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# Quantitative Approaches to Modeling Sovereign Risk

**Bloomberg**

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As sovereign bonds have become an increasingly important part of the global financial system, accounting for roughly one-fifth of financial assets, the methods used to gauge a country's probability of default have become more critical. Whether the interested party is a corporation considering foreign investments, a trader looking for price discrepancies in the sovereign bond markets, or a firm seeking to hedge against country exposure, the need for reliable and accurate models is crucial.

In today's environment, sovereign risk modeling is complex, with a significant number of factors in play. And international markets are more and more intertwined. "When things are going on or going wrong with sovereign bonds, it tends to impact on all other markets, in particular countries, and sometimes even around the world," says Michael Rosenberg, an author of two books on exchange-rate forecasting and a consultant focused on foreign exchange and macro analytics at Bloomberg.

## **Qualitative, Quantitative or Both**

Broadly speaking, sovereign risk models can be classified as qualitative or quantitative, though many of them blend both approaches. In a typical qualitative model, contributors provide subjective scores based on the aggregation of a variety of factors. When a standardized framework is imposed upon that process, it results in a structured qualitative model, which allows for apples-to-apples comparisons of countries' risk scores.

Quantitative models that use discriminant analysis take into account a number of country-specific factors, such as government debt-to-GDP ratio, budget deficit and growth of GDP, and relate them to the sovereign's ability to pay back its debt. A principal components analysis model, on the other hand, simplifies the process by using smaller sets of composite indicators built out of each factor. Logic and probit models assume that the risk of default follows a normal distribution.

Credit rating agencies use similar techniques in arriving at their evaluation of sovereign risk, often applying a subjective approach that includes a number of quantitative inputs—monetary stability and fiscal flexibility, for instance. A committee then determines the rating, says Rajan Singenellore, Global Head of Bloomberg's Risk and Valuation Group. "It's a consultative, deliberate process, not a mechanical weighting of factor scores," notes Singenellore.

A scoring model, such as the one applied by Euromoney in its quarterly country risk ratings, uses multiple factors, or categories, and assigns a weight to each. Economic data is weighted at 25%, political risk at 25%, debt indicators 10%, and so on. Each category is scored from zero to 100, where 100 is the worst possible result, and the weightings are used to determine a country's overall score.

## **Reserve and Non-reserve Countries**

Bloomberg's quantitative Sovereign Risk Model (SRSK) divides the world into reserve and non-reserve currency countries. Reserve currency countries have debt denominated in their

own currency, meaning that the government is able to generate revenue to pay back principal and interest. If you take a reserve currency country's revenues and subtract expenditures, short-term debt due within the next 12 months, and a fraction of its long-term debt, you can define a surplus or deficit. A surplus, if there is one, would allow for interest payments, and would reflect positively on a country's creditworthiness.

A non-reserve currency country, on the other hand, has debt denominated in a foreign currency. Hence, it has to rely on foreign exchange reserves to pay back its debt. "Its own operations within its borders are not the critical thing," explains Singenellore. "What matters is how much reserves they have to pay back the debt." For a non-reserve currency country, the focus is on the reserve ratio, which is the country's reserves divided by its total debt burden over the next year. If that number is larger than one, it's a positive sign.

Beyond a country's financial picture, Bloomberg's quantitative model also takes into consideration economic factors such as GDP growth, which plays a significant role in generating more reserves or a larger surplus to repay interest, and the health of its banking sector. In many emerging market countries and eurozone periphery countries, banks own a large portion of sovereign debt. Any widening in sovereign spreads causes an immediate deterioration in banking system balance sheets, which leads to a decline in lending, in turn weakening growth and increasing a sovereign's

deficit. "So we have a negative feedback loop," says Rosenberg.

In addition, he says, "a decline in asset prices and loan losses can lead to a deterioration in bank balance sheets, which requires the government to bail out the banks. That happened in Ireland. And if the government bails out the banks, it could lead to a wider budget deficit, which leads to a widening in spreads, and then that feeds back again into the deterioration in bank balance sheets."

