

Special Comment

Moody's Global Credit Policy

February 2009

Moody's Senior Ratings Algorithm & Estimated Senior Ratings

Introduction

For a variety of purposes, it is desirable to compare the ratings of different issuers across a single class of debt in order to abstract from differences in ratings that may reflect security-specific differences in seniority or security rather than differences in an issuer's fundamental credit risk. The process Moody's uses to derive issuer-level ratings from particular debt obligation level ratings is called the senior ratings algorithm (SRA), and the resulting ratings are called *estimated senior unsecured ratings* or, more concisely, *estimated senior ratings*. Briefly, a company's estimated senior rating is set equal to its actual senior unsecured debt rating or, if there is none, by implying such a rating on the basis of rated subordinated or secured debt. In most cases, this yields an assessment of credit risk that is relatively unaffected by collateral or position in the capital structure.

The estimated rating that results from this process is not equivalent to an actual Moody's senior unsecured credit rating, which benefits from the careful deliberations of the rating committee process. The method of estimation is, however, designed to ensure that the derived ratings are consistent with Moody's notching practices, and therefore theoretically equivalent to a senior unsecured bond rating. The final product of the senior ratings algorithm is the senior ratings table (SRT), which is a panel data set of estimated senior rating histories for Moody's-rated corporate and sovereign bond issuers for the time period between 1921 and the present. Because these are derived ratings, they should not be construed as official, published rating histories.

This document outlines the SRA process and the contents of the SRT.¹ We also illustrate how to carry out some common queries on the SRT using Microsoft Access.

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Analyst Contacts:

New York 1.212.553.1653

Vivek Gupta

Associate Analyst

Kusum Parwani

Assistant Vice President / Analyst

Kenneth Emery

Senior Vice President

¹ Given the complexity of the senior ratings algorithm and proprietary nature of some of the data used in the creation of the senior ratings table, it is not possible to replicate the senior ratings table using the data tables included in Moody's *Default Risk Service* database.



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The SRA Process

The senior ratings algorithm is made up of four general stages:

1. Issuer and debt obligation selection
2. Senior rating estimation (notching)
3. Historical merge
4. Populate default data

The SRA process uses Moody's database of corporate and sovereign credit ratings to derive as long a time series of estimated senior ratings as possible. The following sections describe each of these stages in detail.

Stage 1: Issuer and Debt Obligation Selection

The first stage of the SRA determines the eligible set of debt issuers and their reference debt obligations from which estimated senior ratings will be derived.

The universe of eligible issuers consists roughly of all corporate and sovereign obligors of Moody's-rated long-term public, Rule 144A debt, and syndicated bank loans. Issuers with only obligor-level ratings (no rated bonds), such as corporate family ratings, are generally excluded. However, issuers with obligor-level ratings that do not have any rated debt of their own are included if they guarantee the rated debt of an entity within their corporate family. The SRA also excludes public finance (municipals) and sub-sovereign entities, government-sponsored enterprises, and certain sovereign-guaranteed and sovereign-related entities.

Since the purpose of the SRA is to generate issuer-level ratings, debt obligations that do not reflect the fundamental default risk of the obligor need to be removed. Therefore, the following types of debt obligations, while possibly issued by corporate or sovereign entities, are excluded:

1. Structured finance transactions
2. Short-term debt (e.g., commercial paper)
3. Secured lease obligations
4. Enhanced equipment trust certificates
5. Industrial revenue bonds
6. Pfandbriefe, covered bonds, super-secured bonds
7. Certificates of deposit
8. Bank note programs
9. Preferred stocks

Once the eligible set of obligors and debt issues is selected based on the criteria above, debt issues carrying external, third-party guarantees are eliminated. All guarantees (credit enhancement) made by obligors outside the debt issuer's corporate family are considered guaranteed by a third-party and are also excluded from the SRA. If the guarantor is in the issuer's corporate family, then the debt issue is not excluded. Jointly issued debts by entities in the same corporate family are also retained.

