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# MARKET RISK CAPITAL CHARGE OF BONDS UNDER THE STANDARDIZED DURATION APPROACH: INSIGHTS FROM SBI

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A B S T R A C T

*This study examines the calculation of the market risk capital charge of bonds under the Standardized Duration Approach of the Basel norms. The background of the research lies in understanding how duration and modified duration determine a bond's sensitivity to interest rate movements and how these measures affect the computation of capital charges for market risk. The purpose of the study is to analyse the procedures involved in calculating market risk capital charges, validate the modified duration formula, and observe the changing patterns of capital charge requirements for the State Bank of India (SBI) over five years. The study uses SBI records and establishes a relationship between the 10-year government security yield and the capital charge for interest rate risk for the SBI group. A step-by-step methodological process of applying the Duration model is used to compute both the overall market risk and specific risk contributions. The results show a negative correlation of –0.21 between the 10-year government security yield and SBI's capital charge for interest rate risk. The analysis also indicates an overall increase in SBI's market risk capital charge over the five years, reflecting higher observed volatility. Significant findings include confirmation that understanding Duration and modified Duration is essential to measuring the sensitivity of bonds to interest rate fluctuations and that, as a bond's maturity increases, its modified Duration also increases, making longer-duration instruments more exposed to market fluctuations and resulting in higher capital charges.*



## INTRODUCTION

Bonds constitute a fundamental component of modern capital markets, enabling sovereigns, corporations, and supranational institutions to mobilize long-term debt capital. Their fixed-income structure, characterized by predetermined coupon payments and principal repayment at maturity, provides investors with relative stability in expected cash flows. However, their valuations remain highly sensitive to changes in market conditions, particularly interest-rate movements. Even modest shifts in the yield curve can materially alter the market value of fixed-income portfolios, highlighting that instruments traditionally perceived as low-risk are deeply intertwined with broader market dynamics and financial stability (Coulier et al., 2024).

This sensitivity has assumed increasing regulatory importance in an environment marked by growing financial sophistication and systemic interdependence. The Basel regulatory framework, formulated by the Basel Committee on Banking Supervision (BCBS) (1988), seeks to ensure that banks maintain sufficient capital buffers to absorb losses arising from credit, operational, and market risks (Curcio et al., 2022). Within this architecture, interest rate risk in the trading book is especially salient for institutions with substantial bond exposures, as yield fluctuations directly influence portfolio valuations and, consequently, capital adequacy (M. Begum, 2024; Haar & Gregoriou, 2023).

For banks that do not rely on internal models such as Value-at-Risk (VaR), the standardized approach provides a structured mechanism for assessing market risk. One of its core components is the duration-based method, which uses Duration and modified Duration to quantify bond price sensitivity to interest rate changes. Duration serves both as a measure of time and as an indicator of price responsiveness. In contrast, modified Duration refines this concept by capturing the percentage change in price for a one-percentage-point change in yield (Armeanu et al., 2008). Moreover, the critical role of modified Duration in regulatory capital computation is highlighted by Huang et al. (2021) and ISDA & IIF (2025), who explain its centrality in risk-weighting and standardized market risk measurement under the Basel framework.

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Despite its practical relevance, the technical implementation of the duration-based approach—and the empirical validity of modified Duration as applied in regulatory capital calculations—has received limited academic attention (Ben Ayed & Ben Hassen, 2024; Kroszner & Robins, 2024). The scientific problem addressed in this study emerges from this gap: the absence of a clear methodological exposition on how Duration and modified Duration operate within the standardized capital framework, and whether the modified duration formula accurately reflects observed sensitivities.

Accordingly, the present research undertakes a systematic examination of the standardized duration approach for computing market risk capital charges on bonds. It empirically validates the modified duration formula by analyzing the relationship between the 10-year government security yield and the interest rate risk capital charge of the State Bank of India (SBI) (2017), situating the research within both theoretical and regulatory frameworks. The primary objective of this study is to validate the modified duration formula and observe the changing patterns of capital charge requirements for SBI over five years, thereby enhancing understanding of market risk capital computation for fixed-income portfolios.

The article first reviews the relevant literature to contextualize interest rate risk and the application of Duration and modified Duration in fixed-income portfolio management. This is followed by a theoretical discussion outlining the principles of Duration and modified Duration in measuring interest rate sensitivity. The standardized duration approach for computing market risk capital charges under the Basel framework is then detailed, highlighting both general and specific risk treatments. The empirical section applies this methodology to five years of SBI data, examining patterns in capital charge requirements and validating the modified duration formula through its relationship with the 10-year government security yield. The study concludes by presenting the main findings and discussing their significance for understanding the computation of market risk capital in fixed-income portfolios.

## LITERATURE REVIEW

Understanding market and interest rate risk in banking requires tracing the evolution of financial institutions, regulatory frameworks, and fixed-income instruments. The literature demonstrates a progressive shift from simple trading-related concerns to more complex frameworks involving valuation models, capital adequacy rules, and interest-rate sensitivity tools. This section synthesizes the key theoretical developments to lay the foundation for examining interest rate risk using duration-based measures.

The early recognition of market risk stemmed from banks' increased participation in trading activities, which exposed institutions to volatility in prices, interest rates, and exchange rates. Hendricks and Hirtle (1997) were among the first to note that such activities created an additional layer of instability, prompting regulators to reconsider capital adequacy standards. However, early regulatory approaches were imperfect. Rahim and Tafri (2013) pointed out that static, percentage-based capital charges underestimated real-time fluctuations, raising questions about whether these models could accurately capture market risk under dynamic conditions.

The literature then shifts toward interest rate risk, especially with respect to fixed-income instruments such as bonds. English (2002) distinguished between the economic value approach capturing the present-value effects of rate changes and the earnings perspective, which focuses on future cash flows. Klobásová (2008) further explained how interest rate mismatches in the banking and trading books influence both net interest income and the valuation of long-term assets. Recent empirical work shows that while aggregate bank exposure to interest rate risk is modest, significant cross-sectional heterogeneity persists (Hoffmann et al., 2019). Hautsch and Ou (2012) argued that the high dimensionality of the term structure makes time-varying interest rate risk difficult to model, leading many studies to focus on selective maturities or aggregated volatility components. Given this complexity, banks often rely on derivatives to hedge exposures, leaving residual risks that redistribute interest-rate impacts across the industry.

The foundational role of interest rate risk in banking is further underscored by Houpt and Embersit (1991), who noted that mismatches between asset yields and liability costs expose banks to potential gains or losses as rates move. While credit risk received explicit treatment in the 1988 Basel Accord, interest rate risk did not initially attract a direct capital charge, despite its material influence on bank performance. Hirtle (2003) found that market risk capital numbers often reveal little about a bank's actual risk profile when viewed cross-sectionally. However, they can help track changes within individual institutions over time. This variability reinforced the need to reconsider capital requirements. The Basel Committee on Banking Supervision (BCBS) (1993), with Madura and Zarruk (1995) demonstrating that banks across countries respond differently to domestic and international rate changes, challenging the notion of uniform global capital rules.

