QFI PM Sample Detailed Study Manual

You have downloaded a sample of our QFI PM detailed study manual. The full version covers the entire syllabus and is included with the online seminar.

Each portion of the detailed study manual is available in PDF with a clickable table of contents. Each reading (and sub-chapters if applicable) are also bookmarked in the PDF for ease of navigation in your favorite desktop, tablet, or smartphone PDF viewer.

If you have additional questions about the detailed study manual or any aspect of the exam, please email me.

Zak Fischer, FSA, CERA

zak@theinfiniteactuary.com

QFI PM Detailed Study Guide - Sample

CRE Ch 20: Commercial Mortgage Backed Securities

Miller & Geltner

Overview

This chapter covers the basics of commercial mortgage backed securities (CMBS), an exciting development in the commercial real estate finance industry

Key topics for the exam include:

- A basic outline of the U.S. CMBS industry
- The process of pooling commercial loans together and creating different tranches of a CMBS
- How tranching can be used to concentrate and stratify risk in CMBS
- Determining the cashflows of different CMBS tranches, and how defaults from the underlying loan pool will impact these cashflows
- Subordination of tranches, and how that determines credit rating
- Challenges facing the CMBS industry, such as moral hazard and adverse selection

Overview and History of CMBS Industry

Commercial mortgage-backed securities (CMBS) are bonds backed by pools of commercial mortgages

- CMBS securities provide claims to cashflows from the underlying mortgages as borrowers make interest and principal payments
- **Securitization** is the process of pooling the mortgages together, and selling new classes of securities (called **tranches**) based on this pool
- Each tranche is characterized by its priority of claim on the mortgage pool's cashflows
- Bond rating agencies assign a credit quality rating to each tranche
- During the 1990s and through 2008, CMBS provided a new and efficient source of debt capital for real estate
- This helped improve the liquidity and transparency of commercial real estate

Securitization redistributes risk to different investors

- Some CMBS tranches have higher credit quality than that of the mortgage loans in the pool, since they have senior priority when receiving the underlying cashflows
- In contrast, other tranches are lower rated and are more risky than the underlying loans

  - To compensate for this risk, these lower tranches are priced at a higher yield-to-maturity

- This unbundling of mortgage credit risk creates different securities that better match the needs of specific investor groups, thus creating value

Illustration of CMBS Structure: Pooling, Tranching, and Subordination

Suppose we have a pool that consists of ten commercial mortgages

- Each mortgage has an outstanding loan balance (par value) of $10 million
- Each mortgage has a 10% coupon rate
- Five of the loans mature in one year, and the other five loans mature in two years
- The total value of all the properties collateralizing the loans is $142.857 million

The mortgage pool can be summarized by the following characteristics:

- Total par value: $100 million
- Weighted average maturity (WAM): 1.5 years
- Weighted average coupon (WAC): 10%
- Loan to value (LTV) ratio: 70%
  - This is calculated from:

$$LTV = \frac{\text{Remaining loan balance}}{\text{Market value of underlying properties}} = \frac{\$100\text{ million}}{\$142.857\text{ million}} = 0.7$$

CMBS reallocates the risk and duration in the underlying mortgage pool among different bonds classes (i.e. tranches). **Exhibit 20-3** illustrates how we can create three tranches of CMBS securities that pass-through the cashflows from this pool of commercial mortgages

- **Tranche A**: The most senior tranche, and has $75 million of par value in the pool
  - Tranche A receives highest priority from mortgage payments. This can be quantified from the tranche's subordination, which is given by the formula:

$$\textbf{Subordination} = \frac{\textbf{Mortgage Pool Par Value - Tranche Par Value}}{\textbf{Mortgage Pool Par Value}}$$

  - The subordination of a tranche is the percentage of total losses that need to occur in the loan pool before the tranche suffers any losses
  - Higher subordination = less default risk in a tranche
  - The underlying property value needs to fall by 52.5% ($75M/$142.857M) before Tranche A has less collateral value than its par value

