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A MULTICRITERIA DECISION AID METHODOLOGY FOR THE ASSESSMENT OF COUNTRY RISK

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ABSTRACT

Country risk assessment is a decision problem which has gained an increasing interest both from the macroeconomic and the microeconomic point of view, mainly during the last two decades. Banks and international lending institutions are interested in developing effective country risk models to determine the creditworthiness of countries. This paper presents the application of a multicriteria decision aid (MCDA) methodology based on the preference disaggregation analysis in country risk assessment. The application involves 66 countries derived from the World Bank tables. The objective is to develop a sorting as well as a ranking country risk model, according to a predefined four-group classification, provided by World Bank and the country risk rating of Euromoney.

KEYWORDS: Multicriteria analysis, Country risk, Preference disaggregation

INTRODUCTION

The world economic recession of the '70s and the '80s led to an unstable and uncertain international economic, political and social environment. Consequently, the expediting of international investment projects became doubtful, and the financing of the countries under development by banks and credit institutions became extremely risky, since many of these countries were unable to meet their debt service obligations. This situation has necessitated the development of effective methodologies which could be used by governmental officers, managers of banks and international credit institutions, as well as by investors, in order to identify in advance the countries which will not be able to fulfill their external debt commitments (Taffler and Abassi, 1984).

Recently the world economy has slowly, but progressively, started to upturn, and it is now mainly characterized by globalization. Moreover, the significant political and social transformations which took place all over the world during the last decade, have changed dramatically the world economic, political and social environment. Within this new context the evaluation of country risk preserves its significance, in order to analyze the world economic environment, to prevent future recessions, and to contribute to the global economic as well as living standard improvement.

The first sophisticated techniques to be applied in country risk assessment originated from the field of multivariate statistical analysis, including discriminant analysis (Frank and Cline, 1971; Grinols, 1976; Saini and Bates, 1978; Taffler and Abassi, 1984), factor analysis (Mumpower et al., 1987), regression analysis and regression trees (Cosset and Roy 1988;1989), cluster analysis (Mumpower et al., 1987), logit analysis (Feder and Just, 1977; Mayo and Barret, 1977; Saini and Bates, 1978; Taffler and Abassi, 1984), and principal components analysis (Dhonte, 1975).

Obviously the statistical approach has been widely applied in the past for country risk assessment. However, its practical applications are restricted by significant limitations. Saini and Bates (1984), in their review study of the application of statistical approaches in country risk assessment, remark that "no institution lending money to developing countries is placing exclusive reliance on a statistical model to guide its actions". According to the authors, there are at least five possible drawbacks of the statistical techniques and the related studies which have been conducted in the past, that justify the aforementioned remark: (i) the definition of the dependent variable: the classification of the countries in the rescheduling and the non-rescheduling ones is not always a realistic approach since it overlooks voluntary and non-voluntary reschedulings, as well as other substitutions for formal reschedulings, (ii) the reliance on debt information which is incomplete at least as far as it concerns the long term case, (iii) the statistical restrictions, such as the reduction of the original data, the determination of the importance of the explanatory variables, the difficulty in interpreting the obtained results, etc., (iv) the exclusion of important social and political factors from the analysis, the assumption of stable statistical relationships across countries, and the overlooking of the dynamic nature of the world economy, and (v) the poor predictability of the statistical models, since statistically significant variables were found to be inadequate in making accurate predictions.

To overcome these limitations and difficulties, new methodological approaches have to be introduced in the assessment of country risk. Amongst them, multicriteria decision aid methods (MCDA) constitute a significant tool which can be used as an alternative to statistical techniques. MCDA methods are free of the aforementioned restrictive statistical assumptions, they incorporate the preferences of the decision maker (managers of banks and international institutions) into the analysis of country risk, they are capable of handling qualitative social and political factors, and they are easily updated taking into account the dynamic nature of the world economy.

The MCDA methodologies which have already been applied in country risk assessment (a review is presented in the next section of this paper; cf. also Doumpos et al., 1997) studied the problem either from the ranking point of view, or the portfolio construction point of view. Their aim was to develop multicriteria decision models in order to rank a set of countries from the less to the more risky ones, or to develop models which could be used to construct a portfolio of countries that maximizes the return of an investment, and minimizes the associated risk.

This paper presents a more integrated approach for country risk assessment, providing both a ranking of countries as well as a sorting of them in classes of risk. This twofold objective is accomplished through the application of the preference disaggregation approach of multicriteria analysis (Zopounidis, 1997). More specifically, the UTASTAR method (UTilités Additives, Siskos and Yannacopoulos, 1985), the UTADIS method (UTilités Additives DIScriminantes, Devaud et al., 1980; Jacquet-Lagrèze and Siskos, 1982; Jacquet-Lagrèze, 1995; Zopounidis and Doumpos, 1997a) and three variants of the UTADIS method (UTADIS I, II and III, cf. Zopounidis and Doumpos, 1998) are applied in the evaluation of country risk, based on a sample of 66 countries. The UTASTAR method is used to develop a model which ranks the countries according to their economic performance, while the UTADIS method and its variants are used to classify the countries in predefined homogenous classes according once again to the countries' economic performance. The country risk rating provided by Euromoney was used in order to develop the ranking country model through the UTASTAR method, while

a classification of the countries provided by World Bank was used to develop the sorting country risk models through the UTADIS method and its variants.

This paper is divided in 4 sections. Initially, section 2 presents a brief overview of the applications of MCDA approaches in country risk assessment, and provides a description of the proposed preference disaggregation methodologies. Section 3, focuses on the application of the UTASTAR, UTADIS, UTADIS I, II, III methods in the assessment of country risk. Finally, in section 4 the concluding remarks as well as some future research directions are discussed.

