INV-101 Detailed Study Manual - Sample

HOFIS Chapter 1 (Background Only)

Fabozzi (2021)

Overview

This chapter is classified as background reading on the syllabus. Many of the concepts introduced in this chapter are discussed in greater detail in later chapters of the book. You should not worry if you do not understand many of the topics mentioned. Just view this chapter as a preview of many of the chapters to come in this book.

The Handbook of Fixed Income Securities (HOFIS) textbook is one of the main INV-101 textbooks, and you are responsible for many of its chapters. The first chapter gives a broad overview of fixed income markets.

Key topics for the exam include:

- State the three largest issuers of debt
- Describe callable bonds
- Describe sinking-fund provisions
- Compute the make-whole call price
- Briefly describe RMBS and CMBS

Bonds

Three Largest Issuers of Debt

1. Domestic corporations
    - Can be public or private and collateralized or unsecured
    - *Private placement* is when bonds are sold directly to one or only a few buyers
    - One reason that debt financing is popular with corporations is that the interest payments are tax-deductible expenses. As a result, the true after-tax cost of debt to a profitable firm is usually much less than the stated coupon interest rate
2. Municipal governments
    - General obligation (GO) bonds are backed by the full faith, credit, and taxing power of the governmental unit issuing them
    - Revenue bonds have a creditworthiness that depends on the success of the particular entity within the municipal government issuing the bond
3. Federal government
    - Includes federally related institutions and government-sponsored entities (GSEs)

Maturity

- Maturity is the date the bond must be redeemed and the principal paid back
- Maturity is critical because:
  1. Indicates expected life
     - Allows the bondholder to understand the number of periods where coupon payments are expected, and when the principal should be repaid
  2. Affects the yield
     - Short-term bonds vs long-term bonds may have different yields depending on the shape of the yield curve
  3. Affects the volatility
     - Changes in rates will result in much larger changes in price for long-term bonds compared to short-term bonds
- The maturity can be modified by the issuer with a:
  1. **Call privilege** – permits the issuing firm to redeem the bond before the scheduled maturity under certain conditions
     - Corporate and municipal bonds may be callable, but the US government no longer issues callable bonds
  2. **Sinking-fund provision** – mandate that the firm retire a substantial portion of the debt, according to a prearranged schedule, during its life and before the stated maturity
     - With a sinking-fund provision, part of the principal is repaid before maturity – like in a mortgage that amortizes
- "Term bonds" are bond issues that have a single maturity
- "Serial bonds" are bundles of bonds with differing maturities
- Bond maturities for corporate bonds are usually between 1 and 30 years
  - There are some outliers, and some corporate bonds have been sold at a maturity of 100 years
- Can classify bonds as short vs intermediate vs long-term based on their maturity using the approximate classification buckets stated below:
  1. Short-term $\Rightarrow$ Less than 5 years
  2. Intermediate-term $\Rightarrow$ 5 to 12 years
  3. Long-term $\Rightarrow$ Greater than 12 years

Coupon and Principal

- Indenture is a legal contract specifying the bond terms including the interest rate the issuer must pay the bondholder, frequency of payments, denomination of currency paid, and the bond's par value
- The coupon is the periodic interest payment; the principal (aka par value and face amount) is the amount repaid at maturity (or at specified times)
- Coupon – the periodic interest payment made to owners during the life of the bond
    - Included in the quotation of a bond price (e.g. IBM 6.5 due in 2028)
    - Coupon rate is the interest rate that the issuer must pay bondholders during the term of the bond
    - Multiplying the coupon rate times the principal on the bond gives the dollar value of the coupon payment[1]
    - Frequency of Coupon Payments
        - In the US, coupons are typically paid semi-annually
        - European bonds typically pay coupons annually
        - Mortgage-backed securities (MBS) and asset-backed securities (ABS) usually deliver monthly cash flows
- Higher coupon bonds have lower volatility
    - Higher coupon bonds have lower duration, and thus less interest rate sensitivity and volatility
- Debt financing is popular with corporations because interest payments are tax deductible expenses (after-tax cost of debt is typically lower than the stated coupon interest rate)
- Original-issue discount bonds (OIDs) – initially issued at a price substantially below par value; coupon rate is deliberately set low enough to make market value less than par value
- Bearer bonds vs registered bonds
    - Bearer bonds – investors must clip coupons and send to obligor for payment
    - Registered bonds – bond owners receive payments automatically
        - All new bond issues must be registered
- Zero-coupon bonds
    - Pay no coupons; the bonds are purchased at a discounted maturity value
    - Have been issued by corporations and municipalities since the early 1980s

[1]Note: If the bond is semi-annual and the coupon rate is annual, then you will also need to multiply times one-half to get the coupon payment.

