JOINT DEFAULT PROBABILITIES AND COUNTRY RISK

Bert Scholtens and Daphne Hameeteman

SOM-theme E: Financial markets and institutions

Abstract

The assessment of country risk is of crucial importance for both developing countries and international lenders and investors. Many existing country risk approaches are opaque and heavily rely on subjective choices. In general, they lack a theoretical basis. To assess country risk, we use the Merton model in which a loan defaults if the value of a firm’s assets falls below the amount due to the loan. In a portfolio context, this implies that default correlations warrant the utmost attention. We find that country default correlations are significant and low. Furthermore, joint defaults tend to be clustered in Latin American and Eastern European transition countries, but not in Asia.

1 Introduction

As a consequence of the emerging market crises in the 1980s and 1990s, and as a result of increasing financial integration, country risk analysis has become a growing field of interest. Both for the host countries and for international lenders and investors, it is of crucial importance that the assessment of country risk takes place on a sound and objective basis. Transparency and good governance are important conditions for (renewed) access to international financial markets (Easterly, 2002). In its new guidelines to promote safety and soundness of the international financial system, the Basel Committee (2001) suggests to develop sophisticated risk models. However, there is no standard approach in the financial industry to country risk analysis. For example, balanced-score cards, ratings, structural models, interest yields and yield spreads all are used to assess country risk (see Caouette et al., 1998). Crucial ingredients of risk management practices and incentives are the correlations of the returns on loans and loan portfolios, which determine the achievable degree of diversification (Stulz, 1998). Traditional methods of country risk assessment usually do not comply with these criteria. Furthermore, they lack a sound theoretical basis. The Basel Committee emphasizes the significance of the contribution of a default correlation in portfolio modeling in their guidelines on credit risk modeling: the more highly default correlated the portfolios, the less portfolio risk will be reduced when diversification is desired. Our aim is to offer a theoretical basis for country risk analysis and to include default correlation in country risk modelling.

Basically, default correlations are estimated in two ways. The first approach uses historical data (Lucas, 1995). The problems with this approach are well known: First, there usually are not enough time-series data available to accurately estimate country default correlations. Second, it does not use country-specific information and, therefore, cannot recognize that the default correlation between, for example, Argentina and Venezuela could be very different from that between Argentina and the Philippines. Third, default correlations are time-varying, so past history may not reflect the current reality. The second approach is based on the work of Merton (1974). His option-theoretic approach to default considers that equity holders have the option to sell the firm's assets rather than to repay the debt if the asset value gets below the debt value. The basic idea is that loan default occurs if the market value of the firm's assets falls below the amount due to the loan. Within the context of a portfolio of borrowers, the default correlation measures the strength of the default relationship between two borrowers. It is constructed using the correlation of the borrowers' returns, and both borrowers' default probabilities. Gersbach and Lipponer (1999) and Li (2000) use this approach for corporate borrowers. Gordy (2000) and Zhou (2001) discuss different types of default risk models. We will try to use the second approach – the Merton model of default risk – for country risk analysis.

Country risk is even more difficult to model than credit risk for several reasons. First, the lack of a liquid market makes it difficult to price country risk for a specific obligor and tenor. Second, although countries do present national accounts, because of valuation issues, these cannot be used in a similar ways as the accounts of corporations. Third, countries cannot technically go into bankruptcy in the way that corporations can. We aim at developing an alternative method to derive country default correlation on the basis of models that successfully have been used to assess credit risk. Our approach fundamentally differs from a previous attempt by Baig and Goldfajn (1999). They determine a country default correlation by calculating the correlation between sovereign spreads, where the spread is an indication for default risk. However, in crisis periods, a significant liquidity premium can get incorporated into the spread. This psychological factor may disturb the outcome. Our approach also differs from the one suggested by Cumby and Pastine (2001). They derive an implied default probability for sovereign bonds on the basis of the market price of bonds and US Treasury rates. They focus on different features of each individual bond (such as different coupons, maturities, amortization schedules, collateral, etc.). As such, Cumby and Pastine develop a measure of credit risk for (sovereign) bonds, instead of analyzing *country* risk. Karmann (2000) uses an option approach to analyze debt (values) of individual countries. Nordal (2001) applies the real options approach to include country risk indices in the valuation of investments.

