

Class: TY BSc

Subject : Financial Engineering – 2

Chapter: Unit 4 Chapter 1

Chapter Name: Structured derivatives and synthetic securities

Topics to be covered

- 1. Securitization
- 1. Risks
- 1. ABS – Asset Backed Securities
- 1. Delinquency Ratio
- 1. Default Ratio
- 1. Debt-Service Coverage Ratio
- 1. Weighted Average Coupon
- 1. Weighted Average Maturity
- 1. Weighted Average Life

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- 10. Credit Loss Calculation
- 10. Securitization Process
- 10. Constant Prepayment Rate
- 10. Public Securities Association
- 10. Prepayment Forecasting Methodologies

1 Securitization



Securitization is the procedure where an issuer designs a marketable financial instrument by merging or pooling various financial assets into one group.

- The issuer then sells this group of repackaged assets to investors. Securitization offers opportunities for investors and frees up capital for originators, both of which promote liquidity in the marketplace.
- In theory, any financial asset can be securitized—that is, turned into a tradeable, fungible item of monetary value. In essence, this is what all securities are.
- However, securitization most often occurs with loans and other assets that generate receivables such as different types of consumer or commercial debt. It can involve the pooling of contractual debts such as auto loans and credit card debt obligations.

1 Securitization

Cashflows

- In securitization, the company holding the assets—known as the originator—gathers the data on the assets it would like to remove from its associated balance sheets.
- For example, if it were a bank, it might be doing this with a variety of mortgages and personal loans it doesn't want to service anymore. This gathered group of assets is now considered a reference portfolio.
- The originator then sells the portfolio to an issuer who will create tradable securities. Created securities represent a stake in the assets in the portfolio. Investors will buy the created securities for a specified rate of return.
- Often the reference portfolio—the new, securitized financial instrument—is divided into different sections, called tranches. The tranches consist of the individual assets grouped by various factors, such as the type of loans, their maturity date, their interest rates, and the amount of remaining principal.
- As a result, each tranche carries different degrees of risk and offer different yields. Higher levels of risk correlate to higher interest rates the less-qualified borrowers of the underlying loans are charged, and the higher the risk, the higher the potential rate of return.

1 Securitization

Examples

Charles Schwab offers investors three types of mortgage-backed securities called specialty products. All the mortgages underlying these products are backed by government-sponsored enterprises (GSEs). This secure backing makes these products among the better-quality instruments of their kind. The MBSs include those offered by:

- i. **Government National Mortgage Association (GNMA):** The U.S. government backs bonds guaranteed by Ginnie Mae. GNMA does not purchase, package, or sell mortgages, but does guarantee their principal and interest payments.
- ii. **Federal National Mortgage Association (FNMA):** Fannie Mae purchases mortgages from lenders, then packages them into bonds and resells them to investors. These bonds are guaranteed solely by Fannie Mae and are not direct obligations of the U.S. government. FNMA products carry credit risk.
- iii. **Federal Home Loan Mortgage Corporation (FHLMC):** Freddie Mac purchases mortgages from lenders, then packages them into bonds and resells them to investors. These bonds are guaranteed solely by Freddie Mac and are not direct obligations of the U.S. government. FHLMC products carry credit risk.

2 Risks

Default Risk

- Default risk is the risk of loss arising from the outright failure of a counterparty to perform on its liabilities and contractual obligations.
- Default risk exposures may be decomposed into trading risk exposures (from derivative/financing contracts), direct credit exposures (from unsecured loans), settlement risk exposures (from currency/securities settlements), and contingent risk exposures (from future commitments and contingencies that may create credit exposures).