  - Example: Barclay's has a zero-coupon bond outstanding due in August 2036 that was issued on August 2006
  - U.S. Treasury does not issue zero-coupon debt with a maturity greater than one year
    - However, government securities dealers can create such securities under the Treasury's Separate Trading of Registered Interest and Principal Securities (STRIPS) Program
    - Treasury strips are discussed in more detail in Chapter 7
  - The investor in a zero-coupon security typically receives interest by buying the security at a price below its principal and holding it to the maturity date
  - Some zeros are issued at par and accrue interest during the bond's life, with the accrued interest and principal payable at maturity

- Inflation-indexed bonds – debt instruments with coupons tied to an inflation index
  - Also called "inflation-linked bonds" or simply "linkers"
  - The US introduced Treasury Inflation Protected Securities (TIPS) in January 1997
  - Can use a variety of designs and reference rates for linkers such as the consumer price index (CPI[2])

- Step-up notes – coupon rates increase over the life of the bond
  - Example: A six-year step-up note might have a coupon rate that is 4% for the first two years, 4.5% for the next two years, and 5% for the last two years

- Floating-rate and variable-rate bonds – reset the coupon rate periodically
  - Example: Bank of America issues a floating-rate bond where the quarterly cash flows are computed using a coupon rate equal to 3-month LIBOR plus 50 basis points
  - Floating-rate securities typically reset *more* than once a year based on a *short*-term index rate
  - Variable-rate bonds typically reset *not more* than once a year based on a *long*-term index

- Floating rate bond alternative features:
  - May have maximum or minimum coupon rate
    - The maximum coupon rate is the cap, while the minimum coupon rate is the floor
  - Coupon can be computed using a variety of indices
    - Most commonly a benchmark interest rate or interest rate index is used
    - However, other indices may be used. For example, the coupon could be indexed to movements in commodity prices
  - The coupon rate may move in the opposite direction of the index rate (called inverse/reverse floaters)

[2]CPI-U is the Consumer Price Index for urban consumers (not seasonally adjusted).

  - The coupon rate may be zero if the index rate is outside a certain range (called range notes)

- Reference Rates
  - Global process has started to find an alternative reference rate to LIBOR
  - Secured Overnight Financing Rate (SOFR) chosen by the Alternative Reference Rate Committee (ARRC) as the replacement in the US
  - SOFR is a volume-weighted median rate based on actual transaction data from overnight tri-party repo and cleared overnight bilateral repo markets (excluding Fed transactions)
  - SOFR has been published by the NY Fed since April 2018
  - LIBOR is unsecured with various maturities; SOFR is a secured overnight rate
  - Biggest issuers of SOFR-linked floating-rate debt are the Federal Home Loan Bank (FHLB), Freddie Mac, Fannie Mae, as well as banks, insurance companies and the World Bank
  - There is a global search for alternative reference rates in other countries (e.g. SONIA in the UK, EONIA/ESTER in Eurozone, TONAR in Japan)
- High-yield bonds can defer payments with deferred interest, step-up, or payment-in-kind bonds
- Extendible reset bonds – coupon rates are reset periodically to maintain the price of the bond at a certain level
  - Coupon rate will be the average of rates suggested by investment banking firms
  - New rate will then reflect the level of interest rates at the reset date and the credit spread the market wants on the issue at the reset date
- Prices are quoted as a percent of par value (discussed in more detail in Chapter 7)

Call and Refunding Provisions

- Indenture may have provisions that grant either the bondholders or the issuer the right to alter the maturity of the bond by taking certain actions
- These rights are called *embedded options* and are discussed below
- A call feature / provision gives the issuer the right to retire debt prior to maturity
- Benefits for corporations:
  - Permits them, should market rates fall, to replace the bond issue with a lower-interest-cost issue
  - More flexibility to manage cash and restructure balance sheets

- Detrimental to investors because:
    - Run the risk of losing a high-coupon bond when rates begin to decline
    - Reinvestment will likely be at a lower yield because of the declining interest rates
    - Limits appreciation on bond value
        - That is, interest rate decreases are typically associated with an increase in PV and bond value. This is limited for a callable bond because it is more likely to be called when rates decrease
- Callable bonds typically have higher yields and are callable at a premium above par
- Bond refunding - the concept of paying off higher-cost bonds with debt that has a lower net cost to the issuer of the bonds. When market rates are about to fall, the borrower may be tempted to replace a high-coupon debt with a new low-coupon bond
    - This action is usually taken to reduce the financing costs of a business
- The price at which the bond may be called is the "call price"
- The difference between the call price and principal is the "call premium"
- Deferment period / period of call protection - specified number of years in the early life of the bond during which the issuer may not call the debt
    - Either non-callable (NC) or nonrefundable (NF) for a specified period
    - A nonrefundable bond can be retired from internally generated funds (<u>not</u> from issuing new debt)
    - A bullet bond is a bond that is <u>non</u>-callable for the life of the bond
    - If a bond does not have any protection against an early call, then it is said to be currently callable
- **Make-whole call provisions**
    - In contrast to the standard call feature that contains a call price fixed by a schedule, a make-whole call price varies *inversely* with the level of interest rates
    - The call price varies with interest rates to protect the investor from reinvestment risk (e.g. when rates are low, the call price is high)
        - Because the make-whole call price increases as interest rates decrease, this gives investors some protection against reinvestment rate risk
    - An issuer will call a bond if the present value of interest savings is greater than call premium and cost to issue new securities
    - The make-whole call price is the greater of:
        1. 100% of the principal amount + accrued interest
        2. Make-whole redemption amount

    - The make-whole redemption amount is the sum of PV of remaining coupon payments and principal + accrued interest
    - PV is calculated at a discount rate given by yield on a Treasury security that matches the bond's remaining maturity plus a spread (e.g. Treasury Rates plus 15bps)

