**Standard Chartered interwju**

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| Share   |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | Associate, Treasury Model Developer – Data Scientist - (2200001001)    **Role:**  The primary objective of the role is to :   * drive **balance sheet optimization** delivery through analytical solutions, * **ALM behavioral models** and statistical data analysis: * **economic life and stability of Non-Maturing Deposits,** * **early redemptions of term deposits,** * **prepayments** * pricing of **embedded optionality**   for Treasury dealers, policy owners and risk managers.  **Key Responsibilities**   * Models for balance sheet positions and key Treasury, Risk / Balance Sheet Management metrics * Python, R SQL and VBA * Co-lead Artificial Intelligence / Machine Learning transformation of Treasury (???) * Design the relevant data extracts as inputs to models and solutions, considering the balance between accuracy and model performance * Provide input into the strategic direction of Treasury platforms * Understanding and practical experience in some of the following:   + Banking products   + Interest Rate Risk – earnings (**NII**) and value (**EVE, PV01**)   + **Liquidity cashflow mismatch**   + **LCR, NSFR** and other regulatory metrics   + Liquidity ratios such as **LDR, deposit concentration** etc   + **Liquidity stress testing**   + Funds Transfer Pricing (**FTP**)   **QUESTION TYPES:**  CV: Calculation of SII Matching Adjustment based on relationship of insurer’s Assets and Liabilities (ALM) -> how did you accomplish that? https://www.ashurst.com/en/news-and-insights/legal-updates/matching-adjustments-under-solvency-ii/  *The MA allows an insurer calculating the best estimate component of the technical provisions to adjust the Risk Free Discount Rate by the difference between:*   * + *the annual effective single discount rate which when applied to the cash flows of the MA Liabilities would give the present value of the MA Assets; and*   + *the annual effective single discount rate which, when applied to the cash flows of the MA Liabilities, would result in the value of the best estimate arrived at using the Risk Free Discount Rate.*   *This difference is then reduced by an EIOPA-prescribed haircut representing the "fundamental spread" for the MA Assets – i.e. the credit spread representing: (i) the probability of default; and (ii) the risk of downgrade. Under Article 53 of the Delegated Acts, the haircut for fundamental spread must be applied by first adjusting the cash flows of the MA Assets to allow for the probability of default of the asset before calculating the MA, and then deducting the remainder of the fundamental spread (i.e. the portion of the fundamental spread representing downgrade risk) from the amount of the MA once calculated.*  *This adjustment to the Risk Free Discount Rate effected by the MA reflects the fact that exposure to volatility in asset spreads could lead to volatility in the balance sheet which could give a false impression of the firm's solvency. To avoid this, firms which match assets and liabilities in an MA Portfolio are permitted to peg the rate at which they discount the MA Liabilities to movements in asset prices, so that falling MA Asset values will be matched by a reduction in the value of MA Liabilities on the balance sheet. Note that the MA only represents an adjustment for spread volatility – the insurer must continue to recognize risk of default in the MA Assets it holds by applying the haircut to the MA represented by the fundamental spread. Note also, however, that the MA can turn negative when spreads are generally low, and in those cases the amount of required technical provisions would be increased by the application of the MA, as once an insurer uses the MA for an MA Portfolio, it cannot revert to an approach which does not use it. If the MA Portfolio ceases to comply with the eligibility requirements and compliance cannot be restored promptly, the insurer will be prevented from using the MA for a period of two years.*  ***Eligibility of assets for the MA Portfolio***  *The expected cash flows from the MA Assets must replicate each of the expected cash flows of the MA Liabilities in the same currency, they must be fixed and cannot be changed by the issuer or any third party (although they may be inflation-linked if the relevant insurance obligations are also inflation-linked) and there must be no mismatch giving rise to material risks. This means that bonds with issuer redemption options and step-up clauses cannot be included in the MA Assets. However, the PRA has indicated that issuer redemption or alteration of the cash flows with an accompanying Spens or similar make-whole clause will be permissible, subject to meeting criteria to ensure sufficiency of the compensation, as will bonds with market standard redemption clauses for events beyond the control of the issuer. If the insurer holds units in collective investment schemes in the MA Assets, the PRA will expect the firm to "look-through" to the underlying assets and ensure that they would qualify for the MA on their own merit, and the fund must be prohibited from investing in assets which do not qualify for the MA. Asset cash flows dependent on longevity, morbidity, the realisable value of property, and exposure to pre-payment risk (such as many equity-release mortgages) are unlikely to qualify for the MA.*  *No separate special purpose vehicle (SPV) is required to hold eligible assets, but they must be identified and managed separately from other assets of the insurer and cannot be used to cover other losses arising elsewhere in the insurer's business. The only assets in the MA Portfolio should be MA-eligible assets.*  ***Repackaging of ineligible assets to achieve eligibility***  *Insurers may wish to consider restructuring portfolios of assets or undertaking risk transformation or repackaging transactions to achieve eligibility or cash flow matching. The PRA has indicated that it expects firms carefully to consider the behaviour of these arrangements under stress and whether the associated risks are well understood and managed, and to consider any new risk created thereby, such as exposure to the credit risk of any counterparty to the transaction.  Repackaging of assets to transform cash flows or other contractual features can be achieved in a number of ways. Typically, however, the underlying instrument (in this case the ineligible asset) is transferred (either physically or economically) into a SPV, which finances the acquisition through the issue of debt. The SPV may enter into derivatives to convert the cash flows and/or transfer risks, or issue different classes of debt, or a combination of these methods, to create a class of instrument whose cash flows and features qualify such instrument for inclusion in the MA Assets. Residual cash flows and risks can be hived off into a separate class of debt or equity. The diagram below shows a very generalised basic form of repackaging of assets.*  https://ashurstcd.azureedge.net/-/media/ashurst/images/news-and-insights/article-images/2017/may/7202_web_solvency-ii-article_colour-or-bw_740wide.jpg?rev=142bee066f924fea83ab4e8df37b45a3&sc_lang=en&hash=F117D9FB17E4E81DC206DE2D6ED06FB1 *The SPV is used here to isolate the ineligible cash flows and risks, and effectively transform the underlying assets into assets complying with the applicable requirements.  Variations can include the addition of credit enhancement to mitigate counterparty risk, the inclusion of a liquidity facility to avoid unexpected cash flow shortfalls, and the appointment of a portfolio manager to make changes to the pool by adding, removing or substituting assets. There is a significant amount of flexibility and customisation that can be achieved through this technique, although insurers would need to ensure that the PRA's concerns are satisfactorily addressed, and also consider the impact of any potential classification of the resulting assets as securitisations.*  <https://www.eiopa.europa.eu/rulebook/solvency-ii/article-2293_en>  *1.  For each currency the matching adjustment referred to in Article 77b shall be calculated in accordance with the following principles:*  *(a) the matching adjustment must be equal to the difference of the following:*  *(i) the annual effective rate, calculated as the single discount rate that, where applied to the cash flows of the portfolio of insurance or reinsurance obligations, results in a value that is equal to the value in accordance with Article 75 of the portfolio of assigned assets;*  *(ii) the annual effective rate, calculated as the single discount rate that, where applied to the cash flows of the portfolio of insurance or reinsurance obligations, results in a value that is equal to the value of the best estimate of the portfolio of insurance or reinsurance obligations where the time value of money is taken into account using the basic risk-free interest rate term structure;*  *(b) the matching adjustment must not include the fundamental spread reflecting the risks retained by the insurance or reinsurance undertaking;*  *(c) notwithstanding point (a), the fundamental spread must be increased where necessary to ensure that the matching adjustment for assets with sub-investment grade credit quality does not exceed the matching adjustments for assets of investment grade credit quality and the same duration and asset class;*  *(d) the use of external credit assessments in the calculation of the matching adjustment must be in accordance with Article 111(1)(n).*  *2.  For the purposes of paragraph 1(b), the fundamental spread shall be:*  *(a) equal to the sum of the following:*  *(i) the credit spread corresponding to the probability of default of the assets;*  *(ii) the credit spread corresponding to the expected loss resulting from downgrading of the assets;*  *(b) for exposures to Member States' central governments and central banks, no lower than 30 % of the long-term average of the spread over the risk-free interest rate of assets of the same duration, credit quality and asset class, as observed in financial markets;*  *(c) for assets other than exposures to Member States' central governments and central banks, no lower than 35 % of the long-term average of the spread over the risk-free interest rate of assets of the same duration, credit quality and asset class, as observed in financial markets.*  *The probability of default referred to in point (a)(i) of the first subparagraph shall be based on long-term default statistics that are relevant for the asset in relation to its duration, credit quality and asset class.*  *Where no reliable credit spread can be derived from the default statistics referred to in the second subparagraph, the fundamental spread shall be equal to the portion of the long-term average of the spread over the risk-free interest rate set out in points (b) and (c).*   * + 1. **Calculation of SII value of financial guarantees and contractual options included in insurance contracts, mainly resulting from a guaranteed interest rate in the indexation of the sum insured -> how did you accomplish that?** * *Simulations of interest rates from the model (either Vasicek or Nelson Siegel)* * *Calculate how many times company would need to pay for the option* * *Average out*   + 1. **Generated Economic Scenarios for cashflow model projections -> AAA VBA macro (Nelson Siegel)**   <https://www.igcp.pt/fotos/editor2/Menu%20Lateral/Publicacoes/Estudos/ModeloNelsonSiegel-Ingles1.pdf>   * + 1. **Valued state bonds in life insurer portfolio (AAA Excel)** * Corporate * State * Take the future CFs * Calculate XIRR() * Discount CFs with IRR, sum up * **Interest rate modelling (Hull White, Vasicek, Ho Lee, CIR, Nelson Siegel, PCA)**   **1977 Vasicek** So far quantitative finance hadn’t had much to say about pricing interest rate products. Some people were using equity option formulæ for pricing interest rate options, but a consistent framework for interest rates had not been developed. This was addressed by Vasicek. He started by modelling a short-term interest rate as a random walk and concluded that interest rate derivatives could be valued using equations similar to the Black–Scholes partial differential equation. Oldrich Vasicek represented the short-term interest rate by a stochastic differential equation of the form dr = μ(r, t) dt + σ(r, t) dX. The bond pricing equation **is a parabolic partial differential equation**, similar to the Black–Scholes equation. See Vasicek (1977).  **1986 Ho and Lee** One of the problems with the Vasicek framework for interest rate derivative products was that it didn’t give very good prices for bonds, the simplest of fixed income products. If the model couldn’t even get bond prices right, how could it hope to correctly value bond options? Thomas Ho and Sang-Bin Lee found a way around this, **introducing the idea of yield curve fitting or calibration**. See Ho and Lee (1986).  **1992 Heath, Jarrow and Morton** Although Ho and Lee showed how to match theoretical and market prices for simple bonds, the methodology was rather cumbersome and not easily generalized. David Heath, Robert Jarrow and Andrew Morton took a different approach. Instead of modelling just a short rate and deducing the whole yield curve, **they modelled the random evolution of the whole yield curve**. The initial yield curve, and hence the value of simple interest rate instruments, was an input to the model. The model cannot easily be expressed in differential equation terms and so relies on either Monte Carlo simulation or tree building. The work was well known via a working paper, but was finally published, and therefore made respectable in Heath, Jarrow and Morton (1992).  **2002 Hagan, Kumar, Lesniewski, Woodward** There has always been a need for models that are both fast and match traded prices well. The interest-rate model of Pat Hagan, Deep Kumar, Andrew Lesniewski & Diana Woodward(2002) which has come to be called the SABR (stochastic,α, β, ρ) model is a model for a forward rate and its volatility, both of which are stochastic. This model is made tractable by exploiting an asymptotic approximation to the governing equation that is highly accurate in practice. The asymptotic analysis simplifies a problem that would otherwise have to be solved numerically. Although asymptotic analysis has been used in financial problems before, for example in modelling transaction costs, this was the first time it really entered mainstream quantitative finance.   * **Balance sheet modelling:**   + 1. ALM (duration,convexity)   *Client behavior deeply impacts a bank's liquidity, funding, interest-rate position and, consequently, the management of its asset/liability mismatch and related profitability. Therefore it is imperative that risk managers and modelers alike understand how to model client behavior according to the needs of their business. It is the aim of this book to improve that understanding and highlight modelling techniques from the simple through to the complex, offering a broad suite of tools to improve the management of an institution's balance sheet.*  **Duration**  *Measure of assets (bonds) sensitivity wrt to a change of interest rates*  **Convexity**  *Second derivative wrt interest rate* What Is Convexity? *Convexity is a measure of the curvature, or the degree of the curve, in the relationship between bond prices and bond yields.*  *Convexity is thus a measure of the curvature in the relationship between bond prices and interest rates. It reflects the rate at which the duration of a bond changes as interest rates change. Duration is a measure of a bond's sensitivity to changes in interest rates. It represents the expected percentage change in the price of a bond for a 1% change in interest rates.* ***KEY TAKEAWAYS***  * *Convexity is a risk-management tool, used to measure and manage a portfolio's exposure to market risk.* * *Convexity is a measure of the curvature in the relationship between bond prices and bond yields.* * *Convexity demonstrates how the duration of a bond changes as the interest rate changes.* * *If a bond's duration increases as yields increase, the bond is said to have negative convexity.* * *If a bond's duration rises and yields fall, the bond is said to have positive convexity.*    **Convexity**Understanding Convexity *Convexity demonstrates how the duration of a bond changes as the interest rate changes. Portfolio managers will use convexity as a risk-management tool, to measure and manage the portfolio's exposure to*[*interest rate risk*](https://www.investopedia.com/terms/i/interestraterisk.asp)*.*  *In the example figure shown below, Bond A has a higher convexity than Bond B, which indicates that all else being equal, Bond A will always have a higher price than Bond B as interest rates rise or fall.*  *Before explaining convexity, it's important to know how bond prices and market interest rates relate to one another. As interest rates fall, bond prices rise. Conversely, rising market interest rates lead to falling bond prices. This opposite reaction is because as rates rise, the bond may fall behind in the payout they offer a potential investor in comparison to other securities.*  *The*[*bond yield*](https://www.investopedia.com/terms/b/bond-yield.asp)*is the earnings or returns an investor can expect to make by buying and holding that particular security. The price of the bond depends on several characteristics including the*[*market interest rate*](https://www.investopedia.com/terms/i/interestrate.asp)*and can change regularly.*  *For example, if market rates rise, or are expected to rise, new bond issues must also have higher rates to satisfy investor demand for lending the issuer their money. However, the price of bonds returning less than that rate will fall as there would be very little demand for them as bondholders will look to sell their existing bonds and opt for bonds, most likely newer issues, paying higher yields. Eventually, the price of these bonds with the lower coupon rates will drop to a level where the rate of return is equal to the prevailing market interest rates.* Bond Duration [*Bond duration*](https://www.investopedia.com/terms/d/duration.asp)*measures the change in a bond's price when interest rates fluctuate. If the duration of a bond is high, it means the bond's price will move to a greater degree in the opposite direction of interest rates. Conversely, when this figure is low the debt instrument will show less movement to the change in interest rates. Essentially, the higher a bond's duration, the larger the change in its price when interest rates change. In other words, the greater its interest rate risk. So, if an investor believes that interest rates are going to rise, they should consider bonds with a lower duration.*  *Bond duration should not be confused with its*[*term to maturity*](https://www.investopedia.com/terms/t/termtomaturity.asp)*. Though they both decline as the maturity date approaches, the latter is simply a measure of time during which the bondholder will receive coupon payments until the principal must be paid.*  *Typically, if market rates rise by 1%, a one-year maturity bond price should decline by an equal 1%. However, for bonds with long-dated maturities, the reaction increases. As a general rule of thumb, if rates rise by 1%, bond prices fall by 1% for each year of maturity. For example, if rates rise by 1%, the two-year bond price would fall 2%, the three-year bond price by 3%, and the 10-year price by 10%.*  *Duration, on the other hand, measures the bond's sensitivity to the change in interest rates. For example, if rates were to rise 1%, a bond or bond fund with a 5-year average duration would likely lose approximately 5% of its value.* Convexity and Risk *Convexity builds on the concept of duration by measuring the sensitivity of the duration of a bond as yields change. Convexity is a better*[*measure of interest rate risk*](https://www.investopedia.com/terms/c/convexity-adjustment.asp)*, concerning bond duration. Where duration assumes that interest rates and bond prices have a linear relationship, convexity allows for other factors and produces a slope.*  *Duration can be a good measure of how bond prices may be affected due to small and sudden fluctuations in interest rates. However, the relationship between bond prices and yields is typically more sloped, or convex. Therefore, convexity is a better measure for assessing the impact on bond prices when there are large fluctuations in interest rates.