MULTICRITERIA DECISION AID METHODOLOGY

The flexibility of MCDA methods, their adaptability to the preferences of the decision makers and to the dynamic environment of decisions related to country risk, as well as to the subjective nature of such decisions (Chevalier and Hirsch, 1981), has already attracted the interest of many researchers in developing more reliable and sophisticated models for country risk assessment. Generally, four different approaches can be distinguished in MCDA (Zopounidis, 1997): (i) the outranking relations, (ii) the multiattribute utility theory, (iii) the multiobjective programming, and (iv) the preference disaggregation.

The latter two approaches have already been applied in country risk assessment. Mondt and Despontin (1986) and Oral et al. (1992) proposed methodologies based on the multiobjective programming approach. More specifically, in their study Mondt and Despontin (1986) used the perturbation method, a variant of the well known STEM method (Benayoun et al., 1971), in order to develop a portfolio of countries which could be financed by a bank. On the other hand, Oral et al. (1992) proposed a goal programming formulation in order to estimate the parameters of a generalized logit model for country risk assessment, taking into account economic and political factors, as well as the geographical region of each country. Actually, one could consider this methodology as a preference disaggregation approach to country risk evaluation. The application of the preference disaggregation approach in country risk assessment was demonstrated in detail by Cosset et al. (1992). In their study Cosset et al. (1992) used the MINORA multicriteria decision support system (Siskos et al., 1993), which is based on the UTASTAR preference disaggregation method, in order to develop a model for assessing country risk. Finally, another study which applied the multicriteria decision aid framework in country risk assessment is that of Tang and Espinal (1989) who used a simple multi-attribute model to assess country risk. In order to develop this model, the authors had a cooperation with several expert analysts and using the Delphi method (Lindstone and Turoff, 1975) they determined the weights of the evaluation criteria.

However, all the aforementioned studies rely on economic, political and social data of the 1980s, which can hardly represent the current situation of the world economy. During the last decade there have been significant changes in the world economic and political environment, which have affected straightly the risk of each country. Consequently, new country risk models should be developed in order to consider the new conditions which govern the world economy. Furthermore, the advances in several scientific fields and more specifically in multicriteria decision aid, provide new powerful tools in the study of complex decision problems including country risk assessment. The exploitation of the capabilities that these advances provide could result in the development of more reliable country risk models, which can be used in real world cases by economic analysts of banks as well as from governmental officers, to derive real time estimations.

This is the basic motivation of the research which is presented in this paper. The aim is to provide an integrated analysis of the country risk of 66 countries, by ranking these countries from the most economically developed ones to the less economically developed countries, as well as by sorting them in classes according to their economic performance. In the first case (ranking) the UTASTAR method was used, while the sorting of the countries was achieved through the UTADIS method and three of its variants, referred to as UTADIS I, II and III. A brief description of these methods is presented below.

The UTASTAR method

The UTASTAR method, a variant of the UTA method (Jacquet-Lagrèze and Siskos, 1982), performs an ordinal regression based on the preference disaggregation approach of MCDA. Given a preordering of a set of alternatives (i.e. countries) defined by the decision maker, the aim of the UTASTAR method is to estimate a set of additive utility functions which are as consistent as possible with the decision maker's preferences. The additive utility function has the following form:

$$U(g) = \sum_{i=1}^{n} u_i(g_i)$$

where $g=(g_1, g_2, \ldots, g_n)$ is the vector of a country's performance on n evaluation criteria and $u_i(g_i)$ is the marginal utility of criterion g_i representing its relative importance in the ranking model. The estimation of the marginal utilities is achieved through the following linear programming formulation:

$$\text{Minimize } F = \sum_{a \in A} \left\{ \acute{o}^{+}(a) + \acute{o}^{-}(a) \right\}$$

s.t.

$$u[g(\alpha)] - u[g(\beta)] + \sigma^{+}(\alpha) - \sigma^{-}(\alpha) - \sigma^{+}(\beta) + \sigma^{-}(\beta) \geq \delta \qquad \text{if} \qquad \alpha \text{ is preferred to } \beta$$

$$u[g(\alpha)] - u[g(\beta)] + \sigma^{+}(\alpha) - \sigma^{-}(\alpha) - \sigma^{+}(\beta) + \sigma^{-}(\beta) = 0 \qquad \text{if} \qquad \alpha \text{ is indifferent to } \beta$$

$$\sum_{i} \sum_{j} w_{ij} = 1$$

$$w_{ij} \geq 0, \sigma^{+}(\alpha) \geq 0, \sigma^{-}(a) \geq 0, u_i(g_i^{*}) = \sum_{k=1}^{a_i - 1} w_{ik} \quad \forall a \in A, \ \forall i, j$$

where A is the set of reference countries used to develop the additive utility model, $u[g(\alpha)]$ is the global utility of a country $a \in A$, σ^{+} and σ^{-} are two error functions, δ is a threshold used to ensure the strict preference of a country a over a country β, a_i is the

number of subintervals $[g_i^j, g_i^{j+1}]$ into which the range of values of criterion g_i is divided, and w_{ij} is the difference $u_i(g_i^{j+1}) - u_i(g_i^j)$ of the marginal utilities between two successive values g_i^j and g_i^{j+1} of criterion g_i ($w_{ij} \geq 0$). In a second stage the method proceeds in a post-optimality analysis to identify other optimal or near optimal solutions which could better represent the preferences of the decision maker. A detailed description of the UTASTAR method can be found in Siskos and Yannacopoulos (1985).