- *Note: The next green box example and the TIA video series will work through examples of the call price calculation.*
- Municipalities sometimes pre-refund the debt by placing securities in an irrevocable trust

Bond Refunding Example

Suppose a firm has outstanding debt that is callable. The firm is determining if refunding is economically favorable. You are given the information below:

Outstanding debt to be refunded	\$300 million
Coupon rate (annual)	10%
Maturity	15 years
Call price for bonds	\$105 per \$100 par value (or 5% premium)
Issuing expenses and legal fees	\$2 million
Tax Rate	30%
Coupon rate on new similar bond	7.8%

Given the information above, answer the following:

(a) Compute the after-tax call premium and expenses

(b) Compute the after-tax annual interest savings

(c) Compute the PV of refunding. Is it an economically profitable transaction? That is, determine whether the net present value of refunding the transaction is positive.

Solution:
Note that answers below are in units of millions.

(a) After-tax call premium and expenses $= \big[(\$300)(5\%) + (\$2)\big](1 - 0.30) = \$11.90$

(b) After-tax annual interest savings $= (10\% - 7.8\%)(\$300)(1 - 0.30) = \$4.62$

(c) The firm has a one-time payment of \$11.90 in exchange for \$4.62 of savings each year for 15 years. The appropriate after-tax discount rate is $7.8\% \cdot (1 - 30\%) = 5.46\%$

$a_{\overline{15}|} = \frac{1-v^n}{i} = \frac{1-(\frac{1}{1+0.0546})^{15}}{0.0546} = 10.06$

PV of savings @ after-tax rate of 5.46% $= (\$4.62)a_{\overline{15}|} = (\$4.62)(10.06) = \$46.48.$

Thus, the net PV is $46.48 - 11.90 = 34.58 > 0$. PV is positive, so it is an economically profitable transaction.

Sinking-Fund Provision

- A *sinking-fund provision* requires the obligor to retire a certain amount of the outstanding debt each year
- This is done by:
    1. Purchasing bonds in open market
    2. Allowing trustee to redeem certain bonds by lottery
- Common in private placements
- Advantages to investor:
    1. Orderly retirement of debt
    2. Enhances liquidity
    3. Prices more stable (issuer continuously buys security)
- Disadvantages to investor:
    1. Time and effort invested in analyzing the bond is wasted if bond is called very early
    2. Bond may be called at par when interest rates are low
    3. Optional acceleration feature – the issuer can retire more than required by sinking fund (issuer will do so if interest rates are low)

Put Provisions

- A *putable bond* grants the investor the right to sell the issue back to the issuer at par value on designated dates
    - Will do this if interest rates have risen, and the investor can force the issuer to redeem the bond at par
- A *hard put* is one that must be redeemed for cash
    - Soft puts can be cash, common stock, or another debt instrument

Convertible or Exchangeable Debt

- With a convertible bond, the investor can exchange the bond for a given amount of common stock
- Conversion cannot be reversed, and the terms of the conversion are set by the company in the bond's indenture

- The conversion ratio specifies the amount of common stock for one bond (it may change over the life of the bond)
    - For example, the conversion ratio may state that each bond (e.g. $1,000 of par value) can be exchanged for 20.6949 shares
    - The conversion price is then $\frac{1000}{20.6949}$, or $48.32 per share
- The conversion privilege may only be for a specified time
- Convertible bonds are usually callable (the issuer can force conversion)
    - May have a call protection period to a specified date or price of the common stock
- An exchangeable bond can be exchanged for the common stock of *another* firm

Warrants

- Warrant - an option for the investor to purchase shares of the company at a preset exercise price (like a call option)
- The exercise price may change over time (according to the bond's indenture)
- Most warrants have a long life
- Some warrants are detachable, meaning they can be traded separately from the bond

Bond Yield

- There are many ways to describe the potential return when investing in a bond
    - Returns can be calculated using a number of different yield measures (current yield, yield-to-maturity, yield-to-call and yield-to-put)
    - "Yield-to-worst" refers to the lowest of these and is often quoted for bonds
- Some yields have gone into negative territory (e.g. Eurozone, Switzerland, Sweden, Japan)
- Decline in yields is driven by many factors, including accommodative monetary policy
- Statistics for Bloomberg Barclays Global Aggregate Treasury Index for June 2020:
    - Average duration of 8.6 years
    - Average yield of 0.55%
    - Total market value of $31 trillion
    - Comprised of government bonds of 41 developed and emerging countries
    - 27% of the index market value offering negative yield

- Bonds with negative yield have such a high current purchase price that the cash flow stream of coupons (if any) and face value at maturity would result in a negative YTM
- Negative yields do not necessarily imply a negative total investment return. For example, a bond with negative yield may appreciate in price and you may get a positive return by selling it before maturity
- Better measure of the potential return from holding a bond over a predetermined investment horizon is the *total return measure*
- Total return measure considers all sources of potential dollar return and can be used to analyze bond swaps and bond performance

Medium-Term Notes

- Medium-term notes are flexible debt instruments that are typically non-callable and unsecured
- Despite the name, terms to maturity range from 9 months to 30+ years
- Structured medium-term notes, or simply structured notes, are debt instruments linked to a derivative position
- Structured notes are usually created with an underlying swap transaction