Debt obligations within the eligible set are then prioritized by their position in the capital structure and level of security for each obligor. The SRA iteratively works down this hierarchy for each obligor to pick a reference rating on which to derive its estimated senior rating in the next stage (notching).

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The priority for estimation of the senior unsecured rating, from highest to lowest, assigned by the SRA:

1. Senior unsecured bonds
2. Issuer ratings
3. Corporate family ratings
4. Senior subordinated bonds
5. Subordinated bonds
6. Junior subordinated bonds
7. Senior secured bonds
8. Syndicated Bank Loans

In cases where the obligor has several debt issues outstanding at a given priority in the capital structure with different credit ratings, the lowest credit rating is taken as the reference rating.

The presence of simultaneously outstanding foreign currency and domestic currency ratings at the same priority complicates the SRA process. In some cases, foreign currency ratings are lower than domestic currency ratings. The SRA must choose which of these ratings to use at any given point in time. Rating histories for debt issuers that have both foreign currency ratings (FCR) and domestic currency ratings (DCR) at the same priority are generated by using the lower of the two ratings. The purpose of this rule is to produce the longest possible rating history for issuers that have both foreign and domestic currency ratings.

Stage 2: Senior Rating Estimation (Notching)

Once the set of reference ratings has been determined in the first stage, the second stage of the SRA "notches" the reference rating to arrive at the obligor's estimated senior rating. The exact notching procedure is a function of the rating level and priority in the capital structure. Moody's existing notching practices are detailed in Cantor (2001).

Intuitively, senior unsecured bonds require no notching. Issuer ratings, whose meanings are very close to estimated senior ratings, also do not require adjustment. Corporate family credit ratings for leveraged finance issuers apply to the debt of the corporate family as if it had a consolidated structure.² Empirically, corporate family ratings have been observed to be on an average one notch higher than senior unsecured bonds and issuer ratings, so the SRA deducts one rating notch. Debt obligations senior in the capital structure and/or secured are notched down to arrive at the estimated senior unsecured rating. Similarly, debt obligations junior in the capital structure or subordinated are notched up.

Moody's current notching rules for the SRA are shown in Table 1. The first column of the table shows the credit rating of the reference debt obligation. The columns show the reference debt obligation's position in the capital structure or rating category (for issuer and corporate family level ratings). Reading the appropriate row/column combinations gives the number of alphanumeric rating notch adjustments applied to the underlying rating to derive the estimated senior rating. For example, the estimated senior rating for an issuer whose reference rating is a B1-rated senior subordinated is Ba3, one rating notch higher than the B1 debt obligation level rating.

² Issuer ratings for speculative-grade rated issuers were discontinued in July 2005 (for details see Marshella, et. al. (2005)). Corporate family ratings were formerly known as Senior Implied ratings, and are not to be confused with the estimated senior ratings discussed in this document.

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Table 1

Bond Rating	Senior Secured	Corporate Family Rating	Lien position			Junior Subordinated	Subordinated	Syndicated Bank Loans
			Senior Unsecured/ Issuer Rating	Senior Subordinated				
Aaa	-1	0	0	0	0	0	0	-2
Aa1	-1	0	0	+1	+1	+1	+1	-2
Aa2	-1	0	0	+1	+1	+1	+1	-2
Aa3	-1	0	0	+1	+1	+1	+1	-2
A1	-1	0	0	+1	+1	+1	+1	-2
A2	-1	0	0	+1	+1	+1	+1	-2
A3	-1	0	0	+1	+1	+1	+1	-2
Baa1	-1	0	0	+1	+1	+1	+1	-2
Baa2	-1	0	0	+1	+1	+1	+1	-2
Baa3	-1	0	0	+1	+1	+1	+1	-2
Ba1	-1	-1	0	+1	+1	+1	+1	-2
Ba2	-2	-1	0	+1	+1	+1	+1	-2
Ba3	-2	-1	0	+1	+1	+1	+1	-2
B1	-2	-1	0	+1	+1	+1	+1	-2
B2	-2	-1	0	+2	+2	+2	+2	-2
B3	-2	-1	0	+2	+2	+2	+2	-2
Caa1	-2	-1	0	+2	+2	+2	+2	-2
Caa2	-2	-1	0	+2	+2	+2	+2	-2
Caa3	-2	-1	0	+2	+2	+2	+2	-2
Ca	-1	-1	0	+2	+2	+2	+2	-1
C	0	0	0	+2	+2	+2	+2	0