The UTADIS method

The UTADIS method, a variant of the UTA method, is well adapted in the study of classification problems. The basic difference between the two methods is that, instead of comparing each alternative (country) with the others so that a predefined ranking can be reproduced as consistently as possible through an additive utility model, the UTADIS method performs comparisons between the alternatives and the utility thresholds which are used to distinguish the classes so that the alternatives can be classified in their original class with the minimum misclassification error. In this case the estimation of the additive utility model and the utility thresholds is achieved through the following linear programming formulation.

$$\text{Minimize } F = \sum_{a \in C_1} \sigma^+(a) + \ldots + \sum_{a \in C_k} \left[\sigma^+(a) + \sigma^-(a)\right] + \ldots + \sum_{a \in C_Q} \sigma^-(a)$$

s.t.

$$u[g(a)] - u_1 + \sigma^+(a) \geq 0 \qquad \forall a \in C_1$$

$$\left.\begin{array}{l} u[g(a)] - u_{k-1} - \sigma^-(a) \leq -s \\ u[g(a)] - u_k + \sigma^+(a) \geq 0 \end{array}\right\} \quad \forall a \in C_k$$

$$u[g(a)] - u_{Q-1} - \sigma^-(a) \leq -s \qquad \forall a \in C_Q$$

$$\sum_{i=1}^{m} \sum_{j=1}^{\alpha_i - 1} w_{ij} = 1$$

$$u_{k-1} - u_k \geq s \qquad k = 2, 3, \ldots, Q-1$$

$$w_{ij} \geq 0, \ \sigma^+(a) \geq 0, \ \sigma^-(a) \geq 0$$

where $C_1, C_2, \ldots, C_Q$ are the Q ordered predefined classes (C_1 the best, C_Q the worst), u_1, $u_2, \ldots, u_{Q-1}$ are the corresponding utility thresholds which distinguish the classes (i.e. the utility threshold u_k distinguishes the classes C_k and C_{k+1}, $\forall k \leq Q-1$), σ^+ and σ^- are two misclassification error functions, s is a threshold used to ensure that $u_{k-1} > u_k$ ($s > 0$), and δ is a

threshold used to ensure that $u[g(\alpha)] < u_{k-1}$, $\forall a \in C_k$, $2 \leq k \leq Q-1$ ($\delta > 0$). The w_{ij} and a_i have the same meaning as in the UTASTAR method. A detailed description of the method can be found in Devaud et al. (1980) and Zopounidis and Doumpos (1997a).

Zopounidis and Doumpos (1998) proposed a variant of the UTADIS method (referred as UTADIS I) which apart of minimizing the misclassification errors, also accommodates the objective of maximizing the distances (variation) of the global utility of an alternative (country) from the utility thresholds. This is achieved through the following linear program:

$$\text{Minimize } F = p_1 \sum_a \left[\sigma^+(a) + \sigma^-(a)\right] - p_2 \sum_a \left[d^+(a) + d^-(a)\right]$$

s.t.

$$u[g(\alpha)] - u_1 + \sigma^+(a) - d^+(a) = 0 \qquad \forall a \in C_1$$

$$\left.\begin{array}{l} u[g(a)] - u_{k-1} - \sigma^-(a) + d^-(a) = -\delta \\ u[g(a)] - u_k + \sigma^+(a) - d^+(a) = 0 \end{array}\right\} \qquad \forall a \in C_k$$

$$u[g(\alpha)] - u_{Q-1} - \sigma^-(a) + d^-(a) = -\delta \qquad \forall a \in C_Q$$

$$\sum_{i=1}^{m} \sum_{j=1}^{a_i - 1} w_{ij} = 1$$

$$u_{k-1} - u_k \geq s \qquad k = 2, 3, \ldots, Q-1$$

$$w_{ij} \geq 0,\ \sigma^+(a) \geq 0,\ \sigma^-(a) \geq 0,\ d^+(a) \geq 0,\ d^-(a) \geq 0$$

where d^+ and d^- are the distances between the global utilities and the utility thresholds, and p_1 and p_2 are weighting parameters of the two objectives of minimizing the misclassification errors and maximizing the distances.

Both methods, UTADIS and UTADIS I, minimize the number of misclassified alternatives in an indirect manner, assuming that minimizing the misclassification errors (in terms of distances) will also minimize the number of misclassifications. However, this is not always the case. A more direct approach would be to minimize the number of the misclassified alternatives using a variant of the UTADIS method (referred as UTADIS II). In this case the two misclassification errors $\sigma^+(\alpha)$ and $\sigma^-(\alpha)$ in the LP model of the UTADIS method are transformed into two boolean variables $M^+(a)$ and $M^-(a) \in \{0,1\}$ indicating the misclassification of the alternatives (countries). If an alternative is correctly classified then $M^+(a) = 0$ and $M^-(a) = 0$, otherwise, if $M^+(a) = 1$ or $M^-(a) = 1$ then the alternative is misclassified. Consequently, the objective is to minimize the number of misclassified

alternatives (the sum of $M^+(a)$ and $M^-(a)$, $\forall a \in A$), with the same constraints of the LP model which was presented in the UTADIS method (replacing the $\sigma^+(\alpha)$ and $\sigma^-(\alpha)$ with $M^+(a)$ and $M^-(a)$ respectively).

Combining this formulation with the objective of maximizing the distances of the correctly classified alternatives from the utility thresholds (UTADIS I) results to another variant of the UTADIS method, which is referred as UTADIS III. The aim of UTADIS III is to minimize the number of classifications and maximize at the same time the distances of the correctly classified alternatives from the utility thresholds. The LP formulation which is used to achieve this objective is similar to the LP formulation of the UTADIS I method. The only difference is that similarly to the UTADIS II method, the misclassification errors $\sigma^+(\alpha)$ and $\sigma^-(\alpha)$ are transformed into two boolean variables $M^-(a)$ and $M^-(a) \in \{0,1\}$. The new LP formulation is the following

$$\text{Minimize } F = p_1 \sum_a \left[M^+(a) + M^-(a)\right] - p_2 \sum_a \left[d^+(a) + d^-(a)\right]$$

s.t.

$$u[g(\alpha)] - u_1 + M^+(a) - d^+(a) = 0 \qquad \forall a \in C_1$$

$$\left.\begin{array}{l} u[g(a)] - u_{k-1} - M^-(a) + d^-(a) = -\ddot{a} \\ u[g(a)] - u_k + M^+(a) - d^+(a) = 0 \end{array}\right\} \qquad \forall a \in C_k$$

$$u[g(\alpha)] - u_{Q-1} - M^-(a) + d^-(a) = -\ddot{a} \qquad \forall a \in C_Q$$

$$\sum_{i=1}^{m} \sum_{j=1}^{a_i - 1} w_{ij} = 1$$

$$u_{k-1} - u_k \geq s \qquad k = 2, 3, \ldots, Q-1$$

$$w_{ij} \geq 0,\ M^-(a) \text{ and } M^-(a) \in \{0,1\},\ d^+(a) \geq 0,\ d^-(a) \geq 0$$

APPLICATION

All the aforementioned methodologies (the UTASTAR and the UTADIS, I, II, and III methods) are applied in the assessment of country risk, in order to develop country risk models for the ranking and sorting of a set of 66 countries according to their economic performance.