Further regulatory refinement emerged with the 1996 Market Risk Amendment, which introduced internal VaR models subject to strict Basel oversight (Rakhimov & Mamadjonov, 2022). Wong et al. (2003) observed widespread adoption of VaR systems under central bank supervision, though they noted chronic backtesting failures in ARCH and GARCH-based models. Bugár and Ratting (2016) reinforced these concerns, particularly after the 2007 financial crisis exposed weaknesses in VaR-based capital frameworks. Subsequent revisions under Basel III sought to strengthen capital adequacy by improving risk coverage and emphasizing liquidity considerations (Dardac & Grigore, 2011). Complementing these developments, Ab-Hamid et al. (2017) linked market risk exposure to bank efficiency, while Burchi and Martelli (2016) highlighted the role of stressed VaR in enhancing risk measurement.

Parallel changes in global banking structures heightened the relevance of fixed-income valuation. De Jong and Fabozzi (2015) noted that the rise of corporate bond markets in emerging economies reshaped bank behaviour, with institutions increasingly acting as underwriters, custodians, and dealers. This integration of securities operations elevated the need to understand bond valuation and its sensitivity to interest rates.

Duration theory forms the core analytical tool for assessing interest rate sensitivity. While Macaulay and modified duration remain foundational, their limitations become evident in low-coupon or long-maturity bonds. Armeanu et al. (2008) proposed discrete Duration as a more accurate alternative that does not require convexity adjustments. Nie et al. (2021) traced Duration back to its origins as a weighted-average measure of cash-flow timing, emphasizing its importance for bond price sensitivity. Earlier, Bierwag et al. (1983) advocated single-factor duration models based on the assumption of perfect correlation, which proved cost-effective for managing option-free bond portfolios. Cohen (1993) refined modified Duration for parallel yield-curve shifts but acknowledged limitations when the curve steepens or flattens. Ajlouni (2012) identified key characteristics of Duration—its decline with higher coupons or yields —and its usefulness as an elasticity measure, underscoring its relevance for stress testing and portfolio management.

In institutional settings, Duration is used in balance sheet management. Wu (2022) described Macaulay-based retention-gap frameworks designed to balance asset and liability durations to stabilize net worth under rate changes. However, Duration interacts with other risk drivers. Chen (2022) noted that default risk also influences valuation: higher credit risk requires higher yields, which in turn cause bond prices to adjust through duration-mediated sensitivity. Earlier work by Boquist (1973) integrated Duration into a linear market model, showing how bond betas decrease as maturity falls, though the model excluded taxes and default risk. Feng and Kwan (2012) further criticized textbook applications of Duration, noting real-world pricing on irregular dates and the inability of modified Duration to fully capture trading dynamics.

Long-term government bond yields particularly the 10-year yield serve as key indicators of inflation expectations, monetary policy, and macro-financial conditions (Fabozzi, 2015; Mishkin, 2019). Movements in these yields influence the valuation of banks' fixed-income holdings, affecting both market-risk capital charges and net interest margins (BCBS, 2016; ESRB, 2018). IMF (2023) and World Bank (2022) studies show that emerging-market banks, often heavy holders of government securities, face amplified vulnerabilities when yields rise. Borio et al. (2014) and Jobst and Oura (2019) demonstrated that shifts in long-term yields affect both the economic value of equity (EVE) and earnings-at-risk (EaR), reinforcing the regulatory significance of yield-curve dynamics.

Overall, the existing literature demonstrates a clear evolution in understanding how market risk, interest rate dynamics, and duration-based measures shape the valuation and stability of fixed-income portfolios. Although Duration remains a central analytical tool, prior studies consistently highlight its conceptual limitations and the need for more precise, context-sensitive measurement—particularly under changing yield-curve conditions.

The insights from the literature review collectively highlight the need for a detailed, step-by-step calculation process for practical application and underscore the importance of examining whether modified Duration accurately captures bond price sensitivity in contemporary market environments.

The study aims to develop a comprehensive understanding of the Duration and modified duration models used for calculating market risk capital charges for bond portfolios under the standardized approach. It systematically explains the step-by-step procedure for computing market risk capital charges by applying the standardized duration model, incorporating both general market risk and specific risk components. In addition, the study examines the trend in market risk capital charges of the State Bank of India (SBI) (2018), measured in ₹ crore, along with the year-on-year percentage changes over five consecutive financial years. It further seeks to validate the modified duration formula by analyzing its relationship with the SBI Group's capital requirement for interest rate risk, particularly in relation to movements in the 10-year government securities yield. Finally, the study provides practical, workable guidance, supported by illustrative examples, to help financial institutions implement the duration model accurately and efficiently in real-world risk management practices. The following are the hypotheses of the study:

**$H_0$**: $\rho \neq 0$: where ρ is the population correlation coefficient, which says that there is a correlation between the variables, '10 year bond yields' and 'capital requirement for interest rate risk' in two populations.

**$H_1$**: $\rho = 0$, where ρ is the population correlation coefficient, indicating that there is no correlation between the variables' 10-year bond yields' and 'capital requirement for interest rate risk' across the two populations.

## MATERIALS AND METHODS

### Participating Variables

The capital requirement for interest rate risk is calculated using the standardized Duration.
Model. Duration is the weighted-average time to receive a bond's or an asset's cash flows and measures the asset's sensitivity to interest rate changes. Modified Duration adjusts Duration to estimate the percentage change in the price of a bond or asset for a 1% change in interest rates. Under the standardized approach, modified Duration is calculated as duration/(1 + yield). Modified Duration represents the capital charge for interest rate risk. By default, the yield has been assumed to be 10% for Duration calculation, and the modified Duration has been calculated on the same basis (10%). Apart from them, the market risk capital charge of SBI has also been analyzed. Correlation has been established between the '10-year govt. Security yield', and 'capital charge for interest rate risk', which were further tested in order to validate the modified duration formula.

### Materials

In order to compute the capital charge of bonds for market risk under the standardized duration approach of Basel norms, a bank's overall investment portfolio, classified into three categories: government securities, bank bonds, and other securities**,** has been considered. The primary dataset comprises information on 15 individual investments, including the date of issue, date of reporting, date of maturity, investment amount, coupon rate (in percentage), and investment type—categorized as Available-for-Sale (AFS), Held-for-Trading (HFT), or Held-to-Maturity (HTM). This data has been sourced from the Reserve Bank of India's (n.d.) Master Circular on Risk Management. Further, to understand the trend in the capital charge for market risk (in ₹ crore) and the percentage change from the previous financial year over 5 successive financial years (from 2020-2021 to 2024-2025), data for the State Bank of India (SBI) (2019) has been used. 10-year government security yields (annual) were calculated from the RBI's website and used in place of bond-specific yields to validate the modified duration model as a tool for calculating the bank's interest rate capital charge.

**Procedure**

The study begins with an analysis of banking risk, with a primary focus on market risk. This analysis explored the definition, properties, and components of market risk, followed by a review of the methodologies for its calculation, including gap analysis, the standardized approach (the duration model and modified Duration), and an internal risk-based model.

For the calculation of the capital charge for bonds under market risk, based on both quantitative and qualitative guidelines given by the Bank for International Settlements and the Reserve Bank of India (2015), a bank's investment portfolio is first analyzed based on investment type, namely Held-for-Trading (HFT), Available-for-Sale (AFS), and Held-to-Maturity (HTM). For this study, 15 different securities (government securities, bank bonds, and other securities) are considered, and only HFT and AFS securities are included in the trading book for market risk computation.

The market risk capital charge is computed in two components: specific risk and general market risk. Specific risk is calculated based on the risk weights prescribed under the standardized duration approach, and the corresponding capital charges are derived by applying the prescribed multipliers. For general market risk, modified Duration is used to estimate each security's price sensitivity, which is then used to calculate the corresponding capital requirement. The total capital charge is the sum of the specific and general market risk charges. Subsequently, the Capital to Risk-Weighted Assets Ratio (CRAR) is calculated by multiplying the capital charge by (100 ÷ 9).

