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Interest rate risk in banking book management at commercial banks in Vietnam

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Abstract: Interest rate risk is potentially averse to a commercial bank's trading book and banking book. The sharp and rapid volatility of interest rates can push commercial banks to fall into difficult situations, thus leading to instability of the whole banking system. Therefore, interest rate risk in banking book (IRRBB) management plays a vital role in banking operations. This paper analyzes the current management of IRRBB at 21 commercial banks in Vietnam by doing in-depth interviews and questionnaires. The finding indicates that the level of IRRBB management of commercial banks in Vietnam is mostly relatively completed or inadequate, with the highest levels belonging to international commercial banks and the banks that implement Basel II. Furthermore, the study also executes a simulation of IRRBB management at one commercial bank according to current regulations of the State Bank of Vietnam. Based on the selected interest rate scenarios, the capital requirement for IRRBB is calculated, which is the actual simulation for commercial banking in implementing the IRRBBB framework. Finally, to improve the effectiveness of IRRBB management in Vietnam, some implications for the State Bank of Vietnam and commercial banks are provided.

Keywords: *Bank management, Basel, Interest rate risk in the banking book, IRRBB.*
JEL Classifications: *E43; G21; G22.*

1. Introduction

The saving and credit crisis in the 1980s is argued to be a consequence of interest rate risk in the banking book (IRRBB), which must be managed more strictly and effectively (BCBS, 2012; Scandizzo, 2016). In the trading book, banks engage in short-term buying and selling of financial instruments such as stocks, bonds, currencies, and derivatives. In contrast, the banking book primarily consists of assets and liabilities held for the long term, including loans, mortgages, and deposits. Therefore, the banking book is more exposed to interest rate risk, as it includes long-term loans and deposits sensitive to interest rate changes (BCBS, 2004). Since 2004, the Basel Committee has provided regulators with some guidelines in interest rate risk management, including interest rate risk on banking book and trading books (BCBS, 2004). According to the Basel Accords, the first thirteen principles are applied for general interest rate management regardless of whether the items are in the banking book or trading book. The next two principles (14 and 15) specifically regulate the monitoring and governance of interest rates in the banking book. Recently, BCBS (2016) has issued separate regulations on this type of risk. This instruction includes 12 principles, which are categorized into three groups: management process (principles 1 to 7), disclosure and internal assessment (principles 8 and 9), and supervisory assessment (principles 10 to 12).

Moreover, the Central Bank and banking supervisory authorities also update and issue separate regulations relating to IRRBB management. In 2015, the European Banking Association (EBA) updated the 2006 version to provide technical guidance for commercial banks in calculating and measuring IRRBB as a part of the ICAAP- Internal Capital Adequacy Assessment Process (EBA, 2015). The Australian Prudential Regulation Authority (APRA) issued guidelines on IRRBB in 2008 and improved

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this version in 2013 (APRA, 2013). Furthermore, the National Bank of Belgium (NBB) introduced the latest regulations regarding IRRBB in 2015, in which commercial banks are required to preserve capital adequacy for IRRBB (NBB, 2015). Otherwise, they have to conduct a review and execute a resolution. Many regulations and modern techniques in IRRBB measurement, assessment, and management have been introduced, demonstrating an increasing concern for this issue.

In Vietnam, commercial banks' primary task is to improve general management skills and risk management following international standards in particular. One challenge Vietnamese commercial banks face is the need for an IRRBB governance mechanism (Vu et al., 2023). Since 2018, the State Bank of Vietnam (SBV), also known as the Central Bank of Vietnam, has introduced Circular No. 13/2018/TT-NHNN, outlining guidelines for the internal control system within credit institutions. Notably, this Circular addresses the management of Interest Rate Risk in the Banking Book (IRRBB) and sets forth capital requirements associated with IRRBB. Circular No. 13/2018/TT-NHNN marks the inaugural acknowledgment by the SBV, on a legal basis, of IRRBB as a material risk in banking operations. Precisely, IRRBB management consists of three segments: (i) Management strategy and limits on IRRBB exposures (Article 56), (ii) Identification, measurement, and control of IRRBB (Article 57); and IRRBB internal report (Article 58). Moreover, SBV requires all banks to determine the capital buffer for IRRBB as one part of internal capital calculation. Although Basel and the State Bank of Vietnam (SBV) have issued guiding principles, commercial banks must still adopt methods appropriate to their individual operations (Bloechlinger, 2021). While IRRBB management is a critical activity for commercial banks in Vietnam, only a few have successfully implemented this process. This paper aims to evaluate the current situation of IRRBB management commercial banks in Vietnam and develop the detail model to implement IRRBB management and computation economic capital for IRRBB. This simulation can assist banks that have not yet effectively implemented IRRBB management by helping them save resources and reduce costs in their IRRBB management activities through the application of the model.

The paper is constructed as follows: Section 1 is about the introduction to the regulation of IRRBB management in Basel and Vietnam, and it shows the IRRBB management framework. Section 2 is a literature review of IRRBB and IRRBB management in banks. Section 3 will describe research method. A picture of current IRRBB management at commercial banks in Vietnam and simulation about IRRBB in a Vietnamese commercial bank are reported in Section 4, and the suggestion to improve IRRBB in Vietnamese commercial banks is given in Section 5.