2 Risks

Default Correlation

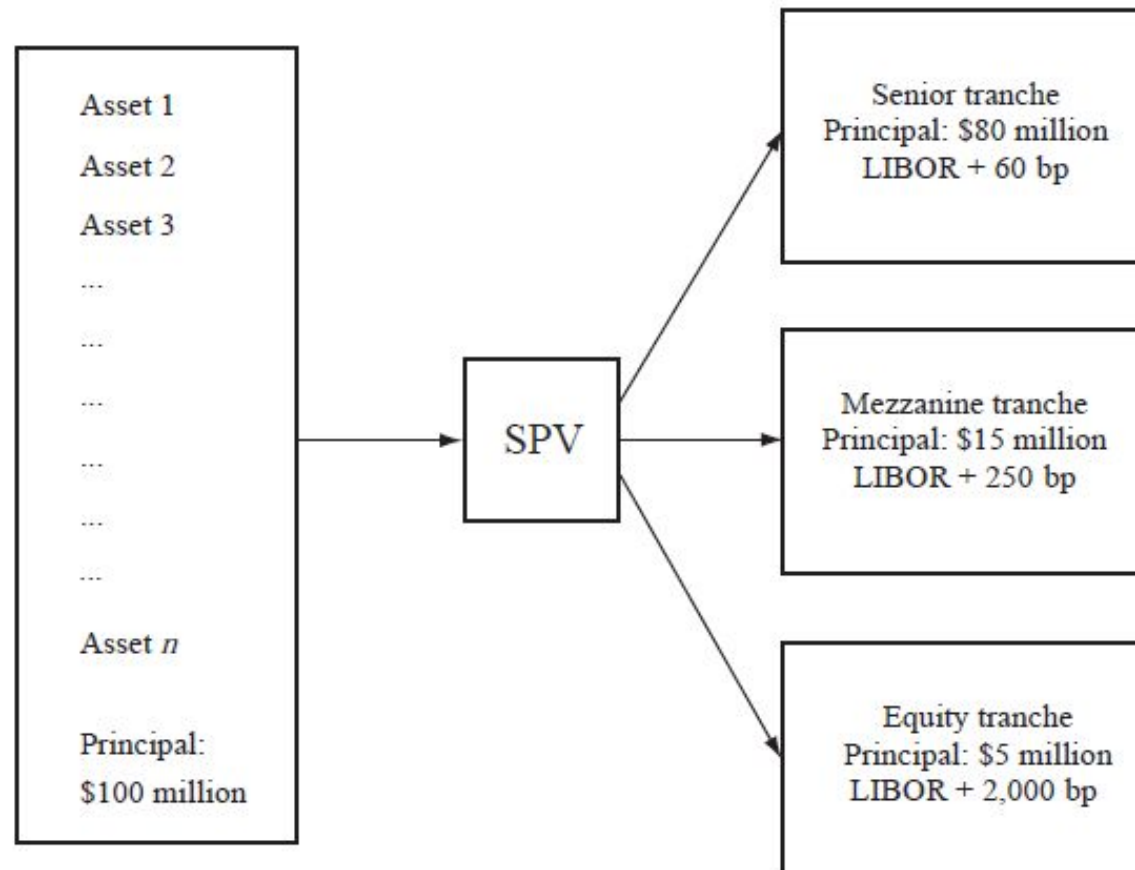
- **Default Correlation denotes a measure of Default Dependency between different borrowers when considered as part of a Credit Portfolio. It measures the likelihood of Joint Default within the period of consideration.**
- Default correlation measures whether credit risky assets are more likely to default together or separately.
- For example, default correlation answers the following question: If 10 bonds each have a 10% probability of default, does that mean: (1) One and only one is definitely going to default? Or (2) is there a 10% chance all of them will default and a 90% chance none of them are going to default? If the answer is “in between,” where in between?
- Default correlation is essential to understanding the risk of credit portfolios, including CDOs. Along with default probability and loss in the event of default, default correlation determines the credit risk of a portfolio and the economic capital required to support that portfolio
- Default correlation determines the credit risk of a portfolio and the economic capital required to support that portfolio, along with default probability and loss in the event of default.
- The difficulty of the problem becomes evident when it is shown that pair wise default correlations are not sufficient to understand the behavior of a credit risky portfolio and introduce “higher orders of default correlation.”

3 **ABS – Asset Backed Securities**

- A typical securitization arrangement is shown in the next figure. This is known as an asset-backed security or ABS. A portfolio of income producing assets such as loans is sold by the originating banks to a special purpose vehicle (SPV) and the cash flows from the assets are then allocated to tranches.
- The depiction is simpler than the structures that were typically created because it has only three tranches (in practice, many more tranches were used).
- These are the senior tranche, the mezzanine tranche, and the equity tranche. The portfolio has a principal of \$100 million. This is divided as follows: \$80 million to the senior tranche, \$15 million to the mezzanine tranche, and \$5 million to the equity tranche. The senior tranche has a yield of LIBOR plus 60 basis points, the mezzanine tranche has a yield of LIBOR plus 250 basis points, and the equity tranche has a yield of LIBOR plus 2,000 basis points.
- It sounds as though the equity tranche has the best deal, but this is not necessarily the case. The payments of interest and principal are not guaranteed. The yield (like the yield on a bond) is the return that will be realized if there are no defaults affecting the tranche.
- The equity tranche is more likely to lose part of its principal, and less likely to receive the promised interest payments on its outstanding principal, than the other tranches. Cash flows are allocated to tranches by specifying what is known as a waterfall.