The State Bank of India (SBI) (2020) data on the capital charge for market risk (in ₹ crore) for five successive financial years is converted into year-on-year percentage changes to analyze trends. Two graphical representations are shown: one depicting the absolute capital charge amount and the other depicting percentage changes, both of which have fluctuated but have shown an overall upward trajectory, indicating a general increase in market risk capital over the observed period.

To validate the modified duration formula, 10-year government security yields (annual) have been calculated from the monthly yields available on the RBI's website. The 10-year government security yield is a risk-free rate that determines the yields of other corporate bonds. In other words, yields on corporate bonds follow those of 10-year government securities. Therefore, to calculate the modified Duration of a bond or its interest rate capital charge, the 10-year government security yield can be considered in place of the bond's specific yield in the modified duration formula. Finally, a correlation test has been conducted between a 10-year government security yield and the interest rate capital charge (modified Duration) to assess the validity of the modified Duration formula for calculating the interest rate risk capital charge for bonds.

**Research Design**

***Research Problem***

The study seeks to calculate the market risk capital charge of bonds under the standardized duration approach of the Basel norms. It also aims to present the trend in the capital charge for market risk (in ₹ crore) and the percentage change from the previous financial year for 5 successive financial years of SBI. Furthermore, it relates to testing the hypothesis of a correlation between "10-year government security yield" and "capital charge for the interest rate risk of the SBI group," thus verifying the formula for modified Duration, and finally to understanding financial sustainability in the financial system.

***Research Methodology***

The study adopts a descriptive approach to systematically examine the procedure for computing market risk capital charges for bond portfolios under the standardized duration model, as envisaged by the Basel regulatory framework. Descriptive research is an appropriate approach because it allows a clear exposition of the financial concepts, regulatory provisions, and quantitative techniques used to assess capital adequacy, without manipulating variables or introducing experimental elements. The descriptive characteristics of the study allow an in-depth exposition of the fundamental concepts of Duration and modified Duration, which constitute an analytical framework for evaluating interest rate risk. These metrics are crucial for estimating how sensitive bond prices are to interest rate fluctuations and, hence, the direct influence they have on the capital requirements prescribed under the Basel norms.

The research also incorporates empirical and exploratory dimensions, presenting the trend in market risk capital charge (in ₹ crore) and the percentage change from the previous financial year over five successive years for the State Bank of India (SBI) (2021). The concept of 'percentage' and 'line charts' has been used to analyse the variables in this case. Additionally, an attempt has been made to establish a relationship between the "10-year government security yield" and "capital charge for the interest rate risk of the SBI group", thereby verifying the practical application of the modified duration formula. Correlation has been used to establish this relationship.

The research methodology is therefore conceptually transparent and practically replicable, as it not only elaborates on the calculation procedure but also provides practical insights into regulatory capital planning and interest rate risk management for bond portfolios at financial institutions.

**Data Collection**
Secondary data is the most important pillar on which this study relies to gather information on regulatory frameworks, bond pricing models, and approaches to computing capital charges. Secondary data sources offer extensive information resources for comprehensive analysis, eliminating the need to collect primary data. The data sources that were used include:

***Academic Journals and Research Articles:*** Academic research, industry white papers, and case studies have been instrumental in understanding bond valuation, interest rate risk, and Duration models, and market risk analysis, thereby providing theoretical understanding and additional perspectives that contribute to the research premises.

***Basel Committee on Banking Supervision (BCBS) Publications:*** Basel II and Basel III are key publications of the BCBS for assessing regulatory standards for the computation of capital charges under the standardized approach. Additional sources consist of circulars and reports from the International Monetary Fund (IMF) (2023), the World Bank, the European Systemic Risk Board (ESRB) (2018) and the Bank for International Settlements (BIS).

***Central Banks' (RBI) Reports:*** Central banks (i.e., the Reserve Bank of India) issue reports describing either the empirical research and methodological discussions on market risk and capital adequacy, their policy developments, etc.

***Commercial Banks' Financial Reports:*** The Balance sheet of a commercial bank provides insight into the composition and valuation of the bank's financial assets. Trading book and Banking book data can be used to comprehend the various types of investment that exist in it- Held to Maturity (HTM), Held for Trading (HFT), and Available for Sale (AFS), which determine the appropriate methodologies of capital charge. Some of the other important reports include annual reports and Pillar 3 disclosures. The annual reports of the State Bank of India from 2015-2016 to 2024-2025 have been considered for various calculations, and interpretations have been drawn based on these calculations.

**Time Frame**
The time frame considered in the paper ranges from 2015-2016 to 2024-2025. To understand the trend of capital charge for market risk (in ₹ crore) and percentage change from previous financial year for five successive financial years of SBI, the time frame considered is from 2020-2021 to 2024-2025, whereas, to test the hypothesis of a correlation between the "10 year government security yield" and "capital charge for the interest rate risk of the SBI group", the time frame considered is 2015-2016 to 2024-2025.

## RESULTS AND DISCUSSIONS

**Banking Risks**
The banking sector risks include the potential for incurring losses that can increase due to numerous factors and uncertainties. The risks in the banking sector can take many forms. However, in reality, they are mainly classified as opportunities in which the actual return on an outcome or investment may differ from the anticipated return. Among the most prominent risks in the banking sector in India, one may list the following: credit risks, operational risks, liquidity risks, interest rate risks, and market risks.

Credit risk arises from the inability of borrowers or counterparties to fulfill contractual obligations. One example is a borrower's default on principal or interest payments on a loan. By virtue of their business model, banks cannot entirely hedge themselves against credit risk; there are a few options available, which they can use to reduce exposure to credit risk- the major one being diversification. As a result, in the event of a credit downturn, a bank will be unlikely to be overexposed to a category that could incur massive losses. Moreover, they have various options to mitigate risk exposure by lending funds to individuals with good credit ratings, entering into transactions with high-quality counterparties, or providing collateral to secure loans.

The risk of loss resulting from errors, interruptions, or damage caused by individuals, systems, or processes is operational risk. Operational risk types are low for simple business operations like retail banking and asset management, and high otherwise, as in sales and trading. Large-scale fraud is achieved by breaching a bank's cybersecurity. Under these circumstances, banks lose capital and customer confidence. Damage to a bank's reputation may impair its future ability to attract deposits or business.

Liquidity risk is the inability of a bank to obtain cash to meet funding requirements. Obligations include permitting customers to withdraw their deposits. Causes of liquidity problems for banks include over-reliance on short-term sources of funds, excessive concentration of the balance sheet in non-liquid assets, and a loss of customer confidence in the bank. There are regulations in place to reduce liquidity issues. They entail an obligatory measure requiring banks to maintain sufficient liquid assets to sustain themselves for a specific period without the influx of external funds.

Interest rate risk is the risk that changes in interest rates will decrease the bank's profits. Bank portfolios are subject to interest rate risks in two ways. Firstly, it affects net interest income, which is an important source of profit for the bank. This risk, referred to as earning risk, represents the risk that, due to the bank's asset and liability repricing schedule, it will experience a decline in net interest income, or, in the worst case, negative net interest income. Secondly, interest rate risk affects the present value of a bank's assets and liabilities.