For most issuers, debts at different seniorities in the capital structure follow the notching scheme in Table 1. However, there can be instances when different debt ratings of the same issuer are not consistent with Table 1. For example, a senior secured debt of an investment-grade issuer sometimes may be rated two notches above the senior unsecured debt instead of one notch shown in Table 1. In such a situation, if the senior unsecured debt matures, the reference debt for generating the senior rating in our algorithm shifts from the senior unsecured debt to the senior secured debt. At this stage, the application of standard notching would result in a senior rating only one notch below the senior secured rating instead of the historical difference of two notches. As a result, it would appear that the issuer has been upgraded on the maturity date of the senior unsecured debt even though there was no rating action on that date.

In order to iron out such 'artificial rating changes', the SRA employs a smoothing procedure. This procedure consists of finding the true notching between the reference debt of an issuer and its senior unsecured debt, and using that notching over the one suggested in Table 1.

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In the absence of a senior unsecured or equivalent debt for an issuer, before applying the standard notching, we search the entire rating history of the issuer to find an instance when both the senior unsecured bond (or equivalent) and a debt of the same seniority as the current reference debt were outstanding at the same time. If no such instance is found then the standard notching in Table 1 is used to obtain the senior rating. In situations where multiple such instances are found, we use the difference in the ratings between the two debts in the most recent instance as the true notching over the one in Table 1.

In the example above, the smoothing procedure will find -2 as the true notching for the issuer instead of -1 as suggested in Table 1 and, consequently, when the reference debt changes from the unsecured debt to the secured debt, the same senior rating will be retained for the issuer.

Stage 3: Historical Merge

The first two stages of the SRA are implemented for obligors in Moody's "live" ratings database. However, Moody's active ratings database does not include the full historical record of Moody's credit ratings. Prior to 1981, Moody's recorded its credit ratings on 3x5 cards; the rating histories on these cards were entered into a database (called Nomad) in the same year. The decision was made at that time not to back-fill the database. Consequently, the only ratings histories entered were those for debt rated as of the date the ratings database was compiled (again, sometime around 1981).

In the mid-1990s, Moody's compiled historical credit ratings data dating as far back as 1919 using Moody's dead ratings files, *Moody's Industrial, Utilities, and Transportation* manuals, and Moody's *Investment Letters*. Only enough data to derive an estimated senior rating for these historical debt issuers was collected, so the scope of this historical data set is much more limited than the full ratings database. In particular, there is almost no recorded data on debt obligation characteristics other than the credit rating and its priority in the capital structure. The data set is static and separate from the "live" ratings database.

We combine estimated senior ratings generated from the first two stages with the historical estimated senior ratings to produce the senior ratings table.

Stage 4: Populate Default Data

The final stage of the SRA populates the senior ratings table with default dates and a dichotomous dummy variable that indicates whether the obligor is a defaulter, where 0 indicates default. In this step, the SRA retrieves default information from Moody's default database. Moody's default database contains default data at the obligor and debt issue level from 1919 to the present. An obligor is categorized as a defaulter if a default has occurred under Moody's definition of default on long-term public debt.³ For example, a default on short-term debt (such as commercial paper) is not recorded as a default in the senior ratings table.

For the purposes of the SRA, a repeat default is recorded only if it satisfies the B3 rule, i.e., the obligor's estimated senior rating has been raised to at least B3 following the initial default. The B3 rule must be met in order for a corporate or sovereign issuer to re-enter the pool of eligible defaulters. This rule screens out events of default that are essentially the continuation of on-going credit problems.