*  *As convexity increases, the*[*systemic risk*](https://www.investopedia.com/terms/s/systemic-risk.asp)*to which the portfolio is exposed increases. The term systemic risk became common during the financial crisis of 2008 as the failure of one financial institution threatened others. However, this risk can apply to all businesses, industries, and the economy as a whole.*  *The risk to a fixed-income portfolio means that as interest rates rise, the existing fixed-rate instruments are not as attractive. As convexity decreases, the exposure to market interest rates decreases and the bond portfolio can be considered hedged. Typically, the higher the*[*coupon rate*](https://www.investopedia.com/terms/c/coupon-rate.asp)*or yield, the lower the convexity—or market risk—of a bond. This lessening of risk is because market rates would have to increase greatly to surpass the coupon on the bond, meaning there is less interest rate risk to the investor. However, other risks, like default risk, etc., might still exist.* Example of Convexity *Imagine a bond issuer, XYZ Corporation, with two bonds currently on the market: Bond A and Bond B. Both bonds have a face value of $100,000 and a coupon rate of 5%. Bond A, however, matures in 5 years, while Bond B matures in 10 years.*  *Using the concept of duration, we can calculate that Bond A has a duration of 4 years while Bond B has a duration of 5.5 years. This means that for every 1% change in interest rates, Bond A's price will change by 4% while Bond B's price will change by 5.5%.*  *Now, let's say that interest rates suddenly increase by 2%. This means that the price of Bond A should decrease by 8% while the price of Bond B will decrease by 11%. However, using the concept of convexity, we can predict that the price change for Bond B will actually be less than expected based on its duration alone. This is because Bond B has a longer maturity, which means it has a higher convexity. The higher convexity of Bond B acts as a buffer against changes in interest rates, resulting in a relatively smaller price change than expected based on its duration alone.* Negative and Positive Convexity *If a bond's duration increases as yields increase, the bond is said to have*[*negative convexity*](https://www.investopedia.com/terms/n/negative_convexity.asp)*. In other words, the bond price will decline by a greater rate with a rise in yields than if yields had fallen. Therefore, if a bond has negative convexity, its duration would increase—the price would fall. As interest rates rise, and the opposite is true.*  *If a bond's duration rises and yields fall, the bond is said to have positive convexity. In other words, as yields fall, bond prices rise by a greater rate—or duration—than if yields rose. Positive convexity leads to greater increases in bond prices. If a bond has positive convexity, it would typically experience larger price increases as yields fall, compared to price decreases when yields increase.*  *Under normal market conditions, the higher the coupon rate or yield, the lower a bond's degree of convexity. In other words, there's less risk to the investor when the bond has a high coupon or yield since market rates would have to increase significantly to surpass the bond's yield. So, a portfolio of bonds with high yields would have low convexity and subsequently, less risk of their existing yields becoming less attractive as interest rates rise.*  *Consequently,*[*zero-coupon bonds*](https://www.investopedia.com/terms/z/zero-couponbond.asp)*have the highest degree of convexity because they do not offer any coupon payments. For investors looking to measure the convexity of a bond portfolio, it's best to speak to a financial advisor due to the complex nature and the number of variables involved in the calculation.*  *Most*[*mortgage-backed securities*](https://www.investopedia.com/terms/m/mbs.asp)*(MBS) will have negative convexity because their yield is typically higher than traditional bonds. As a result, it would take a significant rise in yields to make an existing holder of an MBS have a lower yield, or less attractive, than the current market.* What Is Negative and Positive Convexity? *If a bond's duration increases as yields increase, the bond is said to have negative convexity. In other words, the bond price will decline by a greater rate with a rise in yields than if yields had fallen. Therefore, if a bond has negative convexity, its duration would increase as the price decreased and vice versa.*  *If a bond's duration rises and yields fall, the bond is said to have positive convexity. In other words, as yields fall, bond prices rise by a greater rate—or duration—than if yields rose. Positive convexity leads to greater increases in bond prices. If a bond has positive convexity, it would typically experience larger price increases as yields fall, compared to price decreases when yields increase.* Why Do Interest Rates and Bond Prices Move in Opposite Directions? *As interest rates fall, bond prices rise and vice versa. For example, if market rates rise, or are expected to rise, new bond issues must also have higher rates to satisfy investor demand for lending the issuer their money. However, the price of bonds returning less than that rate will fall as there would be very little demand for them as bondholders will look to sell their existing bonds and opt for bonds, most likely newer issues, paying higher yields. Eventually, the price of these bonds with the lower coupon rates will drop to a level where the rate of return is equal to the prevailing market interest rates.* What Is Bond Duration? *Bond duration measures the change in a bond's price when interest rates fluctuate. If the duration is high, it means the bond's price will move in the opposite direction to a greater degree than the change in interest rates. Conversely, when this figure is low the debt instrument will show less movement to the change in interest rates.*  *Essentially, the higher a bond's duration, the larger the change in its price when interest rates change. In other words, the greater its interest rate risk. So, if an investor believes that a sizable change in interest rates could have a negative effect on their bond portfolio, they should consider bonds with a lower duration.* The Bottom Line *Convexity is a measure of the curvature of its duration, or the relationship between bond prices and yields. It is used to describe the way in which the duration of a bond changes in response to changes in interest rates. When a bond's price is more sensitive to changes in interest rates, it is said to have higher convexity. Convexity is important for bond investors because it can impact the value of their investments. For example, when interest rates rise, the prices of most bonds tend to fall, and the magnitude of the price decline is typically greater for bonds with higher convexity. Conversely, when interest rates fall, the prices of most bonds tend to rise, and the magnitude of the price increase is typically greater for bonds with higher convexity.*  *There are several factors that can impact the convexity of a bond, including the bond's coupon rate, maturity, and credit quality. Higher coupon bonds, for example, tend to have higher convexity than lower coupon bonds because they are more sensitive to changes in interest rates. Similarly, longer-term bonds tend to have higher convexity than shorter-term bonds because they are exposed to interest rate risk for a longer period of time.*  *Bond investors can use convexity to their advantage by managing their bond portfolios to take advantage of changes in interest rates. For example, an investor who anticipates rising interest rates might choose to hold a portfolio of bonds with low convexity, while an investor who anticipates falling interest rates might choose to hold a portfolio of bonds with high convexity.*   * + 1. RoE     2. Funding Costs     3. Tier 1 Capital   *Tier 1 capital consists of* ***shareholders' equity and retained earnings****—disclosed on their financial statements—and is a primary indicator to measure a bank's financial health. These funds come into play when a bank must* ***absorb losses without ceasing business operations****. Tier 1 capital is the* ***primary funding source of the bank****. Typically, it holds nearly all of the bank's accumulated funds. These funds are generated specifically to support banks when losses are absorbed so that regular business functions do not have to be shut down.*  *Under Basel III, the* ***minimum tier 1 capital ratio is 10.5%, which is calculated by dividing the bank's tier 1 capital by its total risk-weighted assets (RWA).RWA measures a bank's exposure to credit risk from the loans it underwrites.***  *For example, assume a financial institution has US$200 billion in total tier 1 assets. They have a risk-weighted asset value of $1.2 trillion. To calculate the capital ratio, they divide $200 billion by $1.2 trillion in risk for a capital ratio of 16.66%, well above the Basel III requirements.*  *Also, there are further requirements on sources of the tier 1 funds to ensure they are available when the bank needs to use them.*   * + 1. Expected Loss     2. Efficiency Ratio      * + 1. Credit Spread * **Liquidity / Treasury Risk:**   + 1. What is liquidity risk? What is a bond haircut?   <https://www.testpreptraining.com/tutorial/treasury-management-module-intermediate-interview-questions/>  ***Treasury Risk*** *is formed of Capital and Liquidity Risk, and Interest Rate Risk in the banking book.*  ***Capital Risk*** *is the potential for insufficient level, composition or distribution of capital, own funds and eligible liabilities to support the Group’s normal activities.*  ***Liquidity Risk*** *is the risk that the Group may not have sufficient stable or diverse sources of funding to meet its obligations as they fall due.*  ***Interest Rate*** *Risk in the banking book is the potential for a reduction in earnings or economic value due to movements in interest rates on banking book assets, liabilities and off-balance sheet items.*  *The Committee receives a Treasurer’s report, at each scheduled meeting, which covers market developments, capital, liquidity and funding, recovery and resolution planning, regulatory updates and rating agency updates.*  *During the year, the Committee considered and discussed the Group’s capital and liquidity position and the regulatory environment, including the approval of the Group’s Internal Capital Adequacy Assessment*  *Process (ICAAP) submission to the PRA, in order to satisfy itself that the Group’s approach to capital planning is comprehensive, rigorous and consistent with both the current regulatory requirements and*  *the likely anticipated outlook.*  *The Committee also considered and discussed the Group’s Internal Liquidity Adequacy Assessment Process (ILAAP) for submission to the PRA, which considers the Group’s liquidity position, its framework and whether sufficient liquidity resources are being maintained to meet liabilities as they fall due (see section on stress testing for further details).*   * + 1. NII   ***What is Non-Interest Income?***  *Non-interest income is bank and creditor income derived primarily from fees including deposit and transaction fees, insufficient funds (NSF) fees, annual fees, monthly account service charges, inactivity fees, check and deposit slip fees, and so on. Credit card issuers also charge penalty fees, including late fees and over-the-limit fees. Institutions charge fees that generate non-interest income as a way of increasing revenue and ensuring liquidity in the event of increased default rates.*  ***Understanding Non-Interest Income***  *Interest is the*[*cost of borrowing*](https://www.investopedia.com/terms/c/costofdebt.asp)*money and is one form of income that banks collect. For financial institutions, such as banks, interest represents*[*operating income*](https://www.investopedia.com/terms/o/operatingincome.asp)*, which is income from normal business operations. The core purpose of a bank's business model is to loan money, so its primary source of income is interest and its primary asset is cash. That said, banks rely heavily on non-interest income when*[*interest rates*](https://www.investopedia.com/terms/i/interestrate.asp)*are low. When interest rates are high, sources of non-interest income can be lowered to entice customers to choose one bank over another.*  ***Strategic Importance of Non-Interest Income***  *Most businesses that are not banks rely entirely on non-interest income. Financial institutions and banks, on the other hand, make most of their money from loaning and re-loaning money. As a result, these firms view non-interest income as a strategic line-item on the*[*income statement*](https://www.investopedia.com/terms/i/incomestatement.asp)*. This is especially true when interest rates are low since banks profit from the spread between the cost of funds and the average lending rate. Low interest rates make it difficult for banks to make a profit, so they often rely on non-interest income to maintain profit margins.*  *From a client perspective, non-interest income sources like fees and penalties are annoying at best. For some people, these fees can quickly add up and do real financial harm to a budget. From an investor's perspective, however, a bank's ability to dial up non-interest income to protect profit margins or even increase margins in good times is a positive. The more drivers of income a financial institution has, the better it is able to weather adverse economic conditions.*  ***Drivers of Non-Interest Income***  *The degree to which banks rely on non-interest fees to make a profit is a function of the economic environment. Market interest rates are driven by benchmark rates such as the*[*Federal funds rate*](https://www.investopedia.com/terms/f/federalfundsrate.asp)*. The Fed funds rate, or the rate at which banks lend money to one another, is determined by the rate at which the*[*Federal Reserve*](https://www.investopedia.com/terms/f/federalreservebank.asp)*pays banks interest. This rate is referred to as the interest rate on excess reserves (IOER). As the IOER increases, banks can make a higher profit from interest income. At a certain point, it becomes more advantageous for a bank to use the reduction of fees and charges as a marketing tool to lure new deposits, rather than as a way to increase profits. Once one bank makes this move, the market competition on fees begins anew.*   * + 1. **LCR**   *Liquidity Coverage Ratio -> promotes short-term resilience*  ***LCR = High Quality Liquid Assets / Net Cash Outflows in the next 30 days > 1***   * + 1. **NSFR**   *Net Stable Coverage ratio – incentivize the use of stable funding sources and reduce dependency on short-term funding*  ***NSFR = Available Amount of Stable Funding / Required Amount of Stable Funding > 1***   * + 1. **Liquidity Black Hole**   *A moment when there is no liquidity in the market (dried up) -> everyone wants to sell, traders lose confidence.*  *E.g.: Asian Crisis, Russian Debt Crisis*   * + 1. **EVE**   ***The economic value of equity (EVE)*** *is a cash flow calculation that takes the* ***present value of all asset cash flows and subtracts the present value of all liability cash flows****. Unlike earnings at risk and value at risk (VAR), a bank uses the economic value of equity to manage its assets and liabilities. This is a long-term economic measure used to assess the degree of interest rate risk exposure—as opposed to net-interest income (NII), which reflects short-term interest rate risk.*  *The simplest definition of EVE is the* ***net present value (NPV) of a bank's balance sheet's cash flows.*** *This calculation is used for asset-liability management to measure changes in the economic value of the bank.*   * + 1. **PV01**   ***Gap analysis*** *can be used to derive the duration profile of the banking book or, equivalently, the profile of the* ***present value of a single basis point change in interest rates (PV01).*** *Gap analysis allocates all relevant interest rate-sensitive assets and liabilities to a certain number of predefined time buckets according to their next contractual reset date. The analysis also allocates* ***equity, NMDs, prepaying loans or other instruments with future cash flows subject to customer behaviors according to general/behavioral assumptions regarding their maturity or reset date****. It then measures the* ***arithmetic difference (the gap****) between the amounts of assets and liabilities in each time bucket, in absolute terms.*  *Each time bucket gap can be multiplied by an assumed change in interest rates to yield an approximation of the change in NII that would result from an increase in interest rates. This method gives a visual impression of the* ***risk exposure dispersion relative to the repricing profile, reflecting exposures to parallel as well as non-parallel gap risk. It does not, however, quantify this risk.*** *The measure* ***assumes that all positions within a particular time bucket mature and reprice simultaneously, ignoring potential basis risks within the gaps.***   * + 1. **Liquidity Cashflow Mismatch**   *Their "Liquidity Mismatch Index" (LMI) measures the mismatch between the market liquidity of assets and the funding liquidity of liabilities, at a firm level. There are many empirical challenges that arise in implementing their theoretical measure.*  *They define the LMI as the “cash equivalent value" of a firm in a given state assuming that:*  *i Counterparties act most adversely. That is, parties that have contracts with the firm act to extract as much cash as possible from the firm under the terms of their contracts. This defines the liquidity promised through liabilities.*  *ii The firm computes its best course of action, given the assumed stress event, to raise as much cash against its balance sheet as it can to withstand the cash withdrawals. That is, the firm computes how much cash it can raise from asset sales, pre-existing contracts such as credit lines, and collateralized loans such as repo backed by assets currently held by the firm. The computation assumes that the firm is unable to raise unsecured debt or equity. The total cash raised is the asset-side liquidity.*  *Central to this definition is that liquidity is computed based on a scenario where counterparties act most adversely. To understand why the worst-case is appropriate, consider defining liquidity for a hypothetical Diamond-Dybvig bank that is subject to a bank run. Suppose that the bank owns 100 long-term illiquid assets where early liquidation generates 50. The bank is financed by 75 of short term demandable deposits and 25 of equity. The liquidity stress that the bank is exposed to is the coordination failure whereby depositors withdraw funds expecting every other depositor to withdraw funds. For this case, the LMI is −25, being the net of 75 and 50. More broadly, the definition of the LMI is based on the idea that liquidity stress always involves coordination failure, which is captured by the scenario that parties with contracts with the bank extract as much cash as possible under the terms of the contract.*   * + 1. Interest rate risk (Gap, Basis, Option Risks)   *Interest rate risk in the banking book (IRRBB) refers to the current or prospective risk to the bank’s capital and earnings arising from adverse movements in interest rates that affect the bank’s banking book positions. When interest rates change, the present value and timing of future cash flows change. This in turn changes the underlying value of a bank’s assets, liabilities and off-balance sheet items and hence its economic value. Changes in interest rates also affect a bank’s earnings by altering interest rate-sensitive income and expenses, affecting its net interest income (NII). Excessive IRRBB can pose a significant threat to a bank’s current capital base and/or future earnings if not managed appropriately. A more detailed description of IRRBB and its management techniques can be found in SRP98.*  *31.2*  *Three main sub-types of IRRBB are defined for the purposes of this chapter. All three sub-types of IRRBB potentially change the price/value or earnings/costs of interest rate-sensitive assets, liabilities and/or off-balance sheet items in a way, or at a time, that can adversely affect a bank’s financial condition.