The Credit Derivatives Market

Presentation to Fields Institute

Sept 25, 2002

John Hull, Alan White, and Florence Wu

Agenda

- Review different types of credit derivatives and how they work
- Discuss some work we have done this summer on the construction of indices of credit default swap spreads
- Provide background for the research that Alan will present

Credit Derivatives

- Derivatives where the payoff depends on the credit quality of one or more corporations or sovereign entities
- A way of classifying credit derivatives
  - No dependence on default correlation; no optionality
  - Dependence on default correlation; no optionality
  - Optionality; no dependence on default correlation
  - Optionality; dependence on default correlation

Credit Default Swaps

- Buyer of they instrument acquires protection against a default by a particular company or sovereign (the reference entity)
- Example: Pay a premium of 90 bps per year for $10 million of 5-year protection against Ford Motor Company
- Premium is known as the *credit default spread*. It is paid for life of contract or until default
- If there is a default the buyer has the right to sell a certain amount of a bond issued by Ford Motor Company for its face value

Credit Default Swaps continued

- To value a CDS we need to calculate the present value of expected payments and the present value of expected payoffs
- Need estimates of risk-neutral default probabilities and recovery rates
- The *n*-year CDS spread is the premium for which an *n*-year CDS has a value of zero

First to Default Basket CDS

- Similar to a regular CDS except that several reference entities are specified and there is a payoff when the first one defaults
- This depends on "default correlation"
- A complication is that there is no generally accepted measure of default correlation

Alternative Ways of Calculating a Default Correlation between A and B

- Calculate correlation between
  - A variable that equals 1 if company *A* defaults between time 0 and time *T* and zero otherwise
  - A variable that equals 1 if company *B* defaults between time 0 and time *T* and zero otherwise

- Transform probability distribution of the time to default so that it is normal and calculate correlation between transformed variables

Options on Credit Default Swaps

- Example: European option to buy 5 year protection on Ford for 100 bps starting in one year. If Ford defaults during the one-year life of the option, the option is knocked out
- If we assume that the CDS spread at option maturity, conditional on no earlier default, is lognormal it turns out that the valuation formula is structurally very similar to that for a European swap option

Data on Credit Default Swap Spreads

- GFI, a major broker of credit default swaps has been collecting data on credit default swap spreads since 1997
- Each day bid and offer quotes are recorded on a variety of names for CDS's
- Number of quotations has risen from 4,759 per year in 1998 to over 125,000 per year in 2002
- 5-year term has become the most common (and now accounts for 85% of trades)

Our Objective

- To provide indices for 5-year mid market spreads for the rating categories Aaa/Aa, A, and Baa
- To provide a mechanism for estimating 5-year CDS spreads for any name on any day
- To provide a mechanism for estimating non-5-year spreads for any name on any day

Alternative Indices

- Spread-change index: measures the average percentage change in spreads for names in the rating category
- Spread-level index: measures the average level of the spreads for names in the rating category
- These are different. To understand why consider the problem of constructing an annual index for the ages of people in the United States….

Alternatives for Constructing an Age Index

- One alternative would be to start the index at 100 and let the increase between the end of year *i* and the end of year *i*+1 be the average increase in the age of people who are alive at both times
- Another alternative would be the measure the average age of the population each year

Alternatives for Constructing the Age Index

continued

- The first index increases at the rate of one year per year. It is analogous to the spread-change index
- The second index is probably increasing, but at not such a fast rate. It is analogous to the spread-level index.
- The second index takes account of births and deaths in calculating an average age. The first index looks only at people who are initially alive and stay alive

Calculation of Observations

- When there is both a bid and an offer for a CDS with a particular maturity on a particular name on a particular day and they satisfy a condition that they are reasonably close together we calculate an "observation" for the name on the day as

  0.5*(maxbid+minoffer)