2. Literature Review

Interest rate risk in banking book (IRRBB) refers to the current or prospective risk to a bank's capital and earnings arising from adverse movements in interest rates that affect banking book positions (Ward, 2004; Lubinska, 2021). Lileikiene and Likus (2011) characterized interest rate risk as the potential for losses resulting from fluctuations in interest rates stemming from imbalances between assets and liabilities. When interest rates change, the present value and the timing of future cash flows change. It, in turn, changes the underlying value of a bank's assets, liabilities, and off-balance sheet items and, hence, its economic value of equity (EVE) (Ward, 2004; Chaudron, 2016; Blochlinger, 2021). Changes in interest rates also affect a bank's earnings by altering interest rate-sensitive income and expenses, thus affecting its net interest income (NII) (Ward, 2004; Chaudron, 2016; Blochlinger, 2021). IRRBB is a combination of three types of risks, namely Gap Risk, Basis Risk, and Option Risk (BCBS, 2016). All three could potentially threaten a bank's value/price or earnings/costs of rate-sensitive liabilities and assets and other off-balance sheet items (Ngalawa & Ngare, 2014).

No unified paradigm has yet emerged on the best method of measuring interest rate risk in the banking book (Kuritzkes & Schuermann, 2006; Alessandri & Drehmann, 2010). The Basel Committee points to this as an essential reason why interest rate risk in the banking book is not standardized in the Basel II capital framework (BCBS, 2004). Interest rate risk in the banking book can either be measured by earnings at risk or using an economic value approach. The latter measures the impact of interest rate shocks on the value of assets and liabilities, whereas the former looks at the impact of the shocks on the cash flow generated by the portfolio (i.e., a bank's net interest income) (BCBS, 2009).

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Banks employ various tools to manage these risks, including using interest rate derivatives (Rose & Hudgins, 2005; Hull, 2003; Lubinska, 2021). Diamond (1984) model suggests that, given the presence of costly bank failures, banks should hedge all market risks, including interest rate risk, where they lack particular monitoring advantages. The model also indicates that effective interest rate risk management can enhance the intermediation efficiency of banks, enabling them to take on more credit risk. Smith and Stulz (1985) demonstrate that hedging interest rate risk can increase firm value by reducing the anticipated transaction costs of bankruptcy. Froot et al., (1993) incorporate the cost of financial distress into their analysis, contending that firms should hedge to avoid the expenses associated with external financing during periods of low internal cash flow. Additional motivations for risk management encompass managerial risk aversion, information asymmetry between firm insiders and outsiders, enhanced debt capacity, and the convexity of taxes (Stulz, 2022; Smith & Stulz, 1985; Demarzo & Duffie, 1999; Leland, 1998).

In recent years, the Regulatory Framework and Guidelines on interest rate risk management put forth by the Basel Committee on Banking Supervision (BCBS) have played a crucial role in shaping risk management practices in the global banking sector. The 2004 version delineates fundamental principles for financial institutions to address interest rate risk comprehensively. It provides a structured approach for risk identification and mitigation (BCBS, 2004). The subsequent 2016 version represents an evolution in response to changes in the financial landscape (BCBS, 2016). This update introduces more stringent standards, emphasizing the importance of stress testing, enhancing disclosure requirements, and providing a more refined framework for managing interest rate risk in the banking book. The 2016 version reflects the BCBS's commitment to adapting regulatory guidelines to address emerging challenges and promote the resilience of banking institutions.

In Vietnam, according to Basel guidelines and Circular No.13/2018/TT-NHNN, the current regulation of SBV, which includes IRRBB management and IRRBB management framework at commercial banks, is shown in Finger 1. In particular, this framework consists of:

(i) Oversight of senior managers on IRRBB, including establishment, approval, implementation, and annual revision of IRRBB management strategies, policies, and limits and development and approval of limits on IRRBB aligned with the bank's risk appetite;

(ii) Risk identification in terms of all causes leading to IRRBB and positions in the banking book suffered by changes in interest rate.

(iii) Measurement and assessment of IRRBB comprising methodology and measurement of IRRBB, IRRBB stress tests, and calculation of capital buffer for IRRBB.

(iv) Monitoring and controls such as controlling, preventing, and mitigating interest rate risk.

(v) Issuance of IRRBB report

In the IRRBB management framework, box number 1 is about the responsible of governing body of each bank for the for the overall oversight of the IRRBB management; Box number 2, 3, and 4 followed the process of IRRBB identification, IRRBB measurement and assessment and IRRBB monitoring and controls; Box number 5 is about IRRBB report on all activities conducted regarding IRRBB management.