This paper is organized as follows. Section 2 gives the methodology to derive the country default correlation. In fact, we elaborate upon two alternatives: the historical default correlation and the expected default correlation. The asset value is crucial in the Merton model of default risk. As such, section 3 argues why foreign exchange reserves are used as our proxy for a country’s assets. Section 4 discusses the dataset. Section 5 gives the results of our analysis. Section 6 concludes.

2. Methodology

This section goes into the methodology used for constructing a country default correlation coefficient (CDC). This correlation coefficient is an attribute of a pair of countries, signaling the extent to which these two countries are in default at the same moment in time. A correlation of 1 indicates that if country X defaults, country Y does too. Two different approaches are used to derive the country default correlation coefficient and we will compare the two throughout the remainder of this paper. The first approach is based on a statistical analysis of past default events: the historical default correlation. The second approach is based on a country pair's asset correlation and expected default frequency: the expected default correlation.

2.1 Default correlation

Consider two random variables $D_1(t)$ and $D_2(t)$ that describe the default status of two countries, country 1 and country 2, over a given time horizon t:

$$D_i(t) = \begin{cases} 1 & \text{if country } i \text{ defaults by } t, \\ 0 & \text{otherwise.} \end{cases}$$

Assuming the independence of default events, the joint default probability of the two countries is $P(D_1(t) = 1 \text{ and } D_2(t) = 1) = P(D_1(t) = 1) * P(D_2(t) = 1)$. When examining the joint probability, however, it is reasonable to assume that when one country defaults, the other country may have a higher likelihood of defaulting. Thus, the two countries may have a positive default correlation. We define the default correlation Corr ($D_1(t)$, $D_2(t)$) as

$$Corr[D_1(t), D_2(t)] = \frac{E[D_1(t) * D_2(t)] - E[D_1(t)] * E[D_2(t)]}{\sqrt{Var[D_1(t)] * Var[D_2(t)]}} \qquad (1)$$

Because $D_1(t)$ and $D_2(t)$ are Bernoulli binomial random variables, we have

E [$D_i(t)$] = P ($D_i(t)$ = 1),

Var [$D_i(t)$] = P ($D_i(t)$ = 1) x [1 - P ($D_i(t)$ = 1)].

From Equation (1), we have

P($D_1(t)$ =1 and $D_2(t)$ =1) = E [$D_1(t)$ * $D_2(t)$)

= E [$D_1(t)$] * E [$D_2(t)$] + + Corr [$D_1(t)$,$D_2(t)$)]

(Var [$D_1(t)$] * Var [$D_2(t)$])^{½} . (*2*)

For example, if P ($D_1(t)$ = 1) = E[$D_1(t)$] = 10% (i.e., country 1 has a 10% probability of default), and P ($D_2(t)$ = 1) = E [$D_2(t)$] = 2%, the joint default probability of both countries, assuming their independence, is 10% * 2% = 0.2%. However, if the default correlation equals 0.3, the joint probability of country default would equal 1.5%. The latter is more than 7 times as large as the former. Thus, default correlation can have a large impact on the probability of joint default events.

Of course, we are well aware of the fact that the correlation coefficient is a rough indicator. It is a measure for the association of random variables that are more or less continuous. One may doubt this assumption in the present case. The underlying phenomenon of default is rather opaque as it can be operationalized in many ways. Moreover, the coefficient is symmetric with regard to two countries. However, these drawbacks do not relate specifically to country defaults. As our aim is to formally analyze country risk with a method that is widely used in analyzing credit risk, we will leave them aside for the time being.

2.2 Historical default correlation

This approach is based on a statistical analysis of past default events. To this extent, we return to Equation (1). To solve for Corr [$D_1(t)$,$D_2(t)$)], we need E [$D_1(t)$ * $D_2(t)$]. With this first approach, the joint default probability is calculated as the number of years in which two countries are in default, divided by the total number of years in the sample period, minus 1. This can be estimated directly from our observations.