### **Appetite for Default**

Also included in the Bloomberg quantitative model is political and social risk. This element of the model examines the willingness of a country to pay back debt—or, one could say, the social appetite for defaulting. It is an area that has seen changes of late.

In the past 200 years, there have been 107 countries that have outright defaulted, according to Rosenberg, and those countries have accounted for 251 total defaults. In the wake of the crisis of 2008, the level of defaults has been declining.

"The emerging market countries now recognize that if they want to retain future market access, defaulting is not a good option," says Rosenberg. "There's reputational risk associated with outright defaults. If you have a default history, it leads to persistently wider spreads than would normally be the case."

The relationship between sovereign credit default swap spreads and default risk is complex, with the probability of default only one of several factors contributing to CDS spreads.

In Bloomberg's quantitative model, there is no input from bond yields or CDS spreads. "Our philosophy would be to provide a creditworthiness estimate that is independent of credit markets," says Singenellore. However, Bloomberg does use the same factors that drive default risk for CDS predictions.

### **Model Validation**

Any quantitative model must be validated against real-life data. Bloomberg tests its SRSK model by looking at the predicted default probability, on average, for countries that experience a default or a distress event, such as a major bailout, in the years prior to and following the occurrence. Bloomberg finds that a quantitative model that uses fundamental factors provides distress warnings as many as three years before the event, and that the default risk begins to fall shortly after.

Beyond a model's predictive ability, it is important that the actual level of predicted defaults is borne out by observed default probabilities. Bloomberg also does a host of statistical and econometric tests for validity and robustness. "We check our regression numbers, we check our coefficients," says Singenellore. "How stable are they over time? Can we do out-of-sample testing? There's a variety of ways in which we stress the model and test it under the most rigorous conditions."

One of the advantages of a quantitative model is its transparency in terms of inputs and outputs. It also

*continued on back page*

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*—Bloomberg's Rajan Singenellore*



## *Quantitative models can give you a language to discuss credit debt.*

gives users the ability to perform “what-if” scenarios. If a user has doubts about a GDP growth rate used in the model, or disagrees with the ratio of non-performing loans in a particular country, they can simply override it.

Another benefit of a quantitative model is that it gives you a language with which to discuss credit debt, according to Singenellore, who points to Greece as a case study. Greece is a reserve currency country; although it does not print its own money, it has debt denominated in its own currency, the euro. Its governmental operations, therefore affect its ability to pay back debt. When you add in other factors, like GDP growth, banking health and political risk, it offers a framework to examine the country’s recent past.

In the early 2000s, Greece’s default risk was very low. The tourism and shipping sectors were healthy, and the deficits were less negative

than they are today. After the crisis in 2008, tourism and shipping were hit hard and its deficit increased dramatically. As a result, default risk began to rise, even after the first IMF bailout of the country. Greece’s probability of default peaked with its default event in 2012.

“You can actually tell the economic story and develop that economic insight,” says Singenellore.

### **Caution Advised**

Another example, Argentina, highlights the limitations of even the best models. The country entered into a recession in 1999, which caused its reserve ratios and GDP to fall sharply. The country defaulted in December 2001 and was essentially frozen out of the international capital markets. After three different restructuring offers, the most recent coming in August 2013, there were still people

litigating against Argentina in an effort to be repaid fully. That litigation has caused the market CDS for Argentina to be well above what Bloomberg’s model predicts.

“One should be very careful about watching out for externalities of this nature, which cannot truly be modeled,” says Singenellore. “The default probability is not that bad, the reserve ratios are not too bad, they are in fact probably able to pay most of their debt at this point. The big question is the overhang coming from the litigation.”

But even in difficult cases such as Argentina, quantitative models, with their flexibility and transparency, help users to think about the actual factors that drive default, and to focus on how a country’s situation may change in the future.

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