Market risk is primarily generated by a bank's activities in the capital markets. This is due to volatility in equity markets, commodity prices, interest rates, and credit spreads. The more a bank invests in capital markets or engages in sales and trading activities, the more it is exposed to market risks. Diversification of investments is necessary in order to reduce market risk. Another way banks minimize their investment is by hedging it with other investments that are inversely correlated. The value of future cash flows is represented as present value and is a key component in determining a bank's value. This form of interest rate risk may be referred to as Economic Value Risk.

This paper examines market risk and its characteristics, along with methods for computing market risk and market risk capital charges for bonds, and the Basel frameworks that regulate these provisions.

**Market Risk**

The origin of market risk is the probability that an investor may suffer financial losses due to changes in market prices that affect the financial ecosystem of the entire market, a specific segment, or both. These volatile movements can be attributed to factors such as interest rate fluctuations, changes in economic indicators, foreign exchange rates, commodity prices, and even the stock market. This paper focuses on the uncertainties arising from changes in interest rates.

To see how the market risk occurs as a result of the fluctuation in the interest rate, we may understand the following example:

Assume a commercial bank has a portfolio of government bonds of fixed interest (coupon) rate at 6% and a maturity of 10 years.

Now, imagine the central bank decides to raise the benchmark interest rate unexpectedly by 1% (from 6% to 7 %) in a bid to curb inflation. As a result:

- New bonds issued in the marketplace begin to yield 7%, making the previously issued 6% bonds unappealing to prospective investors.
- The market value of older 6% bonds decreases to mitigate the reduced return.
- The bank incurs a mark-to-market loss on the bond portfolio, even though the bonds themselves are fundamentally sound and have an ultimate payoff at maturity.

This downward movement in bond prices due to rising interest rates is a typical example of market risk, particularly interest rate risk.

**Properties of Market Risk**

The prominent characteristics of market risk have been explained as follows:

***Systematic Nature:*** Market risk, especially general market risk, affects the entire market or vast market segments, rather than a particular security or industry.

***Non-diversifiable:*** Unlike specific risk, market risk cannot be eliminated through diversification.

***Volatility Driven:*** Market volatility directly creates market risk by being linked to factors such as interest rates, currency exchange rates, equity prices, and commodity prices.

***Dynamic:*** Market risk is driven by constantly changing macroeconomic factors, including GDP growth, inflation, political stability, international events, and monetary policy.

***Quantifiable:*** It can be computed using statistical models, including, but not limited to, duration models, modified duration models, and internal risk-based models.

**Components of Market Risk**

Market risk is broadly built upon the following two main components:

**General Market Risk**

***Definition:*** This is the possibility of loss arising from general market movements that affect the entire categories of securities. It is unattached to any individual issuer or security.

***Sources of General Market Risk:*** Changes in interest rates (impacting bond prices), equity index movements (e.g., Nifty, S&P 500), exchange rate fluctuations (e.g., USD/INR), and commodity price shifts (e.g., oil, gold), etc.

***Example:*** If the Reserve Bank of India raises the repo rate, companies will have to pay higher borrowing rates, which might curtail the pace of economic activity. Consequently, the equity market could decline, and all investors, regardless of their stock choices, would be affected.

**Specific Market Risk (Issuer Risk)**

***Definition:*** Specific market risk, also referred to as issuer risk, brings about price movements corresponding to factors particular to a specific issuer or security.

***Sources of Specific Market Risk:*** Credit rating downgrades for a company, company-specific news (fraud, bankruptcy, management changes), and industry-specific regulations or disruptions.

***Example:*** When a company such as XYZ Ltd. is cited for fraudulent accounting practices, its bond could experience a precipitous price drop, even as the rest of the bond market remains unaffected. This is specific (idiosyncratic) market risk, and it is only fueled by the conditions of one issuer.

In this paper, the "interest rate" under discussion does not refer to the lending rates banks charge for loans. Instead, it refers to the yield or interest rate on bond investments, particularly government securities. Fluctuations in these bond yields directly affect bond valuations and, in turn, carry risks that are central to the calculation of market risk capital charges.

**Different Methodologies to Calculate Market Risk Capital Charge**

Under Basel II and Basel III guidelines, banks are mandated to maintain regulatory capital in response to market risk, which is the risk of loss on-balance sheet or off-balance sheet positions, as a result of movements in market prices. For interest rate risk (a significant component of market risk), the following methodologies are utilized:

**Gap Analysis**

Gap analysis is an essential method in asset-liability management for assessing a bank's vulnerability to interest rate risk. This model classifies assets and liabilities into time buckets based on their repricing dates. For fixed-rate securities, the repricing date is the same as the maturity date. In contrast, in floating-rate securities, the repricing date may be the earliest date the interest rate can be adjusted.

The difference between the volumes of assets and liabilities subject to repricing within each time bucket is computed—this distinction is referred to as the interest rate gap. It indicates the unhedged component of the portfolio, which is thus exposed to interest-rate changes. A positive gap implies that more assets than liabilities are scheduled to be repriced during a particular period (asset-sensitive), whilst a negative gap represents a liability-sensitive position.

Alongside individual gaps, the cumulative interest rate gap is frequently calculated to assess the bank's overall sensitivity to changes in interest rates across all time horizons, whilst being indifferent to the time bucket in which the mismatches occur. It is essential to know in which way and by how much the gap is supposed to be directed. The positive gap indicates that an increase in interest rates will tend to increase net interest income, while a decrease in interest rates will tend to decrease it. On the other hand, a negative gap would suggest that the bank's earnings might be boosted when interest rates decline, but negatively affected when interest rates increase. The wider the gap, whether positive or negative, the higher the interest rate risk to which that institution is subjected.

Despite its prevalence, GAP analysis has several significant limitations that may affect the accuracy and reliability of interest rate risk measurement. One of the most critical problems is creating time buckets. Such buckets need to be fine-grained enough to capture essential mismatches, yet broad enough to support practical measurements. However, in practice, such trade-offs frequently result in mismatches that go undetected, particularly when assets and liabilities are repriced at different frequencies within the same or proximate buckets. For example, a repriced loan at the end of one month and a deposit at the end of three months would look virtually hedged on paper. However, the bank remains exposed to interest rate fluctuations in the interim.

Moreover, GAP analysis relies on a simplifying presupposition centered on parallel yield curve shifts—a scenario in which all interest rates move in the same direction and by the same amount at the same time. This disregards more sophisticated and accredited risks due to non-parallel shifts, such as yield curve risk and basis risk. Moreover, the correct allocation of some banking products to proper timing buckets is not easy by its nature. Current accounts, overdrafts, and bank capital are products whose contractual maturity may differ markedly from their behavioral maturity. Consequently, a practical application of GAP analysis requires numerous assumptions and internal modeling, both of which may introduce subjectivity and limit its applicability as a risk management tool.

**Standardized Methodology**

The Standardized Methodology is a regulatory process stipulated under the Basel framework for computing the market risk capital charge. It offers a systematic, rule-based technique for determining the potential losses a given financial institution may incur due to unfavourable fluctuations in market parameters, including interest rates, equity prices, foreign exchange rates, and commodity prices.

The coupon rate, or the yield a bond pays, is one of the critical factors to consider when calculating Duration. In a situation where the two bonds are identical in every respect except the coupon rate, the bond with the higher coupon rate will be able to repay its incurred expenses more quickly than the bond with the lower coupon rate. The higher the coupon rate, the lower the Duration and the lower the interest rate risk.