  - As a result, the default risk of Tranche A is similar to that of a mortgage with a 52.5% LTV ratio, which is very conservative
  - Tranche A also has a short weighted average maturity, and hence the lowest interest rate risk, of all the tranches
    - This is because any principal repayments from the underlying mortgages will be used to retire Tranche A's par value first
    - **Waterfall sequence** = this type of CMBS payment structure where the most senior tranche is retired before any subordinate tranches begin to receive principal payments

- **Tranche B**: A junior (subordinate) class that has claim to the remaining $25 million of par value in the pool
  - This is the **first-loss tranche** because any credit losses due to defaults in any of the mortgages in the pool are first subtracted from the par value of tranche B
  - Only after the par value of tranche B is completely wiped out will subsequent credit losses be assigned to the more senior tranche A
  - Tranche B has higher default risk than a traditional loan with a 70% LTV ratio
    - Because Tranche B provides credit support for Tranche A, it faces greater conditional *loss severity* when mortgages in the underlying pool default
  - Under a sequential-pay waterfall structure, Tranche B also has the highest interest rate risk because its par value will be retired last
    - In general, the WAM of first-loss tranches are greater than that of senior tranches
  - To compensate for the higher risk that Tranche B faces, Tranche B securities will be sold at a higher yield (YTM) than the senior tranches

- **Interest-only Tranche**: Securities that pay any extra interest left over from the commercial mortgage pool after Tranches A and B have received their coupon payments
  - Senior tranches in a CMBS structure are normally sold at par
  - Because these senior tranches have higher credit quality than the mortgages in the CMBS pool, they typically offer a coupon rate that is lower than the WAC of the mortgages in the pool
  - The remaining interest paid by the mortgages in the pool can then be "stripped" off and sold as a separate security
  - This tranche's claim to these interest payments are equal in seniority to that of class A

Drill Problem: Calculating Subordination of CMBS Tranches

Consider Tranche A from the CMBS setup described in the previous section

Question 1: Calculate the subordination of Tranche A during the first year

Solution:

- Tranche A has **subordination** of 25%, since the total losses need to exceed 25% of the \$100M par value of the loan pool before Tranche A suffers any losses

$$\textbf{Subordination} = \frac{\textbf{Mortgage Pool Par Value - Tranche Par Value}}{\textbf{Mortgage Pool Par Value}} = \frac{\$100M - \$75M}{\$100M} = 0.25$$

Question 2: After one year, the first five loans have paid off their maturity. At the start of year 2, what is the subordination of Tranche A?

Solution:

- After year 1, the underlying loan pool has \$50 million in par value, and tranche A has remaining par value of \$25 million
- As a result, the subordination has increased from 25% to 50%

$$\textbf{Subordination} = \frac{\textbf{Mortgage Pool Par Value - Tranche Par Value}}{\textbf{Mortgage Pool Par Value}} = \frac{\$50M - \$25M}{\$50M} = 0.5$$

Question 3: For a CMBS that has a principal retirement waterfall payment scheme, comment on the impact retirement of loan balances in the pool will have on the amount of subordination in the CMBS structure of a senior tranche

Solution:

- As more loans in the underlying pool pay off the principal over time, the amount of subordination will increase in the CMBS structure

Drill Problem: CMBS Cashflows

Consider the pool of commercial mortgages that was described in the previous section. Assume a CMBS based on this pool has the following three tranches:

- Tranche A has a par value of \$75 million, and will offer an annual coupon rate of 8%
- Tranche B has a par value of \$25 million, and will offer an annual coupon rate of 10%
- Tranche X is an interest-only class that pays the following:
  - In year 1, a coupon rate of 1.5% applied to the \$100 million par value
  - In year 2, a coupon rate of 1% applied on the \$50 million par value remaining in the loan pool

Question 1: Calculate the cashflows each tranche expects to receive in years 1 and 2

Solution:

- At the end of year 1, each tranche will receive an interest payment equal to its coupon rate multiplied by its par value
  - Since half the loans in the mortgage pool will mature in year 1, Tranche A will also receive a $50 million principal payment
  - This is because all principal payments made by the loans will be given to Tranche A until the par value of Tranche A is retired
- At the end of year 2, each tranche will still receive an interest payment
  - The interest payment for Tranche B will still be the same, since Tranche B's par value is still $25 million
  - However, the interest payment for Tranche A is reduced from $6 million to $2 million, since Tranche A's par value has now decreased to $25 million
- At then end of year 2, the remaining mortgage loans will also mature, resulting in a $50 million principal payment that is split between Tranches A and B
- The tables below summarizes the cashflows each tranche will receive