The second term in Equation (1), E [$D_1(t)$] * E [$D_2(t)$], represents the probability of joint country default when the default events are uncorrelated. By unraveling the numerator, we know that the correlation is positive when the probability of joint default (E [$D_1(t)$ * $D_2(t)$]) is greater than E [$D_1(t)$] * E [$D_2(t)$], and negative when the probability of joint default is less than E [$D_1(t)$] * E [$D_2(t)$]. As such, we have a very straightforward approach to country default correlation. The problems with this approach are well known (see Zhou, 2001). Most important is that usually there are not enough time-series data available to accurately estimate the default correlations. Furthermore, the default correlations are time-varying, so past history may not reflect the current reality, let alone the reality of expectations regarding the future. Our second approach aims at dealing with both these two shortcomings.

2.3 Expected default correlation

In section 2.2, we based the country default correlation on historical default data. In this section, we use a transformation model. This model is based on KMV (1998) and Gersbach and Lipponer (1999). The former calculate the default correlation between two borrowers. Gersbach and Lipponer (1999) specify this model in their study on how to determine correlations of bank loan defaults. This literature is based on the work of Merton (1974). According to Merton (1974), loan default occurs if the market value of the firm's assets falls below the amount due to the loan. The default correlation measures the strength of the default relationship between two borrowers. The default correlation between two borrowers is constructed with use of the correlation of the borrowers' returns, and both borrowers' default probabilities.

The model we use here is, just like the historical default correlation, based on Equation (1). The main difference is that the variables in the equation are to be calculated in quite a different manner: In this second approach, the default correlation between two countries depends on the *joint default probability* and their *expected default frequencies*. These can be derived as follows. We start with defining the default event:

$$D_{1,t} = \begin{cases} 1 & \text{if } A_{1,t-1} * (1 + R_{1,t}) < L_{1,t}, \\ 0 & \text{otherwise.} \end{cases}$$

Where $D_{1,t}$ is the default event of country 1 in period t, $A_{1,t-1}$ the asset value of country 1 at the end of period t-1, $R_{1,t}$ – calculated as $(A_{1,t} - A_{1,t-1}) / A_{1,t-1}$ – the asset growth of country 1 in period t, and $L_{1,t}$ is the critical value of country 1 in period t. The expected default frequency (EDF) is defined as

$$EDF_{1,t} = P[A_{1,t-1} * (1 + R_{1,t}) < L_{1,t}] = \Phi[\varepsilon_{1,t} < c_{1,t}] \qquad (3)$$

Where $EDF_{1,t}$ is the default probability, and Φ[ ] is the cumulative density function of the standard normal distribution with $\varepsilon_{1,t}$ as an error term and $c_{1,t}$ as a critical value below which the country defaults. The probability under the critical value is equal to the EDF. Consequently, by knowing the EDF, we can define a country's critical value $c_{1,t}$.

With a joint default event, we need the default points of both defaulting countries. The joint default probability (JDP) indicates the probability that the relevant assets of country 1 and 2 fall below their individual default points (or critical values), indicated by:

$$JDP(1,2) = P[A_{1,t} < L_{1,t}, A_{2,t} < L_{2,t}] \quad (4)$$

By implementing the asset correlation between two countries and both their EDF’s, we are able to calculate their joint default probability. The expected default correlation (EDC) is given in equation (5):

$$EDC_{1,2} = \frac{JDP_{1,2} - EDF_1.EDF_2}{\sqrt{EDF_1.(1 - EDF_1) * EDF_2(1 - EDF_2)}} \quad (5)$$

Here, the EDF_i (expected default frequency) is similar to $D_i(t)$ (default probability), and the JDP (1, 2) (joint default probability) has the same meaning as E $[D_1(t) * D_2(t)]$. However, recall that $D_i(t)$ is based on historical default events. As to the expected default correlation, we derive the default probabilities (or EDF’s) from country ratings, published by renowned rating agencies. The EDF indicates the probability of default within one year, in line with the ratings. Ratings are an important independent variable in credit models (see Caouette et al., 1998). Rating changes are significantly correlated with changes in default rates (Okashima and Fridson, 2000).