Preferred Stock

- Preferred stock is a class of stock, not a debt instrument, but it shares characteristics of both common stock and debt
- In between debt and common stock
- Pays dividends that are a specified percentage of the face value
- Failure to pay dividends will not cause bankruptcy
    - Called *cumulative* if the dividends must be paid at a later date
    - Failure to make dividend payments may lead to certain restrictions for management, such as granting preferred stockholders voting rights
- Dividend payments are not tax deductible (versus coupon payments on bonds, which are tax deductible)
    - Corporations that invest in preferred stock can exclude 70% of the dividends from taxable income
- Implications of preferred stock dividend taxation:

1. Most investors in preferred stock are corporations seeking tax advantages
2. Preferred stock costs less to issue than if there were no tax advantages

- Similarities to debt (if cumulative)
  1. Payments to preferred stockholders promised by the issuer are fixed
  2. Priority over common stockholders in bankruptcy (called senior security)
- Some have no maturity (called perpetual preferred stock)
- Most have sinking fund provisions

Residential Mortgage-Backed Securities (RMBS)

- Residential mortgage-backed security (RMBS) is an instrument whose cash-flow depends on the cash-flows of an underlying pool of mortgages
- Two main groups – agency RMBS and nonagency/private-label RMBS:
  - **Agency RMBS** are issued and fully guaranteed by a government agency like Ginnie Mae, Freddie Mac, or Fannie Mae
    - Ginnie Mae is a federal government agency within the Department of Housing and Urban Development; guarantees RMBS issues with the full faith and credit of the U.S. government
    - Freddie Mac and Fannie Mae are government sponsored enterprises (GSEs). In September 2008, these two entities were placed into conservatorship
    - Bloomberg Barclays U.S. Aggregate Bond Index measures MBS sector
  - **Nonagency RMBS (also called private-label RMBS)** are issued by thrifts, commercial banks, or private conduits (not backed by any government entity)
    - Structured to provide credit enhancement to support the credit ratings they receive
    - Prior to 2007, this was split into prime and subprime markets. The prime markets were generally those borrowers with FICO credit scores of 660 or higher (and, subprime was a FICO score below 660)
    - After the 2008 financial crisis, investors no longer draw as sharp of a distinction between these two sectors of the private-label RMBS market

- RMBS Forms

    1. Mortgage Pass-Through Securities
    2. Collateralized Mortgage Obligations (CMO)
    3. Stripped Mortgage-Backed Securities

- Agency RMBS come in all 3 forms
- Nonagency RMBS are typically CMOs (2nd form)
- Both agency and nonagency RMBS expose investors to prepayment risk

    - Risk that the borrowers in a mortgage pool will prepay their loans when interest rates decline

- Credit risk is the most significant risk associated with nonagency RMBS

Commercial Mortgage-Backed Securities (CMBS)

- Backed by a pool of commercial mortgage loans
- The basic building block of the CMBS transaction is a commercial loan that was originated either to finance a commercial purchase or to refinance a prior mortgage obligation
- Conduits are commercial-lending entities established for the sole purpose of generating collateral to securitize CMBS
- Commercial mortgage loans are non-recourse loans

    - Lender can only look to the income-producing property backing the loan for interest and principal repayment

Asset-Backed Securities (ABS)

- ABS are collateralized by assets that are not mortgage loans (e.g. credit card receivables, home-equity loans, manufactured homes, and automobile loans)
- Pass-throughs (like mortgage pass-throughs) and pay-throughs (like CMOs)
- Three common types of ABS:

    - Credit card receivables
    - Home equity loans
    - Automobile loans

Covered Bonds

- A covered bond is a debt instrument secured by a specific pool of collateralizing assets
- More common in Europe
- Differs from the typical U.S. MBS in the following ways:
    - Cover (collateral) pool stays on issuer's balance sheet
    - Mortgages in cover pool serve only as collateral; principal and interest are paid from issuer's cash flows
    - Cover pool is dynamic – nonperforming mortgages are replaced with performing ones
    - Structured to prevent prepayments before maturity
    - Investors retain an unsecured claim on issuer for any shortfalls

Beyond Traditional Liquid Fixed Income Instruments

- Reasons for the boost of private credit compared to the liquid public fixed income market:
    - Regulatory challenges and pressures on bank balance sheets
    - Decline in interest rates / search for additional yield
- Private/alternative credit has gained traction in recent years and includes:
    - Below investment-grade corporate and securitized bonds
    - Less liquid investments such as direct lending, nonperforming loans and distressed credit
- Private debt borrowers can be grouped into different categories:
    - Residential
    - Commercial Real Estate
    - Corporate
    - Other
- By investing in private credit, investors can take advantage of higher expected return since these opportunities reside in less efficient markets (demanding additional illiquidity premium)
- Private credit strategies typically give more direct control and involve more active involvement than buying or selling publicly traded credit securities
- Investors can get exposure to alternative credit either in a hedge fund structure or in a drawdown structure as private direct lending fund limited partners