Class (Par $M, Coupon)	**Yr 1: Principal**	**Yr 1: Interest**	**Yr 1: Total CF**
A (75, 8%)	50	6	56
B (25, 10%)	0	2.5	2.5
X (100, 1.5%, 1% yr 2)	0	1.5	1.5

Class (Par $M, Coupon)	**Yr 2: Principal**	**Yr 2: Interest**	**Yr 2: Total CF**
A (75, 8%)	25	2	27
B (25, 10%)	25	2.5	27.5
X (100, 1.5%, 1% yr 2)	0	0.5	0.5

Question 2: Assume that Tranche A is priced at a YTM of 8%, Tranche B at a YTM of 12%, and Tranche X at a YTM of 8%. Calculate the total value of the CMBS tranches.

Solution:

- By discounting the expected cashflows from each tranche by its appropriate YTM, we obtain:

$$\textbf{Value of Tranche A} = \frac{56}{1.08} + \frac{27}{1.08^2} = 75$$

$$\textbf{Value of Tranche B} = \frac{2.5}{1.12} + \frac{27.5}{1.12^2} = 24.15$$

$$\textbf{Value of Tranche X} = \frac{1.50}{1.08} + \frac{0.5}{1.08^2} = 1.82$$

- By summing up the values of these tranches, we obtain the total value of the CMBS:

$$\textbf{Total value of CMBS securities} = 75 + 24.15 + 1.82 = \textbf{100.97} \checkmark$$

Question 3: Comment on how much value was created through the securitization process of the commercial mortgages

Solution:

- The underlying mortgages in the pool have a current market value of $100 million
- However, the total value of the newly issued CMBS securities is $100.97 million
- Thus, the securitization process added $0.97 million in value

Question 4: Now, suppose that during year two, one of the loans defaults on its $1 million interest payment. In addition, the property supporting the loan was taken in foreclosure and sold for $5 million, resulting in a loss of principal of $5 million. Recalculate the cashflows each tranche will receive in year 2

Solution:

- According to the normal priority in assignment of loan payments, any recovered money should be first assigned to interest payments, and then to principal
- Thus, out of the $5 million recovered from sale of the property during foreclosure, the first $1 million will be assigned to make up for the missed interest payment
- The entire $6 million loss on the bad loan will then be taken out of the par value of the lowest priority class, which is Tranche B
- As a result, during year 2, Tranche B will receive the following:
  - Its scheduled interest payment of $2.5 million
  - A $19 million principal payment, which is obtained after the $6 million write-down of its original $25 million of par-value
- Tranches A and X still receive the same cashflow payments as before
- Thus, Tranche B (the junior tranche) absorbs the full loss of the $6 million
- The table below summarizes the cashflows each tranche will receive during year 2:

Class (Par $M, Coupon)	**Yr 2: Principal**	**Yr 2: Interest**	**Yr 2: Total CF**
A (75, 8%)	25	2	27
B (25, 10%)	19	2.5	21.5
X (100, 1.5%, 1% yr 2)	0	0.5	0.5

Value Creation through CMBS

The basic principle of mortgage securitization is that the value of the tranches sold to investors must be greater than the par value of the mortgage pool underlying the securites. The securitization process adds the following sources of value:

- The greater variety of securities in the CMBS tranches may be more useful to investors
  - The tranches cover a range of different maturities, default risks, cash flow profiles, and interest rate risk that can appeal to different types of investors
- Makes it easier for passive investors to place their capital into the more senior CMBS tranches
  - These investors don't need to have local real estate expertise to invest in the CMBS
  - Instead, they can just rely on bond ratings of the CMBS tranches to assess risk
- Increased liquidity compared to the underlying whole loans inside the mortgage pool
- Efficiency gains and cost reduction

Bond Ratings of CMBS

A crucial part CMBS industry's growth was that traditional bond-rating agencies developed the ability to rate the default risk of CMBS tranches