To summarize, with the historical default correlation, we calculate E $[D_1(t) * D_2(t)]$ on the basis of historical default events. With the expected default correlation, the joint default probability is constructed on the basis of, first, the asset correlation and, second, the expected default frequency of two countries.

3. Foreign Exchange Reserves as Country Assets

The assets of a country are a key variable in the methodology discussed in the previous section. However, this variable is a rather abstract notion. Unlike a company, a country hardly has any assets that can be liquidated in case of default as it most of the time has no direct access to the securities, investments, etc. of its inhabitants. Therefore, we have to come up with a proxy. To this extent, one can consider a country's assets in an international context from two different perspectives (Krugman and Obstfeld, 1997). First is the country's means of generating (export) earnings (for example, production capacity and natural resources). However, the sovereign seldom has direct access to this component. Therefore, this approach is not very fruitful within the context of this paper. Second is the international liquidity of a country, for a large part consisting of the foreign exchange reserves that are held by the country. It exactly is this item that is within the *de facto* control of the sovereign. Therefore, we opt for the foreign exchange reserves as our proxy for the assets of a country. Data on foreign exchange reserves generally are widely available and are provided on a short-term notice by institutions such as the International Monetary Fund.

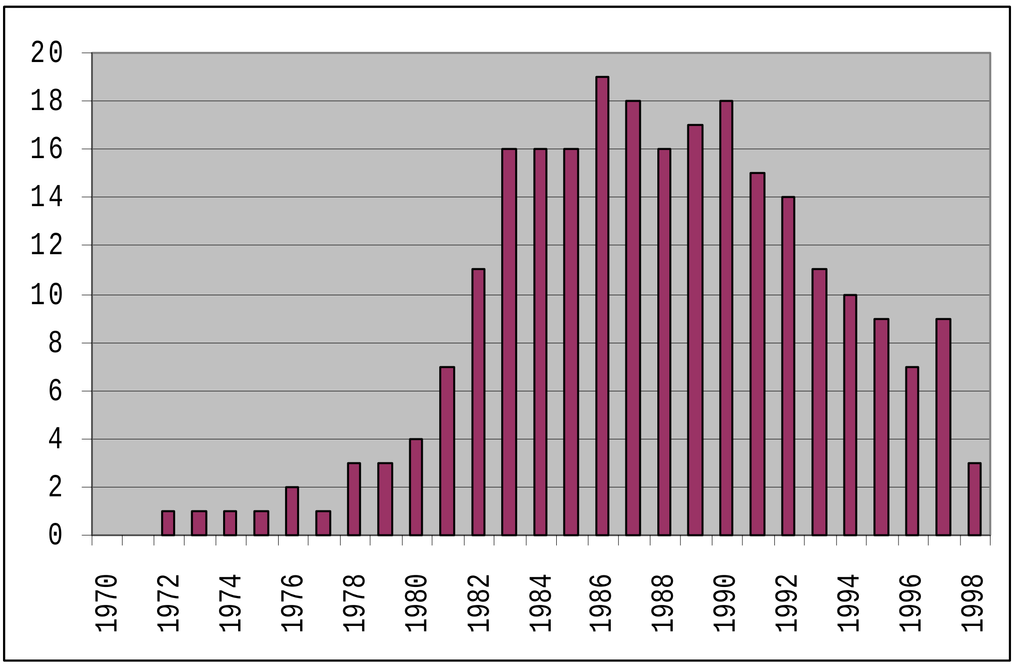
The foreign exchange reserves (FXR) of a country will generally decline to a certain 'critical level' before the country will default. The ability of a country to repay its foreign debt depends on both the solvency and liquidity of the country (see Eaton et al., 1986). Unlike insolvency, illiquidity is directly observable by looking at the direct usable reserves of a country, which consist of the foreign exchange reserves. Other macro economic variables, such as for example GDP-growth or inflation rate, lack the direct connection with country default and, in our opinion, are no suitable candidates to act as a proxy for a country's assets. The importance of the FXR for a country's 'well-being' is also underlined by others. For example, Feldstein (1999) argues that liquidity is the key to self-protection against the devastating effects of crises. A country that has substantial international liquidity, i.e. large foreign exchange reserves, is less likely to be subject to country default given the fact it wishes to maintain a fixed exchange rate (Krugman and Obstfeld, 1997).