The standardized approach, in contrast to internal models, does not depend on risk estimation models developed in-house by a bank but instead uses standard risk weights, position classifications, and parameters set by the Basel Committee on Banking Supervision (BCBS) (2016) to ensure comparability and homogeneity across banks. It contains:

**Duration Model**

The Duration model represents the weighted-average time at which a bondholder receives the bond's cash flows. It is one of the basic gauges used to assess bond prices' sensitivity to interest-rate fluctuations. The Duration can be computed as the sum of the present values of all cash flows, each multiplied by the time until receipt, divided by the bond's current price.

Present Value Factor (PVF) = 1/[1+(r/100)]n
Present Value Cash Flow = PVF x Cash Flow
Weighted Time (Duration) = Proportionate Cash Flow x Time

The merit of the duration model is that it provides a single numerical figure that is readily comprehensible and indicates the portfolio's overall sensitivity to interest rate risk. In that sense, it offers pretty good hedging grounds; portfolios may be hedged by taking opposite positions in the same instrument with the same Duration.

Simplicity is the major weakness of duration analysis. The one number might misrepresent the mismatch that occurs within more precise periods that offset one another in the aggregate. Additionally, duration analysis fails to account for yield-curve risk and basis risk, assuming that all interest rates move in unison by the same percentage. Moreover, duration analysis is quite resource-intensive when large portfolios are involved, as it requires substantial data.

Although the limitations of the duration model have been well documented, such as the fact that it does not form part of the Basel III regulatory framework, the State Bank of India (SBI), which is the largest public sector bank in the country, continues to use the standardized duration approach while assigning the weights in its computation of market risk capital charges.

**Modified Duration Model**

Modified Duration is a derivative of Duration and provides an exact gauge of a bond's price sensitivity to interest rate fluctuations. It is computed as the Duration divided by one plus the yield to maturity per period. This modification turns Macaulay Duration into a measure of elasticity, i.e., the percentage change in price expected with a 1% change in yield.

Modified Duration = Duration/[1+(r/100)] or Modified Duration = Duration/(1+Yield)

**Internal Risk-Based Model**

The Internal-Risk Based Model, also referred to as the Internal Models Approach or the IMA, is an alternative to the standardized approach featured in the Basel regulatory framework for computing the capital requirement for market risk. Under the IMA regime, banks may use their own internally developed models, such as Value at Risk (VaR) and Expected Shortfall (ES), to estimate their exposure to market risk and potential losses arising from market risk, subject to regulatory approval.

Value at Risk (VaR) is one of the most popular models within this approach, seeking to summarize total market risk as a single value by representing the maximum anticipated loss over a defined time period at a designated confidence level. For example, a banking institution may use VaR to quantify the probability that it will not lose over a given amount of money in a single day with 99 percent confidence. The VaR model was pioneered and popularized by J.P. Morgan, an investment bank, and became standard practice among large global banks prior to the 1990s. Nonetheless, during the same time, its use in smaller banks and foreign banks was minimal. The widespread use of VaR models in the Czech banking industry did not become common until the end of the 1990s. In current practice, the most commonly implemented model for determining interest rate risk in banks' trading books is the "pure" VaR model.

Although the Internal Models Approach enables a bank to match the capital requirements closer with its underlying risk exposures, which may subsequently reduce the amount of capital charges in comparison to the use of the standardized approach, the methodology necessitates a complex and expensive infrastructure, a significant amount of data that has been gathered over time, and advanced competency. The versatility of IMA is accompanied by greater regulatory expectations, such as more frequent audits, stringent backtesting, and stress testing. Underestimation of risk can occur when the model's design contains errors or when the assumptions underlying the model are faulty. That is why regulators pay special attention to the application of internal models to ensure they are not erroneous and sound in risk management.

Table 1. Computation of Capital Charge of Bonds for Market Risk under the Standardized Duration Approach of Basel Norms

| Sl. No. | Details | Amount |
|---|---|---|
| **1** | Cash & Balances with RBI | 200.00 |
| **2** | Bank Balances | 200.00 |
| **3** | Investments | 2000.00 |
| | 3.1 Held for Trading (Market Value)<br>3.2 Available for Sale (Market Value)<br>3.3 Held to Maturity (Market Value) | 500.00<br>1000.00<br>500.00 |
| **4** | Advances (net) | 2000.00 |
| **5** | Other Assets | 300.00 |
| **6** | **Total Assets** | **4700.00** |

A bank may have the following position: (all amounts are in ₹ Crore)

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

In terms of counterparty, the investments are assumed to be as follows:

- Government : ₹ 1,000 Crore
- Banks : ₹ 500 Crore
- Others : ₹ 500 Crore

The details of investments are taken as follows:

Table 2. Government Securities

| Date of Issue | Date of Reporting | Date of Maturity | Amount | Coupon (%) | Type |
|---|---|---|---|---|---|
| **01/03/1992** | 31/03/2003 | 01/03/2004 | 100 | 12.50 | AFS |
| **01/05/1993** | 31/03/2003 | 01/05/2003 | 100 | 12.00 | AFS |
| **01/03/1994** | 31/03/2003 | 31/05/2003 | 100 | 12.00 | AFS |
| **01/03/1995** | 31/03/2003 | 01/03/2015 | 100 | 12.00 | AFS |
| **01/03/1998** | 31/03/2003 | 01/03/2010 | 100 | 11.50 | AFS |
| **01/03/1999** | 31/03/2003 | 01/03/2009 | 100 | 11.00 | AFS |
| **01/03/2000** | 31/03/2003 | 01/03/2005 | 100 | 10.50 | HFT |
| **01/03/2001** | 31/03/2003 | 01/03/2006 | 100 | 10.00 | HTM |
| **01/03/2002** | 31/03/2003 | 01/03/2012 | 100 | 8.00 | HTM |
| **01/03/2003** | 31/03/2003 | 01/03/2023 | 100 | 6.50 | HTM |
| **Total** | | | **1000** | | |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Table 3. Bank Bonds

| Date of Issue | Date of Reporting | Date of Maturity | Amount | Coupon (%) | Type |
|---|---|---|---|---|---|
| **01/03/1992** | 31/03/2003 | 01/03/2004 | 100 | 12.50 | AFS |
| **01/05/1993** | 31/03/2003 | 01/05/2003 | 100 | 12.00 | AFS |
| **01/03/1994** | 31/03/2003 | 31/05/2003 | 100 | 12.00 | AFS |
| **01/03/1995** | 31/03/2003 | 01/03/2006 | 100 | 12.50 | AFS |
| **01/03/1998** | 31/03/2003 | 01/03/2007 | 100 | 11.50 | HFT |
| **Total** | | | **500** | | |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Table 4. Other Securities

| Date of Issue | Date of Reporting | Date of Maturity | Amount | Coupon (%) | Type |
|---|---|---|---|---|---|
| **01/03/1992** | 31/03/2003 | 01/03/2004 | 100 | 12.50 | HFT |
| **01/05/1993** | 31/03/2003 | 01/05/2003 | 100 | 12.00 | HFT |
| **01/03/1994** | 31/03/2003 | 31/05/2003 | 100 | 12.00 | HFT |
| **01/03/1995** | 31/03/2003 | 01/03/2006 | 100 | 12.50 | HTM |
| **01/03/1998** | 31/03/2003 | 01/03/2017 | 100 | 11.50 | HTM |
| **Total** | | | **500** | | |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Table 5. Overall Position

| | **Break-up of Total Investments (₹ in Crore)** | | | |
|---|---|---|---|---|
| | **Government Securities** | **Bank Bonds** | **Other Securities** | **Total** |
| **HFT** | 100 | 100 | 300 | **500** |
| **AFS** | 600 | 400 | 0 | **1000** |
| **Trading Book** | **700** | **500** | **300** | **1500** |
| **HTM** | 300 | 0 | 200 | **500** |
| **Total** | **1000** | **500** | **500** | **2000** |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Note: As per the guidelines, Held for Trading (HFT) and Available for Sale (AFS) securities qualify for categorization as Trading Book. Thus, the trading book in the instant case would be ₹ 1,500 crore, as indicated above. Whereas, Held to Maturity (HTM) securities would fall under the Banking Book. While computing market risk, securities held under the trading book would be included, and the risk-weighted assets for market risk would be as follows.

