agencies combine a range of qualitative and quantitative information into single country risk index or ratings.

3. METHODS USED FOR COUNTRY RISK ANALYSIS

The methods used by the banks and other agencies for country risk analysis can broadly be classified as qualitative or quantitative. However many agencies amalgamate both qualitative and quantitative information into a single index or rating. The data are collected from various sources that include expert panel, survey, staff analysis, and published data sources. The country risk index could be either ordinal or scalar. A survey conducted by the US Export-Import Bank in 1976 categorized various methods of country risk appraisal used mainly by the banks into one of four types: (1) fully qualitative method, (2) structured qualitative method, (3) checklist method, and (4) other quantitative method. Since our focus in this paper is on quantitative methods, we will only briefly discuss the other three categories.

The *fully qualitative method* usually involves an in-depth analysis of a country without a fixed format. It usually takes the form of a report that includes a general discussion of a country's economic, political, and social conditions and prospects. It is more of an ad hoc approach which makes it difficult for users to compare one country with another. One advantage of this method is that it can be adapted to the unique strengths and problems of the country under evaluation.

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[10] Some prominent country risk ratings providers include the Bank of America World Information Services, Business Environment Risk Intelligence (BERI), Control Risks Information Services (CRIS), Economist Intelligence Unit (EIU), Euromoney, Institutional Investor, Standard & poor's Rating Group (S&P), Political Risk Services: International Country Risk Guide, Political Risk services: Coplin-O'Leary Rating System, and Moody's Investors Service.

The *structured qualitative method* uses some standardized format with specifically stipulated scope and focus of analysis. Since it adheres to a uniform format across countries and is augmented by economic statistics it is easier to make comparisons between countries. Still, considerable subjective judgment has to be made by analysts. This method was the most popular among the banks during the late seventies. The political risk index provided by Business Environment Risk Intelligence (BERI) S. A. is an example of country risk rating by structured qualitative method[11].

The *checklist method* involves scoring the country under consideration with respect to specific variables that can be either quantitative or qualitative. In case of quantitative variables, the scoring requires no personal judgment or even first-hand knowledge of the country being scored. However, in case of qualitative variables, the scoring requires subjective determinations. Each item is scaled from the lowest to the highest score. The sum of scores is then used as a measure of country risk. It is possible to vary the influence that each component variable has on the final score by assigning a weight to each indicator; this is the *weighted checklist approach*[12]. The main advantage of this method is that the final summary score it yields is amenable to sophisticated quantitative treatment. Such exercises could provide valuable insight into the checklist's past accuracy in evaluating country risk. In recent years, this method has become popular with the banks and other country rating agencies.

3.1   *Quantitative Methods*

Several quantitative methods are being used for addressing various issues concerning country risk. For example, these methods can be useful in establishing relationships

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[11] Chart A.I in Appendix shows various components of this index.
[12] An example of the weighted checklist method is shown in Chart A.II of Appendix.

between political, economic, and financial factors on one hand and some indicator that reflects risk exposure or risky behavior on the other. Since the objective is to classify the countries under consideration into one or the other risk category, these methods are applied to data to identify patterns or/and factors that help assess the risk associated with a particular country. In most cases, the observable indicator of risky behavior or risk exposure takes the form of a discrete (mostly binary) choice variable (e.g. debt rescheduling or not, defaulting or not etc.) or values in a limited range, and the econometric approaches are usually different from simple regression analysis. Sometimes quantitative methods are also used to unveil the importance of various factors in the risk ratings of various agencies. These techniques are further used to evaluate the usefulness of country risk measures published by various banks and agencies in predicting major financial events. A few major approaches used in country risk analysis are discussed below along with their main advantages and shortcomings.