In all, we feel it is justified to take the foreign exchange reserves (FXR) as a proxy for a country's assets. Consequently, $R_{1,t}$ from Equation (3) above will represent the growth of the FXR of country A. We assume that FXR growth is normally distributed. On the basis of the FXR (growth) correlation between two countries, and their expected default frequencies (derived from published country ratings), we can calculate the joint default probability. By substituting this JDP in Equation (5), we calculate the country default correlation (section 5).

4. Data

We selected 37 countries (see Appendix A.1). These countries are included in the IMF's classifications of "developing countries", "countries in transition", and the advanced economies of Hong Kong Special Administrative Region (SAR) of China, Korea, Singapore, Taiwan Province of China and Japan. We selected the countries on the basis of the availability of monthly data of foreign exchange reserves and of their country ratings, as published by Standard & Poor's and the Institutional Investor. We analyze a period of 29 years: 1970-1998. This period includes three major emerging market crises: the 1982 debt crisis, the 1994 balance of payments crisis, and the 1997/1998 Asia crisis. Our 29-year period includes 249 country default events. We obtained these records from Standard and Poor's (S&P) and Salomon Brothers. They include private lending – through bonds, suppliers' credits or bank loans - to sovereign nations. S&P defines default as the failure to meet a principal or interest payment on the due date (or within the specified grace period) contained in the original terms of the debt issue. Salomon Brothers identifies extended periods (six months or more) where all or part of interest and/or principal payments due were reduced or rescheduled. Although these definitions slightly differ, we feel free to combine them to a single country default dataset. The end of each period of default or rescheduling was recorded when full payments were resumed or when a restructuring was agreed upon. Periods of default or rescheduling within five years of each other were combined. We are aware of the fact that a disadvantage of this approach is that default periods can become very extended. Figure 1 gives the distribution of the 249 country default events of the 37 countries during 1970-1998. Figure 1 shows that the number of country defaults exploded in the early 1980s. It gradually fell in the 1990s. The foreign exchange reserves data used in this study are derived from the IMF (*International Financial Statistics*), both yearly and monthly data (IFS-line 11.d).

Figure 1: Number of country defaults of 37 countries (see Appendix A.1), 1970-1998



To calculate a country's default probability, we use the country rating lists of the rating agencies Standard and Poor's (alphabetical, from CC to AAA, with AAA indicating no risk) and Institutional Investor (numerical, from 0-

100, with 100 indicating no risk) (see Trevino and Thomas, 2000). On the basis of research by Oliver, Wyman & Company, we assign a default probability to every S&P-rating. The S&P ratings only go back to 1992. Therefore we need the Institutional Investor (I.I) ratings as they go back until 1978 (Ul Haque et al., 1996). We match the S&P ratings on those of the I.I to cover a time period, as large as possible, for which we need the country default probabilities. Matching is done with an ordered dependent variable model. Within this model, we use the ordered logit method, as this has the least sum square errors. Within the numerical I.I rating, we calculate 19 categories for which every I.I category exactly matches one of the S&P-ratings. The ratings in the period 1970-1977 are equalized to those of 1978. The rating data are summarized in Appendix A.2. The ratings (and, therefore, the EDF's too) concern a period of one year.

5. Results

First, we present the results of our country default correlation calculations between 37 countries worldwide, for the period 1970-1998. Then, we go into the question whether the expected default correlation is better suited for practical use than the historical default correlation.