Conclusion

- Bonds differ on a number of dimensions (e.g. issuer, maturity, coupon, principal amount, method of redemption, embedded options)
- Medium-term notes are highly flexible debt instruments
    - Can be easily structured in response to changing market conditions and investor tastes
- Structured notes are debt instruments that are linked to a derivative position
    - Allow an issuer to create a customized debt instrument for an investor
- Preferred stock is a security that shares characteristics of debt and equity
- Residential RMBS are classified into agency and nonagency securities
- There are three types of RMBS:
    1. Mortgage Pass-Through Securities
    2. Collateralized Mortgage Obligations (CMO)
    3. Stripped Mortgage-Backed Securities
- Asset-backed securities are collateralized by financial assets other than residential mortgages
- A covered bond is a debt instrument secured by a specific pool of collateral called a collateral pool
- Alternative credit covers a wide range of strategies including liquid investments such as below-investment-grade corporate and securitized bonds, as well as less liquid or illiquid strategies such as direct lending, nonperforming loans, and distressed credit

Handbook of Credit RM: Ch. 4

Bouteille, Coogan-Pushner (2022)

Overview

Chapter 4 covers the "Measurement of Credit Risk". This chapter covers the fundamental tools to quantify credit risk.

Key topics for the exam include:

- State the four important metrics used to quantify the level of credit risk
- Describe and compute gross exposure (GE), net exposure (NE), and adjusted exposure (AE)
- State the two steps to compute the probability of default
- Describe recovery rate and state the major elements that influence the amount of recovery
- Compare direct vs contingent exposure
- State how to compute expected loss

Introduction

- Credit risk quantification is done both at the individual transaction level and the portfolio level
- This chapter focuses on individual transactions
- Four important metrics will be used to quantify the level of credit risk:
    1. **Exposure** - amount of money at risk
    2. **Default Probability** - likelihood the counterparty will default
    3. **Recovery Rate** - percentage of money relative to the exposure that can be recovered in the case of default
    4. **Tenor** - time period in which some or all of the money is outstanding
- *The remainder of this chapter explores each of the above four metrics one-by-one in more detail*

1. Exposure

- In most cases, exposure represents *the potential maximum amount of money that could be lost in the case of default*
- Single most important number attached to a transaction for understanding credit risk

- The reading makes a few notes about credit exposure:
  - Methodology to calculate exposure is specific to each product and, as such, has to be clearly documented
  - As precise as guidelines can be, they cannot anticipate all aspects of transactions in real life, particularly for new product areas or for one-off transactions. In these cases, the credit risk assessment team should decide on the methodology used to allocate credit exposure on an ad hoc basis
  - For certain transactions such as long-term supply agreements or derivatives contracts, exposure cannot be observed easily and statistical models are often needed
  - Using a high exposure number has the advantage of rarely underestimating exposure; however, overestimation has the disadvantages of overdeployed resources and potentially lost business opportunities because of high perceived credit risk
  - Underestimating exposure can cause surprises for management if actual losses turn out to be higher than expected, but it gives room to deploy more capital
- Three metrics to understand exposure:
  1. **Gross Exposure (GE)** - represents the amount of money due by the counterparty and, therefore, the money at risk in case of bankruptcy
     - Typically the largest / worst-case measure[3]
     - Example: When a company sells $100 worth of goods, the corresponding Gross Exposure (GE) for the client is the value of the trade receivable, $100
  2. **Net Exposure (NE)** - equal to GE minus the amount of collateral pledged
     - Adjusts[4] for the fact that sale of collateral assets would reduce the credit loss
     - An example of a collateral pledge would be 20% prepayment in cash for delivery of a product or service. In this case, if GE was 100 million then NE would be 80 million
     - Only some forms of collateral such as cash are subtracted. Collateral used to secure a transaction such as a lien on a property is not subtracted or included as part of collateral pledged when calculating NE
  3. **Adjusted Exposure (AE)** - equal to NE times the expected usage given default (UGD)
     - Adjusted Exposure = Net Exposure $\times$ Expected Usage Given Default
     - Another way to state this is that adjusted exposure is equal to net exposure minus any unused facility
     - Adjusted Exposure is also referred to Exposure at Default (EAD)
- Each of the three methods gives a valid way to estimate the level of credit exposure, and the metric chosen will depend on the underlying business and risk management philosophy of the firm

[3] Except for certain contracts discussed in Chapter 5 (off syllabus).

[4] In the second edition of the textbook, the author added a note that these adjustments are rare because it is unusual for a borrower to provide cash at the inception of a deal.

Expected Usage Given Default (UGD)

- UGD is the expected rate of utilization of a facility in case of bankruptcy
- UGD is relevant if a party extends credit but it is only being utilized partially
- Example: One kind of commercial bank loan is a *revolver*. With a revolver, borrowers pay a fee based on the notional amount of the loan. Banks compete heavily for this business and are able to grant large capacity on easy terms. As a result, usage by companies in normal economic times is low and around 15-20% of their full capacity. A company may be able to borrow up to a $5 million loan, but typically only uses $1 million of their credit line
    - Banks typically do not report the full notional (e.g. 5 million) amount available as their credit exposure
    - Instead, they multiply by a standard 20 percent usage assumption (i.e. for the example above they would report 1 million and not 5 million for adjusted exposure)
- Challenges:
    - Borrowers can draw upon their credit line at any time and may behave unpredictably, driving a jump in reported credit exposure for the bank
    - Typically a long time horizon (e.g. 5-10 years)
        * External circumstances can modify the behavior of otherwise predictable borrowers (e.g. COVID-19 crisis led to many companies drawing on revolvers to have rainy-day funds available)
        * Ford drew down $15.4 billion out of two credit lines due to COVID-19
        * Historical usage data may not be relevant because new risk events can impact behavior
    - Normal vs stressed economic times may vary substantially
        * In other words, usage may be 15-20% in a normal environment, but near 100% in a stressed environment