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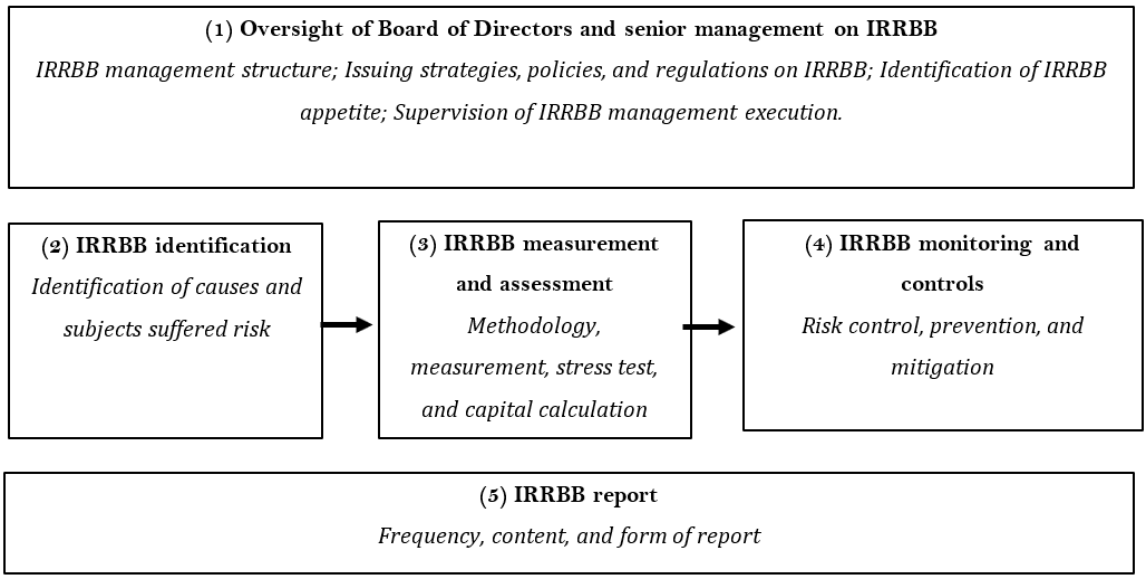

Figure 1.
Interest rate risk in banking book management framework at commercial banks.

To measure IRRBB, BCBS (2004) and BCBS (2005) requires banks to include all sources of interest rate risk and evaluate the impact of interest rate changes following the bank's operations. BCBS (2016) promulgated new regulations about IRRBB, including IRRBB measurement principles that should be based on the results of both economic value measures and income-based measures arising from a range of suitable interest rate shocks and stress scenarios. The set of principles for IRRBB management provides stricter standards (Fessler, 2016; Deloitte, 2017). IRBBB measurement and assessment usually have two objectives: in the long term is the change in economic value equity (EVE), and the short term is the change of net interest income (NII) (Sharma, 2012; Ozdemir & Sudarsana, 2016; Zijderveld, 2017; Wycisk & Blijlevens, 2018). EBA (2018) guides two modeling indicators: unconditional cash flows and cash flows partially or fully conditional on interest scenarios for different categories of institutions.

Applied the guidance of financial supervisors and central banks, authors and commercial banks could apply various tools or techniques to measure and assess IRRBB. Fiori and Iannotti (2006) conducted a stress test of interest rate risk for Italian Banks using Monte Carlo simulation and the principal component VaR model. Esposito et al. (2013) applied the duration gap approach to 68 Italian intermediaries to measure interest rate risk in banks. Zigiene and Valukonis (2022) applied earnings-based gap analysis under unconditional cash flow and tested for the small domestic bank from the Baltics. Curcio et al. (2022) analyzed a supervisory outlier test for net interest income for 28 Italian commercial banks and suggested calibrating the thresholds. ClauBen and Platte (2023) evaluated the validity of interest rate risk measures using a simulation approach. They concluded that EVE and NIII are significant inherent interest rates and that EVE is a robust and conclusive risk measure. Endri et al. (2020) evaluated the macro and micro factors on the net interest margin of commercial banks in Indonesia.

Supervisors and financial institutions commonly use stress testing to evaluate the impact of interest rate scenarios on commercial banks. The IRRBB stress test, therefore, is applied to evaluate the impact of interest rate scenarios on commercial banks in terms of NII and EVE. Nguyen et al. (2017, 2019) investigate the interest rate pass-through from the monetary policy rate to the market rate. Commercial banks must calculate the amount of capital shortage or capital requirement for IRRBB based on the most adverse scenario. The efficiency of the IRRBB stress test depends directly on the scenarios built (Abdymomunov & Gerlach, 2014). BCBS (2014) suggests six alternative methods to make interest rate risk scenarios: parallel shock up, parallel shock down, steeper shock, flattener shock, short rates shock up, and short rates shock down. Memmel (2008) built and evaluated 260 historical interest rate shocks

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on the interest income of banks of German savings banks and cooperative banks. In addition, to conduct an IRRBB stress test on a sample of large United States banks, Abymomuvov and Gerlach (2014) proposed a new methodology for constructing yield-curve scenarios encompassing a diverse range of slopes and shapes. Drager et al. (2021) analyze the effect of a 200 basis points increase in the interest level on the bank's bond portfolio and net income for small and medium-sized German banks.