³ See Hamilton and Varma (2005) for Moody's definition of default.

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The Senior Ratings Table

Table Format

The final product of the senior ratings algorithm is the *senior ratings table* (SRT), essentially a panel data set of estimated senior rating histories. The table contains the following fields:

Table 2

Senior Ratings Table Fields	
Field name	Description
Issr_num	Moody's company number
est_senr_rtg_txt	Estimated senior rating text
Ratg_dt	Rating assignment date
expire_dt	Rating expiration date
Term_dt	Censoring date
Censor	Default variable (0=default)
LM	Indicates rating change of more than 2 notches
Rev	Indicates reversal in rating trend
Meth	Indicates methodology change

The first four fields are self-explanatory. The **term date** and **censor** fields are used to indicate whether an issuer defaulted sometime during its rating history.

The **term_date** field contains one of the following three values:

1. The date of default
2. The date of rating withdrawal
3. The date of the most recent update of the senior ratings table

The **censor** field is a dummy variable indicating whether a default has occurred. Defaults receive a value of zero; otherwise, the field is set to 1.

The senior ratings table enables the researcher to treat rating changes, rating withdrawals, and defaults as mutually exclusive states. While complete rating estimated senior rating histories are contained in the senior ratings table, combinations of the censor and term date fields allow one to construct these mutually exclusive terminal states. In particular:

- **censor**=1 and **term date**=[update date]: the issuer's outstanding credit rating
- **censor**=1 and **term date**=[date<update date]: the issuer's withdrawal date
- **censor**=0 and **term date**=[date<update date]: the issuer's default date

The fields LM and Rev are binary variables set to 1 or 0. LM field indicates a large rating change. It is set to 1 if the cumulative rating action in the past 12 months results in a rating change of 2 or more notches. The Rev field is set to 1 if a rating change in past one year is reversed by the current rating action.

Finally, the Meth field marks rating actions that are a consequence of a methodology change by Moody's instead of a change in the fundamental credit quality of the issuer. This variable takes values 0, 1, 2 or 3. The value 0 indicates no methodology change or a regular rating action and values 1, 2, and 3 indicates that rating action is due to loss given default (LGD), Government Related Institutions (GRI), and joint default analysis (JDA) methodologies respectively.

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Structural Breaks

Moody's has, from time to time, refined its long term rating scale and adjusted its notching practices. Since the ratings in the senior ratings table are "synthetic" in the sense that they are derived from rated bonds, adjustments to the underlying bond ratings due to a structural change in the ratings scale may induce changes in the estimated senior ratings. If one were not aware of these structural changes, one would mistakenly attribute the observed changes in the estimated senior ratings to changes in actual credit quality.

These structural changes have often been implemented as a batch process (many changes on a single day), with subsequent changes occurring incrementally over time. Hence, there are dates when structurally induced senior rating changes tend to cluster. Table 3 lists four significant structural changes that affect estimated senior rating of which researchers should be aware.

Table 3

Structural Breaks in the Senior Ratings Table	
Date	Event
April 26, 1982	Alphanumeric rating scale above Caa introduced
July 28, 1997	Alphanumeric Caa ratings introduced
October 25, 1999	Issuer ratings introduced
July 7, 2005	Issuer ratings for speculative grade begin withdrawal

In the next section, we show an example of a rating transition calculation using the senior ratings table for 2004. If, however, a researcher were doing the same analysis for 1999 (s)he would have to be aware that the introduction of issuer ratings (a new reference rating in the SRA matrix) in that year that may have caused artificial rating changes. In order to attenuate the effects of structural rating changes, one strategy is to omit the date listed in Table 3 from analysis. In general, the researcher should be careful to examine dates (days or months) where rating changes show abnormally high clustering to ensure that they are related to economic or credit events.

Simple Data Queries using the SRT

The following three examples illustrate several useful queries on the SRT included in *Moody's Default Risk Service* database (DRS). The senior ratings table included in DRS is titled **senrratg**. All the examples can be carried out using Microsoft Access or any SQL-based program.