*  *(1)*  ***Gap risk*** *arises from the term structure of banking book instruments, and describes the risk arising from the timing of instruments’ rate changes. The extent of gap risk depends on whether changes to the term structure of interest rates occur consistently across the yield curve (parallel risk) or differentially by period (non-parallel risk).*  *(2)*  ***Basis risk*** *describes the impact of relative changes in interest rates for financial instruments that have similar tenors but are priced using different interest rate indices.*  *(3)*  ***Option risk*** *arises from option derivative positions or from optional elements embedded in a bank’s assets, liabilities and/or off-balance sheet items, where the bank or its customer can alter the level and timing of their cash flows. Option risk can be further characterised into automatic option risk and behavioural option risk.*  *While the three sub-types listed above are directly linked to IRRBB, credit spread risk in the banking book (CSRBB) is a related risk that banks need to monitor and assess in their interest rate risk management framework. CSRBB refers to any kind of asset/liability spread risk of credit-risky instruments that is not explained by IRRBB and by the expected credit/jump to default risk*   * + 1. LDR   ***The loan-to-deposit ratio (LDR)*** *is used to assess a bank's liquidity by comparing a bank's total loans to its total deposits for the same period. The LDR is expressed as a percentage. If the ratio is too high, it means that the bank may not have enough liquidity to cover any unforeseen fund requirements. Conversely, if the ratio is too low, the bank may not be earning as much as it could be.*   * + 1. Deposit Concentration   **A concentration account** is a deposit account used to aggregate funds from several locations into one centralized account. Institutions use concentration accounts to process and settle internal bank transactions, often with same-day settlement.  KEY TAKEAWAYS  A concentration account is a deposit account at a bank used to aggregate funds from multiple accounts into one centralized account.  The primary purpose of a concentration account is for cash management that allows for a simple and efficient movement of cash across multiple funds.  Concentration accounts are useful for accounts that need to maintain minimum balances or for sweeping accounts at the end of the business day.  Money laundering may be facilitated through the use of concentration accounts via the ability of quickly moving funds around.  The U.S. Patriot Act established certain banking guidelines to thwart illicit activity in concentration accounts  **Understanding a Concentration Account**  The intended goal of concentration accounts is to make cash management for customers simple and efficient, allowing them to move funds from one account to another depending on their business needs. Having a centrally located account allows for the quick disbursement of funds as needed.  Banks may employ concentration accounts for fund transfers, private banking transactions, trust and custody accounts, and international transactions. Fund transfers generally occur among checking accounts and savings accounts or from savings to an individual retirement account (IRA); however, these can occur on a larger scale than individual retail transfers.  Concentration accounts are extremely beneficial when some accounts need to maintain minimum balances. If these accounts fall below their requirement threshold then the funds in a concentration account can quickly be moved to the account with a shortfall and thereby satisfying the minimum requirement and avoiding costly penalty fees.  The reverse function of cash management is also an advantage of concentration accounts. Certain clients wish to have a zero end of day balance in an account for a variety of reasons, primarily earned interest, and so sweep accounts at the end of the day, moving funds back to the concentration account or another account that earns higher interest.   * + 1. Liquidity stress testing   <https://www.youtube.com/watch?v=qoPHOPLQHdc&list=PLIYnk9FMYckuau7y6DQOe_6RYzlwLOAUo&index=6>   * + 1. Fund Transfer Pricing   *The Fund Transfer Pricing (FTP) measures* ***the contribution by each source of funding to the overall profitability in a financial institution****.[1] Funds that go toward lending products are charged to asset-generating businesses whereas funds generated by deposit and other funding products are credited to liability-generating businesses.[2]*  ***Details***  *FTP is used to adjust the reported performance of different business units of a financial institution. A financial institution could have different kinds of business units. FTP can be understood as a mechanism for distributing revenue between profit centres, which can contribute to better financial performance evaluation of these business units. The split of these units between deposit-raising units and funds-advancing units affects whether they receive a positive or negative revenue adjustment. Both borrowing and lending contribute to the performance of the bank as a whole. FTP is a mechanism to adjust these profitabilities to incorporate true funding costs. Therefore, FTP can be seen as an internal measurement tool to demonstrate the financial impact of destination and source of funds.[3]*  *The two major objectives of FTP in financial institutions are motivating profitable actions and comparable financial performance evaluation among business units, and when properly utilized, transfer pricing systems allow comparable financial performance evaluation of net fund generators and net fund users.[4] Without an FTP system, net fund users receive credit for interest income without being charged for the total amount of interest expense associated, while net fund generators are charged by interest expense without being credited with revenue of interest associated. In such an environment, net fund users have an advantage because all interest revenues are linked to financial assets and all financial expenses are linked to financial liabilities, and this causes a distortion in business units’ financial performance as net fund users present themselves as more profitable than net fund providers.[2]*  *FTP is an important concept of how financial institutions determine the internal price when allocating funds across different business units. The Organisation for Economic Co-operation and Development (OECD) recommends that each financial institution should have its FTP policy governing the basis on which funds are transferred between different business units and treasury.[5] In financial institutions adopting FTP, the treasury is responsible for liquidity management and the internal pricing of funds to its different business units. One can think of the treasury as a financial institution within the financial institution: it buys funds from the business units, managing the liability side of the financial institution, and sells funds to the divisions that invest in banking assets.[6]*  *FTP is a specific type of transfer pricing and is identified by the Organisation for Economic Co-operation and Development (OECD) as a treasury dealing.[5] FTP measures the value of funds transferred through the treasury between business units within a financial institution. Internal exchanges that are measured by transfer prices result in (1) revenue for the business unit furnishing (i.e. selling) the funds and (2) costs for the business unit receiving (i.e., buying) the funds.[4] Considering a centralised organisation, internal trade is mandated and the fund transfer price unilaterally determined by the treasury.[7] Under centralization, the treasury maintains control over decisions and seeks to maximize the financial institutions’ overall profit. As expected, given the centralized decision making, the transfer price does not affect profit itself, only how it is split among the business units.[8] Finally, financial institutions should manage FTP centrally through a treasury, with sufficient oversight provided by independent risk and financial control staff.[6]*  *Given the importance of measuring the performance of business units and appropriate funding structure for its activities, the financial institution should document how business units have obtained the resources for its operations.[5]*  ***History***  *The way financial institutions manage and assess performance internally is closely intertwined with choices made in terms of operational structures. For instance, financial institutions organised as separate business units are expected to have different amounts for both origination and placement of funds, and the performance of these business units are therefore determined locally and heavily influenced by the local business environment.[9] This type of structure creates the need for a transfer price mechanism between the business units to avoid the distortion in performance caused due to the transferral of funds (through treasury) between the business units.[2]*  *There is evidence that FTP only come into attention recently due to the latest financial crisis, suggesting that economic constraints (e.g., liquidity issues) lead to the implementation of policies requiring FTP. Before the financial crisis of 2007-2008, the pricing of liquidity costs was deemed immaterial and FTP was used by some financial services (mostly by practitioners) to measure performance internally.[10] Due to the financial crisis, particularly in the late 2000s, requirements for monitoring liquidity in financial institutions are implemented by many regulators, including FTP.[6][10] The extensive list of regulators that discuss the implementation of FTP in financial institutions included the Basel Committee on Banking Supervision (BCBS), European Parliament and the European Commission (EC), the Committee for European Banking Supervisors (CEBS), the Institute for International Finance (IIF), the Counterparty Risk Management Policy Group III (CRMPGIII), the US Federal Reserve, and the US Federal Deposit Insurance Corporation.[10][6][11] Formalized processes include requiring large banks to prepare funds transfer pricing reports and a standardized funds transfer pricing process be implemented across the institution.[12]*  ***Banking and finance***  *FTP has become important because banks are expected to state their funding costs accurately as a regulatory requirement because funding costs affect a bank's liquidity reporting. Failure and bail-outs of banks have made reported liquidity a hot topic. FTP calculation is complicated by several factors which make the calculation of the revenue adjustment necessarily difficult. Factors affecting funding cost include the length of time an asset or liability is repaid (Liquidity Term Premium), the extent to which an asset has been or can be securitised (which affects its liquidity) and the behaviour of customers in particular product/customer niches such as customers' propensity to withdraw long-term deposits at a penalty or to repay obligations such as mortgages early, all which affect real funding cost. This behaviour factor complicates the calculation of FTP and has required significant and expensive changes to banking systems. Balance sheets now incorporate new attributes for customer and product which were not previously significant reporting dimensions.*  *FTP may improve profitability through improved pricing, enhance asset and liability management, and provide an important component of an integrated profitability reporting solution.[13] As a practical example of implementing an FTP system, an intermediary is created within the organisation usually treasury or central office. All the fund-raising units raise funds from the market at a particular rate and lend the same to the central office at a higher rate. All the lending units borrow the funds from the central office at a particular rate and lend the same to the borrowers at a higher rate. The central office rate is notional in nature and is aligned to market conditions. Thus for all the units, there are two rates available to measure the performance. For a deposit-raising unit, the difference between interest paid to the deposit-holders and interest receivable from the central office is the contribution to the bank's profitability. For a lending division, the difference between Interest payable to the central office and the interest received from the borrowers is the contribution to the bank's performance.*  *Funds transfer pricing is a way to value the margin contribution from each individual loan and deposit that a bank has on their books. The way each instrument is valued is by calculating a funds transfer charge on the asset side (loans) and funds transfer credit to the liability side (deposits). The funds' transfer charges and credits are calculated based on the bank's opportunity cost of borrowing at the time of origination. The value assigned to a deposit account would be equal to the difference between the cost of an equivalent term borrowing less the cost that is being paid on the instrument. For example, if a bank can obtain 3-year borrowing at 3% but is only paying 2% on their 3-year customer deposits (CDs) then each CD is providing 1% of the value each of the 3 years it is open. The net interest margin assigned to the CD would be 1% multiplied by the balance in each of the 3 years. The same calculation is made on the loan side. For example, if a bank is making a 3-year fixed loan at 4% and they can obtain 3-year borrowing from an outside source at 3%, then the loan would be providing 1% value (multiplied by the balance) each of the 3 years the loan is open.[14]*  *FTP is, therefore, a revenue adjustment made to the bank's balance sheet to reflect the cost of funding. For example, a business unit which manages funds for high-net-worth individuals will create cash which is held on deposit. That deposit will accrue interest and therefore the wealth business unit's profits will have to be increased by the deposit interest which can easily be calculated by using the prevailing rate of interest. This approach became problematic during the Financial crisis of 2007–2008 because actual interest rates paid began to differ from published rates such as LIBOR or bank base rates. With poor credit availability, the profit adjustment made in favour of depositing business units were effectively understated. This had been less of an issue when banks' borrowing costs were close to base rates or quoted rates such as LIBOR. Failure to calculate FTP correctly can thus cause loans to be much less profitable than they initially appear and the fact that banks have extended unprofitable loans is a key factor in the recent financial crisis.*  *One important issue to be considered in calculating FTP is the need to value funding costs on an at arm's length basis. To understand at arm's length, one has to understand how relationships affect behaviour. Some conventional transfer pricing issues can be considered to explore this. A good example is a father selling a home to his son. The value of such a transfer may not be considered to be the same as what would be achieved on the open market. Similarly, businesses often manipulate sales of assets through inter-company trades to maximise profitability in low tax environments.*  *In banking terms, the fact that a loan is made between business units may reflect agreed or contracted recognition of (too low in the financial crisis) costs rather than prevailing actual accurate funding costs and this is both an important audit concern and of taxation interest as transfer pricing affects where and in which business unit profit is reported.*   * + 1. Bid ask spread   *Difference between bid (buy) and ask (sell) price.*  *Used in liquidity stress testing to determine how much would cost a sell of assets in case of liquidity distress / black hole*   * + 1. Mid price / fair price   *Average of bid and ask prices*   * + 1. Cost of liquidation   <https://www.youtube.com/watch?v=TguAvyxM6vg&list=PLIYnk9FMYckuau7y6DQOe_6RYzlwLOAUo>  *Sum bid-offer spreads \* dollar value / number of positions*   * + 1. Liquidity Adjusted VaR   *Regular VaR + the cost of unwinding / liquidating funds under stress scenario*   * + 1. Liquidity Funding Risk   <https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1024.pdf>   * + 1. Sources of Liquidity   ***Primary Sources of Liquidity***  *Primary sources of liquidity can be easily used to generate liquidity for the company. They are generally cash and other near-cash assets. More specifically, they include:*  ***1. Cash balances (generally in a bank account)***  *They can be either actual cash already stored in bank accounts or cash that can be generated by the liquidation of short-term securities (which comes with a maturity of less than 90 days). On the balance sheet, such sources of liquidity are generally indicated by the item “cash and cash equivalents.”*  ***2. Short-term funds***  *They include commercial credit (i.e., trade payables), bank credit, and short-term securities not maturing within 90 days.*  ***3. Cash flow management***  *They are related to the company’s ability to manage cash effectively and the level of decentralization of cash inflows and outflows. For example, a company with a highly decentralized collection system may find it more difficult to access cash resources promptly.*  ***Secondary Sources of Liquidity***  *Unlike the primary sources of liquidity, the secondary sources usually cannot be converted into cash without an effect on the company’s operations. For example, it can be the case of a company that has run out of cash and near-cash assets and needs to liquidate assets, such as inventory, plants, and equipment, to pay its bills.*  *More specifically, a company’s secondary sources of liquidity include:*  ***1. Negotiating its debt obligations***  *A company can generate liquidity by getting more favorable terms on its debt, i.e., by renegotiating maturities, the size and timing of principal repayments, and interest rates.*  ***2. Liquidating assets***  *It can involve relatively liquid assets, such as inventory, or other less liquid assets, such as plant, equipment, and real estate properties. The urgency with which the cash is needed in the situations where liquidation is necessary generally implies that the assets are sold at a discount to their usual price.*  ***3. Bankruptcy protection and reorganization***  ***Sources of Liquidity and Business Health***  *Liquidity is a key factor in assessing a company’s creditworthiness. To fully pay what it owes on time, a company must have access to proper sources of liquidity. Generally speaking, a financially healthy company should be able to meet its obligations relying on its primary sources of liquidity.*  *If access to secondary resources is needed, it means that the company has experienced, or is experiencing, liquidity issues. While it can be due to temporary conditions, it’s often a sign of deeper fundamental problems in the business.*  ***Ratios, Business Fundamentals, and Sources of Liquidity***  *For an analyst or a manager, it’s usually possible to assess whether a company is likely going to need to use secondary resources of liquidity by assessing its financial health. The process generally relies on, but is not limited to, the analysis of the following aspects of a business:*  ***1. Free cash flow generation, margins, and overall business trends***  *For example, other conditions being equal, a company that produces large and rising cash flows will be better equipped to face its current obligations without access to secondary sources of liquidity than a company with small and declining cash flows.*  ***2. Liquidity ratios (Current ratio, quick ratio, and accounts receivable turnover)***  *For example, a deterioration in the ratio between cash and current liabilities can put a company in dangerous territory. Indications that a company is finding it difficult to collect payments can also contribute to increasing the risk of reliance on secondary sources of liquidity.