3.1.1   Discriminant Analysis

This method is used to classify countries into debt rescheduling and non-rescheduling countries by choosing appropriate variables. Let $X_1, X_2, ...X_k$ be a set of k explanatory variables. These k variables are assumed to have a multivariate normal distribution in each population. The discriminant function $Y = \sum_{i=1}^{k} B_i X_i$, $i = 1,2 ....k$ is a linear combination of the explanatory variables. B_i's are to be estimated in such a way that the ability of Y to differentiate between members of the two groups is maximized. This is done by maximizing the ratio of the weighted between-groups variance to the pooled within-groups variance of Y. Using the observations on X_i's, one can then obtain

the estimates of *Y* for each country. Performing this operation for each rescheduling and non-rescheduling country yields a frequency distribution of *Y*-values for each group from which mean *Y*-values are computed. Then a country is assigned to one group or to the other looking at the proximity of its *Y*-value to the respective mean values of the two groups. In most instances, there may be a few overlaps and statistical type I and type II errors may occur. Type I error occurs when debt rescheduling countries are incorrectly classified as non-rescheduling countries, whereas type II error occurs when non-rescheduling countries are incorrectly classified as rescheduling countries. Hence the next task is to determine the optimal cutoff or critical value for *Y* so that type I error or a combination of two errors can be minimized.

This is an example of predictive use of discriminant analysis. One major criticism of this approach is that the variables are assumed to have a multivariate normal distribution, which may not be true. In practice, the data may not often arise from a population having multivariate normal distribution.

3.1.2   *Principal Component Analysis*

In this approach, a large number of variables or indicators are replaced by a smaller set of composite indicators, known as principal components with special properties in terms of variances. For example, the first principal component is the normalized linear combination with maximum variance. Since the objective of the studies using this approach is to describe and analyze how countries differ with respect to various indicators which may be large in number, one way of reducing the number of variables to a manageable quantity is to discard the linear combinations which have small variances. The principal components give a new set of linearly combined variables, which show

considerable variation. Formally, suppose that we have k explanatory variables: X_1, X_2,...........X_k. Then we consider linear functions of these variables :

$$Z_i = \sum_{j=1}^{k} BjXj \qquad i = 1, 2, ...etc. \qquad (1)$$

Suppose we choose the B's in such a way that the variance of Z_1 is maximized subject to the condition that

$$\sum_{i=1}^{k} B_i^2 = 1 \qquad (2)$$

This is the normalization condition. This maximization exercise produces k solutions. Corresponding to these, we construct k linear functions $Z_1, Z_2, ..., Z_k$. These are called the principal components of the X's. They are then ordered so that

$$\text{var}(Z_1) > \text{var}(Z_2) > ...... > \text{var}(Z_k)$$

Z_1 with the highest variance is called the first principal component, Z_2 with the next highest variance is called the second principal component, and so on. One important property of Zs is that the sum of the variances of Zs is equal to the sum of the variances of Xs. Now if, for example, this analysis shows that two principal components account for a large part of the variation in the explanatory variables then by looking at the coefficients, we can identify the countries whether they are rescheduling debt or not. One problem with this method is that often it becomes difficult to interpret the principal components or the composite indicators.

3.1.3   Logit, Probit, and Tobit Analysis

Logit Model

The basic assumption of this approach is that the relationship between the probability of debt rescheduling and a set of explanatory variables can be described by the following functional form that represents a logistic distribution:

$$Pr(Y_i = 1) = P_i = \cfrac{1}{1 + exp\left[-\left(\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}\right)\right]}, \quad i = 1, 2, 3, \ldots\ldots, n \qquad (3)$$

where $\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}$ represents a linear combination of k explanatory variables and a set of coefficients $\boldsymbol{\beta} = (\beta_0, \beta_1, \ldots\ldots)$ which are to be estimated, $Y_i = 1$ for rescheduling cases and $Y_i = 0$ for non-rescheduling cases Note that i indexes country and n is the total number of countries. It is assumed that there is some linear combination of independent variables that is positively related to the probability of rescheduling. Thus, the higher values of $\beta_0 + \sum_{j=1}^{k} \beta_j X_{ij}$ indicate a higher probability of rescheduling, conditional on the country's values for explanatory variables. The coefficient vector $\boldsymbol{\beta}$ is estimated from the known values of explanatory and dependent variables since it is not known *a priori*.