- Many investors in the CMBS industry are passive individuals that lack the time, resources, and expertise to asses the risk of mortgages
- When a CMBS tranche obtained a bond rating, investors could feel more comfortable investing in the CMBS

Typically, bond credit rating agencies determine how much subordination they require for a given credit rating of a CMBS tranche

- For example, rating agencies may require that all tranches rated AAA must have at least 25% subordination, and all tranches rated AA must have at least 20% subordination
- The credit rating a tranche receives largely determines its yield-to-maturity

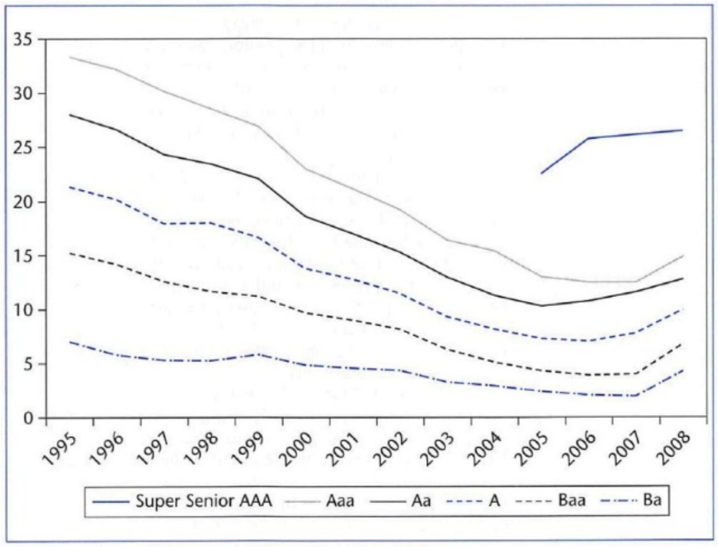
Lessons from the Financial Crisis

From the early 1990s to 2007, two main phenomena shaped the evolution of the CMBS industry

1. *A learning process* - issuers, investors, and rating agencies became more familiar with CMBS
2. Huge growth in the supply of financial capital from investors

EXHIBIT 20-7 History of CMBS Subordination Levels, 1995–2008 (pre-crisis)

Source: Authors' correspondence with Moody's Investors.



As comfort with CMBS grew, parties became less conservative in their risk analysis of CMBS

Exhibit 20-7 shows that over time, rating agencies adjusted their models so that less subordination would be required to obtain a given credit rating

- For example, in the early 1990s, issuers had to provide around 30% subordination for AAA-rated tranches
- By 2000, though, to achieve the same AAA credit rating, the required amount of subordination dropped to 20%
- In addition, starting around 2004, the market began to demand "super-senior" tranches
  - These tranches had even more subordination than what the credit rating agencies were willing to give the top rating, AAA, to
  - This indicated that conservative bond investors believed that the subordination levels the rating agencies were requiring for high-rated bonds were too low

Relatively low CMBS-LIBOR spreads in the early 2000s was also a signal from the bond market that many investors overlooked the default risk in CMBS

- Between 2001 and 2007, the CMBS-LIBOR spreads steadily decreased
- However, after the 2008 financial crisis, the CMBS-LIBOR spreads drastically spiked because of all the defaults from the underlying loans in the mortgage pools
- As a result, the new-issue CMBS market virtually shut down during 2009 and is still recovering
- Today, new CMBS securities have fewer tranches and higher subordination

Moral Hazard and Adverse Selection

Going forward, the CMBS industry also faces challenges in how to deal with **moral hazard** and **adverse selection**

Moral hazard is when one party has control over an action that affects the risk of another party

- In the CMBS industry, moral hazard exists when issuers give loans to high-risk individuals, but then immediately pass on the risk to other parties by selling the loans into a CMBS pool
- After selling the loans, the issuer is no longer subject to the risk it created

Adverse selection occurs when a relevant sample tends to have unfavorable characteristics compared to the average characteristics in a population

- This can occur if bond investors require higher yields from CMBS because they are viewed as more risky
- This causes borrowers of the loans underlying the CMBS pool to pay higher interest rates
- This results in the lowest risk borrowers fleeing to non-CMBS types of lenders, such as whole-loan portfolio lenders, to get loans with lower interest rates
- This leaves the CMBS industry to give loans to the more risky types of borrowers