3 ABS – Asset Backed Securities

An asset-backed security (simplified); bp = basis points (1bp = 0.01%).

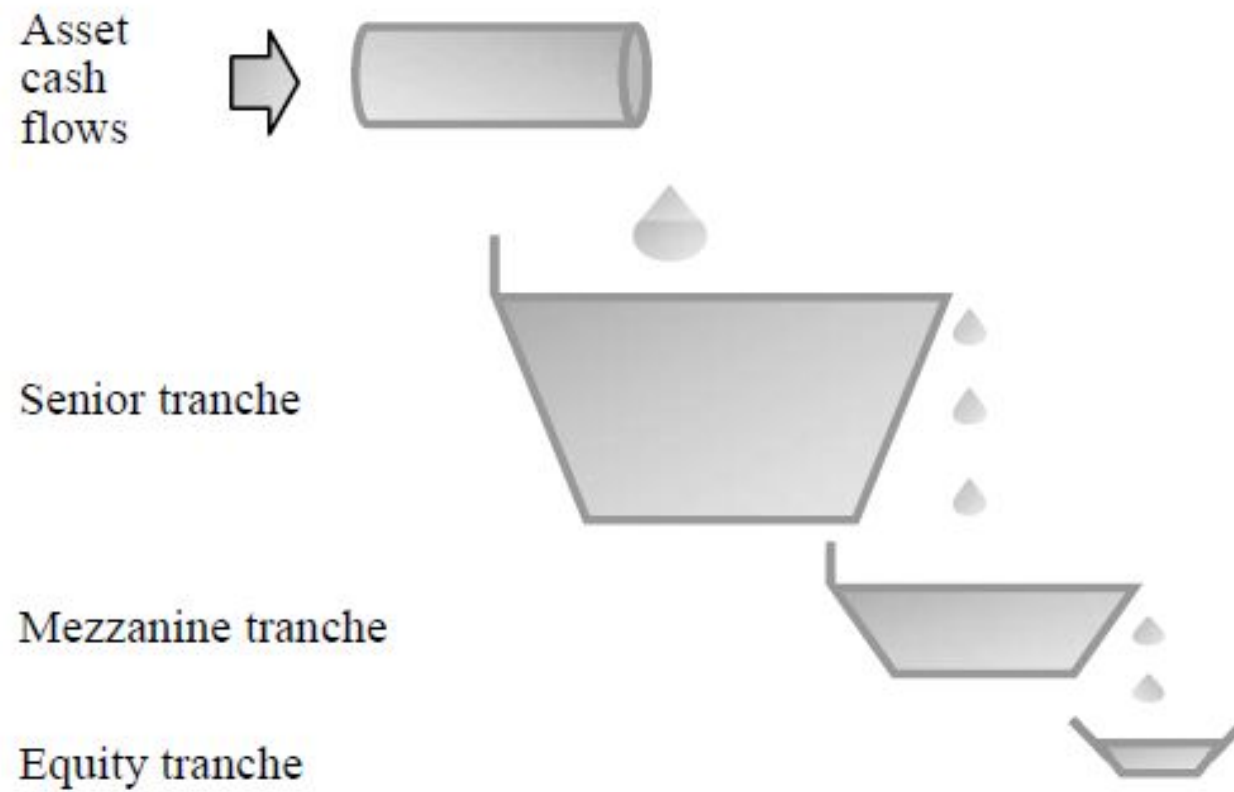


3 **ABS – Asset Backed Securities**

- The general way a waterfall works is illustrated in the next figure. A separate waterfall is applied to principal and interest payments. Principal payments are allocated to the senior tranche until its principal has been fully repaid. They are then allocated to mezzanine tranche until its principal has been fully repaid.
- Only after this has happened do principal repayments go to the equity tranche. Interest payments are allocated to the senior tranche until the senior tranche has received its promised return on its outstanding principal.
- Assuming that this promised return can be made, interest payments are then allocated to the mezzanine tranche. If the promised return to the mezzanine tranche can be made and cash flows are left over, they are allocated to the equity tranche.
- The extent to which the tranches get their principal back depends on losses on the underlying assets. The effect of the waterfall is roughly as follows. The first 5% of losses are borne by the equity tranche. If losses exceed 5%, the equity tranche loses all its principal and some losses are borne by the principal of the mezzanine tranche.
- If losses exceed 20%, the mezzanine tranche loses all its principal and some losses are borne by the principal of the senior tranche.

3 ABS – Asset Backed Securities

The waterfall in an asset-backed security.



3 **ABS – Asset Backed Securities**

- There are therefore two ways of looking at an ABS. One is with reference to the waterfall in the previous figure. Cash flows go first to the senior tranche, then to the mezzanine tranche, and then to the equity tranche.
- The other is in terms of losses. Losses of principal are first borne by the equity tranche, then by the mezzanine tranche, and then by the senior tranche. Rating agencies such as Moody's, S&P, and Fitch played a key role in securitization.
- The ABS in the first figure is likely to be designed so that the senior tranche is given the highest possible rating, AAA. The mezzanine tranche is typically rated BBB (well below AAA, but still investment grade). The equity tranche is typically unrated.
- The description of ABSs that we have given so far is somewhat simplified. Typically, more than three tranches with a wide range of ratings were created. In the waterfall rules, as we have described them, the allocation of cash flows to tranches is sequential in that they always flow first to the most senior tranche, then to the next most senior tranche, and so on.
- In practice, the rules are somewhat more complicated than this and are described in a legal document that is several hundred pages long. Another complication is that there was often some overcollateralization where the total principal of the tranches was less than the total principal of the underlying assets. Also, the weighted average return promised to the tranches was less than the weighted average return payable on the assets.