There is another variation of this logit model used in country risk analysis. This is based on the observation that the country risk ratings that often range between 0 and 100 can be linked to P_i's, the probabilities of debt rescheduling (as in equation (3)). Generally, the higher the country risk rating the lower is the risk of debt rescheduling. Thus, the relationship between country risk rating R and P can be written as follows:

$$P_i = 1 - \frac{R_i}{100} \qquad (4)$$

where R_i is the country risk rating for country i and $0 \leq R_i \leq 100$. Then, suitable transformation of equation (3) yields

$$ln\left(\frac{1 - \frac{R_i}{100}}{\frac{R_i}{100}}\right) = \beta_0 + \sum_{j=1}^{k} \beta_j X_{ij} \qquad (5)$$

The above equation represents a linear regression model with transformed country risk rating scores as the dependent variable.

Of all the models discussed above, this approach has more desirable statistical properties for empirical work involving a binary-valued dependent variable for rescheduling and non-rescheduling cases. One serious limitation of this approach is that a common β is used for all countries. That is, we assume that the countries are homogeneous in nature, which may not be the case. To overcome this shortcoming Oral *et al.* (1992) suggested what they called the Generalized Logit Analysis.

Generalized Logit or G-LOGIT Model

The only difference with the Logit model is that in this model the coefficients, β's, are allowed to be different for different countries. The objective of the model estimation is to find values of β's that minimize the difference between the actual and predicted values of the country risk rating scores. Oral *et al.* (1992) develop a mathematical programming model to estimate the parameters β's. This model produces estimates of R_i's by minimizing various errors that result from over- or under-estimation of the parameters and from incorrect ordinal ranking of countries.

Probit Model

Probit analysis is very similar to the logit model except for the fact that the relationship between the probability of debt rescheduling and the explanatory variables is represented by a normal distribution function instead of a logistic distribution function. Thus,

$$Pr(Y_i = 1) = P_i = F(Z_i) = \int_{-\infty}^{Z_i/\sigma} \frac{1}{\sqrt{2\pi}} exp\left(-\frac{t^2}{2}\right) dt \tag{6}$$

where $Z_i = \beta_0 + \sum_{j=1}^{k} \beta_1 X_{ij}$ and σ is the standard deviation of the distribution to be estimated.

Both logit and probit analysis suffer from the lack of any explicit criterion for selecting the critical probability value for distinguishing rescheduling from non-rescheduling countries.

Tobit Model

The studies that use the logit and probit model are mainly concerned with predicting the *timing* of debt rescheduling by a developing country. However, using a Tobit model can help explain both the quantity and timing of a debt rescheduling. A Type 2 Tobit Model suggested for this purpose assumes that the probability of country *i* rescheduling its debt in a given time period can be represented by a probit equation:

$$Y_i^* = \beta_0 + \sum_{j=1}^{k} \beta_1 X_{ij} + \varepsilon_i \tag{7}$$

where Y_i^* takes the value 1 if rescheduling takes place and 0 otherwise, and X's are the variables that influence the rescheduling decision. The quantity of rescheduling is given by a linear regression:

$$Y_i = \begin{cases} \alpha_0 + \sum_{j=1}^{k} \alpha_1 Z_{ij} + \epsilon_i & if \ Y_i^* > 0 \\ 0 & otherwise \end{cases} \tag{8}$$

where Z's are variables that influence the quantity of debt rescheduled, Y_i. Note that $\varepsilon \rightarrow N(0,1)$ and $\epsilon \rightarrow N(0, \sigma^2)$. Both errors may be correlated and hence $E[\varepsilon_i, \epsilon_i] = \sigma_{12}$. Type 2 Tobit model that combines a probit model with a standard linear regression model is more flexible than Type 1 Tobit model.