Although some studies on IRRBB management in banks exist, most focus on general guidelines (BCBS, 2004; BCBS, 2016; BIS, 2005; EBA, 2018) or specific aspects of the IRRBB process, such as IRRBB measurement (Sharma, M. 2012; Ozdemir & Sudarsana, 2016; Zijderveld, 2017; Wycisk & Blijlevens, 2018); stress test for IRRBB (ClauBen and Platte, 2023; Curcio et al., 2022; Endri et al., 2020; Esposito et al., 2013; Fiori and Iannotti, 2006; Žigienė and Valukonis, 2022) rather than providing a comprehensive analysis of the entire IRRBB management process. The scientific literature on IRRBB management, particularly regarding the whole IRRBB management process to calculate economic capital for IRRBB, remains limited. In addition, there has yet to be any study on the current state of IRRBB management in Vietnamese commercial banks. Therefore, this paper would provide a significant contribution to the subject.

3. Methodology

To assess the current management situation of IRRBB at 21 commercial banks in Vietnam by doing in-depth interviews and questionnaires. This study collected data from a questionnaire sent directly to bank staff working at Basel departments, risk management department, treasury department, and market risk management department of 21 Vietnamese commercial banks. The banks selected are divided into three groups as follows:

Group 1: includes a group of 09 banks selected by SBV to implement Basel II, including BIDV, VietinBank, Vietcombank, Techcombank, ACB, VPBank, MB, Maritime Bank, and VIB.

Group 2: The remaining Vietnamese commercial banks are not in Group 1.

Group 3: Some foreign commercial banks operating in Vietnam. These are international commercial banks that are deployed in Basel II.

From the above bank grouping, 35 questionnaires were sent out, and 27 were received, including 21 valid and six invalid votes. The respondents surveyed are representatives from the banks regarding the management of IRRBB. Of the 21 valid responses, are nine from Group 1, 10 from Group 2, and 2 from Group 3. The questionnaire consists of 14 questions, which focus on assessing the implementation of IRRBB management in Vietnamese commercial banks. The questionnaire consists of open questions and multiple-choice questions. Besides, to measure the level of implementation of each step in IRRBB management, a five (5) point Likert scale is built that ranges from none (0) to full implementation (4) (as shown in the Appendix). This method is applied to assess the state of policy implementation in the banking sector, which is used by ECB (2020) and Nguyen et al. (2021). The specific score scale is as follows:

- 0: None (0%);
- 1: Very few (less than 10%);
- 2: Yes, but still limited/inadequate (less than 50%);
- 3: relatively completed (from 50% to less than 100%);
- 4: Full/completed (100%)

To stimulate the IRRBB management in a Vietnamese commercial bank. This bank is one of 9 commercial banks in the Basel 2 pilot group (called Bank Z). The simulation will be based on the Basel regulations about IRRBB management in banks, Circular No.13/2018/TT-NHNN about the internal control systems of commercial banks and the foreign banks' branches as the current regulations of Vietnam related to IRRBB management. The simulation will follow the IRRBB management process, which includes IRRBB identification, IRRBB measurement and assessment by Gap model to calculate the change in net income and change in economic equity, IRRBB Stress test and Capital requirement for IRRBB to calculate the economic capital requirement for a chosen commercial bank. This simulation outlines each step that needs to be taken in the IRRBB management process, especially in developing a

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model to measure IRRBB and calculate the required economic capital for IRRBB. Commercial banks in Vietnam can save resources in their IRRBB management following this simulation and model.

The simulation followed these steps: (i) IRRBB identification, (ii) IRRBB measurement and assessment by applying the GAP model to calculate the change in net interest income and change in the economic value of equity; (iii) implement IRRBB stress test and calculate the economic capital requirement for IRRBB. Each step will be analyzed and developed in detail based on the principles of Basel and the regulations of the State Bank of Vietnam (SBV) in the following sections.

4. Results and Discussion

4.1. Situation of Interest Rate in Banking Book Management in Vietnamese Commercial Banks

4.1.1. Board of Directors and Senior Management Oversight

In most banks, the oversight function of the Board of Directors and the Senior management in the IRRBB management framework is expected to include (i) supervising the IRRBB management, (ii) building IRRBB management strategy, (iii) defining its risk appetite for IRRBB.

Firstly, about supervising the IRRBB management, Vietnamese commercial banks must establish the three lines of defense model for better risk management according to Circular No.13/2018/TT-NHNN released by SBV. In addition, it is necessary to ensure the oversight function of the Board of Directors and Senior Management in risk management. Specifically, commercial banks must develop a risk management and supervision structure as follows: Board of Directors or Board of Members supervises the CEO; the CEO supervises and conducts individuals and departments based on the recommendations and advice of the Risk Committee. In fact, according to our survey on the implementation of IRRBB management in Vietnamese commercial banks, this structure has been almost completed in the banks of group 1, which have developed the model, organizational structure, functions, and objectives of the committees to support the senior management to conduct the supervision function as prescribed in Circular No.13/2018/TT-NHNN.

Secondly, according to Circular No.13/2018/TT-NHNN, the risk management strategy must cover the following tasks in building the IRRBB management strategy: releasing risk management principles (including the risk parameters) and the uses of IRRBB hedging instruments (including the authority to approve IRRBB hedging instruments).