Method 1: Historical default correlation

We start by calculating the historical country default correlation (HDC) from a sample of 37 countries. From these 37, according to the S&P and Salomon Brothers reports, nine countries did not default during 1970-1998, namely China, Colombia, Czech Republic, Hungary, India, Japan, Malaysia, Singapore and Slovakia. As such, we will not include them in our analysis (implementing it – $D_i(t) = 0$ in equation (1) – would result in an impracticable solution). Consequently, 28 countries remain, of which 378 country pairs ({[28*28]-28}/ 2) are formed. In Appendix A.3, the default correlations of these pairs are presented. Table 1 displays the basic characteristics of the historical default correlations. We could detect (regional) clusters of countries that are mutually connected by joint default. Especially, we found such a cluster of Latin American countries (average HDC among this group was 0.539). There was no such clustering for Eastern European or Asian countries (average HDC 0.0465 and –0.129 respectively).

Table 1: Historical default correlation, period 1970-1998

	average	**maximum value**	**minimum value**	**standard deviation**	**# of pairs included**
total	0.229	1.000	-0.608	0.364	378
total (positive)	0.461	1.000	0.008	0.229	241
HDC ≤ 0	-0.177	-0.008	-0.608	0.114	137
0 ≤ HDC ≤ 0.25	0.139	0.245	0.008	0.068	49
0.25 ≤ HDC ≤ 0.50	0.386	0.498	0.256	0.071	86
0.50 ≤ HDC ≤ 1.00	0.670	1.000	0.506	0.131	106

Of the total results, 137 negative values emerged. We distinct between 'total'- and 'total positive' values of the total sample, for two reasons. First, a negative value is hard to interpret. An example in which it is somewhat imaginable that this situation could occur is between two oil-exporters, A and B. If country A defaults, country B would enjoy an enlargement in its market. This might lead to an increase in income for country B. Secondly, negative values influence the average of the complete matrix strongly.

Method 2: Expected default correlation

Now, we calculate the expected default correlation (EDC) figures for the total 666 country pairs ({[37*37]-37}/ 2) over the period 1970-1998. For this method, we need a country asset correlation, and both countries' default probabilities. For the asset correlation between the country pairs, we correlated the monthly FXR growth. As such, we use 348 (29*12) observations to calculate the asset correlation for each country pair. Appendix A.4 gives the expected default correlations for all country pairs. The key characteristics of the EDCs are in table 2. This default correlation also produces many negative values: 39% of all country pairs has a negative EDC. Table 2 categorizes the total positive values. The most striking feature of this table is the overall low values of default correlation: the average default correlation of the total sample is 0.006 (positives: 0.013), and the largest correlation value is 0.163. Note, however, that these default correlations are in the same order of magnitude as the corporate default correlations (KMV, 1998). As with method 1, we could detect clusters of countries that are mutually connected by joint default. Once again, it appears that Latin America is a significant cluster. Latin American countries have an average expected default correlation of 0.008. Also, the

EDC of the Eastern European transition economies show a slight mutual connection as their average default correlation coefficient is 0.020. For the Asian economies, we find only a very small average EDC, namely 0.001.

Table 2: Expected default correlation, period 1970-1998

	average	maximum value	minimum value	standard deviation	# of pairs included
Total	0.006	0.163	-0.046	0.018	666
total (positive)	0.013	0.163	0.000	0.019	405
MDC ≤ 0	-0.006	-0.00006	-0.046	0.007	261
0 ≤ MDC ≤ 0.05	0.010	0.048	0.000	0.011	386
0.05 ≤ MDC ≤ 0.10	0.066	0.092	0.051	0.011	16
0.10 ≤ MDC ≤ 0.20	0.136	0.163	0.117	0.024	3

We may wonder whether the correlation results in Appendix A.4 are in fact not *too* low. To this extent, we need to elaborate on the significance of the correlation coefficient, notably a default correlation. In this respect, it is important to determine the degrees of freedom. Remember that we calculated the *asset* correlation needed for the EDC, over a period of 29 years, between the monthly FXR-growth data. This means that we use 348 observations to calculate the EDC. Therefore, statistically, a correlation of 0.163 (the maximum value in table 2), with 346 (348-2) degrees of freedom, is significant at a 1%-level (the null hypothesis of no correlation is rejected). This means that a significant positive correlation does occur indeed. However, note that the EDC is not equal to an ordinary Pearson correlation coefficient as it is 'created' by the two default probabilities and an asset correlation. Therefore, we must be very careful with the interpretation of the correlation's significance.