3.1.4 Classification and Regression Tree (CART) Method[13]

In this approach, estimates are obtained through a series of sequential binary splits of a given set of countries, based on critical values of independent variables. To start with, a

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[13] This is essentially a clustering approach. There are other clustering method used for country risk analysis. For example. Yim and Mitchell (2005) use Ward's hierarchical clustering technique.

factor or an indicator is identified to split the countries into two distinct groups. This involves comparing a given country's score with the critical value of the discriminatory factor. These two groups are further split on the basis of other discriminatory factors and their critical values. This process continues until the entire group of countries is completely decomposed into purer or homogeneous groups. The final tree thus obtained is then used to estimate the country risk ratings of the countries. The country risk estimate for a given country is simply taken to be equal to the mean of the actual rating scores of the countries in the subgroup to which the country in question belongs. More specifically, let C_1, C_2, ..., C_p be the disjoint subgroups of countries identified by CART. Then the country risk estimate $\hat{r}_i$ for country i is given by

$$\hat{r}_i = \frac{\left(\sum_{j \in Cg} r_j\right)}{\left|C_g\right|} \tag{9}$$

for $i \in C_g$ and $g = 1, 2, ...p$

where $|C_g|$ is the number of countries in C_g.

3.1.5 Artificial Neural Network (ANN)

Artificial neural networks are also used for country risk analysis. An artificial neural network (ANN) is a computer model that mimics the brain's ability to classify patterns or to make forecasts based on past experiences[14]. It has a hierarchical structure with neurons or information-processing units organized in several layers. The first layer is the input layer and the final one is the output layer, interspersed with one or more intermediate hidden layers that progressively transform the original input stimuli into final output. The

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[14] ANNs have been used in hand-writing recognition, credit risk evaluation, credit card fraud detection and business forecasts.

multi-layer, feedforward ANNs, generally used for country risk analysis, are trained through an iterative process that brings the output (say, the probability of debt rescheduling by a country) sufficiently close to a desired or target level set by the researcher.

[Insert FIGURE 1]

Such an ANN can be illustrated by considering a simple 3-layer, feedforward ANN that comprises an input layer with I_j where $j = 1,2, \ldots J$; a hidden layer with H_k, $k = 1, 2, \ldots K$; and an output layer O. In Figure 1, we show an ANN with $J = 2$ and $K = 2$. In country risk analysis, each I_j would represent an explanatory variable for country risk rating. Let w_{jk} be the weight or the connection strength that links the jth input unit to the kth hidden unit and v_k be the weight that connects the kth hidden unit to the output unit. Suppose, for training purposes, n sets of inputs (2 explanatory variables for each of n countries) to the network with a set of desired or target output – say, some critical value of the rescheduling probability that discriminate the debt rescheduling countries from non-rescheduling countries. The inputs are processed to obtain the components of the hidden layer as follows:

$$H_k = F\left(\sum_j w_{jk} I_j\right) \tag{10}$$

These hidden layer components are further processed to obtain the output as follows:

$$O = G\left(\sum_k v_k H_k\right) \tag{11}$$

Substitution for H_k yields:

$$O = G\left[\sum_k v_k F\left(\sum_j w_{jk} I_j\right)\right] \tag{12}$$

This network is then fed with a set of inputs and an error is calculated as the difference between the desired and actual outputs. Thus, $e = D - O$ where D is the desired or target

level of output. Squaring all errors and summing over all n sets of inputs produces an error function given by:

$$E = \tfrac{1}{2}\Sigma_n\, e_n = \tfrac{1}{2}\Sigma_n(D_n - O_n) \tag{13}$$

The objective is to find a combination of w's and v's that minimizes E. One way is to use the back-propagation algorithm. The network is initialized with randomly selected weights so that it generates large errors when the input data are fed for the first time. These errors are then fed backwards through the network so that the weights can be updated. Each weight is updated by an amount proportional to the partial derivative of E with respect to that weight. The algorithm stops when E does nor decrease any more. This so-called 'gradient descent down the error surface' is accelerated by adding a momentum term that incorporates a proportion of the previous change in the weight.