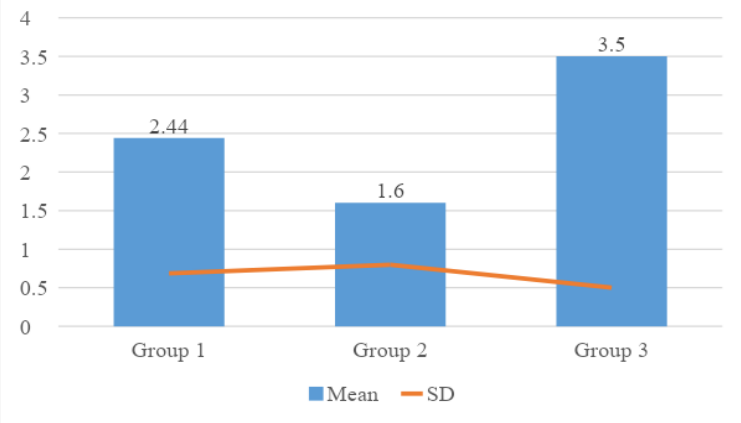

Figure 2.
The level of developing an IRRBB management strategy in Vietnamese commercial banks.

Figure 2 shows that the banks of group 1 have just completed an IRRBB management strategy under level 3 (average 2,44; standard deviation 0,684). It means most Vietnamese commercial banks have completed this task at less than 50% (around 2), while only a few banks accomplished above 50%. For the commercial banks of group 2, the level of completion is much lower (average 1,6, standard deviation 0,8). In this group, only a few banks obtained threshold 2, while most have been in progress

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(at level 1). The banks of Group 3 have built a relatively complete IRRBB management strategy as they fully implemented Basel II.

Thirdly, the issue is defining the bank's risk appetite for IRRBB. While the Vietnamese commercial banks in Group 1 recognize IRRBB as one of the material risks, this does not imply that all banks have specifically defined their IRRBB appetite. Figure 3 illustrates how Vietnamese commercial banks have established a risk appetite for IRRBB.

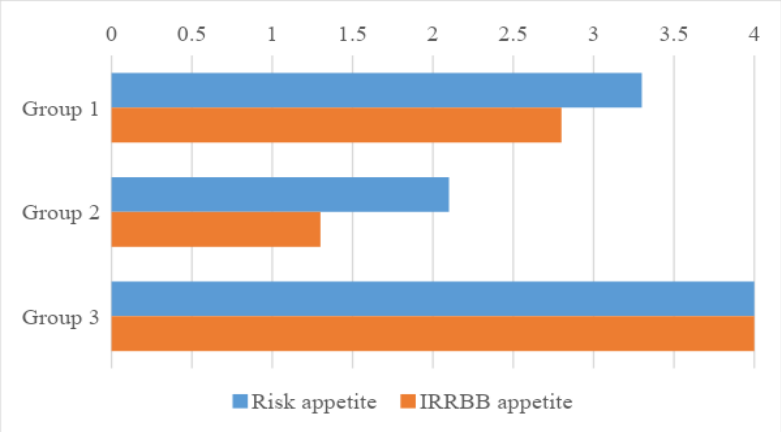

Figure 3.
The level of defining risk appetite and IRRBB appetite in Vietnamese commercial banks.

Figure 3 reveals that the risk appetite definition within Group 1 has been relatively successful. Most banks in this group have surpassed the 50% threshold, with some fully completing the task. However, the definition of IRRBB appetite remains low because many banks either haven't implemented it or have just initiated the process. Additionally, risk appetite definition is in progress for most Group 2, while some in this group have yet to commence. Consequently, these banks have either yet to conduct or have conducted IRRBB appetite determination at a modest level. Conversely, commercial banks in Group 3 have fully defined their IRRBB appetite, recognizing it as a significant risk within the banking sector.

4.2. IRRBB Identification

To identify IRRBB, banks must discern the sources of IRRBB by taking several steps: (i) separating the balance sheet into the banking book and the trading book, then assessing the repricing Gap; (ii) forecasting the fluctuation of interest rate. Currently, according to Circular No.13/2018/TT-NHNN, Vietnamese commercial banks must generate a process of identifying, measuring, monitoring, and controlling IRRBB regularly (at least quarterly) and on an irregular basis consistent with the bank's internal regulation. For Group 1, some banks have conducted the identification process, while others have just started this process.

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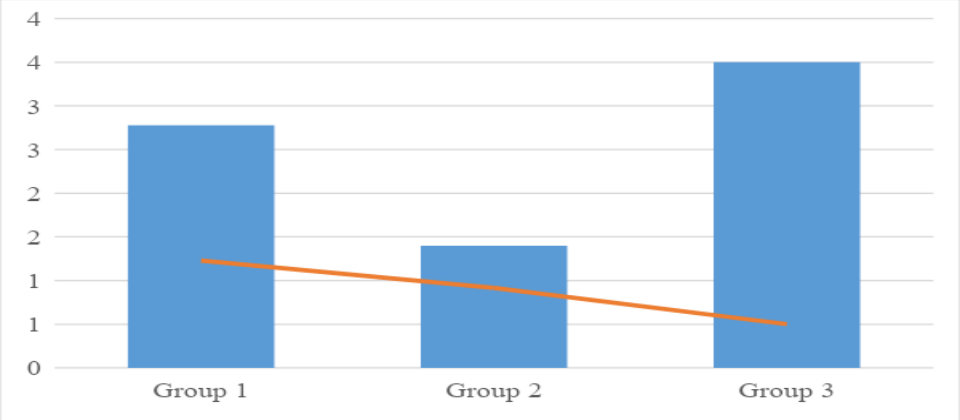

Figure 4.
The extent of implementing the IRRBB identification process in Vietnamese commercial banks.