**Risk-Weighted Assets for Market Risks (Trading Book)**

***Specific Risk***

Government Securities: ₹700 crore—Nil

Table 6. Bank Bonds

| Details | Capital Charge | Amount | Capital Charge |
|---|---|---|---|
| **For the residual term to final maturity of 6 months or less** | 0.30% | 200 | 0.60 |
| **For the residual term to final maturity between 6 and 24 months** | 1.125% | 100 | 1.125 |
| **For the residual term to final maturity exceeding 24 months** | 1.80% | 200 | 3.60 |
| **Total** | | **500** | **5.325** |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Other Securities: ₹300 crore @ 9% = ₹27 crore

**Total charge for specific risk**: (i) + (ii) + (iii)

= ₹0 crore + ₹5.325 crore + ₹27 crore

= **₹32.325 crore**

Therefore, the capital charge for specific risk in the trading book is ₹32.325 crore.

### General Market Risk

Modified Duration is used to determine the price sensitivity of an interest-rate-related instrument. For all the securities listed below, the reporting date is taken as 31/3/2003.

Table 7. Yield (assumed) = 10% (in each case)

| Sl. No. | Counter Party | Maturity Date | Amount (Market Value) | Coupon (%) |
|---|---|---|---|---|
| **1** | Government | 01/03/2004 | 100 | 12.50 |
| **2** | Government | 01/05/2003 | 100 | 12.00 |
| **3** | Government | 31/05/2003 | 100 | 12.00 |
| **4** | Government | 01/03/2015 | 100 | 12.00 |
| **5** | Government | 01/03/2010 | 100 | 11.50 |
| **6** | Government | 01/03/2009 | 100 | 11.00 |
| **7** | Government | 01/03/2005 | 100 | 10.50 |
| **8** | Banks | 01/03/2004 | 100 | 12.50 |
| **9** | Banks | 01/05/2003 | 100 | 12.00 |
| **10** | Banks | 31/05/2003 | 100 | 12.00 |
| **11** | Banks | 01/03/2006 | 100 | 12.50 |
| **12** | Banks | 01/03/2007 | 100 | 11.50 |
| **13** | Others | 01/03/2004 | 100 | 12.50 |
| **14** | Others | 01/05/2003 | 100 | 12.00 |
| **15** | Others | 31/05/2003 | 100 | 12.00 |
| | | | **1500** | |

Source: https://iibf.org.in/documents/MasterCirculars/RiskManagement/1.%20Prudential%20Norms%20on%20Capital%20Adequacy%20-%20Basel%20I%20Framework.pdf

Table 8. Maturity Date = 01/03/2004

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.92** | 111.50 | 0.916 | 102.134 | 1 | **0.92** |

Modified Duration = 0.92/[1+(10/100)] = 0.836 = ₹0.84 crore …………….(1)

Table 9. Maturity Date = 01/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.083** | 100.996 | 0.992 | 100.19 | 1 | **0.083** |

Modified Duration = 0.083/[1+(10/100)] = 0.075 = ₹0.08 crore …………….(2)

Table 10. Maturity Date = 31/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.17** | 102.04 | 0.984 | 100.41 | 1 | **0.17** |

Modified Duration = 0.17/[1+(10/100)] = 0.155 = ₹0.16 crore …………….(3)

Table 11. Maturity Date = 01/03/2015

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 12.00 | 0.91 | 10.92 | 0.096 | 0.096 |
| **2** | 12.00 | 0.83 | 9.96 | 0.088 | 0.176 |
| **3** | 12.00 | 0.75 | 9.00 | 0.079 | 0.237 |
| **4** | 12.00 | 0.68 | 8.16 | 0.072 | 0.288 |
| **5** | 12.00 | 0.62 | 7.44 | 0.066 | 0.330 |
| **6** | 12.00 | 0.56 | 6.72 | 0.059 | 0.354 |
| **7** | 12.00 | 0.51 | 6.12 | 0.054 | 0.378 |
| **8** | 12.00 | 0.47 | 5.64 | 0.050 | 0.400 |
| **9** | 12.00 | 0.42 | 5.04 | 0.044 | 0.396 |
| **10** | 12.00 | 0.39 | 4.68 | 0.041 | 0.410 |
| **11** | 12.00 | 0.35 | 4.20 | 0.037 | 0.407 |
| **11.92** | 111.04 | 0.32 | 35.53 | 0.313 | 3.73 |
| | | | **113.4** | | **7.20** |

Modified Duration = 7.20/[1+(10/100)] = 6.545 = ₹6.55 crore …………….(4)

Table 12. Maturity Date = 01/03/2010

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 11.50 | 0.91 | 10.465 | 0.097 | 0.097 |
| **2** | 11.50 | 0.83 | 9.545 | 0.089 | 0.178 |
| **3** | 11.50 | 0.75 | 8.625 | 0.080 | 0.240 |
| **4** | 11.50 | 0.68 | 7.82 | 0.073 | 0.292 |
| **5** | 11.50 | 0.62 | 7.13 | 0.066 | 0.330 |
| **6** | 11.50 | 0.56 | 6.44 | 0.059 | 0.354 |
| **6.92** | 110.58 | 0.52 | 57.501 | 0.535 | 3.702 |
| | | | **107.53** | | **5.193** |

Modified Duration = 5.193/[1+(10/100)] = 4.721 = ₹4.72 crore …………….(5)

Table 13. Maturity Date = 01/03/2009

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 11.00 | 0.91 | 10.01 | 0.158 | 0.158 |
| **2** | 11.00 | 0.83 | 9.13 | 0.087 | 0.174 |
| **3** | 11.00 | 0.75 | 8.25 | 0.079 | 0.237 |
| **4** | 11.00 | 0.68 | 7.48 | 0.072 | 0.288 |
| **5** | 11.00 | 0.62 | 6.82 | 0.065 | 0.325 |
| **5.92** | 110.12 | 0.57 | 62.77 | 0.601 | 3.56 |
| | | | **104.46** | | **4.742** |

Modified Duration = 4.742/[1+(10/100)] = 4.311 = ₹4.31 crore …………….(6)

Table 14. Maturity Date = 01/03/2005

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 10.50 | 0.91 | 9.56 | 0.095 | 0.095 |
| **1.92** | 109.66 | 0.83 | 91.02 | 0.905 | 1.738 |
| | | | **100.58** | | **1.833** |

Modified Duration = 1.833/[1+(10/100)] = 1.666 = ₹1.67 crore …………….(7)