Hybrid Neural Network

The ANN approach has been shown to be at least as good as, or even better than the traditional statistical models (Cooper 1999). In order to improve further the performance of this approach a hybrid neural network model has been suggested in the literature. This hybrid version combines statistical models with ANN: statistical models are used to select the variables to be used as inputs to the ANN. This procedure reduces the risk of overfitting and efficiently condenses information to be used in the neural network to generate output.

4.   REVIEW OF EMPIRICAL STUDIES

In this section, we briefly review some of the studies that use one or more of the techniques discussed in section 3.1.Most studies have very narrow focus. Broadly these

studies can be classified as having addressed one of the three issues: classifying the countries as debt rescheduling (defaulting) or non-rescheduling (non-defaulting) country; reproducing the country risk ratings of different agencies by using econometric/statistical models; and examining whether these country risk ratings can provide important guides to know about the financial market. Most studies provide in sample analysis of the issue they address. This considerably limits their usefulness for time series forecasting purposes.

[Insert TABLE 1]

Table 1 lists the dependent and independent variables used in these studies. There are 9 dependent and 122 independent variables in total. The choice of the dependent variable depends on which of the three issues mentioned above a particular study is intended to address. If the objective is to assess risk by classifying countries as debt rescheduling or non-scheduling countries then a dummy variable would be an appropriate dependent variable. In contrast, if the objective is to examine the usefulness of country risk rating as a tool for assessing international financial market then changes in financial variable such as exchange rate would be an appropriate dependent variable. Thus, the dependent variables included in the table are closely related to the objective of the particular study under review.

The independent variables can broadly be divided into 3 groups: (1) Economic and financial variables; (2) Political variables; and (3) Agency risk rating variables. Although there are several ways of further classifying the economic and financial variables, we subdivide them into 5 categories: (i) traditional macroeconomic variables including structural variables, (ii) general government variables, (iii) balance of payments

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variables, (iv) external variables, and (v) others[15]. Note that many of these economic and financial variables may be strongly correlated and the choice among them depends on the author(s)' judgment and justifications. Nevertheless, an exhaustive (or near-exhaustive) list of potential explanatory variables is useful for future researchers.

[Insert TABLE 2]

Table 2 lists a sample of 25 studies that are being reviewed for this survey[16]. It may be noted that binary choice models such as logit and probit have been the most popular among the country risk researchers. Some of the recent studies that have compared results from the use of different methods, however, show that although logit/probit model do reasonably well in correctly classifying countries as debt rescheduling and non-rescheduling categories some newer techniques such as ANN or a hybrid version of it may outperform these models.

5.   CONCLUSIONS

With globalization and financial integration, there has been rapid growth of international lending and foreign direct investment. Increased flow of capital to the developing countries has increased the risk exposure of the lenders and investors. Thus, country risk analysis has become extremely important for the international creditors and investors. In this paper, we briefly discuss the concepts and definitions that have evolved over time as the scope and coverage of country risk analysis have expanded. We present a survey of the quantitative methods used to address various issues related to country risk. We also present a summary review of selected empirical studies that use these techniques. While these studies display a distinct chronological pattern of gradual improvements in terms of

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[15] This classification scheme is similar to Table 1 of Yim and Mitchell (2005).
[16] Although we do not explicitly discuss simple linear multiple regression model in section 3.1, we include two studies that use multiple regression in Table 2.

technique and analytical competence none of them is adequate in terms of its scope and coverage.

It may be noted that the changes in global economic and financial environment make it imperative to look at new variables that may be important for assessing country risk. Furthermore, because of the advent of digital storage facility and the improvement in data collection, the researchers have access to enormous amount of data. Thus, together with enhanced computing capacity they can hope to apply better techniques to more extensive models of country risk appraisal.