Exposure Example #1

Suppose you are given the following information:

- A bank gives a $1 million notional loan to a customer
- The customer posts 800,000 of collateral
- The collateral has a 25% haircut. In other words, the collateral is treated as though it is only worth 600,000 for the net exposure calculation
- Also assume that the customer is only able to borrow up to the $1 million and so they are fully utilizing their borrowing capacity from the bank

Given the above, compute:

(a) Gross Exposure (GE)

(b) Net Exposure (NE)

(c) Adjusted Exposure (AE)

Solution:

(a) GE = $1 million

(b) NE = GE - Collateral = $1 million - 800,000 · 75% = 400,000

(c) Because we have full utilization, AE = NE = 400,000

Exposure Example #2

Suppose a bank has $5 million lines of credit each for 10 different customers. For simplicity, assume no collateral is posted. Assume that on average, the customers are not drawing upon the full $5 million of funds, and on average only 20% of the line of credit notional is drawn upon.

Given the above, compute the following:

(a) Gross Exposure (GE)

(b) Net Exposure (NE)

(c) Adjusted Exposure (AE)

Solution:

(a) GE = $50 million

(b) NE = $50 million

(c) AE = NE · 20% = $10 million

Collateral Considerations

The following four checklist questions should be asked to get a fundamental understanding for the value of collateral:

1. Who owns the collateral in case of bankruptcy?
    - Only collateral whose ownership is not disputed should be taken into account
2. Can the collateral be valued?
    - For non-cash collateral that is more difficult to value, a haircut percentage may be applied
    - Overestimating collateral value underestimates the amount of credit risk
3. Can the collateral be sold?
    - Collateral should consist of liquid instruments that can be sold easily
    - Illiquid collateral such as real estate liens can be poor forms of collateral, particularly in a financial panic
4. Is the collateral correlated with the underlying exposure?
    - If this is the case, collateral can be worthless
    - Want collateral that has a stable value, and maintains its worth when it is needed

2. Default Probability

- Default probability is also called "probability of default" or "PD"
    - Less frequently, it can also be called "default rate (DR)"
- Represents the likelihood that a counterparty will default during some future time
- Fundamental notions about default probabilities:
    - They are never zero
        - Some banks were perceived as too big to fail (e.g. Lehman Brothers), and subsequently defaulted
    - Ability of highly rated governments to pay down their debt is in question
    - Default probabilities increase as the time horizon is increased
        - Financial strength of borrowers tends to deteriorate over time, and companies have a higher chance of defaulting in the long term than in the short term
        - When quoting a value for PD, should clearly state the associated time horizon
- Computing default probabilities requires many assumptions, and many different methodologies exist

- Two step process to compute PD:
    1. Analyze a counterparty's financial strength and assign a rating to it that represents its perceived financial strength
    2. Using historical data, observe the default frequency of entities with similar ratings. The observed relative frequency is the estimate of the PD
- *Note: Next, we will explore each of these steps in more detail below.*

Step 1: Rating of a Counterparty

- A credit rating is a relative measurement of financial strength; those with higher ratings are supposed to have a higher chance to pay than those with a lower rating
- Many different rating scales exist:
    - S&P, Moody's, Fitch
    - Could also do a simple R-1 (strong) to R-10 (weak) where R refers to rating and each company gets a score from 1 to 10
- Internal Rating
    - Can set credit ratings through an internal credit assessment team
    - Resource intensive. Because of this, many large firms are able to do this but many small firms cannot
- Rating Agencies (e.g. Moody's, S&P, Fitch)
    - *Note: Possible ratings and descriptions of those ratings are shown at the end of the detailed study manual for this reading*
    - Rating agencies provide an "independent" opinion of the credit quality of an entity
    - Ratings are used for many purposes, including credit decisions such as lending money, loan pricing, selling products, etc.
    - Rating agencies focus on companies that issue public debt because of the large demand from investors around the world for an independent opinion about the credit quality of the firms raising money
    - Note that rating agencies are *paid by the entity seeking a rating*
        * Few were truly aware of their business model until after the financial crisis
        * Agencies are for-profit organizations
        * Revenues come primarily from the entities that want to be rated and from clients buying their ratings
        * Pressured to provide fast and favorable ratings to earn more revenue
        * Since the financial crisis of 2008, rating agencies have implemented major changes for greater transparency