Figure 4 illustrates that the IRRBB identification process has been built relatively well in Group 1. Almost all banks achieved over 50% (average at 2,78), but the standard deviation is significant, reaching 1,227. It is indicated that the level of this task completion varies significantly among the banks of group 1. Many banks must pay more attention to starting the IRRBB identification and measurement process. In group 2, a minority of banks have implemented the IRRRBB identification at threshold 2 (less than 50%), while most banks have just started (level 1) or have not started yet. It explains that Vietnamese banks have paid more attention to traditional risks such as credit risk and liquidity risk, so IRRBB management has been implemented at a low level.

4.3. IRRBB Measurement and Assessment

Currently, according to Circular No.13/2018/TT-NHNN, IRRBB is measured by the analysis of the repricing gap profile, which assesses the impact of interest rate on net interest income (Change in Net Interest Income - IINII) and the economic value of equity (Change in Economic Value of Equity - ΔEVE). Figure 5 shows the IRRBB measurement methods applied at banks in Group 1. The data indicate that in addition to the technique required in Circular No.13/2018/TT-NHNN, these banks also use advanced methods such as static simulation, Dynamic simulation (Dynamic simulation), Duration Gap analysis, cash flow analysis, and behavior analysis method. However, the number of commercial banks in Group 1 deploying those advanced methods is not much.

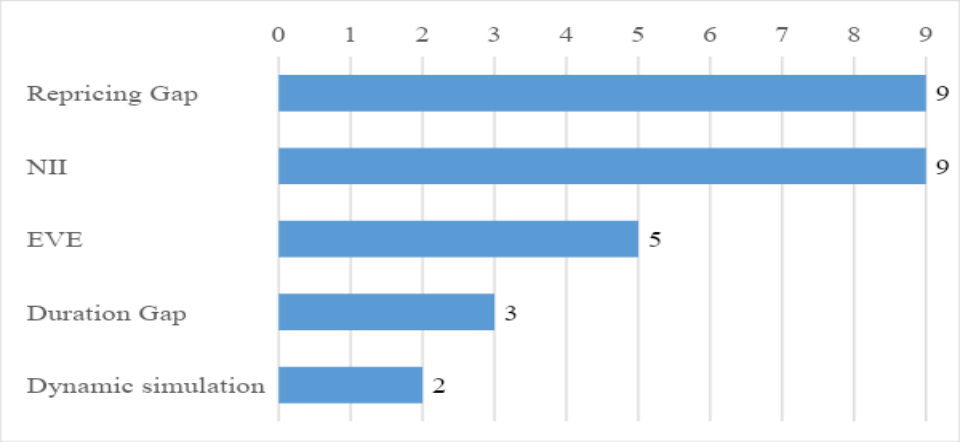

Figure 5.
The uses of IRRBB measurement methods in group 1.

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In determining the required capital adequacy for IRRBB, the calculation is typically conducted through a stress test. Circular No. 13/2018/TT-NHNN mandates commercial banks to perform stress tests for material risks, including IRRBB. However, within Group 1, only a few commercial banks engage in stress tests, particularly for additional risks in Pillar 2, such as IRRBB. Specifically, out of the nine commercial banks in Group 1, only two have performed stress tests for IRRBB. The remaining banks need to implement the tests or have conducted them without applying the output to calculate the necessary internal capital.

4.4. IRRBB Monitoring and Controls

According to Circular No.13/2018/TT-NHNN, Vietnamese commercial banks must monitor and control the IRRBB. The monitoring and control of IRRBB must ensure compliance with risk limits and have an early warning system in case of exceeding the limits. At commercial banks, the Risk Management Department gives the limit, which is then submitted to the Board of Directors for approval and issued by the CEO based on the approval of the Board of Directors. The limit is usually approved annually and is periodically re-evaluated or when the market changes abnormally or in crisis conditions to ensure IRRBB management is maintained in all cases. It can be seen from Figure 6 that at commercial banks in group 1, the implementation of IRRBB monitoring and control is relatively good (mean = 2.89). Some commercial banks have implemented at 100%, meaning a full establishment of risk limits and early warning systems of risks. The remaining commercial banks mainly perform at the level of over 50%. However, there are still commercial banks performing below 50%.