Example 1 – List Defaulters

To produce a list of all corporate and sovereign issuers that Moody's rated as of January 1, 2003 and that defaulted by the end of the 2003.

```
SELECT senrratg.issr_num, senrratg.ratg_dt, senrratg.est_senr_rtg_txt,
senrratg.ratg_expire_dt, senrratg.term_dt, senrratg.censor

FROM senrratg

WHERE (((senrratg.ratg_dt)<=#1/1/2003#) AND ((senrratg.est_senr_rtg_txt)<>"WR") AND
((senrratg.ratg_expire_dt)>#1/1/2003#) AND ((senrratg.term_dt) Between #1/1/2003# And
#12/31/2003#) AND ((senrratg.censor)=0)) OR (((senrratg.ratg_dt)<=#1/1/2003#) AND
((senrratg.est_senr_rtg_txt)<>"WR") AND ((senrratg.ratg_expire_dt) Is Null) AND
((senrratg.term_dt) Between #1/1/2003# And #12/31/2003#) AND ((senrratg.censor)=0));
```


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The first ten rows of output will resemble the following table:

issr_num	est_senr_rtg_txt	ratg_dt	ratg_expire_dt	term_dt	sensor
600012257	Ca	12/19/2002	4/14/2005	12/31/2003	0
600036998	B2	8/30/2002	4/15/2005	12/17/2003	0
600054443	B3	6/11/2002	4/16/2005	12/15/2003	0
600058936	B3	11/1/2002	4/17/2005	12/15/2003	0
600044011	Ca	10/30/2002	4/18/2005	12/12/2003	0
600042267	B2	3/16/1999	4/19/2005	12/4/2003	0
600042265	Caa3	3/16/1999	4/20/2005	12/4/2003	0
600016223	B3	10/29/2001	4/21/2005	12/1/2003	0
600052017	Caa3	10/28/2002	4/22/2005	11/11/2003	0
600055468	Caa2	5/23/2001	4/23/2005	10/29/2003	0

(Note, a unique join with the **mastissr** table will allow one to identify defaults by name, rather than by company number.)

Example 2 – List Withdrawn Ratings

To produce a list of all corporate and sovereign issuers that Moody's rated as of January 1, 2003 and whose ratings were withdrawn by the end of the 2003:

```
SELECT senratg.issr_num, senratg.ratg_dt, senratg.est_senr_rtg_txt, senratg.ratg_expire_dt,
senratg.term_dt, senratg.sensor

FROM senratg

WHERE (((senratg.ratg_dt)<=#1/1/2003#) AND ((senratg.est_senr_rtg_txt)<>"WR") AND
((senratg.ratg_expire_dt)>#1/1/2003#) AND ((senratg.term_dt) Between #1/1/2003# And #12/31/2003#)
AND ((senratg.sensor)=0)) OR (((senratg.ratg_dt)<=#1/1/2003#) AND
((senratg.est_senr_rtg_txt)<>"WR") AND ((senratg.ratg_expire_dt) Is Null) AND ((senratg.term_dt)
Between #1/1/2003# And #12/31/2003#) AND ((senratg.sensor)=0));
```

The first ten rows of output will resemble the following table:

issr_num	est_senr_rtg_txt	ratg_dt	ratg_expire_dt	term_dt	sensor
483500	Ba3	5/1/2002	12/30/2003	12/30/2003	1
19440	Baa2	1/16/2002	12/30/2003	12/30/2003	1
752550	B1	10/21/1998	12/25/2003	12/25/2003	1
600043444	Caa3	2/27/2002	12/24/2003	12/24/2003	1
16155	Ba3	3/15/2002	12/23/2003	12/23/2003	1
600064175	Ba3	3/15/2002	12/23/2003	12/23/2003	1
600011860	A2	1/19/1994	12/21/2003	12/21/2003	1
600020066	B1	8/1/1996	2/4/2003	12/18/2003	1
600042519	B2	8/14/2002	12/17/2003	12/17/2003	1
600021928	Caa1	6/17/1999	12/17/2003	12/17/2003	1

(As with Example 1, a unique join with the **mastissr** table will allow one to identify withdrawn issuers by name, rather than by company number.)