4 Delinquency Ratio



Delinquency rate/ratio refers to the percentage of loans within a financial institution's loan portfolio whose payments are delinquent.

- When analyzing and investing in loans, the delinquency rate is an important metric to follow; it is easy to find comprehensive statistics on the delinquencies of all types of loans.
- Typically, a lender will not report a loan as being delinquent until the borrower has missed two consecutive payments, after which a lender will report to the credit reporting agencies, or "credit bureaus," that the borrower is 60 days late in their payment. If late payments persist, then each month that the borrower is late, the lender may continue reporting the delinquency to the credit agencies for as long as 270 days.
- After 270 days of late payments, the code of federal regulations considers any type of federal loan to be in default. Loans between borrowers and private-sector lenders follow individual U.S. state codes that define when a loan is in default. To begin the process of retrieving delinquent payments, lenders generally work with third-party collection agents.

4 Delinquency Ratio

- The credit bureaus may give borrowers various delinquency rate marks on the individual tradelines included with their credit reports. If a borrower is consistently delinquent, they will receive marks for 60 days late, 90 days late, and so on. If a borrower makes a payment and defaults again, then a new cycle of delinquency appears on the tradeline. When considering a borrower for credit approval, credit agencies and lenders consider all of a borrower's delinquent marks.
- Often, especially with corporate debt, lenders will report total delinquency rates on loans according to the borrower's credit quality; this can help investors gain insights into the risks involved with specific loans.
- To calculate a delinquency rate, divide the number of loans that are delinquent by the total number of loans that an institution holds. For example, if there are 1,000 loans in a bank's loan portfolio, and 100 of those loans have delinquent payments of 60 days or more, then the delinquency rate would be 10% (100 divided by 1,000 equals 10%).

5 Default Ratio



The default rate/ratio is the percentage of all outstanding loans that a lender has written off as unpaid after a prolonged period of missed payments.

- The term default rate—also called penalty rate—may also refer to the higher interest rate imposed on a borrower who has missed regular payments on a loan.
- An individual loan is typically declared in default if payment is 270 days late. Defaulted loans are typically written off from an issuer's financial statements and transferred to a collection agency.
- The default rate of banks' loan portfolios, in addition to other indicators—such as the unemployment rate, the rate of inflation, the consumer confidence index, the level of personal bankruptcy filings, and stock market returns, among others—is sometimes used as an overall indicator of economic health.

