

Northfield's Internal Corporate Credit Rating Model

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July 2021

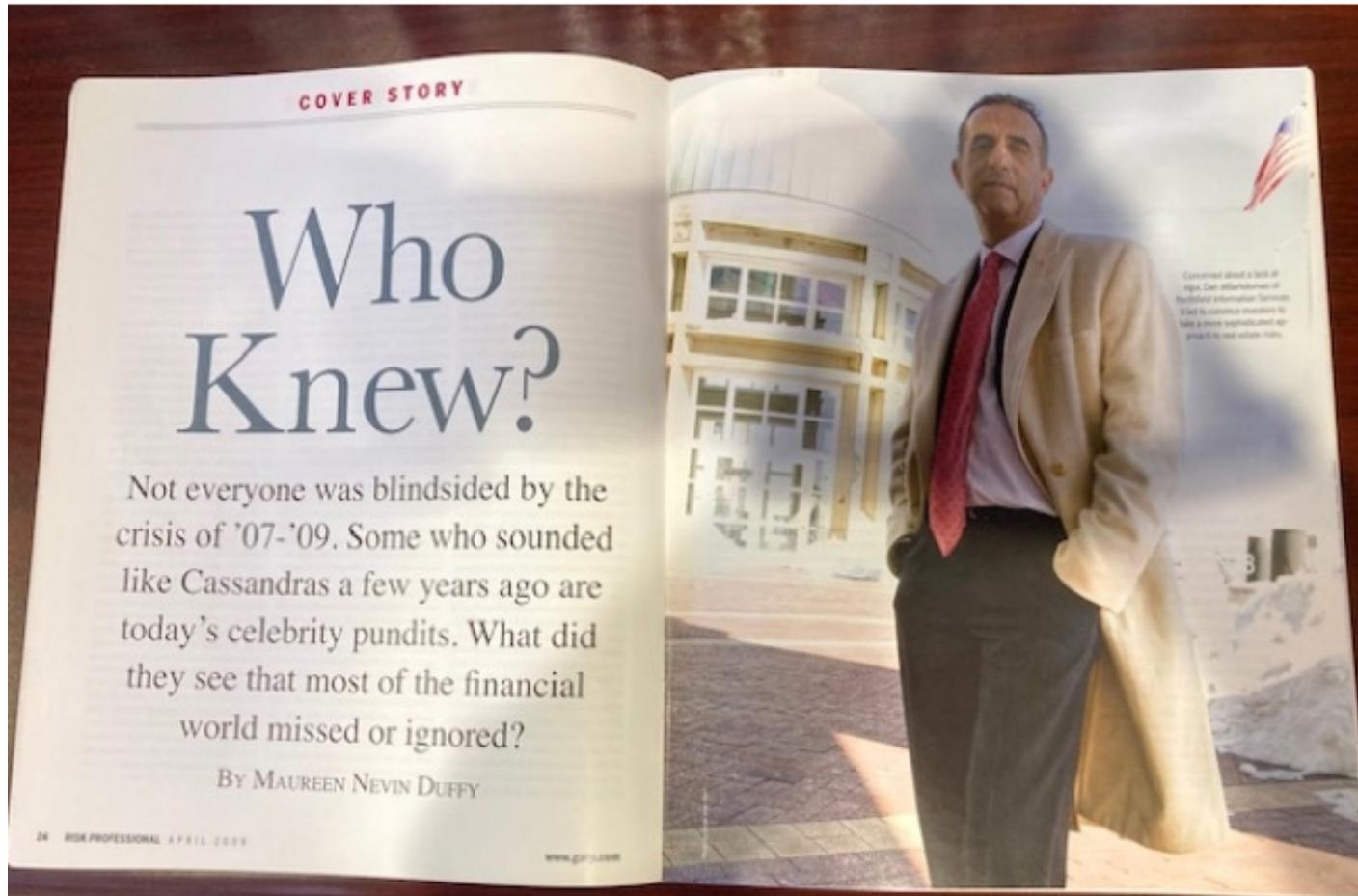
Introduction

- We've always had concerns about quality of credit ratings from the traditional rating agencies as was evident during the meltdown of the Global Financial Crisis.
- Among roughly 200 sovereign governments in the world, there are a few that have no recognized rating (e.g. Syria), and many have ratings from "non-major" rating agencies.
- Of the roughly 80,000 corporate entities covered by our risk models, no rating single rating agency rates more than 6000.
 - The various credit rating agencies all publish different rating scales with various levels of granularity.