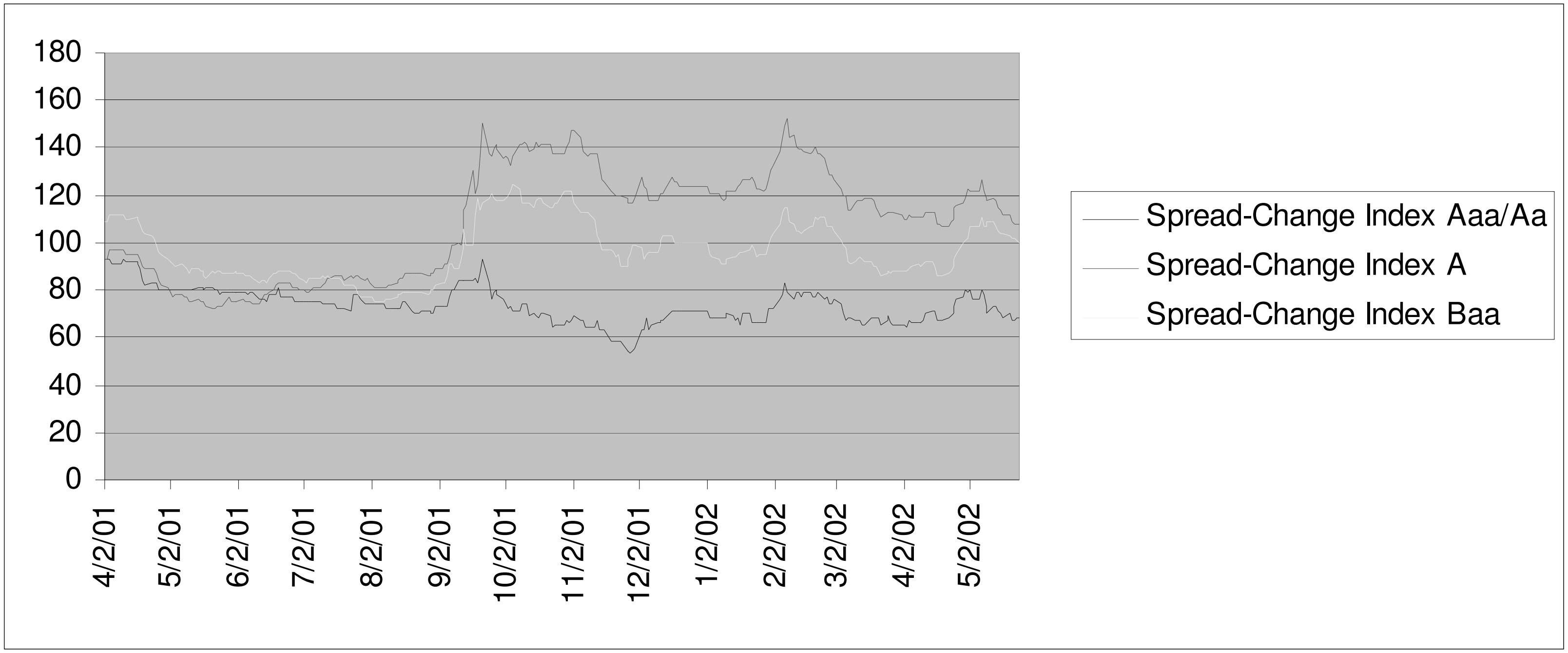
Calculation of Spread-change Index

- Not all names trade on all days
- After testing a number of different models we chose

  $$\ln x_{i,j} = \ln c_i A_j + e_{ij}$$

  where A_j is the index on day j, x_{ij} is the 5-year spread for the ith company on day j, and e_{ij} are iid normals with zero mean
- Once the index has been calculated up to day n-1 model enables a maximum likelihood estimate for the index on day n to be calculated from available data in a straightforward way