5 Default Ratio

- Default rates are an important statistical measure used by lenders to determine their exposure to risk. If a bank is found to have a high default rate in their loan portfolio, they may be forced to reassess their lending procedures in order to reduce their credit risk—the possibility of a loss resulting from a borrower's failure to repay a loan or meet contractual obligations. The default rate is also used by economists to evaluate the overall health of the economy.
- Standard & Poor's (S&P) and the credit reporting agency Experian jointly produce a number of indexes that help lenders and economists track movements over time in the level of the default rate for various types of consumer loans, including home mortgages, car loans, and consumer credit cards. Collectively, these indexes are referred to as the S&P/Experian Consumer Credit Default Indexes.

5 Default Ratio

- Lenders do not get overly concerned with missed payments until the second missed payment period is passed. When a borrower misses two consecutive loan payments (and is thus 60 days late in making payments), the account is considered delinquent and the lender reports it to the credit reporting agencies. Delinquency describes a situation wherein an individual with a contractual obligation to make payments against a debt—such as loan payments or any other kind of debt—does not make those payments on time or in a regular, timely manner.
- The delinquent payment is then recorded as a black mark on the borrower's credit rating. The lender may also increase the borrower's interest rate as a penalty for late payment.
- If the borrower continues to miss payments the lender will continue to report the delinquencies up until the loan is written off and declared to be in default. For federally-funded loans such as student loans, the default timeframe is approximately 270 days. The timetable for all other loan types is established by state laws.
- Default on any kind of consumer debt damages the borrower's credit score, which may make it difficult or impossible to get credit approval in the future.

6 Debt-Service Coverage Ratio (DSCR)



The debt-service coverage ratio (DSCR) is a measure of the cash flow available to pay current debt obligations.

- The debt-service coverage ratio applies to corporate, government, and personal finance. In the context of corporate finance, the debt-service coverage ratio (DSCR) is a measurement of a firm's available cash flow to pay current debt obligations. The DSCR shows investors whether a company has enough income to pay its debts.

$$DSCR = \frac{\text{Net Operating Income}}{\text{Total Service Debt}}$$

- where: Net Operating Income = Revenue – COE & COE = Certain operating expenses
- Total Debt Service = Current debt obligations
- Net operating income is a company's revenue minus certain operating expenses (COE), not including taxes and interest payments. It is often considered the equivalent of earnings before interest and tax (EBIT).
- Some calculations include non-operating income in EBIT. As a lender or investor comparing different companies' credit-worthiness—or a manager comparing different years or quarters—it is important to apply consistent criteria when calculating DSCR. As a borrower, it is important to realize that lenders may calculate DSCR in slightly different ways.
- Total debt service refers to current debt obligations, meaning any interest, principal, sinking fund, and lease payments that are due in the coming year. On a balance sheet, this will include short-term debt and the current portion of long-term debt.

7 Weighted Average Coupon



The weighted average coupon (WAC) is a measurement of the rate of return on a pool of mortgages that is sold to investors as a mortgage-backed security (MBS).

- The underlying mortgages are repaid at different lengths of time, so the WAC represents its return at the time it was issued and may differ from its WAC later.
- Banks routinely sell the mortgages they issue on a secondary mortgage market. The buyers are institutional investors such as hedge funds, and investment banks. These buyers package the mortgages into marketable securities that can be traded to investors on the open market as mortgage-backed securities (MBS).
- MBS holders receive interest or coupon payments which are calculated as the weighted average of the underlying coupon of the mortgage loans backing the MBS.

7 Weighted Average Coupon

Calculation

- The weighted average coupon (WAC) is calculated by taking the gross of the interest rates owed on the underlying mortgages of the MBS and weighting them according to the percentage of the security that each mortgage represents.
- The WAC represents the average interest rate of different pools of mortgages with varying interest rates. In the weighted average calculation, the principal balance of each underlying mortgage is used as the weighting factor.
- To calculate the WAC, the coupon rate of each mortgage or MBS is multiplied by its remaining principal balance. The results are added together, and the sum total is divided by the remaining balance.
- Another way to calculate the weighted average coupon is by taking the weights of each mortgage pool, multiplying by their respective coupon rates, and adding the result to get the WAC.