*  ***3. Competition, business risks, and other factors***  *Additional factors that are not visible in financial statements can indicate that a company’s primary sources of liquidity will not be enough to face obligations. For example, it can be the case of a company that is going to face a large fine or a business that is going to face a sudden increase in competition or whose cash has been seized by authorities.*   * + 1. Other Liquidity ratios:   *Many financial institutions use liquidity indicators to estimate their liquidity needs based on experience and industry averages. The ratios are employed to estimate liquidity needs and to monitor changes in the liquidity position. The following liquidity indicators are often used for depository institutions:*  ***Cash position indicator=Cash and cash deposits due from depository institutions / Total assets***  *A higher proportion of cash implies that the institution is in a stronger position to handle immediate cash needs.*  *The liquidity securities indicator compares the most marketable securities an institution can hold with the overall size of its asset portfolio.*  ***Liquidity Securities Indicator=Government securities / Total assets***  *The higher the proportion of government securities, the more liquid the depository institution’s position tends to be.*  *Net federal funds and repurchase agreements position measures the comparative importance of overnight loans relative to overnight borrowings of reserves.*  ***Net federal funds and repurchase agreements position=(Fs–Fp) / Total assets***  *Where:*  ***Fs=Federal funds sold and reverse repurchase agreements.***  ***Fp=Federal funds purchased and repurchase agreements.***  *A rise in this ratio increases liquidity.*  *Capacity ratio is a negative liquidity indicator because loans and leases are the most illiquid of the assets.*  ***Capacity Ratio=Net loans and leases / Total assets***  *Pledged securities ratio is also a negative liquidity indicator. This is because the higher the proportion of securities pledged to back U.S. government deposits, the less the securities available to sell when liquidity needs arise.*  ***Pledged securities ratio=Pledged securities / Total security holdings***  *Hot money ratio shows whether the institution has balanced the volatile liabilities it has issued with the money market instruments that it holds that could be sold quickly to cover the liabilities.*  ***Hot money ratio=Money market (short-term) assets / Volatile liabilities***  *or could be rewritten as:*  ***=(Cash and due from deposits held at other depository institutions +***  ***Holdings of short-term securities +***  ***Federal funds loans +***  ***Reverse repurchase agreements) /***  ***(Large CDs +***  ***Eurocurrency deposits +***  ***Federal funds borrowings +***  ***repurchase agreements)***  *and*  ***Deposit brokerage index=Brokered deposits / Total deposits***  *Where brokered deposits consist of packages of funds (usually at most $100,000 to obtain the advantage of deposit insurance) arranged by securities brokers for their customers with firms paying the highest yields, brokered deposits are interest-sensitive and may be withdrawn quickly. The more a depository institution holds, the higher the chance of a liquidity crisis.*  ***Core deposit ratio=Core deposits / Total assets***  *Where core deposits are typically small-denomination checking and savings accounts that are treated as unlikely to be withdrawn on short notice, thus having lower liquidity requirements.*  *Deposit composition ratio measures how stable a funding base each institution possesses. A decline suggests more excellent deposit stability and a lesser need for liquidity.*  ***Deposit composition ratio=Demand deposits / Time deposits***  *Where demand deposits are prone to immediate withdrawal via check writing, on the other hand, time deposits carry fixed maturities with penalties for early withdrawal.*  *Loan commitment ratio measures the volume of promises a lender has made to its borrowers to provide credit up to a prespecified amount for a specified period.*  ***Loan commitments ratio = Unused loan commitments / Total assets***   * + 1. Yield Curve (steepness, interpolation, increasing/decreasing, negative values)   ***What Is a Yield Curve?***  *A yield curve is a line that plots yields (interest rates) of bonds having equal credit quality but differing*[*maturity dates*](https://www.investopedia.com/terms/m/maturitydate.asp)*. The slope of the yield curve gives an idea of future interest rate changes and economic activity.*  *There are three main shapes of yield curve shapes: normal (upward sloping curve), inverted (downward sloping curve), and flat.*  ***KEY TAKEAWAYS***  *Yield curves plot interest rates of bonds of equal credit and different maturities.*  *The three key types of yield curves include normal, inverted, and flat. Upward sloping (also known as normal yield curves) is where longer-term bonds have higher yields than short-term ones.*  *While normal curves point to economic expansion, downward sloping (inverted) curves point to economic recession.1*  *Yield curve rates are published on the Treasury’s website each trading day.2*  ***How a Yield Curve Works***  *A yield curve is used as a benchmark for other debt in the market, such as mortgage rates or bank lending rates, and it is used to predict changes in economic output and growth. The most frequently reported yield curve compares the three-month, two-year, five-year, 10-year, and 30-year U.S. Treasury debt.*[*Yield curve rates*](https://home.treasury.gov/policy-issues/financing-the-government/interest-rate-statistics?data=yield)*are usually available at the Treasury's interest rate websites by 6:00 p.m. ET each trading day.32*  *A normal yield curve is one in which longer maturity bonds have a higher yield compared to shorter-term bonds due to the risks associated with time. An*[*inverted yield curve*](https://www.investopedia.com/terms/i/invertedyieldcurve.asp)*is one in which the shorter-term yields are higher than the longer-term yields, which can be a sign of an upcoming recession. In a flat or humped yield curve, the shorter- and longer-term yields are very close to each other, which is also a predictor of an economic transition.*  ***Types of Yield Curves***  ***Normal Yield Curve***  *A normal or up-sloped yield curve indicates yields on longer-term bonds may continue to rise, responding to periods of*[*economic expansion*](https://www.investopedia.com/terms/e/expansion.asp)*. A normal yield curve thus starts with low yields for shorter-maturity bonds and then increases for bonds with longer maturity, sloping upwards. This is the most common type of yield curve as longer-maturity bonds usually have a higher yield to maturity than shorter-term bonds.*  *For example, assume a two-year bond offers a yield of 1%, a five-year bond offers a yield of 1.8%, a 10-year bond offers a yield of 2.5%, a 15-year bond offers a yield of 3.0%, and a 20-year bond offers a yield of 3.5%. When these points are connected on a graph, they exhibit a shape of a normal yield curve.*  *A normal yield curve implies stable economic conditions and should prevail throughout a normal*[economic cycle](https://www.investopedia.com/terms/e/economic-cycle.asp)*. A steep yield curve implies strong economic growth in the future—conditions that are often accompanied by higher inflation, which can result in higher interest rates.*  ***Inverted Yield Curve***  *An inverted yield curve instead slopes downward and means that short-term interest rates exceed long-term rates. Such a yield curve corresponds to periods of economic recession, where investors expect yields on longer-maturity bonds to become even lower in the future.1 Moreover, in an economic downturn, investors seeking safe investments tend to purchase these longer-dated bonds over short-dated bonds, bidding up the price of longer bonds driving down their yield.*  *An inverted yield curve is rare but is strongly suggestive of a severe economic slowdown. Historically,*[*the impact of an inverted yield curve*](https://www.investopedia.com/articles/basics/06/invertedyieldcurve.asp)*has been to warn that a recession is coming.1*  ***Flat Yield Curve***  *A flat yield curve is defined by similar yields across all maturities. A few intermediate maturities may have slightly higher yields, which causes a slight hump to appear along the flat curve. These humps are usually for the mid-term maturities, six months to two years.*  *As the word flat suggests, there is little difference in yield to maturity among shorter and longer-term bonds. A two-year bond could offer a yield of 6%, a five-year bond 6.1%, a 10-year bond 6%, and a 20-year bond 6.05%.*  *Such a flat or humped yield curve implies an uncertain economic situation. It may come at the end of a high economic growth period that is leading to inflation and fears of a slowdown. It might appear at times when the central bank is expected to increase interest rates.*  *In times of high uncertainty, investors demand similar yields across all maturities.*  ***What Is a U.S. Treasury Yield Curve?***  *The U.S. Treasury yield curve refers to a line chart that depicts the yields of short-term*[*Treasury bills*](https://www.investopedia.com/ask/answers/033115/what-are-differences-between-treasury-bond-and-treasury-note-and-treasury-bill-tbill.asp)*compared to the yields of long-term Treasury notes and bonds. The chart shows the relationship between the interest rates and the maturities of U.S. Treasury fixed-income securities. The Treasury yield curve (also referred to as the*[*term structure of interest rates*](https://www.investopedia.com/terms/t/termstructure.asp)*) shows yields at fixed maturities, such as one, two, three, and six months and one, two, three, five, seven, 10, 20, and 30 years. Because Treasury bills and bonds are resold daily on the secondary market, yields on the notes, bills, and bonds fluctuate.*  ***What Is Yield Curve Risk?***  [*Yield curve risk*](https://www.investopedia.com/terms/y/yieldcurverisk.asp)*refers to the risk investors of fixed-income instruments (such as bonds) experience from an adverse shift in interest rates. Yield curve risk stems from the fact that bond prices and interest rates have an*[*inverse relationship*](https://www.investopedia.com/ask/answers/why-interest-rates-have-inverse-relationship-bond-prices/)*to one another. For example, the price of bonds will decrease when market interest rates increase. Conversely, when interest rates (or yields) decrease, bond prices increase.*  ***How Can Investors Use the Yield Curve?***  *Investors can use the*[*yield curve to make predictions*](https://www.investopedia.com/articles/economics/08/yield-curve.asp)*on where the economy might be headed and use this information to make their investment decisions. If the bond yield curve indicates an economic slowdown might be on the horizon, investors might move their money into defensive assets that traditionally do well during recessionary times, such as consumer staples. If the yield curve becomes steep, this might be a sign of future inflation. In this scenario, investors might avoid long-term bonds with a yield that will erode against increased prices.*   * + 1. IR swap counterparty disagrees with settlement amount on a particular value date. Describe how you will address this.   ***What is an interest rate swap?***  *An interest rate swap is an agreement between two parties to exchange one stream of interest payments for another, over a set period of time. Swaps are derivative contracts and trade over-the-counter.*  *The most commonly traded and most liquid interest rate swaps are known as “vanilla” swaps, which exchange fixed-rate payments for floating-rate payments based on LIBOR (London Inter-Bank Offered Rate), which is the interest rate high-credit quality banks charge one another for short-term financing. LIBOR is the*[*benchmark*](https://global.pimco.com/en-gbl/resources/education/understanding-benchmarks)*for floating short-term interest rates and is set daily. Although there are other types of interest rate swaps, such as those that trade one floating rate for another, vanilla swaps comprise the vast majority of the market.*  *Investment and commercial banks with strong credit ratings are swap market makers, offering both fixed and floating-rate cash flows to their clients. The counterparties in a typical swap transaction are a corporation, a bank or an investor on one side (the bank client) and an investment or commercial bank on the other side. After a bank executes a swap, it usually offsets the swap through an inter-dealer broker and retains a fee for setting up the original swap. If a swap transaction is large, the inter-dealer broker may arrange to sell it to a number of counterparties, and the risk of the swap becomes more widely dispersed. This is how banks that provide swaps routinely shed the risk, or interest rate exposure, associated with them.*  *Initially, interest rate swaps helped corporations manage their floating-rate debt liabilities by allowing them to pay fixed rates, and receive floating-rate payments. In this way, corporations could lock into paying the prevailing fixed rate and receive payments that matched their floating-rate debt. (Some corporations did the opposite – paid floating and received fixed – to match their assets or liabilities.) However, because swaps reflect the market’s expectations for interest rates in the future, swaps also became an attractive tool for other fixed income market participants, including speculators, investors and banks.*  ***What is the swap rate?***  *The “swap rate” is the fixed interest rate that the receiver demands in exchange for the uncertainty of having to pay the short-term LIBOR (floating) rate over time. At any given time, the market’s forecast of what LIBOR will be in the future is reflected in the forward LIBOR curve.*  *https://global.pimco.com/-/media/global-assets/resources/education/emea/charts/45177_understanding_interest_rate_swaps_fig1.ashx?sc_lang=en-gbl&hash=1ADD47DE8DBCB8872AF88B21B2EA9D99*  *At the time of the swap agreement, the total value of the swap’s fixed rate flows will be equal to the value of expected floating rate payments implied by the forward LIBOR curve. As forward expectations for LIBOR change, so will the fixed rate that investors demand to enter into new swaps. Swaps are typically quoted in this fixed rate, or alternatively in the “swap spread,” which is the difference between the swap rate and the equivalent local government*[*bond*](https://global.pimco.com/en-gbl/resources/education/everything-you-need-to-know-about-bonds)*yield for the same maturity.*  *A similar principle applies when looking at money itself and considering interest as the price for money. If the real return (adjusted for*[*inflation*](https://global.pimco.com/en-gbl/resources/education/understanding-inflation)*) on a financial asset differs between two countries, investors will flock to the country with the higher returns. Interest rates have to change to stop this movement. The theory behind this relationship is called the interest rate parity theory. (When looking at interest rates, it is important to distinguish between real rates and nominal rates, with the difference reflecting the rate of inflation. The higher the expected inflation in a country, the more compensation investors will demand when investing in a particular*[*currency*](https://global.pimco.com/en-gbl/resources/education/understanding-currencies)*.)*  ***What is the swap curve***  *The plot of swap rates across all available maturities is known as the swap curve, as shown in the chart below. Because swap rates incorporate a snapshot of the forward expectations for LIBOR, as well as the market’s perception of other factors such as liquidity, supply and demand dynamics, and the credit quality of the banks, the swap curve is an extremely important interest rate benchmark.*  *https://global.pimco.com/-/media/global-assets/resources/education/emea/charts/45177_understanding_interest_rate_swaps_fig2.ashx?sc_lang=en-gbl&hash=CD1C4FAC23C00AA5DEA15B4F67AA2CD3*  *Although the swap curve is typically similar in shape to the equivalent sovereign yield curve, swaps can trade higher or lower than sovereign yields with corresponding maturities. The difference between the two is the “swap spread”, which is shown in the chart below. Historically the spread tended to be positive across maturities, reflecting the higher credit risk of banks versus sovereigns. However, other factors, including liquidity, and supply and demand dynamics, mean that in the U.S. today the swap spread is negative at longer maturities.*  *https://global.pimco.com/-/media/global-assets/resources/education/emea/charts/45177_understanding_interest_rate_swaps_fig3.ashx?sc_lang=en-gbl&hash=E241A3D19900805CCFC4CC98E4FC0971*  *Because the swap curve reflects both LIBOR expectations and bank credit, it is a powerful indicator of conditions in the fixed income markets. In certain cases, the swap curve has supplanted the Treasury curve as the primary benchmark for pricing and trading corporate bonds, loans and mortgages.*  ***How does a swap contract work?***  *At the time a swap contract is put into place, it is typically considered “at the money,” meaning that the total value of fixed interest rate cash flows over the life of the swap is exactly equal to the expected value of floating interest rate cash flows. In the example below, an investor has elected to receive fixed in a swap contract. If the forward LIBOR curve, or floating-rate curve, is correct, the 2.5% he receives will initially be better than the current floating 1% LIBOR rate, but after some time, his fixed 2.5% will be lower than the floating rate. At the inception of the swap, the “net present value,” or sum of expected profits and losses, should add up to zero.*  *https://global.pimco.com/-/media/global-assets/resources/education/emea/charts/45177_understanding_interest_rate_swaps_fig4.ashx?sc_lang=en-gbl&hash=B99AE0B674FE8C93C91C445E0C48DFDB*  *However, the forward LIBOR curve changes constantly. Over time, as interest rates implied by the curve change and as credit spreads fluctuate, the balance between the green zone and the blue zone will shift. If interest rates fall or stay lower than expected, the “receiver” of fixed will profit (green area will expand relative to blue). If rates rise and hold higher than expected, the “receiver” will lose (blue expands relative to green).*  *If a swap becomes unprofitable or if a counterparty wishes to shed the interest rate risk of the swap, that counterparty can set up a countervailing swap – essentially a mirror image of the original swap – with a different counterparty to “cancel out” the impact of the original swap.*  ***How to invest in interest rates swaps?***  *Interest rate swaps became an essential tool for many types of investors, as well as corporate treasurers, risk managers and banks, because they have so many potential uses. These include:*  ***Portfolio management.*** *Interest rate swaps allow portfolio managers to adjust interest rate exposure and offset the risks posed by interest rate volatility. By increasing or decreasing interest rate exposure in various parts of the yield curve using swaps, managers can either ramp-up or neutralize their exposure to changes in the shape of the curve, and can also express views on credit spreads. Swaps can also act as substitutes for other, less liquid fixed income instruments. Moreover, long-dated interest rate swaps can increase the*[*duration*](https://global.pimco.com/en-gbl/resources/education/understanding-duration)*of a portfolio, making them an effective tool in Liability Driven Investing, where managers aim to match the duration of assets with that of long-term liabilities.*  ***Speculation.*** *Because swaps require little capital up front, they give fixed income traders a way to speculate on movements in interest rates while potentially avoiding the cost of long and short positions in Treasuries. For example, to speculate that five-year rates will fall using cash in the Treasury market, a trader must invest cash or borrowed capital to buy a five-year Treasury note. Instead, the trader could “receive” fixed in a five-year swap transaction, which offers a similar speculative bet on falling rates, but does not require significant capital up front.*  ***Corporate finance.