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Example 3 – Rating Transition Matrix

The following query shows how to construct the rating transition matrix for the year 2003. Here, the term date and censor fields are used to construct mutually exclusive transition states: rating change, rating withdrawal, and default, denoted "D".⁴ The query generates a count of issuers matrix. To transform the output into percentages (as in Moody's default study), divide each cell in a given row by the row sum.

```
TRANSFORM Count(senrratg.issr_num) AS CountOfissr_num

SELECT senrratg.est_senr_rtg_txt

FROM senrratg INNER JOIN senrratg AS senrratg_1 ON senrratg.issr_num = senrratg_1.issr_num

WHERE ((([senrratg].[term_dt]-#1/1/2003#)>=0) AND ((senrratg.rtg_dt)<=#1/1/2003#) AND
((senrratg.rtg_expire_dt)>#1/1/2003# Or (senrratg.rtg_expire_dt) Is Null) AND
((senrratg_1.rtg_dt)<=#12/31/2003#) AND ((senrratg_1.rtg_expire_dt)>#12/31/2003# Or
(senrratg_1.rtg_expire_dt) Is Null))

GROUP BY senrratg.est_senr_rtg_txt

ORDER BY senrratg.est_senr_rtg_txt

PIVOT If([senrratg].[censor]=0 And [senrratg].[term_dt]<=DateAdd("yyyy",1,#1/1/2003#)-
1,"D",If([senrratg].[censor]=1 And
[senrratg].[term_dt]<>[senrratg_1].[term_dt],"WR",[senrratg_1].est_senr_rtg_txt));
```

⁴ Moody's does not have a D symbol in its ratings scale. The symbol "D," denoting default, is used simply for convenience.

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The output will resemble the familiar ratings transition table from Moody's default studies, with the first column the start (January 1) ratings and the remaining columns the ending (December 31) ratings. Again, this query generates counts of issuers rather than transition rates.

est_senr_rtg_txt	Aaa	Aa1	Aa2	Aa3	A1	A2	A3	Baa1	Baa2	Baa3	Ba1	Ba2	Ba3	B1	B2	B3	Caa1	Caa2	Caa3	Ca	C	D	WR		
Aaa	180																						6		
Aa1	9	134	2	3	1																			8	
Aa2	1	15	158	26	6																			13	
Aa3			11	298	33	6	1																	25	
A1	1			17	253	36	11	3																24	
A2					31	353	57	34	4	3														21	
A3					6	15	391	36	9	5		1												16	
Baa1						6	9	295	36	14	3		1	6										18	
Baa2							5	13	318	38	11	2	6	4	1									25	
Baa3								11	20	280	20	14	3	2	4	3								22	
Ba1						1		8		12	125	8	20	8	3									1	17
Ba2										2	16	93	10	6	4	2	6							1	11
Ba3							1			1		9	157	20	9	4	1	2						3	19
B1										1		9	10	179	33	14	9							2	19
B2											2		4	24	183	32	17	8						7	29
B3								1				1	1	5	28	94	15	10	2	3				11	26
Caa1														1		9	61	4	5	3				9	17
Caa2																2	3	28	2	6	1	14		8	
Caa3																	2	5	18					14	10
Ca																2	3			16	1	14		18	
C																					4	5		3	

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Moody's Related Research

Special Comments

- Summary Guidance for Notching Secured Bonds, Subordinated Bonds, and Preferred Stocks of Corporate Issuers, September 2001 (70456)
- Default Rates of Corporate Bond Issuers, 1920-2004, January 2005 (91233)
- Moody's Announces Intent to Withdraw Issuer Ratings for Speculative-Grade Corporate Issuers, July 2005 (92642)

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Author(s)

Vivek Gupta
Kusum Parwani

Production Specialist

Ida Chan

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