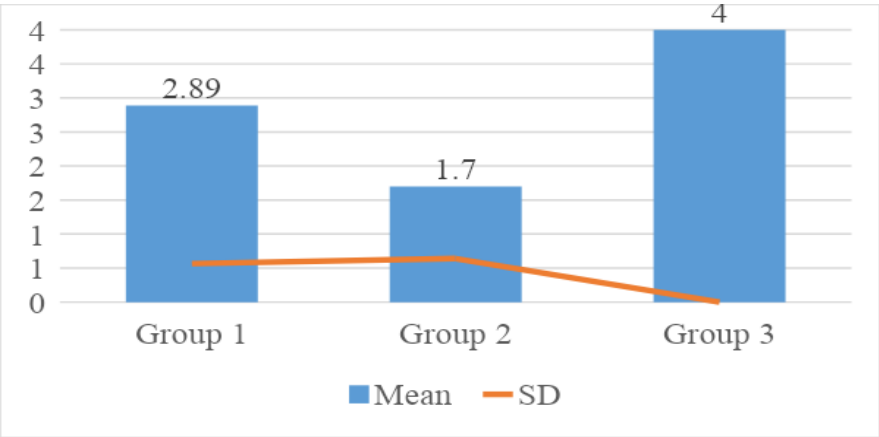

Figure 6.
The level of monitoring and control of IRRBB.

The figure also indicates that the risk control at foreign commercial banks is better implemented than that of Vietnamese banks. These foreign commercial banks have completed the risk-based risk control and have an early warning system for risk exceeding the limit. As for commercial banks in group 2, most of these commercial banks are performing below 50% (level 2). Some banks have not taken this step yet.

4.5. IRRBB Report

According to Circular No.13/2018 / TT-NHNN on internal reporting for IRRBB, commercial banks must make periodic reports at least quarterly or unexpectedly. The content of the report must include (i) Risk position including repricing gap, NII change, EVE change (if any); (ii) Status of compliance with IRRBB limits; (iii) instruments used to hedge IRRBB and the results of those instruments; (iv) Proposals and recommendations on IRRBB management; and (v) Results of the implementation of requests and recommendations on IRRBB management from stakeholders such as internal audit, SBV.

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Currently, the implementation of risk reports at commercial banks in Group 1 is relatively good, with 4 out of 9 fully implementing internal reporting IRRBB. Only two commercial banks have a reporting level below 50%. Risk monitoring is done much lower for commercial banks that have not implemented Basel. Figure 7 illustrates the level of implementation of IRRBB reporting at Vietnamese commercial banks.

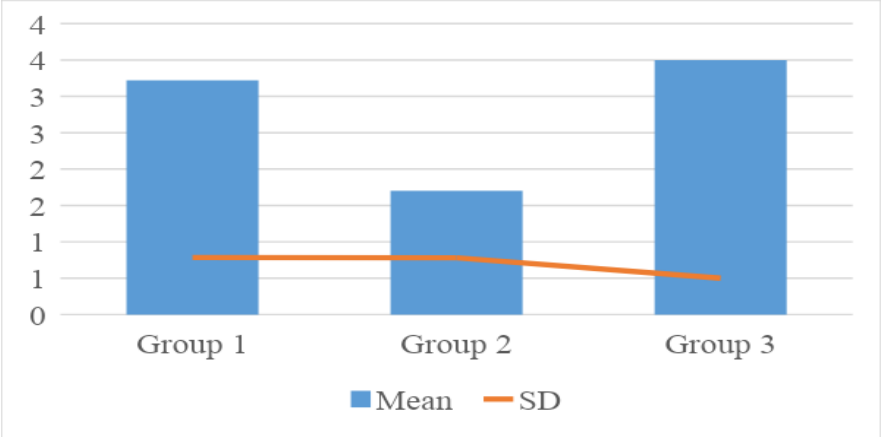

Figure 7.
The level of IRRBB reporting.

The above figure shows that although there is still a gap between Vietnamese and foreign banks, the internal reporting implementation of IRRBB at banks in Group 1 has approached commercial banks in Group 3. Meanwhile, there is still a big gap between banks in Group 2 with the remaining commercial banks. It is also consistent with the level of governance implementation of IRRBB in three groups of commercial banks.

Generally, there is still a significant gap in the implementation of IRRBB management between commercial banks of groups 1, 2, and 3. The implementation of IRRBB management at commercial banks in Group 3 is entirely completed in many aspects, while banks in Group 1 only implement IRRBB management at around 2 (nearly 50% completed). Regarding group 2, banks have deployed at a modest level (above 10%).

In conclusion, through the survey questionnaire, most Vietnamese commercial banks are increasingly aware of the critical role of IRRBB management in the banking business. In Group 1, the implementation of IRRBB is almost completed. However, there were some issues in implementing IRRBB in Vietnamese commercial banks. First, the level of implementation of IRRBB, in general, still needs to be higher compared to the requirements of Circular 13/2018/TT-NHNN and Basel II. Second, regarding the model of RRLSS measurement, commercial banks are applying a relatively simple repricing gap model, have yet to use advanced measurement methods, and perform stress tests due to the lack of some conditions, such as interest rate curves and interest rate scenarios. Moreover, some banks need more resources to conduct new management methods. The risk manager's awareness of IRRBB still needs to be improved. Last, Vietnam lacks a legal framework for interest rate risk management. Circular 13/2018/TT-NHNN is newly issued and has a relatively short implementation period, which makes it challenging to complete the IRRBB management mechanism. Our results align with previous research conducted by Do et al. (2018). However, do et al. (2018) just stated the current situation of IRRBB management of commercial banks in Vietnam rather than prove as our research.