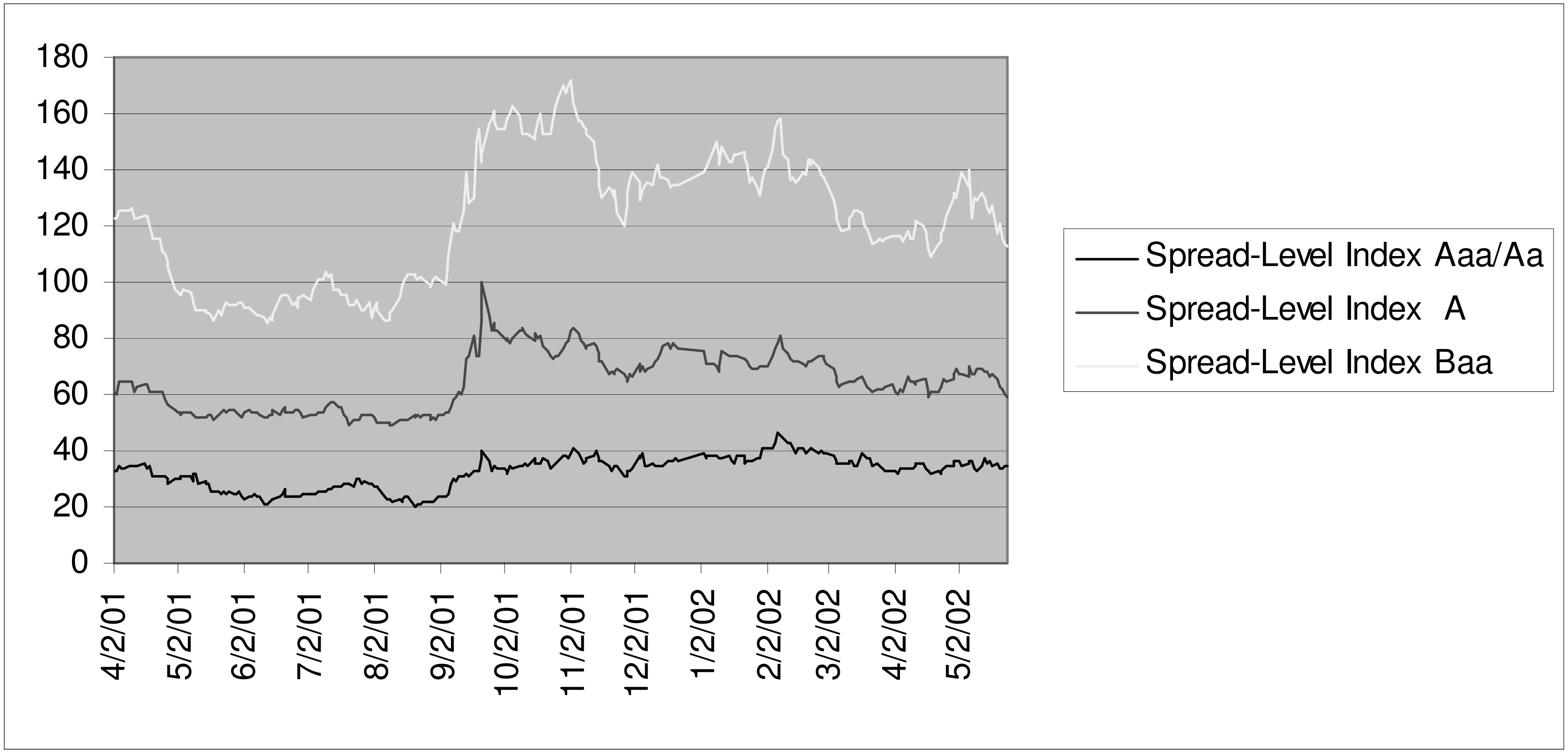
Results for Spread-change Index



Calculation of Spread-level Index

- The index is too volatile if we calculate it as the average spread for all names that provide observations on a particular day
- We therefore supplement observations with "pseudo observations" that are estimated using the spread-change index and the most recent observation