        - Ratings remain a key and reliable element of credit decisions made by many different parties
    - Rating agencies publish methodologies and ratings on their websites
        - Consider business risk (e.g. country risk, industry characteristics, company position, peer group comparisons) and financial risk (e.g. accounting, governance, cash-flow adequacy, capital structure, liquidity)
    - In the United States, A.M. Best, Fitch, Kroll Bond Rating Agency, DBRS, EganJones, HR Ratings de Mexico, Japan Credit Rating Agency, Moody's, and S&P are nationally recognized statistical ratings organizations (NRSROs)
        - They are regulated by the Securities and Exchange Commission (SEC) to:
            1. Protect users of credit ratings and the public interest
            2. Promote ratings accuracy
            3. Ensure that ratings are not unduly influenced by conflicts of interest
    - Strengths of rating agencies:
        - Dedicated analytics specialized in industry sectors who follow a small number of companies
        - Offices around the world close to companies they are rating
        - Access to executive officers of the firms
    - Rating agencies can downgrade a company if they think an external event may reduce profitability
        - One frequent critique of rating agencies is they are slow to react, and it may take several months before a company is downgraded
        - Capital markets may react much more quickly than rating agencies
        - Rating agencies argue they need time to fully analyze trends instead of reacting quickly to market events without full information
        - Firms that are downgraded typically do not bounce back in the short term to the original rating
    - CFOs of large companies issuing debt in the capital markets dedicate a good amount of time to support the rating agencies' due diligence processes
    - Ratings are reviewed periodically (when financial statements are issued again, or upon material changes)
    - Most important rating is the long-term "issuer" rating that corresponds to the assessment of an entity to meet its obligations maturing in more than one year
    - Originally, just **four** industrial companies earned a AAA rating
        - This ballooned to around 50,000 instruments, many of which were structured finance vehicles that were heavily critiqued during the 2008 financial crisis
        - AAA structured financial vehicles resulted in billions of dollars of losses to investors in the financial crisis
    - When the housing bubble collapsed and the AAA-rated vehicles defaulted in large numbers, the actions of the rating agencies were heavily criticized

        - Observers and legislators called for more regulation via Dodd-Frank
        - Led to stronger oversight of NRSROs by the SEC in the United States and enhanced supervision in Canada, the EU, and other jurisdictions

- Scoring Systems for Smaller Companies
    - Two main challenges with scoring smaller companies are (1) access to financial data and (2) exploiting the data
    - Challenge #1: Access to Financial Data
        - Companies dealing with smaller counterparties have to find alternative ways of assessing the credit quality since the rating agencies do not rate these smaller entities
        - Since 2000, public companies, under Regulation Fair Disclosure (Reg FD), must disseminate their financial statements and any other material information
        - Disclosures requirements for nonpublic companies are generally less stringent, and vary by country
        - Data vendors (e.g. Dun & Bradstreet in the US) format available financial information for those entities that do disclose financial information
    - Challenge #2: Exploit the Data
        - Analyzing information and credit reports for thousands of counterparties is time and resource intensive
        - Could try to automate the process as much as possible by weighting key ratios to create a summary statistic (e.g. Altman's Z-score) of each counterparty's financial strength
        - More sophisticated systems can complement the numerical assessment with subjective information input by the analyst, such as management strength or the economic environment

- Hierarchy and Mapping
    - The last part of the process is to summarize all of the information collected into one final rating
        - For example, the internal model may assign one rating and the rating agency may give another rating
        - This last step considers how to aggregate all of the prior information collected in this step to arrive at one final credit rating
    - Three considerations:
        1. Establish a hierarchy (e.g. internal ratings rank higher than external ratings)
        2. Deal with inconsistencies
            - For example, S&P and Moody's may give different ratings. You could be conservative and pick the lower of the two ratings, or pick whatever approach is most suitable to deal with inconsistencies
        3. Map internal ratings to external ratings

    - For example, map R-3 to an A rating
    - Will want to map to a common external rating to make it easier to understand rating agency data regarding default probabilities

Step 2: Use of Historical Data

- Once a counterparty has been assigned a rating, the next step is to deduce a probability of default
- Observe historical default frequency of companies with a similar rating
    - Example: Suppose you assigned a rating of AA in Step 1. Suppose also you found that historically AA rated entities experienced a .5% default rate after five years. Then, you can estimate PD over 5 years to be approximately .5%
- Default frequency is not stable across economic cycles; it is a challenge to pick a representative PD across economic cycles
    - Higher default frequencies seen historically in recessions, lower default frequencies seen historically during economic booms
- Rating agencies publish both one-year default frequencies and cumulative default frequencies over various elapsed time periods
- Rating agencies refrain from stating that a particular rating corresponds to a probability of default; instead, they publish all the necessary data to allow users to make this connection
    - This allows each firm the flexibility to work with the numbers most relevant for their own analysis

3. Recovery Rate

- **Recovery rate** - amount of money recovered upon default, expressed as a percent of the gross exposure
- Rarely do credit losses result in loss of the entire amount of the nominal exposure
- Creditors vie for residual assets upon bankruptcy; often a portion of the notional is recovered
- Major elements that influence the amount of recovery:
    - Amount of assets available
    - Seniority of the position (i.e. senior creditors typically have greater recoveries)
    - Security package (i.e. whether the security has a lien on any assets). Secured creditors are paid first and typically experience higher recovery rates
- Many institutions exposed to credit risk having the equivalent to senior unsecured exposures consider that an acceptable recovery rate is between 40 percent and 50 percent

- Loss Given Default = 1 - Recovery Rate
    - Recovery rate and loss given default sum to 100 percent
    - Example: Consider a zero-coupon bond with 100 notional. If we have a 40% recovery rate, we expect to recover 40 upon default. The loss given default is 60%, and we expect to experience a loss of 60 upon default

4. Tenor

- Longer time horizon is generally associated with higher levels of credit risk
- Long-term financial strength of a borrower is much harder to predict than its short-term financial strength
- Default probability of a counterparty increases with time
- Longer-dated transactions typically require a more stringent credit approval process
- Longer tenor securities can be more expensive due to credit risk and result in having to set aside large amounts of capital
- Contractual and expected tenor may be different
    - Example: A long-dated 30 years mortgage may be repaid much earlier due to prepayment. Many mortgages may be paid within 10 years due to refinancing, prepayment, sale of home, etc.