8 Weighted Average Maturity



Weighted average maturity (WAM) is the weighted average amount of time until the maturities on mortgages in a mortgage-backed security (MBS).

- This term is used more broadly to describe maturities in a portfolio of debt securities, including corporate debt and municipal bonds. The higher the WAM, the longer it takes for all of the mortgages or bonds in the portfolio to mature. WAM is used to manage debt portfolios and to assess the performance of debt portfolio managers.
- WAM is closely related to weighted average loan age (WALA).
- WAM is calculated by computing the percentage value of each mortgage or debt instrument in the portfolio. The number of months or years until the bond's maturity is multiplied by each percentage, and the sum of the subtotals equals the weighted average maturity of the bonds in the portfolio.

8 Weighted Average Maturity

- WAM is used as a tool to manage bond portfolios and to assess the performance of portfolio managers. Mutual funds, for example, offer bond portfolios with a variety of WAM guidelines, and a fund portfolio may have a WAM as short as five years or as long as 30 years. The investor can choose a bond fund that matches a particular investing time frame. The fund's investment objective includes a benchmark, such as a bond index, and the benchmark portfolio's WAM is available for investors and portfolio managers. A portfolio manager's investment performance is judged based on the rate of return and the WAM on the fund's bond portfolio.
- Bond laddering is an investment strategy that involves purchasing bonds with different maturity dates, which means that the dollars in the portfolio are returned to the investor at different points over time. A laddering strategy allows the owner to reinvest bond maturity proceeds at current interest rates over time, which reduces the risk of reinvesting the entire portfolio when interest rates are low. Bond laddering helps an income-oriented investor maintain a reasonable interest rate on a bond portfolio, and these investors use WAM to assess the portfolio.

9 Weighted Average Life



The weighted average life (WAL) is the average length of time that each dollar of unpaid principal on a loan, a mortgage, or an amortizing bond remains outstanding.

- Calculating WAL shows an investor, an analyst, or a portfolio manager how many years it will take to receive roughly half of the amount of the outstanding principal. The formula is useful in measuring the credit risk associated with fixed-income securities.
- The time weightings used in weighted average life calculations are based on payments to the principal. In many loans, such as mortgages, each payment consists of payments to principal and payments to interest. In WAL, only the principal payments are considered and these payments tend to get larger over time, with early payments of a mortgage going mostly to interest, while payments made towards the end of the loan are applied mostly to the principal balance of the loan.
- Time periods with higher dollar amounts have more weight in WAL. For example, if the majority of the repayment to principal is in 10 years, the weighted average life will be closer to 10 years.

10 Credit Loss Calculation

- Credit losses due to migration or default are calculated per scenario basis for all exposures. In standardized Structural Credit Models asset values below certain thresholds trigger default. The procedure is as follows:
 - Transform simulated obligor asset value, for each obligor, into a default 0-1 variable by comparing with a pre-calculated default threshold.
 - For valuation purposes, compute also migration states by comparing asset return with pre-calculated rating thresholds.
 - Calculate the losses for each obligor, given the default / migration variable and the aggregation of all exposures to that obligor.
 - Sum all losses to get one value for total portfolio loss in each simulation.
 - Repeat the simulation as many times as desired.

10 Credit Loss Calculation

- Monte Carlo simulation of Credit Portfolios is a computational method typically used for the calculation of Credit Value at Risk and economic capital for credit portfolios held by banks and similar institutions. The approach is an example of using Simulation Models for the purpose of establishing a Risk Distribution. Once the distribution is obtained it is possible to estimate various risk measures for the credit portfolio.

Model Categories

- There are several broad categories of models (which generally overlap) and very many variations in data inputs, model specification and model calibration:
 - Copula Based Credit Portfolio Models
 - Econometric Credit Portfolio Models
 - Structural Credit Portfolio Models
 - Credit Contagion Models
 - An Economic Scenario Generator together with a suite of satellite models for Credit Risk estimation

11 Securitization Process

- A number of participants are involved in the securitization process. In most cases, the process begins with the **originator**. This is the institution that owns the pool of assets such as mortgages, auto-loans, or receivables which it wishes to repackage and sell. An issuer will then acquire these assets.
- The **issuer** is often a firm specially set up to facilitate the securitization process. It is usually set up as an SPV that is domiciled offshore. For the sale to be considered a “true sale,” the issuer must have a legal identity that is distinct from the originator. The assets being securitized permanently shift from the originator’s balance sheet to that of the SPV. The SPV is set up such that it is bankruptcy-remote, meaning that the underlying asset pool is held separately from the other assets of the originator. In effect, the SPV and its assets are protected from insolvency or bankruptcy of the originator. In other words, the originator’s credit rating and financial status become almost irrelevant to the bondholders when assets are held within an SPV framework.