Data and methodology

This application involves the assessment of the country risk of 66 countries from different geographical regions all around the world. More specifically, the sample data includes 18 European countries, 16 countries from Asia, 15 countries from Africa, 15 countries from America, and finally two countries from Oceania. These countries were selected among the 133 countries which are included in the World Bank tables. The selection was based on the availability of the data of the countries, in order to have a complete sample of data. The period of the analysis involves the year 1994. The data of this specific year were the most recent that could be obtained during the period that this research was conducted.

The countries are evaluated along 12 criteria, including 10 economic indicators, the political risk, as well as a development level indicator concerning the life expectancy. The data concerning the economic indicators and the life expectancy were drawn from the World Bank tables (World Bank Development Indicators of 1996), while the data regarding the political risk were drawn for the estimations of Euromoney. More specifically, the 12 evaluation criteria which are used in this case study are the following:

1. *Current account balance as percentage of Gross National Product (GNP)*: This variable is related to the probability of default, since the current account deficit represents the amount of new financing that a country requires. Consequently, countries with large account deficits are more likely to default.

2. *Exports average annual growth rate*: For most countries, especially those of high income economies, exports are the main source of foreign exchange earnings. Consequently, countries with high average annual growth rate are more capable in meeting their commitments regarding their foreign debt. The computation of this criterion was based on the exports of the countries during the period 1980-1994.

3. *Imports average annual growth rate*: Unlike exports, imports lead to loss of foreign exchange earnings. This criterion represents the imports' average annual growth rate during the period 1980-1994.

4. *GNP per capita*: GNP per capita is a very common criterion used in country risk assessment. It represents the country's level of development, indicating the flexibility of a country in reducing the consumption. Countries with low income economy are expected to be more inflexible in reducing the consumption which can result in debt service difficulties, and therefore default.

5. *Average annual growth rate of GNP per capita*: This criterion provides a dynamic measurement of the development of a country. In this case study it represents the evolution of the GNP per capita during the period 1980-1994.

6. *Gross domestic investment*: Gross domestic investment is strictly related to the development of a country. Domestic investments contribute directly to the GNP growth, and furthermore they conduce to the decrease of unemployment (Calverley, 1990).

7. *External debt as percentage of GNP*: External debt represents the commitments of each country to its debtors. This ratio represents the size of the debt in relation to

the economy's resources. Therefore, the higher the ratio the greater the probability of a country to default.

8. *Gross international reserves as percentage of GNP*: Gross international reserves (international reserves excluding gold) are the main mean for servicing foreign debt. Developed countries are expected to have more international reserves available than countries of low income economies.

9. *Reserves to imports ratio*: Possible fluctuations in foreign exchange receipts may result in significant debt servicing problems for a country. On the other hand, reserves provide a protection to such fluctuations, at least for the short-term, since the larger reserves to imports, the larger is the amount of reserves which is available for the payment of the external debt.

10. *Net foreign debt to exports ratio*: As already mentioned exports constitute the main source of foreign exchange earnings for a country. On the other hand, net foreign debt, measured as the foreign debt minus reserves, represents the debt load of a country. Therefore, a high net foreign debt to exports ratio means that the country could be exposed to significant debt servicing problems due to foreign exchange earning crises.

11. *Life expectancy*: Life expectancy provides an acceptable general measure of the socio-economic development of countries. Countries of significant economic as well as social development are expected to have high life expectancy, while on the contrary the life expectancy of countries facing essential social and economic problems is low.

12. *Political risk*: The evaluation of the countries according to their political risk was drawn from Euromoney. Euromoney polls risk analysts, risk insurance brokers and bank credit officers and asks them to give each country a score between 25 and zero. A score of 25 indicates no political risk, while zero indicates that there is high political risk. Countries are scored in comparison both with each other and with previous years.

The criteria involving the imports' average annual growth rate, the external debt as percentage of GNP and the net foreign debt to exports, have negative rates, which means that the higher the values of these criteria the more likely is for a country to default. On the contrary, all the other evaluation criteria have positive rates, which means that the higher the values of these criteria, the higher is the overall economic performance of a country.

Of course the World Bank tables also include many other indicators (more or less significant), regarding the overall economic performance of each country, including detailed trade indicators, economic growth indicators, external economic indicators, and balance of payments indicators, among others. However, the evaluation of country risk in this case study had to be based on a finite, flexible and acceptable set of evaluation criteria which could sufficiently describe the overall socio-economic and political situation in each country. Hence, the aforementioned 12 evaluation criteria where selected upon their relevance in country risk assessment based on previous studies which have been presented by academic researchers in

this field (Mumpower et al., 1987; Cosset and Roy, 1989; Oral et al., 1992; Cosset et al., 1992).

The World Bank apart from the valuable data that it provides concerning the indicators which affect the countries' socio-economic development, it also provides a grouping of the countries based mainly on their economic performance. More specifically, the World Bank classifies the countries in four major groups:

- High income economies (group C_1): This group includes 20 countries, mostly western European ones, as well as United States, Canada, Japan, Australia, New Zealand and Israel. These countries are considered as the world's top economies, with a stable political and social environment.