Moral hazard and adverse selection can compound each other's effects on the CMBS industry

- For example, bond market investors' awareness of moral hazard can cause them to require higher yields in CMBS bonds to compensate for this risk
- These higher yields will force the CMBS conduit loan originators into an adverse selection situation where the main borrowers in the CMBS pool have poor credit quality
- The higher credit risk will give more incentives for the loan issuers to sell off the loans quickly and pass the risk to other parties, thus worsening this moral hazard / adverse selection feedback loop

Credit Portfolio Management: Ch 6

Ben-Dor

Overview

- Recall from Chapter 5 that OAS stands for the **O**ption **A**djusted **S**pread
- OAS is a "measurement of the spread of a fixed-income security rate and the risk-free rate of return, which is adjusted to take into account an embedded option" -Investopedia
- Risky bonds are typically issued at a positive yield spread over T-bonds to compensate for the embedded credit risk
- This chapter focuses on splitting OAS into three components:
  1. Risk Premium
  2. Expected Default Cost
  3. Expected Liquidity Cost

Uses of Spread Decomposition

- Can help portfolio managers understand spread movements better
- Investors can use spread decomposition for:
  - Hedging
  - Forecasting future OAS changes
  - Developing alpha strategies

Basics of OAS Decomposition

- Understanding the components of OAS is important. One example the reading provides is an insurance company holding a large portfolio of corporate bonds. If they have a buy-and-hold strategy, they may be more concerned about default risk than liquidity risk
- Risk Premium
  - Represents the market-level risk premium and not a risk premium specific to each bond
  - Represents the variation of the market risk premium that is not already embedded in the other variables (e.g. LCS, CDS)
  - When the intercept explains a relatively high proportion of OAS, it suggests that systematic factors rather than bond-specific factors are driving spreads

- Expected Default Cost
  - Part of the OAS is driven by the possibility of default and the recovery level of defaults
  - Two Models - CDS and CDP/CRR
  - Can look at both models to determine stability of model
  - Credit Default Swap (CDS) Model
    * $ExpectedDefaultCost_{it} = CDS_{it}$
    * Use market-quoted five-year CDS as a measure of expected default cost
    * Generally the five year point is most liquid
    * Restrict analysis to CDX Index
    * CDX Index - an index comprised of the most liquid North American entities that trade in the CDS market
  - CDP/CRR Model
    * $ExpectedDefaultCost_{it} = CDP_{it} \cdot (1 - CRR_{it})$
    * CDP = Conditional Default Probability
    * CRR = Conditional Recovery Rate
    * CDP, CRR are not market variables
    * Calculated from a firm-specific macroeconomic model
    * Computed independently of a bond's OAS
- Expected Liquidity Cost
  - The Expected Liquidity Cost calculated will use the Liquidity Cost Score (LCS) model from Chapter 5
  - Another portion of the OAS is from the degree of uncertainty associated with the timing, magnitude, and recovery of defaults and liquidity costs
- The author states that credit bond spreads are generally much larger than is justified by their subsequent default and recovery experience
- If an investor seeks to hedge the default or liquidity components separately, then the contribution to OAS in bps is relevant
- If an investor is analyzing current market compensation for taking on additional amounts of expected default or liquidity cost, the **coefficients** provide that information

Spread Decomposition Methodology

This is probably the most important section of this reading. The functional form of the spread decomposition regression is specified. Pay particular attention to the interpreting results section. The SOA could give you sample results and ask you to interpret them.