*** *Firms with floating rate liabilities, such as loans linked to LIBOR, can enter into swaps where they pay fixed and receive floating, as noted earlier. Companies might also set up swaps to pay floating and receive fixed as a hedge against falling interest rates, or if floating rates more closely match their assets or income stream.*  ***Risk management.*** *Banks and other financial institutions are involved in a huge number of transactions involving loans, derivatives contracts and other investments. The bulk of fixed and floating interest rate exposures typically cancel each other out, but any remaining interest rate risk can be offset with interest rate swaps.*  ***Rate-locks on bond issuance****. When corporations decide to issue fixed-rate bonds, they usually lock in the current interest rate by entering into swap contracts. That gives them time to go out and find investors for the bonds. Once they actually sell the bonds, they exit the swap contracts. If rates have gone up since the decision to sell bonds, the swap contracts will be worth more, offsetting the increased financing cost.*  ***What are the risks***  *Like most non-government fixed income investments, interest-rate swaps involve two primary risks: interest rate risk and credit risk, which is known in the swaps market as counterparty risk.*  *Because actual interest rate movements do not always match expectations, swaps entail interest-rate risk. Put simply, a receiver (the counterparty receiving a fixed-rate payment stream) profits if interest rates fall and loses if interest rates rise. Conversely, the payer (the counterparty paying fixed) profits if rates rise and loses if rates fall.*  *Swaps are also subject to the counterparty’s credit risk: the chance that the other party in the contract will default on its responsibility. This risk has been partially mitigated since the financial crisis, with a large portion of swap contacts now clearing through central counterparties (CCPs). However, the risk is still higher than that of investing in a “risk-free” U.S. Treasury bond.*   * + 1. about Fixed Income: duration, convexity of a bond...   <https://analystprep.com/study-notes/frm/part-1/one-factor-risk-metrics-and-hedges/>  *DV01, Duration, Convexity, Effective Duration, Portfolio Hedging, Barbell vs Bullet Portfolios*   * + 1. Questions on ALM: What is the difference between securities AFS and HTM?   *AFS – Available for Sale (hence, can be traded on the secondary market)*  *HTM – Held to Maturity – owner collects coupons, does not intend to sell before maturity, bets on no-default*   * + 1. Regulation: BRRD, etc. Bonus?   <https://goldenmark.com/pl/mysaver/dyrektywa-brrd/>   * + 1. What kind of products do you expect us to hold in our portfolio and why? What financial instruments "fit" a life insurance on a balance sheet?  |  | | --- | | * *Cash and balances at central bank* | | * *Loans and advances to banks* | | * *reverse repurchase agreements (reverse repo)* | | * *Loans and advances to customers* | | * *Investment securities – debt securities* | | * *Fair value through profit or loss* | |  | | * *Derivative financial instruments (IRS, Swaptions, FI derivatives, FX derivatives)* | | * *Accrued income* | | * *Assets held for sale* |  * + 1. Eine Bank hat auf der aktiven und auf der passiven Seite der Bilanz Einträge. Welche Risiken hat diese Bank?   *Interest rate risk / Gap risk / Cashflow Mismatch / Credit - Counterparty Risk*   * + 1. Treasury Risk - Hedging, Futures/Forwards difference, Credit risk, market risk, options questions     2. How will you handle a settlement failure?   ***What Is Settlement Risk?***  *Settlement risk is the possibility that one or more parties will fail to deliver on the terms of a contract at the agreed-upon time. Settlement risk is a type of counterparty risk associated with default risk, as well as with timing differences between parties. Settlement risk is also called delivery risk or Herstatt risk.*  ***KEY TAKEAWAYS***  *Settlement risk is the possibility that one or more parties will fail to deliver on the terms of a contract at the agreed-upon time.*  *Settlement risk is usually nearly nonexistent in securities markets.*  *The two main types of settlement risk are default risk and settlement timing risks.*  *Settlement risk is sometimes called "Herstatt risk," named after the well-known failure of the German bank Herstatt.*  ***Understanding Settlement Risk***  *In principle, settlement risk is simply the chance that a buyer or seller fails to keep their end of a deal. Whenever anyone buys goods online, there is the risk that the goods will show up late or never arrive. This risk is very similar to settlement risk in securities markets.*  *The idea of an "honest broker" who can be trusted to ensure that both parties keep an agreement is crucial for reducing settlement risk. Brokerage firms and individual brokers must maintain their reputations as honest brokers to stay in business. When most investors buy and sell securities, they are really dealing with their brokers rather than each other. Settlement risk is minimized by the solvency, technical skills, and economic incentives of brokers.*  *Settlement risk can be reduced by dealing with honest, competent, and financially sound counterparties.*  *Unsurprisingly, settlement risk is usually nearly nonexistent in securities markets. However, the perception of settlement risk can be elevated during times of global financial strain. Consider the example of the collapse of Lehman Brothers in September 2008. There was widespread worry that those who were doing business with Lehman might not receive agreed upon securities or cash.*  *Settlement risk has historically been an issue in the foreign exchange (forex) market. The creation of continuously linked settlement (CLS) helped improve this situation. CLS, facilitated by CLS Bank International, eliminates time differences in settlement and is considered to have provided a safer forex market.*  ***Types of Settlement Risk***  *The two main types of settlement risk are default risk and settlement timing risks.*  ***Default Risk***  *Default risk is the possibility that one of the parties fails to deliver on a contract entirely. This situation is similar to what happens when an online seller fails to send the goods after receiving the money. Default is the worst possible outcome, so it is really only a risk in financial markets when firms go bankrupt. Even then, U.S. investors still have Securities Investor Protection Corporation (SIPC) insurance.*  ***Settlement Timing Risks***  *Settlement timing risks include potential situations where securities are exchanged as agreed, but not in the agreed-upon time frame. Settlement timing risks are generally far less serious than default risk, as transactions still take place. These risks are the securities market equivalent of everyday situations where a pizza or a package from Amazon shows up late. However, the speed and liquidity of financial markets make the consequences much more severe.*  ***A Real World Example of Settlement Risk (Herstatt Risk)***  *Settlement risk is sometimes called "Herstatt risk," named after the well-known failure of the German bank Herstatt. On June 26, 1974, the bank had taken in its foreign-currency receipts in Europe but had not made any of its U.S. dollar payments. When German banking regulators closed the bank down, the event left counterparties with substantial losses.*  *The case of the collapse of Herstatt led to the creation of the Basel Committee on Banking Supervision, consisting of representatives from both central banks and regulatory authorities in the Group of Ten (G10) nations. The Basel Committee is now headquartered within the Bank for International Settlements (BIS) in Basel, Switzerland.*  *It is generally considered to have formed the basis of bank capital requirements in countries represented by the committee and beyond.*   * + 1. 9. Do you have any experience working with treasury bonds and other financial instruments?   *-> state / corporate bonds valuation (AAA excel) + Nelson Siegel Svenson fitting in AAA excel (read about it more!!! Maybe add to Github!!!)*   * + 1. We want to improve our cash flow. What strategies would you recommend to help us do this?   *This question is an opportunity to show your analytical skills and ability to make recommendations that can help the company improve its cash flow. When answering this question, it’s important to focus on strategies you’ve used in the past or ones you’re familiar with.*  *Example: “Cash flow is a critical component of any successful business, and I am confident that I can help your organization improve its cash flow. My experience as a Treasury Analyst has taught me the importance of developing strategies to maximize liquidity while minimizing risk.*  *One strategy I would recommend is utilizing short-term investments such as money market funds or treasury bills to increase available cash without taking on too much risk. This approach allows you to keep your capital liquid while earning interest income.*  *Another strategy I would suggest is optimizing working capital management. This involves closely monitoring accounts receivable and payables, ensuring timely collection of payments from customers and negotiating favorable payment terms with suppliers. These measures will help reduce the amount of time it takes for cash to move through the system, thus improving overall cash flow.*  *Lastly, I believe that implementing an effective budgeting process is key to managing cash flow. By setting clear financial goals and tracking performance against those goals, organizations can better control their spending and ensure they have sufficient cash reserves to meet their obligations.”*   * + 1. **Know the bond mathematics well. Be ready to calculate or explain Duration, Convexity and shocks in yield curve and their effects well. Know some common Fixed income products like MBS,CDOs, Credit tranches, etc well.** * **Duration (up)** * **Convexity (up)** * **MBS**   ***Mortgage-backed securities (MBS)*** *are investment products similar to bonds. Each MBS consists of a bundle of home loans and other real estate debt bought from the banks that issued them. Investors in mortgage-backed securities receive periodic payments similar to bond coupon payments.*  ***KEY TAKEAWAYS***  *Mortgage-backed securities (MBS) turn a bank into an intermediary between the homebuyer and the investment industry.*  *The bank handles the loans and then sells them at a discount to be packaged as MBSs to investors as a type of collateralized bond.*  *For the investor, an MBS is as safe as the mortgage loans that back it up.*  ***Understanding Mortgage-Backed Security (MBS)***  *Mortgage-backed securities (MBS) are variations of*[*asset-backed securities*](https://www.investopedia.com/terms/a/asset-backedsecurity.asp)*that are formed by pooling together mortgages exclusively. The investor who buys a mortgage-backed security is essentially lending money to home buyers. An MBS can be bought and sold through a broker. The minimum investment varies between issuers.*  *As became glaringly obvious in the subprime mortgage meltdown of 2007-2008, a mortgage-backed security is only as sound as the mortgages that back it up. An MBS may also be called a mortgage-related security or a mortgage pass-through.*  *Essentially, the mortgage-backed security turns the bank into an intermediary between the homebuyer and the investment industry. A bank can grant mortgages to its customers and then sell them at a discount for inclusion in an MBS. The bank records the sale as a plus on its balance sheet and loses nothing if the homebuyer defaults sometime down the road.*  *This process works for all concerned as everyone does what they're supposed to do. That is, the bank keeps to reasonable standards for granting mortgages; the homeowner keeps paying on time, and the credit rating agencies that review MBS perform due diligence.*  *In order to be sold on the markets today, an MBS must be issued by a*[*government-sponsored enterprise*](https://www.investopedia.com/terms/g/gse.asp)*(GSE) or a private financial company. The mortgages must have originated from a regulated and authorized financial institution. And the MBS must have received one of the top two ratings issued by an accredited*[*credit rating agency*](https://www.investopedia.com/terms/c/credit-agency.asp)*.*  *Mortgage-backed securities loaded up with subprime loans played a central role in the financial crisis that began in 2007 and wiped out trillions of dollars in wealth.1*  ***Types of Mortgage-Backed Securities***  *There are two common types of MBSs:* ***pass-throughs and collateralized mortgage obligations (CMO).***  ***Pass-throughs****: Pass-throughs are structured as trusts in which mortgage payments are collected and passed through to investors. They typically have stated maturities of five, 15, or 30 years. The life of a pass-through may be less than the stated maturity depending on the principal payments on the mortgages that make up the pass-through.*  ***Collateralized mortgage obligations (CMO)****: CMOs consist of multiple pools of securities which are known as slices, or*[*tranches*](https://www.investopedia.com/terms/t/tranches.asp)*. The tranches are given credit ratings which determine the rates that are returned to investors.*  ***History of MBS***  *Mortgage-backed securities were introduced after the passage of the Housing and Urban Development Act in 1968. The act created the*[*Government National Mortgage Association*](https://www.investopedia.com/terms/g/ginniemae.asp)*, or Ginnie Mae, which was split off from*[*Fannie Mae*](https://www.investopedia.com/articles/economics/08/fannie-mae-freddie-mac-credit-crisis.asp)*.*  *The new body allowed banks to sell their mortgages to third parties so that they would have more capital to lend out and originate new loans. This in turn made it possible for institutional funds to buy up and package many loans into an MBS.*  *Ginnie Mae introduced the first mortgage-backed securities for the retail housing market in 1970. The first private MBS was introduced by Bank of America in 1977.*  ***MBS and the Financial Crisis of 2007/2008***  *Mortgage-backed securities played a central role in the*[*financial crisis*](https://www.investopedia.com/terms/s/subprime-meltdown.asp)*that began in 2007 and went on to wipe out trillions of dollars in wealth, bring down*[*Lehman Brothers*](https://www.investopedia.com/terms/l/lehman-brothers.asp)*, and roil the world financial markets.*  *In retrospect, it seems inevitable that the rapid increase in home prices and the growing demand for MBS would encourage banks to lower their lending standards and drive consumers to jump into the market at any cost.*  ***The Crisis***  *That was the beginning of the*[*subprime*](https://www.investopedia.com/terms/s/subprime_mortgage.asp)*MBS. With*[*Freddie Mac and Fannie Mae*](https://www.investopedia.com/articles/economics/08/fannie-mae-freddie-mac-credit-crisis.asp)*aggressively supporting the mortgage market, the quality of all mortgage-backed securities declined, and their ratings became meaningless. Then, in 2006, housing prices peaked.*  *Subprime borrowers started to*[*default*](https://www.investopedia.com/terms/d/default2.asp)*, which is the failure to repay a loan. As a result, the housing market began its long collapse. More people began walking away from their mortgages because their homes were worth less than their loans. Even the conventional mortgages underpinning the MBS market saw steep declines in value. The avalanche of non-payments meant that many MBSs and collateralized debt obligations (CDOs) based on pools of mortgages were vastly overvalued.*  *The losses piled up as institutional investors and banks tried and failed to unload bad MBS investments. Credit tightened, causing many banks and financial institutions to teeter on the brink of insolvency. Lending was disrupted to the point that the entire economy was at risk of collapse.*  ***The Bailout***  *The U.S. Treasury stepped in with Congress to authorize a $700 billion financial system bailout intended to ease the*[*credit crunch*](https://www.investopedia.com/terms/c/creditcrunch.asp)*. Also, the*[*Federal Reserve*](https://www.investopedia.com/terms/f/federalreservebank.asp)*bought $4.5 trillion in MBS over a period of years while the*[*Troubled Asset Relief Program*](https://www.investopedia.com/terms/t/troubled-asset-relief-program-tarp.asp)*(TARP) injected capital directly into banks.*  *Some of the measures of the bailout included the following:*   * *Nearly $250 billion to stabilize the banking Industry* * *Nearly $27 billion o stabilize the credit markets* * *$80 billion to support the U.S. auto industry* * *Almost $70 billion to bail out the insurance giant, AIG for the American International Group* * *$46 billion was allocated to help struggling families avoid home*[*foreclosure*](https://www.investopedia.com/terms/f/foreclosure.asp)*, which is when a mortgage lender or bank seizes a borrower's home due to nonpayment of the loan*   *On Oct. 3, 2010, the authority to initiate new financial commitments ceased, essentially ending any new bailouts under the TARP program.*  *Also, in 2010, Congress authorized the*[*Dodd-Frank Wall Street Reform and Consumer Protection Act.*](https://www.investopedia.com/terms/d/dodd-frank-financial-regulatory-reform-bill.asp)*The Dodd-Frank Act reduced the initial amount of the $700 billion authorized for the TARP program to $475 billion.*  ***Advantages and Disadvantages of MBS***  ***Attractive Yield***  *For investors, mortgage-backed securities have some advantages over other securities. They pay a fixed interest rate that is usually higher than U.S. government bonds. Moreover, they typically offer monthly payouts, whereas bonds offer a single lump-sum payout at maturity.*  ***Safe Investments***  *Mortgage-backed securities are also considered relatively low-risk. If an MBS is guaranteed by the federal government, investors do not have to absorb the costs of a borrower's default. Moreover, they also offer diversification from the markets of corporate and government securities.*  ***Prepayment Risk***  *If borrowers fail to repay their loans, the investor may ultimately lose money. Also, if borrowers pay off their loans early or refinance their loans, that can also have a negative impact on expected returns.*  ***Interest Rate Risk***  *MBSs are also sensitive to changes in the interest rates on loans and mortgages. If interest rates rise, fewer people will take out mortgages causing the overall value of the housing market to decline.*  *MBS Pros and Cons*  ***Pros***   * *Fixed interest rate and monthly payouts.* * *More diversification than single loans.* * *Relatively low correlation with corporate bonds or the stock market.*   ***Cons***   * *Returns may be affected by borrowers refinancing or paying off their loans early.* * *If interest rates increase, the price of an MBS may drop.*   ***Mortgage-Backed Securities Today***  *Mortgage-backed securities are still bought and sold today. There is a market for them again simply because people generally pay their mortgages if they can. The Fed still owns a huge chunk of the market for MBSs, but it is gradually selling off its holdings.*  *Even CDOs have returned after falling out of favor for a few years post-crisis. The assumption is that*[*Wall Street*](https://www.investopedia.com/terms/w/wallstreet.asp)*has learned its lesson and will question the value of MBSs rather than heedlessly buying them. Time will tell.*  ***What Are the Types of Mortgage-Backed Securities (MBS)?***  *There are two common types of MBSs: pass-throughs and collateralized mortgage obligations (CMO).5 Pass-throughs are structured as trusts in which mortgage payments are collected and passed through to investors. They typically have stated maturities of five, 15, or 30 years. CMOs consist of multiple pools of securities which are known as slices, or tranches. The tranches are given credit ratings which determine the rates that are returned to investors.*  ***What's the Relationship Between MBS and a Bank?***  *Essentially, the mortgage-backed security turns the bank into an intermediary between the homebuyer and the investment industry. A bank can grant mortgages to its customers and then sell them at a discount for inclusion in an MBS. The bank records the sale as a plus on its balance sheet and loses nothing if the homebuyer defaults sometime down the road.