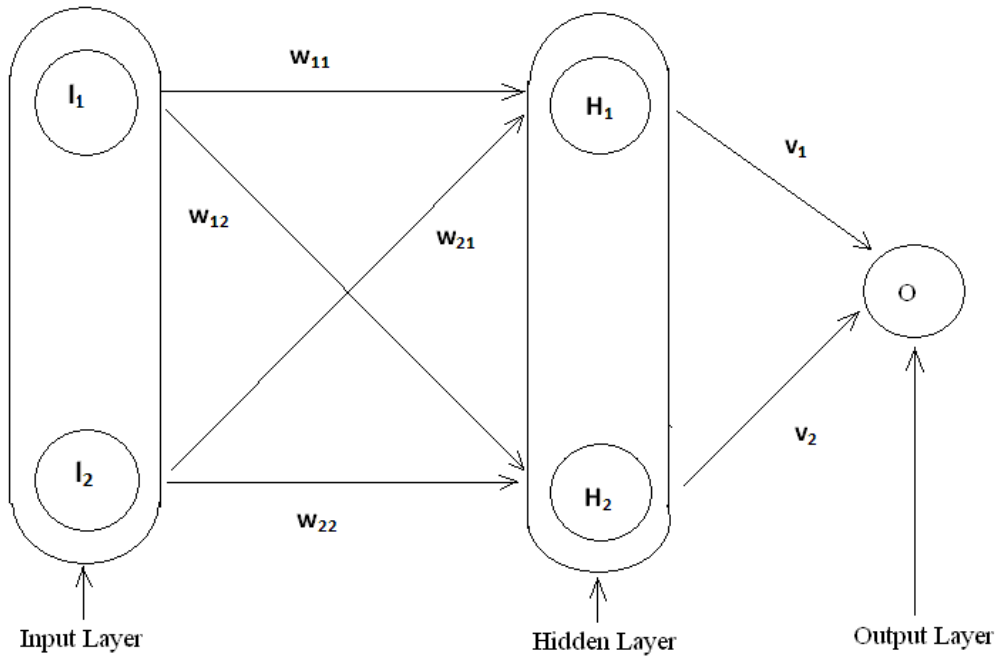Figure 1 – *A Simple Feedforward Artificial Neural Network*

TABLE 1 – *List of Dependent and Independent Variables*

A. Dependent variables	• Average grace period of new rescheduling
• Agency risk rating	• Average maturity of new rescheduling
• Change in the net position in US Direct Investment	• Average mark-up on current rescheduling
• Dummy variable that takes the value 1 if currency value drop by 10 % in one month and 0 otherwise	• Short-term debt to total bank debt ratio
• Dummy variable that takes the value 1 if currency value drop by 40 % in one month and 0 otherwise	• Foreign exchange reserves to IMF quota ratio
• Dummy variable that takes the value 1 if currency value gain by 10 % in one month and 0 otherwise	• Long-term borrowing to bank debt ratio
• Dummy variable that takes the value 1 if default takes place and 0 otherwise.	• Total bank borrowing to bank deposits ratio
• Dummy variable that takes the value of 1 if rescheduling takes place and 0 otherwise	• Indicator of default history (dummy variable that takes the value 1 if the country defaulted on external debt and 0 otherwise)
• Average value of debt rescheduling	• Debt-service payment to exports ratio
• Spread over LIBOR	• Amortization to debt service ratio
B. Independent variables	• Capital inflow to debt service ratio
1) *Economic and Financial Variables*	• Short-term external debt to exports ratio
1.1 Macroeconomic (including structural variables)	• Interest payments to exports ratio
• GNP/GDP per capita	• Amortization to total debt ratio
• Savings/GDP (%)	• Net resource transfer to GDP ratio
• Investment to GNP/GDP ratio	• External debt to reserves ratio
• Growth rate of real GDP	• Medium-term plus long-term bank debt to short-term bank debt ratio
• Growth rate of per capita GDP/GNP	• Undisbursed credit commitments to total bank debt ratio
• Growth rate of real investment	• Unallocated credits to total debt ratio
• Unemployment rate	• Medium and long-term debt to bank debt ratio
• Inflation rate	• Use of IMF credits to IMF reserves(quota) ratio
• Indicator of economic development (Dummy variable that takes the value 1 if the country is classified as industrialized by IMF and 0 otherwise)	• Reserves (excluding gold) to IMF quota ratio