- Upper-middle income economies (group C_2): Ten countries are included in this second group. These countries can not be considered as developed ones neither from the economic nor from the socio-political point of view. However, they do have some positive perspectives for future development. The countries which belong in this group include two European countries (Greece and Hungary), South-Eastern Asian countries such as South Korea and Malaysia, as well as countries located in Latin and South America such as Mexico, Brazil, Chile, etc.

- Lower-middle income economies (group C_3): This group includes 18 countries, located in Europe (Romania and Poland), Asia (Indonesia, Philippines, Jordan, Thailand, Turkey, etc.), Africa (Morocco, Algeria, Tunisia) and South-Latin America (Bolivia, Guatemala, Ecuador, El Salvador, Peru, etc.). These countries are facing economic as well as social and political problems, which make their future doubtful and uncertain.

- Low income economies (group C_4): This final group consists of 18 countries facing significant problems from any aspect (economic, political or social). Such countries include Asian countries (Nepal, Bangladesh, India, Pakistan, etc.), African countries (Kenya, Mali, Nigeria, Senegal, etc.) and Nicaragua.

This grouping of the countries was used as input to the UTADIS, I, II, and III methods, in order to develop classification country risk models representing the evaluation methodology and policy which is followed by the top officers of the World Bank.

Moreover in order to develop a ranking country risk model through the UTASTAR method, the country risk rating of Euromoney was used. Euromoney provides country risk assessments based on nine categories of indicators that fall into three broad groups: analytical, credit and market indicators. This indicators include the economic data of the countries, their political risk, debt indicators, credit ratings, and access to capital markets among others. Based on these indicators, a simple weighted average model is used to rank the countries according to their creditworthiness from the best to the worst ones. The country risk rating provided by Euromoney is considered as a reliable estimation which has already been used in many previous studies of country risk assessment.

This Euromoney's country risk rating was used as input to the UTASTAR method in order to develop the country risk model to rank the countries according to their

creditworthiness. It is worth noting that the ranking provided by Euromoney depicts some differences compared to the grouping provided by World Bank. Some countries that the World Bank considers to be of low income economy, such as China and India, according to Euromoney they have a higher country risk rating than most of the countries that the World Bank considers to be of lower-middle economy and even than some of countries with upper-middle income economy.

PRESENTATION OF RESULTS

Following the methodology that was described above the UTADIS, I, II, III, and UTASTAR methods were applied in the sample data of the 66 countries under consideration to develop a sorting and ranking country risk models according to the grouping and the ranking provided by World Bank and Euromoney respectively. The obtained results of the five methods are presented in this section.

Results of the UTADIS method

The additive utility model developed through the UTADIS method is fully consistent with the predefined grouping of the countries according to their economic performance, which is related to the risk and the creditworthiness of a country. All countries are classified by the model in the group they actually belong, resulting in a classification accuracy of 100%. Furthermore, the model also provides the competitive level between the countries of the same class. More specifically, according to the global utilities of the countries, the most creditworthy and economically developed ones are Switzerland, Norway, Belgium, Netherlands, Denmark and Japan. The global utilities of these countries were over 0.96. South Korea and Greece were found to be the best countries amongst the upper-middle income economies group. The global utilities of these two countries (0.9153 and 0.9142 respectively) are very close to the utility threshold (0.9167) that distinguishes the high income economies from the upper-middle income economies. South Korea is located in a geographical region (East Asia) with a significant economic improvement during the last decades, while Greece is a member of the European Union which has financed several major investment projects for this country. These are the basic characteristics that distinguish these two specific countries from the other upper-middle income economies. Thailand, Costa Rica and Peru were found to be the best in the lower-middle income economies group. Finally, Nicaragua, Malawi and Cameroon were found to be countries with the higher country risk. Table 1, presents in detail the obtained results, as well as the original and the estimated classification of the countries.

TABLE 1: CLASSIFICATION RESULTS OBTAINED THROUGH THE UTADIS METHOD

Countries	Original class	Utility	Estimated Class
Switzerland	C_1	0.9692	C_1
Norway	C_1	0.9658	C_1
Belgium	C_1	0.9645	C_1
Netherlands	C_1	0.9619	C_1
Denmark	C_1	0.9618	C_1
Japan	C_1	0.961	C_1
Italy	C_1	0.9608	C_1
Australia	C_1	0.9607	C_1
Austria	C_1	0.9599	C_1
United States	C_1	0.9597	C_1
France	C_1	0.9594	C_1
U.K.	C_1	0.9591	C_1
Sweden	C_1	0.9585	C_1
Finland	C_1	0.9581	C_1
Canada	C_1	0.9518	C_1
Israel	C_1	0.946	C_1
Ireland	C_1	0.9403	C_1
New Zealand	C_1	0.9377	C_1
Spain	C_1	0.9365	C_1
Portugal	C_1	0.9174	C_1
u_1		0.9167	
Korea, Rep.	C_2	0.9153	C_2
Greece	C_2	0.9142	C_2
Uruguay	C_2	0.8101	C_2
Mexico	C_2	0.7778	C_2
Hungary	C_2	0.7476	C_2
Chile	C_2	0.7313	C_2
Trinidad & Tobago	C_2	0.7312	C_2
Malaysia	C_2	0.7294	C_2
Mauritius	C_2	0.6979	C_2
Brazil	C_2	0.6723	C_2
u_2		0.6723	
Thailand	C_3	0.6391	C_3
Costa Rica	C_3	0.6227	C_3
Peru	C_3	0.5837	C_3
Tunisia	C_3	0.573	C_3
Poland	C_3	0.5682	C_3
Turkey	C_3	0.5294	C_3
El Salvador	C_3	0.5288	C_3
Algeria	C_3	0.5278	C_3
Ecuador	C_3	0.5166	C_3
Papua-New Guinea	C_3	0.5133	C_3
Jordan	C_3	0.5107	C_3
Guatemala	C_3	0.5103	C_3
Dominican Republic	C_3	0.5086	C_3
Morocco	C_3	0.5062	C_3
Romania	C_3	0.5032	C_3
Indonesia	C_3	0.4952	C_3
Philippines	C_3	0.493	C_3
Bolivia	C_3	0.4639	C_3
u_3		0.4636	
Egypt	C_4	0.4622	C_4
Sri Lanka	C_4	0.4621	C_4
India	C_4	0.4385	C_4
Pakistan	C_4	0.4358	C_4
China	C_4	0.433	C_4
Ghana	C_4	0.4303	C_4
Senegal	C_4	0.4254	C_4
Bangladesh	C_4	0.4173	C_4
Kenya	C_4	0.4168	C_4
Nepal	C_4	0.4134	C_4
Ivory Coast	C_4	0.3988	C_4
Mali	C_4	0.3767	C_4
Mauritania	C_4	0.3766	C_4
Nigeria	C_4	0.3737	C_4
Togo	C_4	0.3552	C_4
Cameroon	C_4	0.3542	C_4
Malawi	C_4	0.3495	C_4
Nicaragua	C_4	0.2056	C_4