*  *This process works for all concerned as long as everyone does what they're supposed to do. That is, the bank keeps to reasonable standards for granting mortgages; the homeowner keeps paying on time, and the credit rating agencies that review MBS perform due diligence.*  ***What Is an Asset-Backed Security (ABS)?***  *An asset-backed security (ABS) is a type of financial investment that is collateralized by an underlying pool of assets—usually ones that generate a cash flow from debt, such as loans, leases, credit card balances, or receivables. It takes the form of a bond or note, paying income at a fixed rate for a set amount of time, until maturity.*  *For income-oriented investors, ABSs can be an alternative to other debt instruments, like corporate bonds or bond funds. For issuers, ABSs allow them to raise cash which can be used for lending or other investment purposes.*  ***The Bottom Line***  *A mortgage-backed security is a type of investment vehicle composed of a large basket of mortgages. As each homeowner pays off their loans, the loan payments provide a steady income stream for investors who hold the MBS. These securities may be particularly attractive to investors who seek exposure to the housing market, rather than ordinary corporate or debt securities.*   * **CDO**   A **collateralized debt obligation** (**CDO**) is a type of [structured](https://en.wikipedia.org/wiki/Structured_finance) [asset-backed security](https://en.wikipedia.org/wiki/Asset-backed_security) (ABS).[[1]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-1) Originally developed as instruments for the corporate debt markets, after 2002 CDOs became vehicles for refinancing [mortgage-backed securities](https://en.wikipedia.org/wiki/Mortgage-backed_security) (MBS).[[2]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Lepke_2013-2)[[3]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-3) Like other private label securities backed by assets, a CDO can be thought of as a promise to pay investors in a prescribed sequence, based on the cash flow the CDO collects from the pool of bonds or other assets it owns.[[4]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-4) Distinctively, CDO credit risk is typically assessed based on a [probability of default](https://en.wikipedia.org/wiki/Probability_of_default) (PD) derived from ratings on those bonds or assets.[[5]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-5)  The CDO is "sliced" into sections known as ["tranches"](https://en.wikipedia.org/wiki/Tranche), which "catch" the cash flow of interest and principal payments in sequence based on seniority.[[6]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-ssrn.com-6) If some loans default and the cash collected by the CDO is insufficient to pay all of its investors, those in the lowest, most "junior" tranches suffer losses first.[[7]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-7) The last to lose payment from default are the safest, most senior tranches. Consequently, [coupon](https://en.wikipedia.org/wiki/Coupon_(bond)) payments (and interest rates) vary by tranche with the safest/most senior tranches receiving the lowest rates and the lowest tranches receiving the highest rates to compensate for higher [default risk](https://en.wikipedia.org/wiki/Default_risk). As an example, a CDO might issue the following tranches in order of safeness: Senior AAA (sometimes known as "super senior"); Junior AAA; AA; A; BBB; Residual.[[8]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Lemke_2014-8)  Separate [special purpose entities](https://en.wikipedia.org/wiki/Special_purpose_entity)—rather than the parent [investment bank](https://en.wikipedia.org/wiki/Investment_bank)—issue the CDOs and pay interest to investors. As CDOs developed, some sponsors repackaged tranches into yet another iteration, known as "[CDO-Squared](https://en.wikipedia.org/wiki/CDO-Squared)", "CDOs of CDOs" or "[synthetic CDOs](https://en.wikipedia.org/wiki/Synthetic_CDO)".[[8]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Lemke_2014-8)  In the early 2000s, the debt underpinning CDOs was generally diversified,[[9]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-9) but by 2006–2007—when the CDO market grew to hundreds of billions of dollars—this had changed. CDO collateral became dominated by high risk ([BBB or A](https://en.wikipedia.org/wiki/Credit_ratings#Corporate_credit_ratings)) tranches recycled from other asset-backed securities, whose assets were usually subprime mortgages.[[10]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-p127-10) These CDOs have been called "the engine that powered the mortgage supply chain" for subprime mortgages,[[11]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-130-11) and are credited with giving lenders greater incentive to make subprime loans,[[12]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-133-12) leading to the 2007-2009 [subprime mortgage crisis](https://en.wikipedia.org/wiki/Subprime_mortgage_crisis).[[13]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-13) Market history In 1970, the US government-backed mortgage guarantor [Ginnie Mae](https://en.wikipedia.org/wiki/Ginnie_Mae" \o "Ginnie Mae) created the first MBS ([mortgage-backed security](https://en.wikipedia.org/wiki/Mortgage-backed_security)), based on FHA and VA mortgages. It guaranteed these MBSs.[[14]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-14) This would be the precursor to CDOs that would be created two decades later. In 1971, [Freddie Mac](https://en.wikipedia.org/wiki/Freddie_Mac) issued its first Mortgage Participation Certificate . This was the first [mortgage-backed security](https://en.wikipedia.org/wiki/Mortgage-backed_security) made of ordinary mortgages.[[15]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-15) All through the 1970s, private companies began mortgage asset securitization by creating private mortgage pools.[[16]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-16)  In 1974, the [Equal Credit Opportunity Act](https://en.wikipedia.org/wiki/Equal_Credit_Opportunity_Act) in the United States imposed heavy sanctions for financial institutions found guilty of discrimination on the basis of race, color, religion, national origin, sex, marital status, or age[[17]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-17) This led to a more open policy of giving loans (sometimes subprime) by banks, guaranteed in most cases by [Fannie Mae](https://en.wikipedia.org/wiki/Fannie_Mae) and Freddie Mac. In 1977, the [Community Reinvestment Act](https://en.wikipedia.org/wiki/Community_Reinvestment_Act) was enacted to address historical discrimination in lending, such as '[redlining](https://en.wikipedia.org/wiki/Redlining)'. The Act encouraged commercial banks and savings associations (Savings and loan banks) to meet the needs of borrowers in all segments of their communities, including low- and moderate-income neighborhoods (who might earlier have been thought of as too risky for home loans).[[18]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-18)[[19]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Federal_Reserve-19)  In 1977, the investment bank [Salomon Brothers](https://en.wikipedia.org/wiki/Salomon_Brothers) created a "private label" MBS (mortgage backed security)—one that did not involve [government-sponsored enterprise](https://en.wikipedia.org/wiki/Government-sponsored_enterprise) (GSE) mortgages. However, it failed in the marketplace.[[20]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-20) Subsequently, [Lewis Ranieri](https://en.wikipedia.org/wiki/Lewis_Ranieri) ([Salomon](https://en.wikipedia.org/wiki/Salomon_Brothers)) and [Larry Fink](https://en.wikipedia.org/wiki/Laurence_D._Fink) ([First Boston](https://en.wikipedia.org/wiki/First_Boston)) invented the idea of [securitization](https://en.wikipedia.org/wiki/Securitization); different mortgages were pooled together and this pool was then sliced into [tranches](https://en.wikipedia.org/wiki/Tranche), each of which was then sold separately to different investors.[[21]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-21) Many of these tranches were in turn bundled together, earning them the name CDO (Collateralized debt obligation).[[22]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-22)  The first CDOs to be issued by a private bank were seen in 1987 by the bankers at the now-defunct [Drexel Burnham Lambert](https://en.wikipedia.org/wiki/Drexel_Burnham_Lambert) Inc. for the also now-defunct Imperial Savings Association.[[23]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Cresci-23) During the 1990s the collateral of CDOs was generally [corporate](https://en.wikipedia.org/wiki/Corporate_bond) and [emerging market bonds](https://en.wikipedia.org/wiki/Emerging_market_debt) and bank loans.[[24]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-129-24) After 1998 "multi-sector" CDOs were developed by Prudential Securities,[[25]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-129-30-25) but CDOs remained fairly obscure until after 2000.[[26]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Nocera,_p.120-26) In 2002 and 2003 CDOs had a setback when rating agencies "were forced to downgrade hundreds" of the securities,[[27]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Nocera,_p.121-27) but sales of CDOs grew—from $69 billion in 2000 to around $500 billion in 2006.[[28]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-mclean-p123-28) From 2004 through 2007, $1.4 trillion worth of CDOs were issued.[[29]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Endangerment-283-29)  Early CDOs were diversified, and might include everything from aircraft lease-equipment debt, manufactured housing loans, to student loans and credit card debt. The diversification of borrowers in these "multisector CDOs" was a selling point, as it meant that if there was a downturn in one industry like aircraft manufacturing and their loans defaulted, other industries like manufactured housing might be unaffected.[[30]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-reckless-279-30) Another selling point was that CDOs offered returns that were sometimes 2-3 percentage points higher than corporate bonds with the same credit rating.[[30]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-reckless-279-30)[[31]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-31) Explanations for growth  * **Advantages of securitization –** Depository banks had incentive to "[securitize](https://en.wikipedia.org/wiki/Securitization)" loans they originated—often in the form of CDO securities—because this removes the loans from their books. The transfer of these loans (along with related risk) to security-buying investors in return for cash replenishes the banks' capital. This enabled them to remain in compliance with [capital requirement](https://en.wikipedia.org/wiki/Capital_requirement) laws while lending again and generating additional origination fees. * **Global demand for fixed income investments** – From 2000 to 2007, worldwide fixed income investment (i.e. investments in bonds and other conservative securities) roughly doubled in size to $70 trillion, yet the supply of relatively safe, income generating investments had not grown as fast, which bid up bond prices and drove down interest rates.[[32]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-giantpoolpeabody-32)[[33]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-giantpool-33) Investment banks on Wall Street answered this demand with [financial innovation](https://en.wikipedia.org/wiki/Financial_innovation) such as the [mortgage-backed security](https://en.wikipedia.org/wiki/Mortgage-backed_security) (MBS) and collateralized debt obligation (CDO), which were assigned safe ratings by the credit rating agencies.[[33]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-giantpool-33) * **Low interest rates** – Fears of deflation, the bursting of the [dot-com bubble](https://en.wikipedia.org/wiki/Dot-com_bubble), a U.S. recession, and the U.S. trade deficit kept interest rates low globally from 2000 to 2004–5, according to Economist [Mark Zandi](https://en.wikipedia.org/wiki/Mark_Zandi).[[34]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-34) The low yield of the safe [US Treasury bonds](https://en.wikipedia.org/wiki/United_States_Treasury_security) created demand by global investors for subprime mortgage-backed CDOs with their relatively high-yields but credit ratings as high as the Treasuries. This search for yield by global investors caused many to purchase CDOs, though they lived to regret trusting the credit rating agencies' ratings.[[35]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Zandi_2009-35) * **Pricing models** – [Gaussian copula models](https://en.wikipedia.org/wiki/Gaussian_copula_model), introduced in 2001 by [David X. Li](https://en.wikipedia.org/wiki/David_X._Li), allowed for the rapid pricing of CDOs.[[36]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-36)[[37]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-37)  Subprime mortgage boom**[**[**edit**](https://en.wikipedia.org/w/index.php?title=Collateralized_debt_obligation&action=edit&section=4)**]** [https://upload.wikimedia.org/wikipedia/commons/thumb/b/bd/Collateralized_Debt_Obligations.svg/450px-Collateralized_Debt_Obligations.svg.png](https://en.wikipedia.org/wiki/File:Collateralized_Debt_Obligations.svg)  Source: [Final Report of the National Commission on the Causes of the Financial and Economic Crisis in the United States](https://www.gpo.gov/fdsys/pkg/GPO-FCIC/pdf/GPO-FCIC.pdf), p.128, figure 8.1  [https://upload.wikimedia.org/wikipedia/commons/thumb/1/12/CDO_-_FCIC_and_IMF_Diagram.png/800px-CDO_-_FCIC_and_IMF_Diagram.png](https://en.wikipedia.org/wiki/File:CDO_-_FCIC_and_IMF_Diagram.png)  IMF Diagram of CDO and RMBS  [https://upload.wikimedia.org/wikipedia/commons/thumb/3/37/Securitization_Market_Activity.png/350px-Securitization_Market_Activity.png](https://en.wikipedia.org/wiki/File:Securitization_Market_Activity.png)  Securitization markets were impaired during the crisis.  [https://upload.wikimedia.org/wikipedia/commons/thumb/6/62/CDO_issuances_2004-2012-darker.png/350px-CDO_issuances_2004-2012-darker.png](https://en.wikipedia.org/wiki/File:CDO_issuances_2004-2012-darker.png)  The volume of CDOs issued globally crashed during the subprime crisis but has recovered slightly. (source: SIFMA, Statistics, Structured Finance[[38]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-38)  In 2005, as the CDO market continued to grow, subprime mortgages began to replace the diversified consumer loans as collateral. By 2004, mortgage-backed securities accounted for more than half of the collateral in CDOs.[[11]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-130-11)[[39]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-39)[[40]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-40)[[41]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-41)[[42]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-42)[[43]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-43) According to the *Financial Crisis Inquiry Report*, "the CDO became the engine that powered the mortgage supply chain",[[11]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-130-11) promoting an increase in demand for mortgage-backed securities without which lenders would have "had less reason to push so hard to make" non-prime loans.[[12]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-133-12) CDOs not only bought crucial tranches of subprime mortgage-backed securities, they provided cash for the initial funding of the securities.[[11]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-130-11) Between 2003 and 2007, Wall Street issued almost $700 billion in CDOs that included mortgage-backed securities as collateral.[[11]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-130-11) Despite this loss of diversification, CDO tranches were given the same proportion of high ratings by rating agencies[[44]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-44) on the grounds that mortgages were diversified by region and so "uncorrelated"[[45]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-45)—though those ratings were lowered after mortgage holders began to default.[[46]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-hart-46)[[47]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-econintersect-47)  The rise of "ratings arbitrage"—i.e., pooling low-rated tranches to make CDOs—helped push sales of CDOs to about $500 billion in 2006,[[28]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-mclean-p123-28) with a global CDO market of over US$1.5 trillion.[[48]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-48) CDO was the fastest-growing sector of the structured finance market between 2003 and 2006; the number of CDO tranches issued in 2006 (9,278) was almost twice the number of tranches issued in 2005 (4,706).[[49]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-nber-49)  CDOs, like mortgage-backed securities, were financed with debt, enhancing their profits but also enhancing losses if the market reversed course.[[50]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-134-50) Explanations for growth Subprime mortgages had been financed by [mortgage-backed securities](https://en.wikipedia.org/wiki/Mortgage-backed_security) (MBS). Like CDOs, MBSs were structured into tranches, but issuers of the securities had difficulty selling the more lower level/lower-rated "mezzanine" tranches—the tranches rated somewhere from AA to BB.  Because most traditional mortgage investors are risk-averse, either because of the restrictions of their investment charters or business practices, they are interested in buying the higher-rated segments of the loan stack; as a result, those slices are easiest to sell. The more challenging task is finding buyers for the riskier pieces at the bottom of the pile. The way mortgage securities are structured, if you cannot find buyers for the lower-rated slices, the rest of the pool cannot be sold.[[51]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-reckless-278-51)[[52]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-52)  To deal with the problem, investment bankers "recycled" the mezzanine tranches, selling them to underwriters making more structured securities—CDOs. Though the pool that made up the CDO collateral might be overwhelmingly mezzanine tranches, most of the tranches (70[[53]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-53) to 80%[[54]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-54)[[55]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-55)) of the CDO were rated not BBB, A−, etc., but triple A. The minority of the tranches that were mezzanine were often bought up by other CDOs, concentrating the lower rated tranches still further. (See the chart on "The Theory of How the Financial System Created AAA-rated Assets out of Subprime Mortgages".)  As one journalist ([Gretchen Morgenson](https://en.wikipedia.org/wiki/Gretchen_Morgenson)) put it, CDOs became "the perfect dumping ground for the low-rated slices Wall Street couldn't sell on its own."[[51]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-reckless-278-51)  Other factors explaining the popularity of CDOs include:   * Growing demand for fixed income investments that started earlier in the decade continued.[[32]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-giantpoolpeabody-32)[[33]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-giantpool-33) A "global savings glut"[[56]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-56) leading to "large capital inflows" from abroad helped finance the housing boom, keeping down US mortgage rates, even after the [Federal Reserve Bank](https://en.wikipedia.org/wiki/Federal_Reserve_Bank) had raised interest rates to cool off the economy.[[57]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-57) * [Supply](https://en.wikipedia.org/wiki/Supply_(economics)) generated by "hefty" fees the CDO industry earned. According to "one hedge fund manager who became a big investor in CDOs", as much "as 40 to 50 percent" of the cash flow generated by the assets in a CDO went to "pay the bankers, the CDO manager, the rating agencies, and others who took out fees."