General Model: $OAS_{it} = \alpha_t + \beta_t \cdot ExpectedDefaultCost_{it} + \gamma_t \cdot ExpectedLiquidityCost_{it} + \eta_{it}$

CDS Model: $OAS_{it} = \alpha_t + \beta_t \cdot CDS_{it} + \gamma_t \cdot ExpectedLiquidityCost_{it} + \eta_{it}$

CDP/CRR Model: $OAS_{it} = \alpha_t + \beta_t \cdot CDP_{it} \cdot (1 - CRR_{it}) + \gamma_t \cdot ExpectedLiquidityCost_{it} + \eta_{it}$

Notation Summary

- i: Bond Index
- t: Time Index
- α_t: Risk Premium Coefficient (the intercept term)
- β: Expected Default Cost Coefficient
- γ: Expected Liquidity Cost Coefficient
- η_{it}: Residual Term

Interpreting Results

- First add the expected default cost component through CDS or CDP/CRR
- Then add LCS
- Should see that adding LCS does not substantially change the CDS or CDP/CRR coefficient and an improvement in R-squared if LCS is a useful explanatory variable
- When regressors are added in one-by-one in a multi-step regression analysis, the coefficients should not change substantially when new regressors are added. For example, the CDS coefficient should be similar in the CDS-only model and the LCS & CDS model. If there are substantial changes to coefficient values of existing regressors when new regressors are added, this could indicate multicollinearity problems. Keep this in mind if you are given sample results on the exam and asked to interpret them
- Expect statistically signficant coefficients both with positive signs for β and γ

Disadvantages of the Spread Decomposition Methodology

- Liquidity and default are unlikely to be completely independent of each other, so **multicollinearity** may be a concern. Recall that multicollinearity is when two or more predictor variables in a regression model are highly correlated

- If the CDS model is used, the CDS market may not necessarily be liquid and therefore cannot always be considered as a pure default proxy

Interpreting Sample Regression Results

- Q: Suppose that you are given the following regression results using the CDS spread decomposition model. Interpret these regression results, emphasizing which parameters are statistically significant at the 5% level using a one-sided test.

Parameter	Value	t-statistic
α	.05	.4
β	1.17	12.05
γ	.28	4.27

Solution:

- Both the CDS and LCS coefficients are statistically significant and positive.
- The positive sign should be intuitive - spreads increase when default and liquidity costs increase. Both impacts are statistically significant based on the regression results
- The intercept, which represents the variation of the market risk premium that is not already embedded in the CDS/LCS variables, is insignificant

Understanding Multicollinearity

- Q: Suppose that a two-step regression is run for the spread decomposition model. The first step of the regression with the CDS model (using no LCS regressor) is run, but the CDS coefficient changes substantially when incorporating LCS.

  Regression Model - Step #1: CDS only

  Regression Model - Step #2: CDS and LCS

- Explain why this could be problematic.

Solution:

- This kind of behavior hints that there may be strong multicollinearity
- The model form assumes independence between liquidity and default

How Has The Composition of OAS Changed?

- In the first half of 2007, when liquidity was abundant, LCS might not have played an important role in explaining spread differences across bonds
- CDS and LCS coefficients can be interpreted as the compensation (in spread terms) demanded by investors per unit of the corresponding cost. The coefficients, therefore, generally change over time (e.g. higher in 2008)
- The intercept increased substantially from early 2007 to 2008 and 2009. This reflects an increased market risk premium

Spread Decomposition with CDP and CRR

- CDP = Conditional Default Probability
- CRR = Conditional Recovery Rate
- The word *conditional* is used to denote that the CDP and CRR quantities are calculated conditioning on the fact that there has been no previous default. For example, the CDP is the probability of default given no prior default. This is not explictly stated in the reading, but I think it is helpful to keep in mind
- Estimates regressions using $CDP_{i,t} \cdot (1 - CRR_{i,t})$ as the expected default loss variable
- Advantages of CDP/CRR Model:
  - CDP and CRR are independent of market spreads
  - Larger sample, because CDP/CRR data spans over a larger supply of tickers than the number of CDS in the CDX
- Disadvantages of CDP/CRR Model:
  - Market CDS spreads are likely to be more closely related to OAS than to a modeled default probability estimator. This advocates the CDS model over the CDP/CRR model
  - In the dataset the author uses, the CDP/CRR coefficient changes (more significantly than the CDS model) when LCS is included as an additional variable.