In the remainder of this section, we compare the two methods. As such, five differences stand out. First, the historical default data on average show higher levels of default correlation, and a larger spread and standard deviation. Secondly, with historical data, a default correlation only can be established when the countries in question actually default in the sample period. Therefore, no default correlation could be calculated for 288 country pairs. For the approach based on the Merton model, this is not a problem. Furthermore, both methods produce many negative default correlations: 36% and 39% of the sample for the historical defaults and the expected defaults respectively. In case of a negative correlation, we assume that no default relation exists between the two countries in question. From this, we conclude that the Merton-based approach leads to a much broader data range than the approach that is purely based on historical data. A third difference is that with the historical approach, strict assumptions must be made to come up with the default correlation. For example, we only count the *years* in default, even if a country defaulted for 7 months. This also means that we are highly dependent on the period focussed on. A short period, for instance 10 years, is less likely to include enough default events to produce default correlations between X country pairs, than when we focus on a period of 100 years. In contrast, the Merton-based approach can produce default correlations for every test period one prefers, as long as plausible asset correlations and default probabilities are available. Fourth, in using the historical default correlation, one is highly dependent on the political situation in a country. A country can be ‘selectively’ in default, which relates to ‘unwillingness’ to pay. This does not mean that the country is not capable to pay other creditors. With the Merton-based approach, we assume that a country defaults when its “assets” decrease until under a certain critical point. Fifth is the period of time to which the default correlation relates. The level of correlation relates to the probability of two countries defaulting in the same time period. For the expected country default correlation, this time period refers to one year, as the default probabilities may change in the next year. In contrast, the historical default correlation is not restricted to this kind of time limit. Basically, it is workable in every time period one might wish to use. If country B defaults two years after country A does, it could still be due to the default event of country A: i.e. strong default correlation. However, it can be doubted whether it is recommendable to use the correlation figure for an indefinite long period of time. Economic and political developments worldwide make it quite unrealistic to assume that the relations based on historical events will continue to remain exactly the same. From these differences, we conclude that with the Merton-based approach, we may derive superior information in relation to relying purely on historical data.

1.1.1 6. Conclusion

For developing countries, it is of huge importance to get assessed on a proper and transparent basis. Many existing country risk approaches lack transparency. The aim of this paper is to give country risk analysis a sound theoretical basis. To this extent, we depart from the work of Merton (1974). In his model, loan default occurs if the market value of a firm's assets falls below the amount due to the loan. Within the context of a portfolio, default correlation is a crucial ingredient of the model. As a proxy for the asset value of a country, we use foreign exchange reserves. We suggested two ways in which to derive country default correlations. One is on the basis of historical default data, the other is on the basis of expected default frequencies and joint default probabilities. We compared the two approaches on the basis of a dataset for 37 countries for which we analyzed defaults during 1970-1998.

We found small but significant country default correlations. The correlations were in the same order of magnitude as those for corporate borrowers. We detected clusters of countries that are mutually connected by joint defaults, Latin American countries being the clearest case. However, we could not detect clustering with Asian countries. It appears that a country's foreign exchange reserves serve rather well as a proxy for a country's assets. We found interesting differences between the two approaches. The expected default correlation presented significantly smaller values than the historical default correlation. Furthermore, it allowed us to produce a figure for any country pair, whereas the historical default approach could only produce correlation data in case both countries actually default during the sample period. Although the historical default method is not restricted to any time limit, it is not recommendable to use the correlation figure for an indefinite long period of time, due to changes in the economic and political environment. Updating the historical default correlation would be impractical given the limited amount of observable country defaults and the large periods between these defaults. In all, we may conclude that the option-theoretic approach appears to be quite promising in analyzing country risk in a portfolio perspective.

REFERENCES

[Click HERE to type your first reference.]