- Interest rate on private loans
- Interest rate on all debts
- Rate of change of inflation
- Difference between GNP and GDP growth rates
- Outward orientation index

- Log population

- Income distribution index

- Agriculture share in GDP
- Savings investment ratio
- Long-run multiplier

- Residuals (domestic) - unluckiness

1.2 General Government

- Net government debt to GDP ratio

- Debt net of government deposits to GDP ratio

- Gross government debt to GDP ratio
- Budget surplus (deficit) to GDP ratio
- Primary balance to GDP ratio
- Government revenue to GDP ratio
- Government spending to GDP/GNP ratio
- Interest to GDP ratio
- Government debt held domestically to GDP ratio

1.3 Balance of Payments
- Current account receipts to GDP ratio
- Current account balance to exports ratio
- Current account balance to current account receipts ratio
- Net borrowing to current account receipts

- Reserves to GNP/GDP ratio
- Loan duration
- Loan value

- Reserves variability

- Rate of devaluation
- Debt service difficulties (dummy variable that takes the value 1 when a country ask some of its creditors for debt relief and 0 otherwise)
- Accumulated arrears to long-term debt ratio
- International reserves to debt outstanding and disbursed ratio

1.5 Others
- Growth rate of OECD countries
- Country group indicator (a dummy variable that takes the value 1 if the country belongs to group G and 0 otherwise)

2) *Political Variables*

- Political instability indicator (number of political strikes, riots, demonstrations, assassinations, coups d'etats, coup attempts)

- Lagged value of political risk

- Number of changes in the head of government
- Number of changes in the governing group
- Political rights scores
- Armed conflict scores
- Democracy
- Political instability

- High political violence

- Low political violence
- Assassinations
- Government crises

- Demonstrations

- Guerilla warfare

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ratio

- Reserves to imports ratio
- Import to reserves ratio
- Gross financing gap
- Current account balance to GNP/GDP ratio
- Export variability
- Export growth rate
- Imports to GNP ratio
- Import growth rate
- Terms of trade
- Export shares of raw materials

1.4 External

- Net FDI to GDP ratio
- Net external liabilities to exports ratio
- Gross external debt to exports ratio
- Net external debt to exports ratio
- Narrow net external debt to exports ratio
- Net public sector external debt to exports ratio
- Gross external debt to GNP/GDP ratio
- Net investment payments to exports ratio
- Net interest payments to exports ratio
- Number of external debt rescheduling
- Value of external debt rescheduling

- Purges
- Revolutions
- Riots
- Strikes
- Balkban's PI
- Political protest
- Successful and unsuccessful irregular executive transfer

3) *Agency Risk Rating Variables*

- ICRG political risk rating
- ICRG economic risk rating
- ICRG financial risk rating
- II semiannual risk rating
- Euromoney semiannual risk rating
- ICRG repudiation variable
- ICRG expropriation variable
- ICRG rule of law variable
- ICRG corruption variable
- ICRG bureaucracy variable
- PRS political turmoil risk rating
- PRS finance transfer risk rating
- PRS direct investment risk rating
- PRS export market risk rating

Note: II = Institutional Investor
ICRG = International Country Risk Guide
PRS = Political Risk Services