Results for Spread-level Index

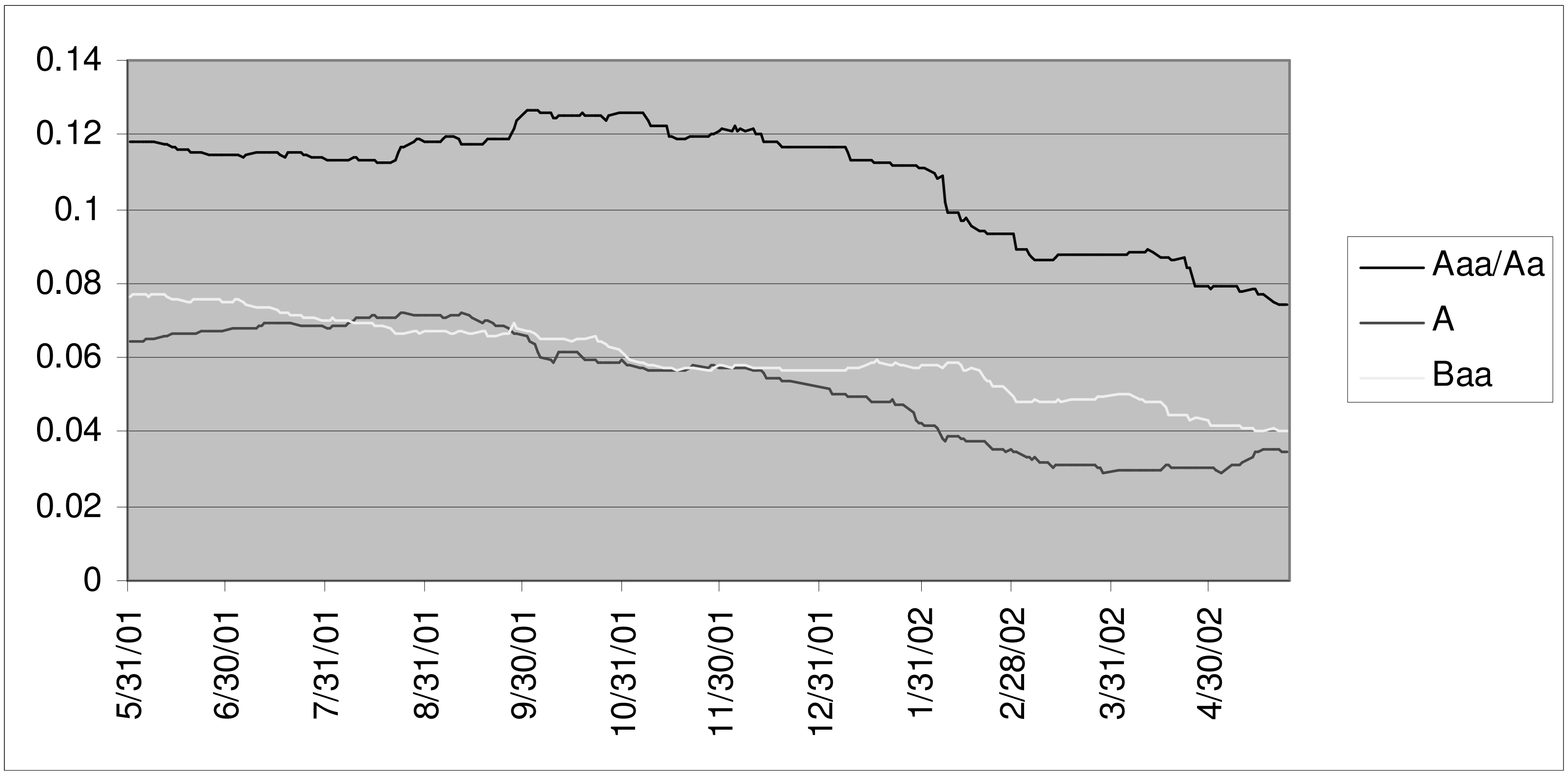


Estimating Spreads for Names

- The five-year spread for a name can be estimated from the most recent observation and the spread-change index
- For non-five-year spreads we assume a model

  Spread(k)=Spread(5)+a*Spread(5)*(k-5)
- The parameter a is estimated from a regression analysis where weights assigned to observations decrease exponentially as we move back through time
- The model enables estimates of non-5-year spreads to be produced from estimates of 5-year spreads

Results for Parameter *a*



Estimates for increase in spread (bps) per year of life of CDS