The Problem with Traditional Ratings

- After the GFC, I wrote an essay about what went wrong with the ratings that lead to the meltdown of the banking system.
 - The obvious key concern is that the borrower is paying for the rating, so the agencies have business incentives to be optimistic and to rate new instruments with which they have no experience.
 - [Five Easy Steps to Fixing the Rating Agencies \(northinfo.com\)](#)
- Previous work on what went wrong with credit ratings during was presented at our 2009 client conferences in Venice and London.
 - [Mortgage Securitization Meltdown: Analytical Failures and Proposals \(northinfo.com\)](#)
 - I played the role of Cassandra (nobody listened until it was too late) in a 1998 working paper about weaknesses in the ratings of CLOs, <https://www.northinfo.com/Documents/55.pdf>.

Cassandra's Curse: *Risk Professional* April 2009



Problems with Corporate Credit Ratings

- A large portion of global companies have no credit rating by virtue of having no debt, or no debt that is traded or syndicated.
- Corporate ratings are highly fragmented across many rating agencies
 - No one rating agency covers more than 6000 firms
 - In some countries (e.g. China), investors clearly do not attach credibility to local ratings.
 - While the vast majority of the corporate bond market value arises from large firms with ratings, a significant portion of corporate bonds are “unrated”.
- Different rating agencies disagree on what a rating should be.
 - Some focus strictly on PD within a year, some PD before maturity, and others consider both the probability and likely severity of default.
- Responsiveness of rating changes to new information is very slow. The frequency of rating changes is about once every three years.

The Contingent Claims Approach

- The core of our corporate ratings is the “contingent claims” model of Merton (Journal of Finance, 1974).
 - This method was first commercialized by the KMV division of Moody’s many years ago.
 - The equity in a firm can be modeled as a call option to purchase all assets of a firm with a strike price of paying off the debt.
 - The limited liability of corporate shareholders provides the corresponding “put” on the assets wherein lenders receive the assets in a bankruptcy proceeding.
 - We previously used this process to describe corporate sustainability in diBartolomeo (Journal of Investing, 2010).
- Like any option, the key input is assumed volatility of the *market value* of the assets of the firm (i.e. equity market cap + debt).

Phrasing the Key Question

- Since Northfield has very elaborate and sophisticated models for traded equity, we can rephrase as:

What would the volatility of a firm's stock be if the firm had no debt?

- Given our models, this is a pretty easy answer to estimate.
 - We can update our ratings on a daily basis using our *Risk Systems That Read®* method of conditioning risk estimates on financial news.
- The other inputs to the problem are standard option inputs like strike price (value of debt), dividend yield, risk free rate, and option maturity.
 - For easy comparison to published ratings history we follow the popular convention of focusing on *probability of default within the upcoming year*.