Table 15. Maturity Date = 01/03/2004

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.92** | 111.50 | 0.916 | 102.134 | 1 | **0.92** |

Modified Duration = 0.92/[1+(10/100)] = 0.836 = ₹0.84 crore …………….(8)

Table 16. Maturity Date = 01/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.083** | 100.996 | 0.992 | 100.19 | 1 | 0.083 |

Modified Duration = 0.083/[1+(10/100)] = 0.075 = ₹0.08 crore …………….(9)

Table 17. Maturity Date = 31/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.17** | 102.04 | 0.984 | 100.41 | 1 | **0.17** |

Modified Duration = 0.17/[1+(10/100)] = 0.155 = ₹0.16 crore …………….(10)

Table 18. Maturity Date = 01/03/2006

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 12.50 | 0.91 | 11.375 | 0.107 | 0.107 |
| **2** | 12.50 | 0.83 | 10.375 | 0.097 | 0.194 |
| **2.92** | 111.50 | 0.76 | 84.74 | 0.796 | 2.324 |
| | | | **106.49** | | **2.625** |

Modified Duration = 2.625/[1+(10/100)] = 2.386 = ₹2.39 crore …………….(11)

Table 19. Maturity Date = 01/03/2007

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **1** | 11.50 | 0.91 | 10.465 | 0.099 | 0.291 |
| **2** | 11.50 | 0.83 | 9.545 | 0.091 | 0.182 |
| **3** | 11.50 | 0.75 | 8.625 | 0.082 | 0.246 |
| **3.92** | 110.58 | 0.69 | 76.300 | 0.727 | 2.849 |
| | | | **104.935** | | **3.568** |

Modified Duration = 3.568/[1+(10/100)] = 3.244 = ₹3.24 crore …………….(12)

Table 20. Maturity Date = 01/03/2004

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.92** | 111.50 | 0.916 | 102.134 | 1 | **0.92** |

Modified Duration = 0.92/[1+(10/100)] = 0.836 = ₹0.84 crore …………….(13)

Table 21. Maturity Date = 01/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.083** | 100.996 | 0.992 | 100.19 | 1 | **0.083** |

Modified Duration = 0.083/[1+(10/100)] = 0.075 = ₹0.08 crore …………….(14)

Table 22. Maturity Date = 31/05/2003

| Years | CF | PVF | PVCF | Prop. CF | Duration |
|---|---|---|---|---|---|
| **0.17** | 102.04 | 0.984 | 100.41 | 1 | **0.17** |

Modified Duration = 0.17/[1+(10/100)] = 0.155 = ₹0.16 crore …………….(15)

**Total charge for general market risk :** (1) + (2) + (3) + (4) + (5) + (6) + (7) + (8) + (9) + (10) + (11) + (12) + (13) + (14) + (15)

= ₹0.84 crore + ₹0.08 crore + ₹0.16 crore + ₹4.84 crore + ₹4.27 crore + ₹3.92 crore + ₹1.28 crore + ₹0.84 crore + ₹0.08 crore + ₹0.16 crore + ₹1.66 crore + ₹2.07 crore + ₹0.84 crore + ₹0.08 crore + ₹0.16 crore

= **₹21.28 crore**

Therefore, **the capital charge for general market risk** in the trading book is **₹21.28 crore.**

**Total Charge for Market Risk**

Adding the capital charges for specific risk and general market risk would give the total capital charge for the trading book of interest-rate-related instruments. Therefore,

**Capital Charge for Market Risks** = **₹**32.33 crore + **₹**21.28 crore
= **₹**53.61 crore

**Computation of CRAR—Whole Book**

To facilitate the computation of CRAR for the entire book, this capital charge must be converted into equivalent risk-weighted assets. In India, the minimum CRAR is 9%. Hence, the capital charge could be converted to risk-weighted assets by multiplying the capital charge by (100 ÷ 9).

Thus, risk-weighted assets for market risk = 53.61 x (100 ÷ 9)
= 5,361 ÷ 9
= ₹595.67 crore

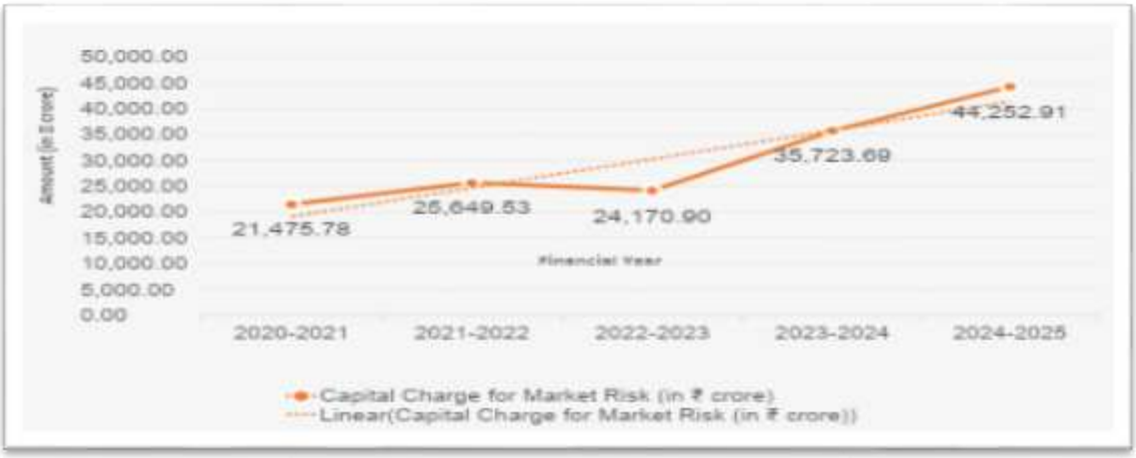
**Market Risk Capital Charge of SBI under Pillar III Disclosures**

The following table presents the capital charge for market risk (in ₹ crore) and percentage change from the previous financial year for 5 successive financial years starting from 2020-2021 of State Bank of India (SBI):

Table 23. Financial Year (FY) with Capital Charge for Market Risk

| Financial Year (FY) | Capital Charge for Market Risk (in ₹ crore) | Percentage Change (from previous FY) |
|---|---|---|
| **2020-2021** | 21,475.78 | N/A |
| **2021-2022** | 25,649.53 | 19.43 |
| **2022-2023** | 24,170.90 | -5.76 |
| **2023-2024** | 35,723.69 | 47.80 |
| **2024-2025** | 44,252.91 | 23.88 |

Source: SBI Annual Reports 2020-2021, 2021-2022, 2022-2023, 2023-2024, and 2024-2025