11 Securitization Process

- To further boost the credit quality of the SPV, the process of securitization often involves credit enhancements. The term refers to methods used to improve the credit profile of the SPV to make the securitized assets on sale more marketable. One form of credit enhancement occurs in the form of a third-party guarantee of performance. Notes issued by an SPV that has obtained third-party guarantee are often rated at investment grade and up to AAA-grade.
- To ensure that the originator secures lower-cost funding, any securitization structure is set up such that the liability side of the SPV – the issued notes – carries lower cost than the asset side of the SPV. In other words, the compensation paid to investors will be less than the total inflow from the underlying pool of assets. That way, the originator is able to lock cheaper funding that it would struggle to obtain in the unsecured market. This can be especially beneficial to originators with lower credit ratings.
- When choosing the location of a SPV, originators look at factors such as taxation, operating costs, legal requirements, and investor considerations. Taxation is particularly a major factor because SPVs are subject to different tax treatments in different countries. To secure favorable tax treatment, most originators set up SPVs either in areas that have set up SPV-friendly business legislation such as Dublin or the Netherlands, or in offshore business centers such as Jersey or the Cayman Islands. In these jurisdictions, all cash flows both received and paid out by the SPV attract low or no tax.

12 Constant Prepayment Rate



A constant prepayment rate (CPR) is an estimate of the percentage of a loan pool's principal that is likely to be paid off prematurely.

- The estimate is calculated based on a number of factors, such as historical prepayment rates for previous loans similar to the ones in the pool and future economic outlooks. These calculations are important for investors in evaluating assets like mortgage-backed securities or other securitized bundles of loans.
- The higher the CPR, the more prepayments are expected and the less interest the investor is likely to receive in total. This is called prepayment risk.

12 Constant Prepayment Rate

- The CPR can be used for a variety of loans. Pools of mortgages, student loans, and pass-through securities all use the CPR as estimates of prepayment. Typically, the CPR is expressed as an annual percentage.
- For example, if a pool of mortgages has a CPR of 8%, that suggests that 8% of the pool's outstanding principal will be paid off prematurely in a given year.
- The CPR helps investors anticipate prepayment risk, which is the risk involved with the premature return of principal on an income-producing security.
- In simple terms, when a borrower pays a portion of their loan's principal off early that portion stops incurring interest and investors in that debt will no longer receive interest payments from it. The risk of prepayment is most prevalent in fixed-income securities such as callable bonds and mortgage-backed securities (MBSs).

13 Public Securities Association (PSA)

- Public Securities Association (PSA) was the predecessor association to the Bond Market Association, which represents the largest securities markets in the world, the bond markets. The Public Securities Association was incorporated in 1976 and underwent a name change to the Bond Market Association in 1997 to better reflect its broadened constituency and membership.
- The Bond Market Association represented a diverse mix of securities firms and banks, from large firms to niche specialists, with 70 percent of member firms having their headquarters outside of New York City. Its members collectively accounted for a significant majority of U.S. municipal bond underwriting and trading.
- In November 2006, the Bond Market Association combined with the Securities Industry Association. The two organizations joined together to form what then became the Securities Industry and Financial Markets Association or SIFMA. SIFMA's current membership represents 75% of the U.S. broker-dealer sector by revenue and includes more than 13,000 professionals in the finance and banking industries. SIFMA is a major trade association that represents securities brokerage firms, investment banking institutions, and other investment firms.

14 Prepayment forecasting methodologies

- The prepayment rate of a mortgage pool may be expressed in a number of different ways.
- These measures are equally valid, although a particular method may be more useful in a given instance.
- The three popular and widely used mortgage prepayment models are:
 - i. The SMM (Single Monthly Mortality) model
 - ii. The CPR (Conditional Prepayment Rate or Constant Prepayment Rate) model
 - iii. The Standard Prepayment Model of The Bond Market Association