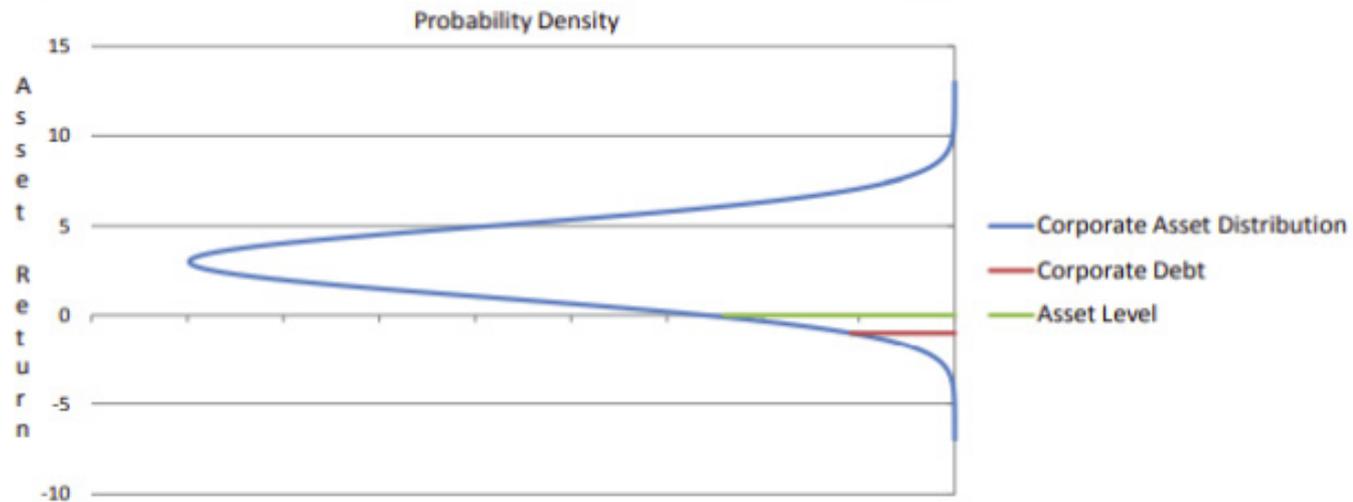
Estimating “Loss Given Default”

- Obviously, investors also care about the possibility of receiving partial payment in the event of default rather than assuming there is will be no payment at all.
- The expected value of LGD can also be mathematically extracted from the option model.
- The full mathematical derivation was presented in a published paper on using similar methods for sovereign debt.

Belev, Emilian and Dan diBartolomeo “Finance Meets Macroeconomics: A Structural Model of Sovereign Credit Risk”, M. Crouhy, D. Galai and Z. Weiner Editors, [Contingent Claims Analysis in Corporate Finance](#), World Scientific, 2019.

A Quick Picture

Analogy with Corporate Debt



Inputs to Credit Model: σ Debt Asset Level

Model States: $\beta_{\text{bond}} = \beta_{\text{stock}} * -(P_{\text{stock}} / P_{\text{bond}}) * (\Delta_{\text{put}} / \Delta_{\text{call}})$

Corollaries: ① $\text{LGD} = P_{\text{bond}} * \text{scalar}$; ② $\text{LGD} \ \& \ \text{OAS} \rightarrow \text{Prob. Default}$

Analysis of the Banking Sector

- In the aforementioned paper on sovereign debt, we explored how the banking system and governments are interdependent.
 - Banks are required to hold government bonds as reserves
 - Governments often guarantee bank deposits (e.g. FDIC)
 - This effect was also explored in a parallel paper published in the same book which was an update of Bodie, Gray, and Merton (2004).
- This effect was very evident during the GFC our internal credit analysis dramatically outperformed traditional ratings until national governments stepped in to “bail out” the banks.
- Important to counterparty risk too.



Industry Level Nuances

- Besides banking, there are other industries that are regulated in some countries (e.g. utilities).
- There are resource industries that are almost entirely nationalized (oil in the Middle East, coal mining in India) that involve implicit national guarantees.
- There are industries where government support or outright ownership of companies is popular (e.g. airlines)
- Some industries (airlines again) where the definition of debt is a little fuzzy because of the different flavors of financing (e.g. leasing a plane versus a financed purchase)

Reverend Bayes to the Rescue

- To address industry specific “peculiarities” that are not part of the basic Merton model, we use a standard application of Bayes’s Theorem.
- We break all 80,000 corporate entities we cover into 31 sector groups.
- For the subset of companies for which credit ratings are available from major credit rating agencies, we compare our average rating within each group with the average of the traditional ratings.
 - There are 20 levels of granularity in the rating comparison (e.g. AAA, AAA-, AA+, etc.)
 - Cross-sectional correlation between our ratings and the traditional ones runs around 80%, but is less for some industries like banking and airlines.
 - We then calibrate our ratings against the published ratings using Bayes’s Theorem (i.e. weighting by inverse variances as sample sizes within group are the same).

Boundary Condition for Small Firms

- For small firms (e.g. frontier markets), the highest rating a company can be given is equal to the rating of the sovereign government.
 - This bound is applied to firms that are too small to have any GICS industry code assigned to them.
- If a firm is too small to be assigned a GICS code, it has to be very local so its viability is contingent on the geopolitical and economic stability in the country in which it operates.
 - Current examples would be countries like Syria, Lebanon and Venezuela.