TABLE 2 – *Summary of Selected Empirical Studies*

Quantitative Method	Study	Dependent variable(s)	No. of independent variables	No. of countries	Sample period
Discriminant Analysis	1) Frank and Cline (1971) 2) Grinlos (1976) 3) Abassi and Taffler (1982) 4) Cooper (1999) 5) Yim and Mitchell (2005)	-	8 20 42 4 31	26 64 95 70 52	1960-68 1961-74 1967-78 1982-83 2002
Principal Component Analysis	1) Dhonte (1975)	-	10	82	1959-71
Logit Analysis	1) Feder and Just (1977) 2) Edwards (1984) 3) Brewer and Rivoli (1990) 4) Kutty (1990) 5) Cosset and Roy (1991) 6) Oral *et al.* (1992) 7) Brewer and Rivoli (1997) 8) Easton and Rockerbie (1999) 9) Cooper (1999) 10) Oetzel *et al.* (2001) 11) Yim and Mitchell (2005)	Dummy variable for default Spread over LIBOR Agency risk rating Dummy variable for default Agency risk rating Agency risk rating Dummy variable for rescheduling Dummy variable for default Dummy variable for rescheduling Dummy variables for 10 & 40% 1-month drop, and 10% 1-month gain in currency Agency risk rating	9 14 6 12 9 9 14 6 4 11 31	55 19 30 79 71 70 80 24 70 17 52	1965-72 1976-80 1967-86 1964-82 1987 1982-87 1980-90 1971-92 1982-83 1979-98 2002
G-LOGIT	1) Oral *et al.* (1992)	Agency risk rating	9	70	1982-87
Probit Analysis	1) Kharas (1984) 2) Rahnama-Moghadam *et al.* (1991) 3) Balkan (1992)	Dummy variable for rescheduling Dummy variable for rescheduling Dummy variable for rescheduling	4 4 13	43 16 33	1965-76 1980-87 1971-84

	4) Hernandez-Trillo (1995)	Dummy variable for default	7	33	1970-88
	5) de Haan *et al.* (1997)	Dummy variable for rescheduling	24	65	1984-93
	6) Easton and Rockerbie (1999)	Dummy variable for default	6	24	1971-92
	7) Cooper (1999)	Dummy variable for rescheduling	4	70	1982-83
	8) Yim and Mitchell (2005)	Agency risk rating	31	52	2002
Tobit Analysis	1) Lloyd-Ellis *et al.* (1990)	Dummy variable for rescheduling, Average value of rescheduling	8	59	1977-1985
	2) Lanoie and Lemarbre (1996)	Dummy variable for rescheduling, Average value of rescheduling	31	93	1989-90
CART	1) Oral *et al.* (1992)	Agency risk rating	9	71	1987
ANN	1) Chattopadhyay (199&)	Change in the net position of US direct investment	3	-	1988
	2) Cooper (1999)	Dummy variable for rescheduling	4	70	1982-83
	3) Yim and Mitchell (2005)	Agency risk rating	31	52	2002
Hybrid Neural Networks	1) Yim and Mitchell (2005)	Agency risk rating	31	52	2002
Multiple Regression	1) Lee (1993)	Agency risk rating	9	29	1986
	2) Cantor and Packer (19996)	Agency risk ratings and Spread	8	49	1995

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CHART A.I — *Example of Structured Qualitative Method*

The BERI Political Risk Index

Components
Political Factionalization
Linguistic/Ethnic/Religious Tension
Coercive Measure to Maintain Regime
Mentality : Nationalism, Corruption, Nepotism
Social Conditions : Population, Income Distribution
Radical Left Strength
Dependence on Outside Major Power
Regional Political Forces
Social Conflict
History of Regime Instability

Source: Harvey (1996), Appendices

The ICRG Composite Rating System

Political	Weight	Financial	Weight
Economic expectations versus reality	6%	Loan default or unfavorable loan restructuring	5%
Economic planning failures	6%	Delayed payment of suppliers' credits	5%
Political leadership	6%	Repudiation of contracts by government	5%
External conflict	5%	Losses from exchange controls	5%
Corruption in government	3%	Expropriation of private investments	5%
Military in politics	3%	*Total Financial Points*	25%
Organized religion in politics	3%	*Economic*	
Law and order tradition	3%	Inflation	5%
Racial and nationality tension	3%	Debt service as a % of exports of goods and services	5%
Political terrorism	3%	International liquidity ratios	3%
Civil War	3%	Foreign trade collection experience	3%
Political party development	3%	Current account balance as % of goods and services	8%
Quality of bureaucracy	3%	Parallel foreign exchange rate market indicators	3%
Total Political Points	50%	*Total Economic Points*	25%
		Overall Points	100%

Source: Erb *et al.* (1996) and Harvey (1996)