The GNP per capita, was found to be the dominant factor in the classification of the countries, with a weight of over 50% (52.141%). This is in accordance with the findings of other studies related to country risk assessment, which have also concluded in the same result (Cosset and Roy, 1989; Oral et al., 1992). The rest of the evaluation criteria have rather similar significance in the developed classification model, ranging from 1.409% for the exports' average annual growth rate, to 7.966% for the net foreign debt/exports ratio. Furthermore, the significance of the GNP per capita in the classification of the countries in this case study, is also confirmed by the fact that according to the data of the 66 countries under consideration, this specific criterion is able to provide an accurate classification. More specifically, all the high income economies have a GNP per capita over $9,320 (Portugal); the GNP per capita for the upper-middle income economies ranges between $2,970 (Brazil) and $8,260 (South Korea). Similarly, the GNP per capita of the lower-middle and low income economies ranges between $770 (Bolivia) and $2,500 (Turkey) and $170 (Malawi) and $720 (Egypt) respectively.

Results of the UTADIS I method

The different objective between UTADIS I and UTADIS leads to results which differ from the corresponding results obtained through the UTADIS method, although the classification accuracy is once again 100%.

The global utilities of the high income economies are very close to 1 (most of the global utilities are over 0.999), so that the distance from the utility threshold (0.4784) is maximized. Only Portugal's global utility is close to the utility threshold. The rest of the high income economies obtain global utilities over 0.7102. Concerning the upper-middle income economies Greece and South Korea were found to be the most creditworthy and economically sound countries in this group. This result was also obtained through the UTADIS method. Turkey, Poland, Costa Rica and Thailand were found to be the less risky countries within the group of lower-middle income economies, while Malawi, Nepal and Bangladesh are the most risky countries. Table 2 presents in detail the obtained results, as well as the original and the estimated classification of the countries.

TABLE 2: CLASSIFICATION RESULTS OBTAINED THROUGH THE UTADIS I METHOD

Countries	Original class	Utility	Estimated Class
Switzerland	C_1	1	C_1
Norway	C_1	1	C_1
Japan	C_1	0.9999	C_1
Netherlands	C_1	0.9999	C_1
Belgium	C_1	0.9999	C_1
France	C_1	0.9999	C_1
U.K.	C_1	0.9998	C_1
Sweden	C_1	0.9998	C_1
Austria	C_1	0.9998	C_1
Finland	C_1	0.9997	C_1
United States	C_1	0.9997	C_1
Denmark	C_1	0.9997	C_1
Italy	C_1	0.9996	C_1
Australia	C_1	0.9995	C_1
Canada	C_1	0.9995	C_1
Israel	C_1	0.8229	C_1
Ireland	C_1	0.728	C_1
Spain	C_1	0.7186	C_1
New Zealand	C_1	0.7102	C_1
Portugal	C_1	0.4785	C_1
u_1		0.4784	
Greece	C_2	0.4774	C_2
Korea, Rep.	C_2	0.4774	C_2
Uruguay	C_2	0.3979	C_2
Mexico	C_2	0.356	C_2
Hungary	C_2	0.3266	C_2
Trinidad & Tobago	C_2	0.3187	C_2
China	C_4	0.0426	C_4
Ivory Coast	C_4	0.0381	C_4
Senegal	C_4	0.0377	C_4
Mauritania	C_4	0.0271	C_4
Nicaragua	C_4	0.0244	C_4
Pakistan	C_4	0.0235	C_4
Ghana	C_4	0.0213	C_4
India	C_4	0.016	C_4

Countries	Original class	Utility	Estimated Class
Chile	C_2	0.2997	C_2
Malaysia	C_2	0.2959	C_2
Mauritius	C_2	0.2674	C_2
Brazil	C_2	0.2526	C_2
u_2		0.2526	
Turkey	C_3	0.2119	C_3
Poland	C_3	0.2039	C_3
Costa Rica	C_3	0.2038	C_3
Thailand	C_3	0.2038	C_3
Peru	C_3	0.1777	C_3
Tunisia	C_3	0.1505	C_3
Algeria	C_3	0.1378	C_3
Jordan	C_3	0.1195	C_3
El Salvador	C_3	0.1133	C_3
Dominican Republic	C_3	0.1107	C_3
Romania	C_3	0.1059	C_3
Ecuador	C_3	0.1058	C_3
Guatemala	C_3	0.0994	C_3
Morocco	C_3	0.0945	C_3
Papua New Guinea	C_3	0.0937	C_3
Philippines	C_3	0.078	C_3
Indonesia	C_3	0.0678	C_3
Bolivia	C_3	0.0523	C_3
u_3		0.0522	
Egypt	C_4	0.0512	C_4
Sri Lanka	C_4	0.0508	C_4
Cameroon	C_4	0.0445	C_4
Togo	C_4	0.0134	C_4
Nigeria	C_4	0.01	C_4
Kenya	C_4	0.008	C_4
Mali	C_4	0.0072	C_4
Bangladesh	C_4	0.0057	C_4
Nepal	C_4	0.0037	C_4
Malawi	C_4	0.0003	C_4

Concerning the significance of the evaluation criteria in the sorting model developed through the UTADIS I method, the GNP per capita is clearly the dominant factor with a weight of 98.62%. This extreme weight is fully justifiable, since as its has been already observed, in this specific case study, the GNP per capita is able by itself to provide an accurate classification of the countries in the four classes of risk defined by the World Bank. The weights of the other evaluation criteria are less than 1%.