Imitation is the Sincerest Form of Flattery

- To further refine our internal rating process, we are now building non-parametric models based on the Analytic Hierarchy Process
- These models break the processes followed by traditional credit analysts into a series of multiple-choice questions, which can then be filled in based on company specific data.
 - The analytical model is expressed as a series of N square matrices where N is the number of rating levels.
 - The required number of matrices is equal to the number of possible responses to an input question plus one.
- AHP is a widely used approach from the industrial management literature, and AHP-based credit analysis has been around for a long time.
 - See Bolster and Trahan (1990) on sovereign bonds and Bolster and Srinivasan (1990) for industrial corporates.
 - We will be adapting these models to bank loans and private credit.

AHP in a Picture

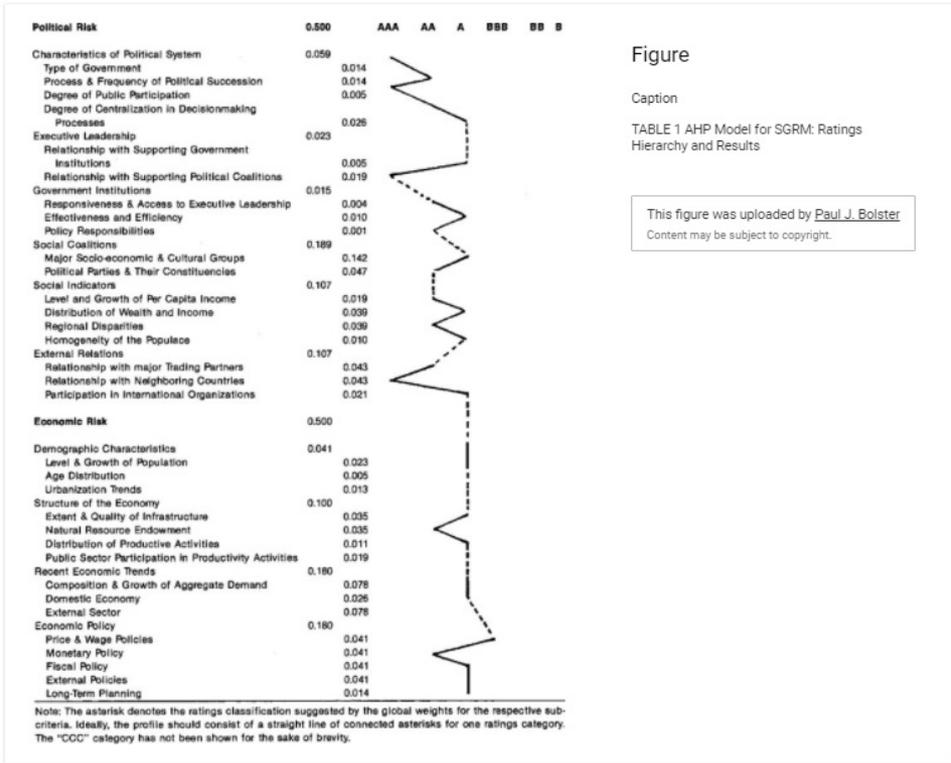
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Figures (3)

Sovereign Debt Ratings: A Judgmental Model Based on the Analytic Hierarchy Process

Article Feb 1990

[Download](#)



Figure

Caption

TABLE 1 AHP Model for SGRM: Ratings Hierarchy and Results

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Conclusions

- In order to fulfill the concept of “Everything, Everywhere” asset coverage we need to have ratings of creditworthiness of a large number of corporate entities where traditional ratings are either unavailable or unreliable.
- Our internal credit rating model is entirely quantitative which allows for both unbiased and rapid updating.
- Use of our equity risk models to answer the question of “how volatile would the stock of a firm be if the firm had no debt” is a key advantage relative to the traditional rating process.
- To account for externalities outside the CCM for certain industries we calibrate against traditional ratings using Bayes’s Theorem.
- To further refine the results and allow extension to bank loans, we are employing AHP models which imitate the processes of human credit analysts.