High Yield Spread Decomposition

- The main point to remember here is that *default risk* has more importance for high yield bonds than for investment grade bonds
- Therefore, compared to investment grade bonds, default risk will play a relatively bigger role for the spread decomposition of high yield bonds
- Liquidity cost provides additional explanatory power in high-yield spreads only during period of market stress in the data set the author analyzes

- The intercept is larger for high yield, suggesting that risk aversion, unrelated to liquidity/default characteristics, may drive a large proportion of yield spreads

Applications of Spread Decomposition: Ex-Ante Analysis

- This section switches the perspective from an ex post analysis to an ex ante analysis
- Bond's market OAS can be compared with estimated OAS using the parameters from the spread decomposition model
- If the actual OAS is wider than the estimated OAS, the bond may be trading too wide. This difference will be captured in the initial residual $\hat{\eta}_{it}$
- This could cause a trading signal to reverse the mispricing and (theoretically) more closely align the actual and estimated OAS
- Mathematically, the reverting can be seen through a negative θ (if so, the OAS model is predictive)

$$\Delta OAS = \alpha + \theta\hat{\eta}_{it} + \delta MonthDummy_t + e_{it}$$

- $\hat{\eta}_{it}$ is the initial residual, and e_{it} are the future residuals. Both residuals are defined as the observed OAS minus the expected OAS
- Results show that θ is statistically significantly negative

Applications of Spread Decomposition: Hedging

Risk	Recommended Hedge Asset
Bond Default	Issuer's CDS
Liquidity Risk	VIX Futures

- Hedging could be added to help neutralize spread changes
- Bond default could be hedged through the issuer's CDS
- Liquidity risk could be hedged through VIX futures
- Neither is perfect (or close to perfect). The book simulates a hedging strategy, and the results reduce volatility somewhat - but there is still substantial portfolio volatility. One explanation is basis risk
- Hedging is employed to neutralize spread changes, so changes in OAS/CDS/LCS are relevant

Alternative Spread Decomposition Models - I

While the alternative models presented below are important, they do only receive minor attention in the reading. Focus the most on the equations in the spread decomposition methodology section. Be aware of the equations below, but keep in mind they are not the key focus of the chapter. They each get only about a paragraph shout out in the book.

$$OAS_{it} = \alpha + \beta CDS_{it} + \gamma LCS_{it} + \phi LCSVol_{it} + \delta MonthDummy_t + \eta_{it}$$

- **Bond-level liquidity risk premium** - the additional premium investors demand as compensation for the risk that the actual liquidity may be different than the expected liquidity cost as measured by LCS
- Can use bond's LCS volatility over the past 12 months to approximate the bond-level liquidity risk premium level
- The bond-level liquidity risk premium is captured in the $LCSVol_{it}$ term
- Results show that the $LCSVol_{it}$ term is significant, but also that it absorbs about 20% of the LCS coefficient

Alternative Spread Decomposition Models - II

The next alternative model focuses on changes in OAS instead of the OAS level.

$$\Delta OAS_{it} = \alpha + \beta \Delta CDS_{it} + \gamma \Delta LCS_{it} + \delta MonthDummy_t + \eta_{it}$$

- Another specification is to use the changes in LCS and CDS spreads
- This suggests that changes in liquidity and default measures directly impact contemporaneous returns

Alternative Spread Decomposition Models - III

The last alternative model looks at log-spreads to see if outliers are overpowering the results.

$$\ln(OAS_{it}) = \alpha + \beta \ln(CDS_{it}) + \gamma \ln(LCS_{it}) + \eta_{it}$$

- One might guess that outliers could drive the results seen in this reading. The author uses log-spreads to see if the results change substantially. If they do, this could suggest that outliers were driving the results
- The conclusions are the same with both the general and log-spread models, indicating that outliers are not driving the results

Conclusion

- This chapter focuses on splitting OAS into three components:
    1. Risk Premium
    2. Expected Default Cost
    3. Expected Liquidity Cost
- **General Model:** $OAS_{it} = \alpha_t + \beta_t \cdot ExpectedDefaultCost_{it} + \gamma_t \cdot ExpectedLiquidityCost_{it} + \eta_{it}$
- Two models for expected default cost:
    1. CDS Model: $ExpectedDefaultCost_{it} = CDS_{it}$
    2. CDP/CRR Model: $ExpectedDefaultCost_{it} = CDP_{it} \cdot (1 - CRR_{it})$