Results of the UTADIS II method

The additive utility model developed by the UTADIS II method is very similar to the model which was developed through the UTADIS method. This new model is also able to provide a correct classification of the countries to the classes to which they belong, providing a classification accuracy of 100%. The global utilities of the countries are a little bit lower than the global utilities which were calculated through the UTADIS method, but they are still similar. Switzerland was once again found to be the most creditworthy country with global utility of 0.9692, followed by Japan (with global utility 0.9579), United States (with global utility 0.9566), The Netherlands (with global utility 0.9529), and United Kingdom (with global utility 0.9504). On the contrary, Nicaragua was found the be the most risky country (with global utility 0.2026), followed by Malawi (with global utility 0.2866) and Togo (with global utility 0.3309).

The significance of the evaluation criteria is also very similar to corresponding results obtained through the UTADIS method. More specifically, the GNP per capita is once again the most important criterion for the evaluation of country risk. Its weight is the same with the weight which was estimated using the UTADIS method (52.141%). Among the rest of the evaluation criteria the most significant ones were found to be the current account balance as percentage of GNP and the imports' average annual growth rate with weights 8.713% and 7.386% respectively.

Results of the UTADIS III method

The final method which is applied in this case study in order to asses country risk, is the UTADIS III method. This method's objective is to minimize the number of misclassification, and at the same time to maximize the distances of the correctly classified countries from the utility thresholds.

As in all of the previous variants of the UTADIS method, the developed additive utility model developed through the UTADIS III method, is also able to correctly classify the 66 countries under consideration to their original class. The obtained results, as expected, are very similar to the results of the UTADIS I method. There are some small differences in the global utilities of the countries, but overall, both the global utilities as well as the marginal utilities of the evaluation criteria are very similar. In this new model, the weight of the GNP per capita is 98.78%. Only two other criteria are considered by the model; the life expectancy and the current account balance as percentage of GNP, with weights of 1.114% and 0.106% respectively. All the other evaluation criteria are not included in this model.

Comparison with Discriminant Analysis

For comparison purposes, discriminant analysis was also applied in the sample of countries under consideration in order to develop a discriminant model to classify the countries in their original class. Discriminant analysis is a well known multivariate statistical method for the study of classification problems. The objective of performing the discriminant analysis was to examine how a different statistical approach could perform in this specific case study compared to the UTADIS method and its variants. Using the discriminant analysis, three discriminant functions were developed. The standardized canonical discriminant function coefficients are presented in Table 3.

TABLE 3: STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTS

	Function 1	Function 2	Function 3
Current account balance as percentage of GNP	0.45885	-0.04456	-0.16249
Exports average annual growth rate	0.11630	0.31303	0.10225
Imports average annual growth rate	0.22316	-0.25159	0.08784
GNP per capita	-0.52407	0.57905	-0.24871
Average annual growth rate of GNP per capita	0.16006	0.25970	0.72630
Gross domestic investment	0.02591	-0.01777	0.58668
External debt as percentage of GNP	-0.46660	-0.66440	-0.29804
Gross international reserves as percentage of GNP	0.56902	0.31611	0.98785
Reserves to imports ratio	-0.00288	-0.23087	-1.25469
Net foreign debt to exports ratio	-0.53252	-0.05670	0.55342
Life expectancy	0.30895	-0.01538	0.31106
Political risk	0.1828	0.18540	-0.60543

The developed discriminant model based on these three discriminant functions is unable to correctly classify all countries in their original class. More specifically, there are 9 misclassified countries, resulting in an overall classification accuracy of 86.36%. On the contrary, as already presented, the UTADIS, I, II, and III methods were all able to provide an accurate assignment of each country to its original (predefined) class (classification accuracy 100%). This result clearly depicts the superiority of the preference disaggregation approach over the discriminant analysis, at least in this specific case study.

A detailed error analysis of the results obtained by the discriminant analysis is presented in Table 4. The first part of Table 4 presents how the classification of the countries was made by the discriminant functions. The diagonal represents the correct classifications, while all the other elements represent the differences (misclassifications) between the actual classification of the countries and their classification by the discriminant functions. The second part of Table 4 presents the same kind of information expressed as percentage of the number of countries which are included in each original class.