[[27]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Nocera,_p.121-27) Rating agencies in particular—whose high ratings of the CDO tranches were crucial to the industry and who were paid by CDO issuers —earned extraordinary profits. [Moody's Investors Service](https://en.wikipedia.org/wiki/Moody%27s_Investors_Service), one of the two biggest rating agencies, could earn "as much as $250,000 to rate a mortgage pool with $350 million in assets, versus the $50,000 in fees generated when rating a municipal bond of a similar size." In 2006, revenues from Moody's structured finance division "accounted for fully 44%" of all Moody's sales.[[58]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-reckless-280-58)[[59]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-59) Moody's [operating margins](https://en.wikipedia.org/wiki/Operating_margin) were "consistently over 50%, making it one of the most profitable companies in existence"—more profitable in terms of margins than [Exxon Mobil](https://en.wikipedia.org/wiki/Exxon_Mobil) or [Microsoft](https://en.wikipedia.org/wiki/Microsoft).[[60]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-McLean-124-60) Between the time Moody's was spun off as a public company and February 2007, its stock rose 340%.[[60]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-McLean-124-60)[[61]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-61) * Trust in rating agencies. CDO managers "didn't always have to disclose what the securities contained" because the contents of the CDO were subject to change. But this lack of transparency did not affect demand for the securities. Investors "weren't so much buying a security. They were buying a triple-A rating," according to business journalists [Bethany McLean](https://en.wikipedia.org/wiki/Bethany_McLean) and [Joe Nocera](https://en.wikipedia.org/wiki/Joe_Nocera).[[27]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-Nocera,_p.121-27) * [Financial innovations](https://en.wikipedia.org/wiki/Financial_innovation), such as [credit default swaps](https://en.wikipedia.org/wiki/Credit_default_swap) and [synthetic CDO](https://en.wikipedia.org/wiki/Synthetic_CDO). Credit default swaps provided insurance to investors against the possibility of losses in the value of tranches from default in exchange for premium-like payments, making CDOs appear "to be virtually risk-free" to investors.[[62]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-132-62) Synthetic CDOs were cheaper and easier to create than original "cash" CDOs. Synthetics "referenced" cash CDOs, replacing interest payments from MBS tranches with premium-like payments from credit default swaps. Rather than providing funding for housing, synthetic CDO-buying investors were in effect providing insurance against mortgage default.[[63]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-63) If the CDO did not perform per contractual requirements, one counterparty (typically a large [investment bank](https://en.wikipedia.org/wiki/Investment_bank) or [hedge fund](https://en.wikipedia.org/wiki/Hedge_fund)) had to pay another.[[64]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-propublica.org-64) As underwriting standards deteriorated and the housing market became saturated, subprime mortgages became less abundant. Synthetic CDOs began to fill in for the original cash CDOs. Because more than one—in fact numerous—synthetics could be made to reference the same original, the amount of money that moved among market participants increased dramatically.  Crash [https://upload.wikimedia.org/wikipedia/commons/thumb/d/df/Impaired_Securities.GIF/450px-Impaired_Securities.GIF](https://en.wikipedia.org/wiki/File:Impaired_Securities.GIF)  More than half of the highest-rated (Aaa) CDOs were "impaired" (losing [principal](https://en.wikipedia.org/wiki/Bond_(finance)#Principal) or downgraded to junk status), compared to a small fraction of similarly rated Subprime and Alt-A mortgage-backed securities. (source: Financial Crisis Inquiry Report[[65]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-impaired-65))  In the summer of 2006, the [Case–Shiller index](https://en.wikipedia.org/wiki/Case%E2%80%93Shiller_index) of house prices peaked.[[66]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-66) In California, home prices had more than doubled since 2000[[67]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-87-67) and median house prices in Los Angeles had risen to ten times the median annual income. To entice those with low and moderate income to sign up for mortgages, [down payments](https://en.wikipedia.org/wiki/Down_payment) and [income documentation](https://en.wikipedia.org/wiki/No_income,_no_asset) were often dispensed with and [interest and principal payments were often deferred](https://en.wikipedia.org/wiki/Negative_amortization) upon request.[[68]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-lewis-94-68) Journalist [Michael Lewis](https://en.wikipedia.org/wiki/Michael_Lewis) gave as an example of unsustainable underwriting practices a loan in Bakersfield, California, where "a Mexican strawberry picker with an income of $14,000 and no English was lent every penny he needed to buy a house of $724,000".[[68]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-lewis-94-68) As two-year "[teaser" mortgage rates](https://en.wikipedia.org/wiki/Introductory_rate#Teaser_rate)—common with those that made home purchases like this possible—expired, mortgage payments skyrocketed. Refinancing to lower mortgage payment was no longer available since it depended on rising home prices.[[69]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-69) Mezzanine tranches started to lose value in 2007; by mid year AA tranches were worth only 70 cents on the dollar. By October triple-A tranches had started to fall.[[70]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-CDOh-70) Regional diversification notwithstanding, the mortgage backed securities turned out to be highly correlated.[[24]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-129-24)  Big CDO arrangers like [Citigroup](https://en.wikipedia.org/wiki/Citigroup), [Merrill Lynch](https://en.wikipedia.org/wiki/Merrill_Lynch) and [UBS](https://en.wikipedia.org/wiki/UBS) experienced some of the biggest losses, as did financial guaranteers such as [AIG](https://en.wikipedia.org/wiki/AIG), [Ambac](https://en.wikipedia.org/wiki/Ambac), [MBIA](https://en.wikipedia.org/wiki/MBIA).[[24]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-129-24)  An early indicator of the crisis came in July 2007 when rating agencies made unprecedented mass downgrades of mortgage-related securities[[71]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-71) (by the end of 2008 91% of CDO securities were downgraded[[72]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-FCIR-148-72)), and two highly leveraged [Bear Stearns](https://en.wikipedia.org/wiki/Bear_Stearns) hedge funds holding MBSs and CDOs collapsed. Investors were informed by Bear Stearns that they would get little if any of their money back.[[73]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-73)[[74]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-74)  In October and November the CEOs of [Merrill Lynch](https://en.wikipedia.org/wiki/Merrill_Lynch) and [Citigroup](https://en.wikipedia.org/wiki/Citigroup) resigned after reporting multibillion-dollar losses and CDO downgrades.[[75]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-75)[[76]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-76)[[77]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-77) As the global market for CDOs dried up[[78]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-78)[[79]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-79) the new issue pipeline for CDOs slowed significantly,[[80]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-sifma-80) and what CDO issuance there was usually in the form of [collateralized loan obligations](https://en.wikipedia.org/wiki/Collateralized_loan_obligation) backed by middle-market or leveraged bank loans, rather than home mortgage ABS.[[81]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-autogenerated2-81) The CDO collapse hurt mortgage credit available to homeowners since the bigger MBS market depended on CDO purchases of mezzanine tranches.[[82]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-82)[[83]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-83)  While non-prime mortgage defaults affected all securities backed by mortgages, CDOs were especially hard hit. More than half—$300 billion worth—of tranches issued in 2005, 2006, and 2007 rated most safe (triple-A) by rating agencies, were either downgraded to junk status or lost principal by 2009.[[65]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-impaired-65) In comparison, only small fractions of triple-A tranches of Alt-A or subprime mortgage-backed securities suffered the same fate. (See the Impaired Securities chart.)  Collateralized debt obligations also made up over half ($542 billion) of the nearly trillion dollars in losses suffered by financial institutions from 2007 to early 2009.[[46]](https://en.wikipedia.org/wiki/Collateralized_debt_obligation#cite_note-hart-46)   * **CDS** * A credit default swap (CDS) is a contract between two parties in which one party purchases protection from another party against losses from the default of a borrower for a defined period of time. * A CDS is written on the debt of a third party, called the reference entity, whose relevant debt is called the reference obligation, typically a senior unsecured bond. * A CDS written on a particular reference obligation normally provides coverage for all obligations of the reference entity that have equal or higher seniority. * The two parties to the CDS are the credit protection buyer, who is said to be short the reference entity’s credit, and the credit protection seller, who is said to be long the reference entity’s credit. * The CDS pays off upon occurrence of a credit event, which includes bankruptcy, failure to pay, and, in some countries, involuntary restructuring. * Settlement of a CDS can occur through a cash payment from the credit protection seller to the credit protection buyer as determined by the cheapest-to-deliver obligation of the reference entity or by physical delivery of the reference obligation from the protection buyer to the protection seller in exchange for the CDS notional. * A cash settlement payoff is determined by an auction of the reference entity’s debt, which gives the market’s assessment of the likely recovery rate. The credit protection buyer must accept the outcome of the auction even though the ultimate recovery rate could differ. * CDS can be constructed on a single entity or as indexes containing multiple entities. Bespoke CDS or baskets of CDS are also common. * The fixed payments made from CDS buyer to CDS seller are customarily set at a fixed annual rate of 1% for investment-grade debt or 5% for high-yield debt. * Valuation of a CDS is determined by estimating the present value of the payment leg, which is the series of payments made from the protection buyer to the protection seller, and the present value of the protection leg, which is the payment from the protection seller to the protection buyer in event of default. If the present value of the payment leg is greater than the present value of the protection leg, the protection buyer pays an upfront premium to the seller. If the present value of the protection leg is greater than the present value of the payment leg, the seller pays an upfront premium to the buyer. * An important determinant of the value of the expected payments is the hazard rate, the probability of default given that default has not already occurred. * CDS prices are often quoted in terms of credit spreads, the implied number of basis points that the credit protection seller receives from the credit protection buyer to justify providing the protection. * Credit spreads are often expressed in terms of a credit curve, which expresses the relationship between the credit spreads on bonds of different maturities for the same borrower. * CDS change in value over their lives as the credit quality of the reference entity changes, which leads to gains and losses for the counterparties, even though default may not have occurred or may never occur. CDS spreads approach zero as the CDS approaches maturity. * Either party can monetize an accumulated gain or loss by entering into an offsetting position that matches the terms of the original CDS. * CDS are used to increase or decrease credit exposures or to capitalize on different assessments of the cost of credit among different instruments tied to the reference entity, such as debt, equity, and derivatives of debt and equity. * **Credit tranche**   "Credit tranche" refers to a system of releasing loan funds in phases that the International Monetary Fund (IMF) uses to govern its lending activities with member countries. When a member nation applies for a loan to help with economic difficulties, the IMF will disburse the loan in a series of credit tranches. The credit tranches are portions of the loan that are released to the member country, usually upon the member fulfilling conditions or requirements set forth by the IMF.  KEY TAKEAWAYS  A "credit tranche" is a system of releasing loan funds to member countries used by the International Monetary Fund (IMF).  When a member country needs a loan from the IMF, the IMF will disburse the loan in a series of credit tranches.  Before a country can receive the following credit tranche loan disbursement, it will have to meet certain criteria as laid out by the IMF.  The criteria, or reforms, the IMF stipulates have a free market focus.  The loans that the IMF disburses come in four tranches with the first usually being 25% of a member's quota.  Understanding Credit Tranches  Credit tranches are the chunks of credit that the IMF makes available to a member country as they make financial reforms according to IMF guidance. Generally, the reforms have a free market focus and may include making it easier for entrepreneurs to start businesses, reducing public debt, and privatizing nationalized sections of the economy.  An International Monetary Fund loan usually lasts between 18 months and three years. At the start of the loan, the borrowing nation must demonstrate that reasonable efforts have been taken to overcome its financial difficulties. If this requirement is met, the country will receive the first credit tranche of the loan, which is usually kept within 25% of a member’s quota. Quota is assigned to new member countries based on their GDP, economic openness, and international reserves  The number of member countries in the International Monetary Fund (IMF).  The later series of credit tranches will have additional conditions, each of which the borrower must satisfy before receiving the next portion of funding. The purpose of the conditions is to remove the moral hazard that might be created by the IMF essentially bailing out a country. Instead of merely giving over capital, the IMF requires economic reform to ensure that the country is stable and able to weather future challenges.  Real-World Examples  There are many case studies of IMF successes and failures. Successes include countries like Jordan that have completed an IMF program and have emerged as global economies. Failures are sometimes harder to analyze, as one of the criticisms of the IMF is that social spending suffers under the free-market reforms. There is some truth to this, but social spending is usually at the point of being unsustainable before the IMF comes along with the austerity solution.  The IMF granted a three-year, $12 billion bailout program to Egypt in 2016. After the Arab Spring saw Hosni Mubarak’s 30-year regime topple, investors and tourists gave the country a wide berth. This badly damaged the Egyptian economy, and the country’s debt-to-GDP ratio climbed.  In June 2020, the IMF approved a 12-month standby arrangement for Egypt in the amount of $5.4 billion (184.8% of Egypt's quota). The first tranche was an immediate disbursement of $2 billion. The remaining tranches were spread across two reviews, the first in December 2020 and the next in June 2021, each in the amount of $1.7 billion.  What Is a Reserve Tranche Position With the IMF?  The reserve tranche, as stipulated by the IMF, is the difference between the IMF's holdings of a country's currency and the country's IMF quota. The reserve tranche functions as an emergency account for countries that they can access without having to agree to any conditions beforehand.  Who Funds the IMF?  The IMF is funded by its member countries, all of whom pay a capital subscription, known as a quota. Each country has a different quota that is based on the strength and size of its economy  What Happens If a Country Fails to Pay Back a Loan From the IMF?  If a country fails to pay back a loan from the IMF, the IMF will create a new debt repayment schedule that the country can abide by so that it can pay back its loan over time  What Is the Difference Between the IMF and the World Bank?  The primary goal of the IMF is to act as a source of stability for the world's monetary system and ensure the stability of currencies. The World Bank, on the other hand, is an organization that works to reduce global poverty through assistance programs for developing nations.   * + 1. **Take Joy's advice into account and also pay attention details in credit derivatives since he was asked only questions about them. First question was about the pricing bond when coupon dates do not match the delivery date when reselling the bond. Second, he was asked many questions from pricing credit derivatives with many underlings --- reviewing copulas might be helpful.**     2. Know all the yields. 10 yr for sure and know how it has been moving last 2 months atleast.     3. Know 10 yr bunds. Know $-EUR/Yen/CAD/Yuan at least     4. 1. Graph the price yield relationship of bonds.     5. 2. What is duration/Macaulry duration/Modified duration? Show me     6. 3. What is convexity?     7. 4. The following are prices of four different bonds: 25, 23, 22, 24. Assuming that you can sell or buy these bonds at no cost, if you know that tomorrow, three of them will go to 0 and one of them, 100, how would you arbitrage? (buy them all)     8. 5. How would you explain credit spread?\     9. 3)Explain duration? Differentiate between modified and macaulry duration? Where can you use these durations?     10. 4) What do you understand by credit spread? Define convexity?     11. 5) Discuss the factors behind credit risk?     12. 6) Suppose you have three bonds having values: 24, 22, 25, 26 and you can buy and sell these bonds at no cost. Next day, you come to know that their price has gone up? Explain will you buy all these bonds?     13. 7) Explain the different factors which play important role in fixed income market?     14. 8) What are the different forms of fixed income available in the market?     15. 9) Do you think there is less risk by investing money in fixed income plans?     16. 10) State the price yield relation of bonds? What is the method to find out whether the bond in cheap or expensive?     17. How is the IRR calculated in Excel? what are the potential problems associated with using this Excel formula? * **Stoch Calculus (Filtration, Wiener process, stationarity, Black Scholes, Ito Lemma, Greeks, Delta hedging, Risk neutral measure, Girsanov theorem, Vol smile)**   + 1. math questions about normal/log normal stochastic processes (even the interviewer admitted it’s probably not useful for the role, weird flex but ok) * **VaR, SVaR, ES, EaR**   + 1. Methods of estimating VaR (diff between historical / parametric / simulation). Pros and cons of each     2. What are the cons of VaR?     3. ES – what does it bring comp to VaR?     4. What is the difference between VaR and SVaR?     5. What s RNIV? * **Econometrics / ML (OLS, Logistic, VAR, Random Forrest, XGBoost)**   + 1. State the assumptions of Linear Regression. Difference between predicted and confidence interval.     2. How do you deal with linear regression with AR(1) errors? * **Python / SQL (data structures like arrays/DataFrame/dictionary/tuple/list, sorting algorithms, loc/iloc, OOP – classes/inheritance, Github/Git commit/push)** | |  | |