Direct vs Contingent Exposure

- The difference between direct and contingent exposure is whether money or goods have actually been exchanged or if there is just a commitment to do so
    - **Direct Exposure:** Money/goods have actually been exchanged
        - Example: A funded loan where a bank has lent out cash to a corporation
    - **Contingent Exposure:** There is just a commitment to exchange money/goods
        - Example: Letter of credit that has not yet had any cash disbursements
- If reliable usage data exists, may apply the adjustment factor from GE to AE
    - However, care should be taken. A reduction is only recommended if there is no reliable predictor of the commitment becoming a funded position
    - Often, there is correlation between the chain of events that cause a contingent exposure to become a direct exposure
    - Contingent exposures (e.g. letter of credit) are often drawn upon when a firm is in financial distress and needs additional funds

- Thus, bank exposure may increase at the time where the financial quality of the firm is the weakest
- In these cases, gross exposure may be the best measure for deciding whether to approve a credit line and AE may understate the true level of credit risk

The Expected Loss

- **Expected Loss = Exposure $\times$ Default Probability $\times$ (1 - Recovery Rate)**
- Expected loss combines three of our metrics into one single quantity
- Useful for pricing transactions and portfolio management
- A single statistic cannot predict the loss behavior of any transaction
  - A single transaction is unlikely to experience exactly its expected loss
  - However, if we have a large number of transactions in our portfolio, the portfolio expected loss may be fairly predictable under certain restrictive conditions

Expected Loss Example

Suppose you are given the following:

- Notional = 200 million
- Time Horizon = 4 years
- The probability of default over the 4 years is 3%
- LGD = 35%

Compute the expected loss over a four year time horizon.

Solution:

Expected Loss = Exposure $\times$ Default Probability $\times$ (1 - Recovery Rate)

= 200 million $\times$ 3% $\times$ 35% = $\boxed{2.1 \text{ million}}$

S&P and Moody's Ratings

Recall we previously saw that:

Moody's	S&P	Fitch	Grade
Aaa	AAA	AAA	Investment
Aa1	AA+	AA+	Investment
Aa2	AA	AA	Investment
Aa3	AA-	AA-	Investment
A1	A+	A+	Investment
A2	A	A	Investment
A3	A-	A-	Investment
Baa1	BBB+	BBB+	Investment
Baa2	BBB	BBB	Investment
Baa3	BBB-	BBB-	Investment
Ba1	BB+	BB+	Speculative
Ba2	BB	BB	Speculative
Ba3	BB-	BB-	Speculative
...	...	...	Speculative

This reading additionally gives verbal descriptions for selected S&P ratings:

- **AAA:** Extremely strong capacity to meet financial commitments
- **AA:** Very strong capacity to meet financial commitments
- **A:** Strong capacity to meet financial commitments, but somewhat susceptible to adverse economic conditions and changes in circumstances
- **BBB:** Adequate capacity to meet financial commitments, but more subject to adverse economic conditions
- **BB:** Less vulnerable in the near term but faces major ongoing uncertainties to adverse business, financial, and economic conditions
- **B:** More vulnerable to adverse business, financial, and economic conditions but currently has the capacity to meet financial commitments
- **CCC:** Currently vulnerable and dependent on favorable business, financial, and economic conditions to meet financial commitments
- **CC:** Highly vulnerable; default has not yet occurred, but is expected to be a virtual certainty
- **C:** Currently highly vulnerable to nonpayment, and ultimate recovery is expected to be lower than that of higher obligations
- **D:** Payment default on financial commitment or breach of an imputed promise; also used where a bankruptcy petition has been filed

This reading additionally gives verbal descriptions for selected Moody's ratings:

- **Aaa:** Obligations rated Aaa are judged to be of the highest quality with minimal credit risk
- **Aa:** Obligations rated Aa are judged to be of high quality and are subject to very low credit risk
- **A:** Obligations rated A are considered upper-medium grade and subject to low credit risk
- **Baa:** Obligations rated Baa are subject to moderate credit risk and are considered medium grade and as such may possess certain speculative characteristics
- **Ba:** Obligations rated Ba are judged to have speculative elements and are subject to substantial credit risk
    - Note: Ba is further split into Ba1 / Ba2 / Ba3, and the explanations here are describing the category as a whole. Within Ba, Ba1 is the strongest credit score and Ba3 is the weakest credit score
- **B:** Obligations rated B are speculative and are subject to high credit risk
- **Caa:** Obligations rated Caa are judged to be of poor standing and have very high credit risk
- **Ca:** Obligations rated Ca are highly speculative and are likely in or very near default, with some prospect of recovery of principal and interest
- **C:** Obligations rated C are the lowest rated class and are typically in default, with little prospect of recovery of principal and interest