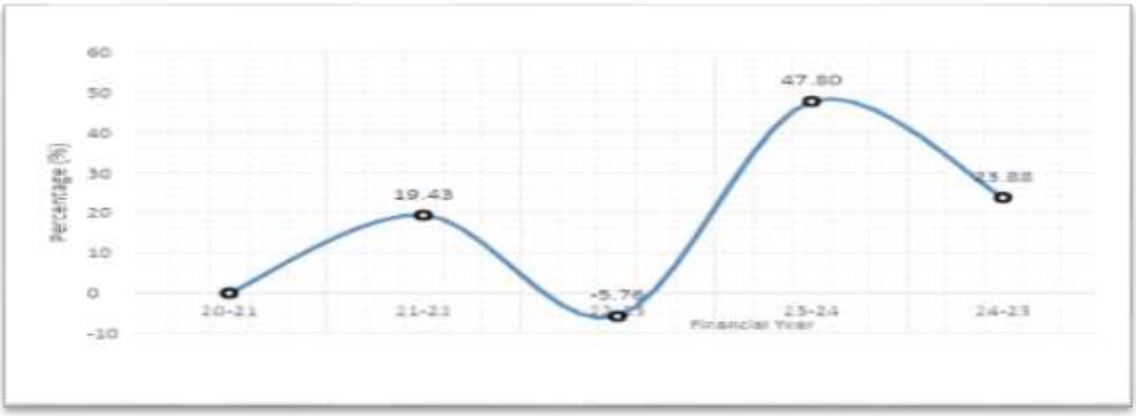




Figure 1. Market risk capital charge over the five consecutive

The graph of the market risk capital charge over the five consecutive financial years shows fluctuating but generally upward movement. A minimal increase was observed between 2020-2021 and 2021-2022, suggesting that the bank's exposure to market risk increased during the period, followed by a subsequent drop in 2022-2023, reflecting greater market stability. Nevertheless, the capital charge increased in 2023-2024 and was followed by further growth in 2024-2025, demonstrating heightened risk exposure.

Notwithstanding these annual variations, the general trend line is upwards, indicating an overall increase in the market risk capital charge of the State Bank of India (SBI) over the five years. This indicates that the SBI is experiencing greater market volatility.

**Validating Modified Duration Formula**

***Relationship between 10-year bond yields and the capital requirement for interest rate risk***

Modified Duration expresses the change in the value of an interest rate security (bond) due to a one percent change in yield. If there is an increase in the yield of one per cent, it will decrease the value of a bond by the percentage amount of the modified Duration and vice versa. Modified Duration provides the capital charge that banks must maintain against downward fluctuations in bond prices at a given yield. Modified duration= Duration/1+Yield. As yield changes, the modified duration changes. Modified Duration is the capital charge or capital requirement for a bond. If the yield increases, the modified Duration or the capital charge/requirement for the bond decreases, and vice versa. Here, a correlation between' 10-year bond yields' and 'Capital charge/requirement for interest rate risk of a bond' has been calculated to assess the impact on the modified Durations of the bonds of the State Bank of India from 2015-16 to 2019-2020.

Table 24. Year bond yields and capital requirement for the interest rate risk

| Year | 10-year govt. securities yields (%) | Capital requirement for interest rate risk (Rs Cr) |
|---|---|---|
| **15-16** | 7.71 | 7621.38 |
| **16-17** | 7.05 | 10,491.37 |
| **17-18** | 7.05 | 14481.42 |
| **18-19** | 7.7 | 11328.37 |
| **19-20** | 6.8 | 9913.09 |
| **20-21** | 6.04 | 13,789.64 |
| **21-22** | 6.43 | 14,552.67 |
| **22-23** | 7.35 | 12,373.98 |
| **23-24** | 7.17 | 18,801.14 |
| **24-25** | 6.86 | 9,117.78 |

Source: https://data.rbi.org.in/BOE/OpenDocument/2409211437/OpenDocument/opendoc/openDocument.jsp?logonSuccessful=true&shareId=1

The correlation coefficient (ρ) between '10 year bond yields' and 'capital requirement for interest rate risk' is -0.21.

**Hypothesis Testing**

At the 5% level of significance and with the test statistic t = r*√(n-2)/√(1-r2), with r = -0.21 and n = 5, the t statistic is -0.37. The table value at 3 degrees of freedom for a two-tailed test is 3.18. As the table value is more than the calculated t value, the null hypothesis is accepted, and the alternative hypothesis is rejected. The result supports the formula of modified Duration—both the variables 10-year govt. Security yields and 'capital requirement for interest rate risk' are negatively correlated with each other. This means that a decrease in bond yields increases the capital requirement for interest rate risk and vice versa.

## CONCLUSIONS

The purpose of this study was to understand the concept of Duration and modified duration models in calculating market risk capital charges for bond portfolios under the standardized methodology, and to assess its effectiveness in capturing interest rate sensitivity of bonds while also demonstrating the trend of capital charge for market risk (in ₹ crore) and its percentage change over five successive financial years of SBI.

The analysis of market risk capital charges under the standardized duration model illustrates the significant role of Duration and modified Duration in measuring the interest rate sensitivity of bonds. These measures provide a more risk-sensitive basis of capital allocation, ensuring that regulatory capital requirements align with underlying market risks. The computation of the general market risk capital charge shows that as a bond's maturity increases, its modified Duration rises, thereby increasing the capital charge due to the greater sensitivity of long-term bonds to interest rate fluctuations. Similarly, longer maturities also lead to higher specific risk capital charges, reinforcing the regulatory premise that instruments with longer durations carry greater market risk.

At the portfolio level, converting capital charges into risk-weighted assets (RWAs) provides a clear picture of capital adequacy. For SBI, the total market risk capital charge of ₹53.61 crore—comprising ₹32.33 crore of specific risk and ₹21.28 crore of general market risk—translates into RWAs of ₹595.67 crore.

Although the limitations of the duration model have been well documented, the State Bank of India (SBI), the largest public sector bank in the country, continues to use the standardized duration approach when assigning weights in its computation of market risk capital charges. The upward trend over the last five financial years suggests that the bank requires greater capital buffers to cushion against market shocks.

Correlation analysis indicates a negative relationship (-0.21) between the 10-year government security yield and the capital charge for interest rate risk. Though the correlation is relatively weak, this is due to the following reasons: a. interest rate derivatives may have long positions, which increase capital charges, which are different from the yield effect; b. interest rate derivatives may have short positions decreasing the capital charges, which again are different from the yield effect; c. bonds are subject to 'specific risk capital charge', which are different from the yield effect; d. Options are also subject to both general market risk capital charges and specific market risk capital charges, which are separate from the yield effect on the capital charge.

This increase in capital requirements has important macro-financial implications. When banks issue more capital, the cost of capital rises because new funds cannot be obtained at the previous, prevailing low rates. Banks, therefore, experience an increase in the cost of funds, ultimately raising the interest rates they charge on loans. This increases the cost of borrowing for corporations and other borrowers and, consequently, discourages investment owing to lower profitability. Although this might seem like a deterrent to economic activities, it is actually a strategic monetary tool used to regulate inflation. In essence, it makes borrowing more costly and, in turn, reduces excessive investment and demand, thereby promoting financial sustainability and overall economic stability, which remain the ultimate objectives of the financial system.

The study's unique contribution is a systematic, step-by-step framework for calculating market risk capital charges under the standardized duration model, demonstrating its practical applicability in real-world banking operations. Additionally, it contributes by validating the modified duration formula and understanding how changes in bond yields affect the capital requirement for interest rate risk, and vice versa.

Limitations of the study include: the focus on a single bank, SBI, which, while the major public sector banking institution of the country, may not capture all variations in banking practices; the five-year timeframe, which may not reflect longer-term market cycles; and the focus on interest rate risk, with other types of market risks (foreign exchange risk and equity risk) not examined in detail.

Future research can extend this framework to include multiple banks, longer time horizons, and additional market risk factors to provide a broader understanding of capital adequacy under evolving financial conditions.

To sum up, the standardized duration model, despite its shortcomings, remains crucial to the regulatory framework for market risk in India, especially for capital adequacy. The trends in the capital charge and subsequent macroeconomic factors underscore that risk regulation is inseparably linked to bank activity and the overall stability of the economy.

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