**Dictionary:**

* **Balance Sheet optimization**

The set of actions / models, whose target is to determine asset allocation such that bank’s ROE is maximized given the capital constraints (regulatory requirements, strategic objectives etc)

* **ALM behavioral model**

Client behavior deeply impacts a bank's liquidity, funding, interest-rate position and, consequently, the management of its asset/liability mismatch and related profitability. Therefore it is imperative that risk managers and modelers alike understand how to model client behavior according to the needs of their business. It is the aim of this book to improve that understanding and highlight modelling techniques from the simple through to the complex, offering a broad suite of tools to improve the management of an institution's balance sheet.

* **Economic life and stability of Non-Maturing Deposits**

Non-maturity deposits (‘NMDs’), such as retail savings, interest and non-interest-bearing checking and money-market accounts have no stated maturities. Thus, depositors can withdraw their funds at any time without any penalty. Modeling this early redemption option can be very challenging, but very rewarding, since NMDs are typically viewed as one of the most stable sources of funding for banks’ assets. Banks have other means of funding at their disposal, such as FHLB advances or the repo market but holding a substantial proportion of core deposits allows easy access to a stable and cheaper source of funding. Due to their short-term maturity and repricing nature, these instruments have relatively low interest rate risk which makes them more attractive.

* **early redemptions of term deposits / prepayments / embedded optionality**

Risk for the bank stating that the customers may withdraw their funds early (liability side)

* **Interest Rate Risk**

Interest rate risk in the banking book (IRRBB) refers to the current or prospective risk to the bank’s capital and earnings arising from adverse movements in interest rates that affect the bank’s banking book positions. When interest rates change, the present value and timing of future cash flows change. This in turn changes the underlying value of a bank’s assets, liabilities and off-balance sheet items and hence its economic value. Changes in interest rates also affect a bank’s earnings by altering interest rate-sensitive income and expenses, affecting its net interest income (NII). Excessive IRRBB can pose a significant threat to a bank’s current capital base and/or future earnings if not managed appropriately. A more detailed description of IRRBB and its management techniques can be found in SRP98.

31.2

Three main sub-types of IRRBB are defined for the purposes of this chapter. All three sub-types of IRRBB potentially change the price/value or earnings/costs of interest rate-sensitive assets, liabilities and/or off-balance sheet items in a way, or at a time, that can adversely affect a bank’s financial condition.

(1)

**Gap risk** arises from the term structure of banking book instruments, and describes the risk arising from the timing of instruments’ rate changes. The extent of gap risk depends on whether changes to the term structure of interest rates occur consistently across the yield curve (parallel risk) or differentially by period (non-parallel risk).

(2)

**Basis risk** describes the impact of relative changes in interest rates for financial instruments that have similar tenors but are priced using different interest rate indices.

(3)

**Option risk** arises from option derivative positions or from optional elements embedded in a bank’s assets, liabilities and/or off-balance sheet items, where the bank or its customer can alter the level and timing of their cash flows. Option risk can be further characterised into automatic option risk and behavioural option risk.

While the three sub-types listed above are directly linked to IRRBB, **credit spread** **risk** in the banking book (CSRBB) is a related risk that banks need to monitor and assess in their interest rate risk management framework. CSRBB refers to any kind of asset/liability spread risk of credit-risky instruments that is not explained by IRRBB and by the expected credit/jump to default risk

* **NII**

Non-interest income is bank and creditor income derived primarily from fees including **deposit and transaction fees, insufficient funds (NSF) fees, annual fees, monthly account service charges, inactivity fees, check and deposit slip fees**, and so on. Credit card issuers also charge **penalty fees**, including **late fees and over-the-limit fees**. Institutions charge fees that generate non-interest income as a way of increasing revenue and ensuring liquidity in the event of increased default rates.

* **EVE**

**The economic value of equity (EVE)** is a cash flow calculation that takes the **present value of all asset cash flows** and subtracts the **present value of all liability cash flows**. Unlike **earnings at risk and value at risk (VAR),** a bank uses the **economic value of equity to manage its assets and liabilities**. This is a long-term economic measure used to assess the degree of interest rate risk exposure—as opposed to net-interest income (NII), which reflects short-term interest rate risk.

The simplest definition of EVE is the net present value (NPV) of a bank's balance sheet's cash flows. This calculation is used for asset-liability management to measure changes in the economic value of the bank.

* **PV01**

Gap analysis can be used to derive the duration profile of the banking book or, equivalently, **the profile of the present value of a single basis point change in interest rates (PV01).** Gap analysis allocates all relevant interest rate-sensitive assets and liabilities to a certain number of predefined time buckets according to their next contractual reset date. The analysis also allocates equity, NMDs, prepaying loans or other instruments with future cash flows subject to customer behaviors according to general/behavioral assumptions regarding their maturity or reset date. It then measures the arithmetic difference (the gap) between the amounts of assets and liabilities in each time bucket, in absolute terms.

Each time bucket gap can be multiplied by an assumed change in interest rates to yield an approximation of the change in NII that would result from an increase in interest rates. This method gives a visual impression of the risk exposure dispersion relative to the repricing profile, reflecting exposures to parallel as well as non-parallel gap risk. It does not, however, quantify this risk. The measure assumes that all positions within a particular time bucket mature and reprice simultaneously, ignoring potential basis risks within the gaps.

* **Liquidity cashflow mismatch (LMI)**

Their "Liquidity Mismatch Index" (LMI) measures the mismatch between the market liquidity of assets and the funding liquidity of liabilities, at a firm level. There are many empirical challenges that arise in implementing their theoretical measure

* **LCR**

The LCR is an essential component of the Basel III reforms, which are global regulatory standards on bank capital adequacy and liquidity endorsed by the G20 Leaders.

The LCR promotes the short-term resilience of a bank's liquidity risk profile. It does this by ensuring that a bank has an adequate stock of unencumbered **high-quality liquid assets (HQLA)** that can be converted into cash easily and immediately in private markets to meet its liquidity needs for a **30 calendar day liquidity stress scenario.** It will improve the banking sector's ability to absorb shocks arising from financial and economic stress, whatever the source, thus reducing the risk of spillover from the financial sector to the real economy.

* **NSFR (Net Stable Funding Ratio)**

The NSFR is expressed as a ratio that must equal or exceed 100%. The ratio relates **the bank's available stable funding to its required stable funding**, as summarised in the following formula:

https://www.bis.org/fsi/fsisummaries/nsfr_formula.jpg

To determine total ASF and RSF amounts, factors reflecting supervisory assumptions are assigned to the bank's sources of funding and to its exposures, with these factors reflecting the liquidity characteristics of each category of instruments.

* **Deposit concentration**

A risk situation, in which a large part of the deposits sits in only a few institutions

* **Liquidity stress testing**

Liquidity stress testing: Considers a financial institution's ability, in the absence of market or funding liquidity, to meet obligations during periods of stress by accurately measuring the liquidity profile of the balance sheet at an enterprise-wide level.

* **FTP**

**The Fund Transfer Pricing (FTP)** measures the contribution by each source of funding to the overall profitability in a financial institution.[1] Funds that go toward lending products are charged to asset-generating businesses whereas funds generated by deposit and other funding products are credited to liability-generating businesses.[2]

1. **Balance Sheet Optimization**

<https://www.cefpro.com/wp-content/uploads/2020/01/D2-11.20-Bogie-Risk-Americas-2019_widescreen.pdf>

**YT COURSE ON LIQUIDITY RISK:**

<https://www.youtube.com/watch?v=TguAvyxM6vg&list=PLIYnk9FMYckuau7y6DQOe_6RYzlwLOAUo>

<https://www.sc.com/en/feature/why-balance-sheet-efficiency-key-for-2022/>

**!!!**

<https://www.linkedin.com/pulse/banks-balance-sheet-optimization-martin-macko/>

**!!!**

<https://repositorio.ucp.pt/bitstream/10400.14/17972/1/MsC%20Thesis-Joao%20Freire.pdf>

**!!!**

<https://www.math.vu.nl/~sbhulai/papers/thesis-hellemons.pdf>

**Coding implementations:**

https://github.com/rajeshvaraham/basel\_collateral\_optimization

<https://github.com/lilythepooh/Indifference-Pricing-of-Options-and-Balance-Sheet-Optimization>

<https://github.com/TommasoBelluzzo/SystemicRisk>

1. **ALM behavioral model**

<http://www.afgap.org/wp-content/uploads/2020/10/20201022_AFGAP_DepositModelling.pdf>

**!!!**

<https://assets.ey.com/content/dam/ey-sites/ey-com/cs_cz/topics/financial-services/vse-mr-predictive-modeling-for-market-risk-in-the-banking-book-v3.pdf?download>

**!!!**

1. **Economic life and stability of Non-Maturing Deposits**

<https://www.eba.europa.eu/sites/default/documents/files/document_library/Publications/Consultations/2022/Consultation%20on%20draft%20RTS%20on%20IRRBB%20standardised%20approach/1025041/CP%20Draft%20RTS%20on%20SA.pdf>

<https://www.bdo.com/insights/advisory/key-factors-to-consider-when-valuing-and-modeling-non-maturity-deposits>

<https://www.moodysanalytics.com/-/media/whitepaper/2014/2014-22-05-Asset-Liability-Management-Applications-Modeling-Non-Maturing-Deposits.pdf>

1. **Early redemptions of term deposits**

[**https://www.commbank.com.au/guidance/consumer-finance/what-are-your-options-when-your-term-deposit-matures--201609.html**](https://www.commbank.com.au/guidance/consumer-finance/what-are-your-options-when-your-term-deposit-matures--201609.html)

**!!!**

[**https://kth.diva-portal.org/smash/get/diva2:1319672/FULLTEXT02.pdf**](https://kth.diva-portal.org/smash/get/diva2:1319672/FULLTEXT02.pdf)

**!!!**

[**https://www.econstor.eu/bitstream/10419/174177/1/wp\_2016\_10\_dzmuranova.pdf**](https://www.econstor.eu/bitstream/10419/174177/1/wp_2016_10_dzmuranova.pdf)

1. **Interest Rate Risk**

[**https://www.bis.org/basel\_framework/chapter/SRP/31.htm**](https://www.bis.org/basel_framework/chapter/SRP/31.htm)

1. **NII**

[**https://journals.umcs.pl/ijsr/article/download/6591/4943**](https://journals.umcs.pl/ijsr/article/download/6591/4943)

[**https://mpra.ub.uni-muenchen.de/65114/1/MPRA\_paper\_65114.pdf**](https://mpra.ub.uni-muenchen.de/65114/1/MPRA_paper_65114.pdf)

1. **EVE**

[**https://www.bis.org/bcbs/publ/d368.pdf**](https://www.bis.org/bcbs/publ/d368.pdf)

[**https://www.hkma.gov.hk/media/eng/doc/key-functions/banking-stability/basel-3/IRRBB-CP.pdf**](https://www.hkma.gov.hk/media/eng/doc/key-functions/banking-stability/basel-3/IRRBB-CP.pdf)

1. **PV01**

[**https://www.theice.com/publicdocs/futures/Price\_Sensitivity.pdf**](https://www.theice.com/publicdocs/futures/Price_Sensitivity.pdf)

[**https://analystprep.com/study-notes/frm/part-1/valuation-and-risk-management/one-factor-risk-metrics-and-hedges/**](https://analystprep.com/study-notes/frm/part-1/valuation-and-risk-management/one-factor-risk-metrics-and-hedges/)

1. **Liquidity mismatch**

[**https://www.chicagofed.org/-/media/others/events/2011/bsc/krishnamurthy-830-0504-pdf.pdf**](https://www.chicagofed.org/-/media/others/events/2011/bsc/krishnamurthy-830-0504-pdf.pdf)

[**https://www.bis.org/events/conf140909/bai\_krishnamurthy\_weymuller\_paper.pdf**](https://www.bis.org/events/conf140909/bai_krishnamurthy_weymuller_paper.pdf)

1. **Liquidity Coverage Ratio**

[**https://www.investopedia.com/terms/l/liquidity-coverage-ratio.asp**](https://www.investopedia.com/terms/l/liquidity-coverage-ratio.asp)

1. **Net Stable Funding Ratio**

[**https://www.knf.gov.pl/knf/pl/komponenty/img/M\_Brzozowski.pdf**](https://www.knf.gov.pl/knf/pl/komponenty/img/M_Brzozowski.pdf)

[**https://www.moodysanalytics.com/-/media/whitepaper/2015/2015-25-06-Modeling-Methodology-Net-Stable-Funding-Ratio.pdf**](https://www.moodysanalytics.com/-/media/whitepaper/2015/2015-25-06-Modeling-Methodology-Net-Stable-Funding-Ratio.pdf)

1. **Deposit concentration**

[**https://www.norges-bank.no/contentassets/67c1aa037ccc48eca40b8c1a9c97031b/ny-mappe/granular\_depositors\_novemberdraft.pdf**](https://www.norges-bank.no/contentassets/67c1aa037ccc48eca40b8c1a9c97031b/ny-mappe/granular_depositors_novemberdraft.pdf)

[**https://www.imf.org/external/pubs/ft/wp/2016/wp16158.pdf**](https://www.imf.org/external/pubs/ft/wp/2016/wp16158.pdf)

1. **Liquidity Stress Testing**

[**https://www.bis.org/publ/bcbs\_wp24.pdf**](https://www.bis.org/publ/bcbs_wp24.pdf)

[**https://www.moodysanalytics.com/risk-perspectives-magazine/stress-testing-north-america/regulatory-spotlight/liquidity-risk-management-is-a-game-changer**](https://www.moodysanalytics.com/risk-perspectives-magazine/stress-testing-north-america/regulatory-spotlight/liquidity-risk-management-is-a-game-changer)

[**https://pep.vse.cz/pdfs/pep/2020/03/01.pdf**](https://pep.vse.cz/pdfs/pep/2020/03/01.pdf)

[**https://www.bis.org/bcbs/events/cbrworkshop09/vandenend.pdf**](https://www.bis.org/bcbs/events/cbrworkshop09/vandenend.pdf)

1. **FTP**

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