## EDFs and Ratings

The following table shows the correspondence between EDFs and the ratings of Standard & Poor’s and Moody’s.

|  |  |  |
| --- | --- | --- |
| **EDF** | **S&P** | **Moody’s factors** |
| 2 to 4 bps | >=AA | > = Aa2 |
| 4 to 10 bps | AA/A | A1 |
| 10 to 19 bps | A/BBB+ | Baa1 |
| 19 to 40 bps | BBB+/BBB- | Baa3 |
| 40 to 72 bps | BBB-/BB | Ba1 |
| 72 to 101 bps | BB/BB- | Ba3 |
| 101 to 143 bps | BB-/B+ | B1 |
| 143 to 202 bps | B+/B | B2 |
| 202 to 345 bps | B/B- | B2 |

Within any rating class the default probabilities of issuers are clustered around the median. However, the average default rate for each class is considerably higher than the default rate of the typical firm. The table below shows the variation of the EDFs within each rating class.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| *Quantiles* | 10 | 25 | 50 | 75 | 90 | *Mean* |
| *AAA* | 0.02 | 0.02 | 0.02 | 0.02 | 0.10 | 0.04 |
| *AA* | 0.02 | 0.02 | 0.02 | 0.04 | 0.10 | 0.06 |
| *A* | 0.02 | 0.03 | 0.08 | 0.13 | 0.28 | 0.14 |
| *BBB* | 0.05 | 0.09 | 0.15 | 0.33 | 0.71 | 0.30 |
| *BB* | 0.12 | 0.22 | 0.62 | 1.30 | 2.53 | 1.09 |
| *B* | 0.44 | 0.87 | 2.15 | 3.80 | 7.11 | 3.30 |
| *CCC* | 1.43 | 2.09 | 4.07 | 12.24 | 18.82 | 7.21 |

Three consequences follow from the previous analysis. First, since the rating agencies are slow to change their ratings, the historical frequency of staying in a rating class should overstate the true probability of keeping the same credit quality. Second, the average historical probability of default overstates the true probability of default for typical firms within each rating class, due to the difference between the mean and the median default rates. Third, if both the probability of staying in a given rating class, and the probability of default are too large, then the transition probabilities must be too small.

KMV has constructed a transition matrix based upon default rates rather than rating classes. They start by ranking firms into groups based on non-overlapping ranges of default probabilities that are typical for a rating class. For instance all firms with an EDF less than 2 bp are ranked AAA, then those with an EDF comprised between 3 bp and 6 bp are in the AA group, firms with an EDF of 7 bp to 15 bp belong to A rating class, and so on. Then, using the history of changes in EDFs we can produce a transition matrix shown in Table 5 which is similar in structure to the one produced in Table 1 of Chapter 8 and reproduced below as Table 6.

However, the difference in the various probabilities between the two tables is striking, but as expected. According to KMV, except for AAA, the probability of staying in the same rating class is between half and one third of historical rates produced by the rating agencies. KMV’s probabilities of default are also lower, especially for the low-grade quality. Migration probabilities are also much higher for KMV, especially for the grade above and below the current rating class.

**Table: KMV one-year transition matrix based on non-overlapping EDF ranges**

|  |  |
| --- | --- |
| **Initial**  | **Rating at year-end (%)** |
| **Rating** | AAA | AA | A | BBB | BB | B | CCC | Default |
| AAA | 66.26 | 22.22 | 7.37 | 2.45 | 0.86 | 0.67 | 0.14 | 0.02 |
| AA | 21.66 | 43.04 | 25.83 | 6.56 | 1.99 | 0.68 | 0.20 | 0.04 |
| A | 2.76 | 20.34 | 44.19 | 22.94 | 7.42 | 1.97 | 0.28 | 0.10 |
| BBB | 0.30 | 2.80 | 22.63 | 42.54 | 23.52 | 6.95 | 1.00 | 0.26 |
| BB | 0.08 | 0.24 | 3.69 | 22.93 | 44.41 | 24.53 | 3.41 | 0.71 |
| B | 0.01 | 0.05 | 0.39 | 3.48 | 20.47 | 53.00 | 20.58 | 2.01 |
| CCC | 0.00 | 0.01 | 0.09 | 0.26 | 1.79 | 17.77 | 69.94 | 10.13 |

*Source: KMV Corporation*

**Table: Transition matrix based on actual rating changes**

|  |  |
| --- | --- |
| **Initial** | **Rating at year-end (%)** |
| **Rating** | AAA | AA | A | BBB | BB | B | CCC | Default |
| AAA | 90.81 | 8.33 | 0.68 | 0.06 | 0.12 | 0 | 0 | 0 |
| AA | 0.70 | 90.65 | 7.79 | 0.64 | 0.06 | 0.14 | 0.02 | 0 |
| A | 0.09 | 2.27 | 91.05 | 5.52 | 0.74 | 0.26 | 0.01 | 0.06 |
| BBB | 0.02 | 0.33 | 5.95 | 86.93 | 5.30 | 1.17 | 1.12 | 0.18 |
| BB | 0.03 | 0.14 | 0.67 | 7.73 | 80.53 | 8.84 | 1.00 | 1.06 |
| B | 0 | 0.11 | 0.24 | 0.43 | 6.48 | 83.46 | 4.07 | 5.20 |
| CCC | 0.22 | 0 | 0.22 | 1.30 | 2.38 | 11.24 | 64.86 | 19.79 |

*Source: Standard & Poor’s CreditWeek (April 15, 1996)*

These differences may have a considerable impact on the VaR calculations such as those derived in the previous section related to CreditMetrics.

## On the Actuarial Approach

* CreditRisk+ applies an actuarial science framework to the derivation of the loss distribution of bond/loan portfolio.
* Only default risk is modelled, while downgrade risk is ignored.
* Unlike the KMV approach to modelling default, there is no attempt to relate default risk to the capital structure of the firm.
* Also no assumptions are made about the causes of default (hence the name sometimes used as reduced-form model), an obligor is either in default with a specific probability PA or it is not in default with the complementary probability.

Main assumptions

* The probability of default in a given period is the same as in other period.
* For a large number of obligors, the probability of default by any particular obligor is small, and the number of defaults that occur in any given period is independent of the number of defaults that occur in any other period.

Under these assumptions, the probability distribution for the number of defaults during a given period is represented by a Poisson distribution:

$Prob\left(n defaults\right)=\frac{\overbar{n}^{n}e^{-\overbar{n}}}{n!}$ for n = 0, 1, 2…

Where $\overbar{n}=\sum\_{A}^{}P\_{A}$

For instance, assuming that the mean is 3, then the probability that there are no defaults in the next period is:

$$Prob\left(0 deafults\right)=\frac{3^{0}e^{-3}}{0!}=0.05=5\%$$

While the probability of exactly three defaults is:

$$Prob\left(3 deafults\right)=\frac{3^{3}e^{-3}}{3!}=0.224=22.4\%$$