TABLE 4: ERROR SUMMARY OF THE CLASSIFICATION RESULTS OBTAINED BY DISCRIMINANT ANALYSIS

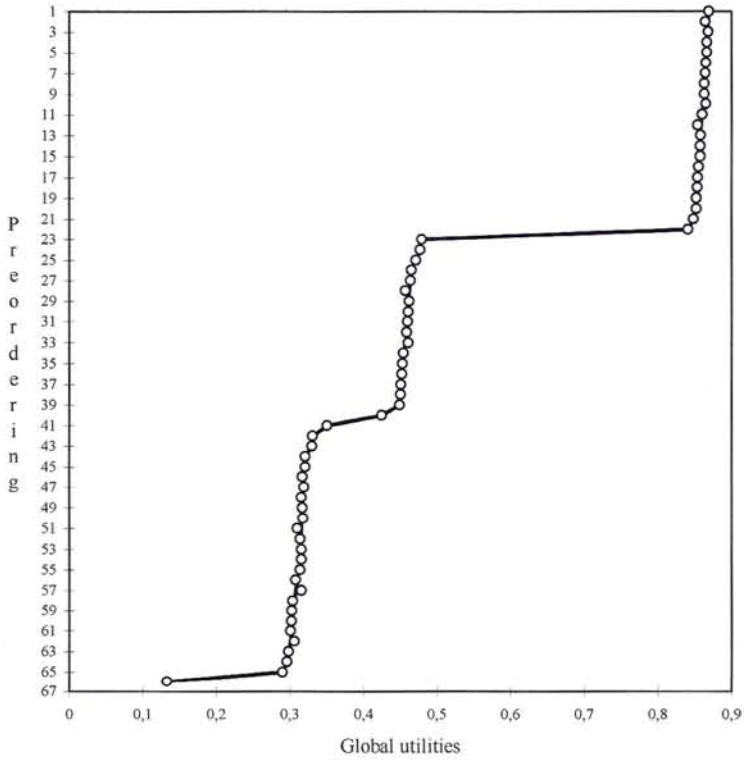
		Estimated class							
		C_1	C_2	C_3	C_4	C_1	C_2	C_3	C_4
Original class	C_1	19	1	-	-	95.0%	5.0%	-	-
	C_2	-	8	2	-	-	80%	20%	-
	C_3	-	2	15	1	-	11.1%	83.3%	5.6%
	C_4	-	-	3	15	-	-	16.7%	83.3%

Results of the UTASTAR method

The additive utility model which was developed using the ranking provided by Euromoney was unable to represent consistently the evaluation policy of the officers of Euromoney. More specifically, the ranking obtained by the developed additive utility model depicted some differences with the initial ranking of Euromoney. These inconsistencies are justified by the differences between the evaluations provided by Euromoney and the corresponding estimations of World Bank. Nevertheless, the inconsistencies of the developed country risk model are not considered to be significant ones. The most significant inconsistency concerns Nepal. According to the Euromoney's country risk rating Nepal was ranked in the 57th place among the 66 countries of this case study. The additive utility model which was developed through the UTASTAR method ranks Nepal in the 50th place. However, it should be noted that the difference between the global utility of Nepal (0.316) and the global utility of Senegal (0.308) which is ranked in the 57th place is small (0.008). Consequently, although Nepal is ranked higher by the developed model, its score (global utility) is still similar to other under-developed countries.

The similarity between the rankings of Euromoney and the model is also confirmed using the Kendall's τ rank correlation coefficient. The value of Kendall's τ is 0.961, very close to 1, showing that there is a significant consistency between the two rankings. Figure 1 illustrates the countries' ranking versus their global utilities estimated by the UTASTAR method.

FIGURE 1: COUNTRIES' RANKING VERSUS GLOBAL UTILITIES



According to the global utilities of the 66 countries under consideration, three major groups can be distinguished. The first one includes 22 countries whose global utility is over 0.8. This group includes all the high income economies, except Israel, and three countries which are considered by World Bank as upper-middle economies (South Korea, Malaysia and Chile). The second group includes 18 countries with global utilities ranging between 0.425 and 0.479. Most of these countries are of upper-middle income economy. Additionally, this group also includes Israel (high income economy), Thailand, Indonesia, Philippines, Poland, Morocco and Turkey, which are considered by World Bank as lower-middle income economies. Finally, the third group consists of 26 countries with global utilities below 0.35. These countries are considered as lower-middle and low income economies. In this group of risky countries, the most untrustworthy one was found to be Nicaragua, with global utility 0.133.

The significance of the evaluation criteria in the ranking model developed through the UTASTAR method differs from the importance of the evaluation criteria in the classification models developed through the UTADIS method and its variants. More specifically, the most important criterion in the ranking model developed by the UTASTAR method is the political risk followed by the gross domestic investment, the net foreign debt/exports and the import's average annual growth rate, with weights 55.454%, 12.111%, 11.959%, and 11.927% respectively. This result is in accordance with the decision policy of the Euromoney's

managers, who considers the political risk as the most important criterion in their country risk rating.

CONCLUDING REMARKS

This paper has presented an alternative approach for the analysis and evaluation of country risk. The proposed methodology based on the preference disaggregation approach of multicriteria decision aid, constitutes a flexible tool which can be used by economic analysts, managers of banks and international credit institutions, in order to derive integrated estimations concerning the assessment of country risk.

The country risk problem in this application was studied as a ranking as well as a sorting problem. In both cases the obtained results are very satisfactory since the obtained country risk models are consistent with the preferences and the decision policy of two international institutions, namely the World Bank and Euromoney. The use of the five methods (UTADIS, I, II, III and UTASTAR), illustrated their ability in deriving flexible decision models taking into account the preferences of the decision makers. The decision maker plays a significant role in the decision process by interacting with the methods to take decisions in real time. Furthermore, these methods are free of restrictive statistical assumptions, they are able of incorporating in the decision process qualitative social and political factors, and they can be easily adapted to the changes in the decision environment. Finally, the proposed methods compared to other MCDA methods (ELECTRE, PROMETHEE, etc.) need significantly less information involving only the determination of a preordering of the countries according to their creditworthiness and economic performance, or an a priori classification of a reference set of countries in classes of risk. This information (preordering or classification) can be easily obtained based on past decisions that the decision maker has already taken.

Based on this approach a multicriteria decision support system (MCDSS), such as the FINCLAS system (FINancial CLASsification, cf. Zopounidis and Doumpos, 1997b) could be developed to provide real time support in the study of decision problems related to country risk assessment. Using the three powerful disaggregation methods presented in this paper, and based on economic, social and political indicators, the FINCLAS system could provide integrated support to analysts in the study of country risk, either by ranking the countries according to their creditworthiness and economic performance, or by classifying them into classes of risk.

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