4.6. Simulation for IRRBB Management in a Vietnamese Commercial Bank

4.6.1. IRRBB Identification

To identify IRRBB, Bank Z issued internal regulation and guidance that point out the positions in the banking and trading books of commercial banks. The banking book includes positions that do not

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belong to trading books. The items in the bank book are recorded in VND or foreign currencies with a value of 5% of total banks' assets or more.

There are three main types of IRRBB gap risk: basic risk, optional risk, and gap risk itself. Gap risk includes repricing risk, which occurs when there is a difference in the repricing time points of assets and liabilities, and yield curve risk, which arises from movement in the yield curves of terms in a banking book. Basic risk occurs when the terms in the banking book are priced based on different yield curves. Option risk occurs with interest rate options (such as cap, floor, and collar) and behavioral options (when a customer has behavioral options different from the contract terms with the bank). When the above risks occur and affect the positions in the banking book, they likely adversely affect the income and/or capital of commercial bank Z, which is recognized as IRRBB. Besides, the interest rate profile is built and monitored regularly. This profile includes information related to interest rates, yield curves, maturities, and tenors of terms in the banking book. This method of IRRBBE identification followed the principals and the guidelines of BCBS (2016) and EBA (2018).

4.7. IRRBB Measurement and Assessment

According to circular No.13/2018/TT-NHNN, commercial bank Z uses the Repricing gap to measure the impact of IRRBB on interest rate income and the bank's economic value. These measurements are calculated, analyzed, and monitored on a monthly basis.

Firstly, the Repricing gap. Repricing gap, or Gap, measures the difference between interest-sensitive assets and debt (both in and off the balance sheet) by repricing periods or buckets. The repricing date of the fixed-rates term is the contractual maturity. The repricing date of the floating-rate term is the earliest. The repricing date of the non-maturity terms (such as a non-maturity deposit) is based on the maturity of stable non-maturity terms according to the Replicating Portfolios approach. The repricing date term having option risk is based on historical and expert data analysis.

The interest rate repricing gap position of the whole bank is established corresponding to each time bucket, as the formula below:

$$GAP_k = RSA_k - RSL_k + (long_k - short_k) \quad (1)$$

In which:
GAPk: The repricing gap position for time bucket k
RSAk: interest rate sensitivity assets for time bucket k
RSLk: interest rate sensitivity liabilities for time bucket k
long: long position for off-balance sheet items for time bucket k
short: short position for off-balance sheet items for time bucket k

All indices of equation 1 are collected from the annual report of commercial banks, which includes on-balance sheet and off-balance sheet items. The repricing gap table, the sum of all repricing gap positions in each time bucket of bank Z, is shown in Table 1:

Table 1.
The repricing gap table (unit: million VND).

	0-1m	1-3m	3-6m	6-12m	1-5yrs	>5yrs	Total
GAP	840,521	2,224,837	-7,892,219	5,795,336	-11,616,593	10,208,787	-439,331

At the time of the report, bank Z remains the positive repricing gap with all buckets, except the 3-6 months and 1-5 years buckets. When there is a gap in different buckets, bank Z tends to bear the risk when the interest rate changes. To measure the IRRBB more specifically, Bank Z will compute the change in net interest income-ΔNII) and the change in the economic value of equity ($\Delta\, EVE$) when the interest rate changes every quarter.

Secondly, Change in net interest income- ΔNII. This indicator measures the impact of interest rates in the short term (generally in 1 year) when market rates change. The NII indicator calculation depends on banks' repricing gap positions and the change in interest rate. Bank Z is based on the historical data and then measures the change of interest rate income for the change interest rate of 50 basis points.

The steps to calculate the impact on the net interest income of Z Bank for 12 months are as the

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formula below:

Step 1: Determine the impact of interest rate risk on 1-year net interest income for each Gap position having less than 1-year time bucket

$$\Delta NII_k = GAP_k * \Delta r(t_k) * \frac{12-t_k}{12} \quad (2)$$

In which:

ΔNII_k: Change in net interest income for time bucket k

GAPk: The repricing gap position for time bucket k

Δr(tk): change in interest rate for time bucket k

tk: the middle point of time for time bucket k (unit: month)

The indices of equation 2 are collected from equation 1, and the change in interest rate for time bucket k is based on the historical data of change in the interest rate curve.

Step 2: Determine the total impact of interest rate risk on 1-year net interest income for all Gap positions have less than 1-year time bucket

$$\Delta NII = \sum \Delta NII_k \quad (3)$$

The Change in net interest income of bank Z is shown in Table 2:

Table 2.
Change in net interest income- ΔNII (unit: million VND).

Time buckets	GAP	Δr	ΔNIIi	Δr	ΔNIIi
0-1m	840,521	0.50%	4,027	-0.50%	-4,027
1-3m	2,224,837	0.50%	9,270	-0.50%	-9,270
3-6m	-7,892,219	0.50%	-24,663	-0.50%	24,663
6-12m	5,795,336	0.50%	7,244	-0.50%	-7,244
Total			-4,121		4,121

From the results in Table 2, the worst and total impact of NII is a decrease of 4,12 million interest rate income when there is a 50 basis points increase in the yield curve.

Thirdly, Change in the economic value of equity (Δ EVE). This indicator measures the impact of interest rates over the long term through the effect of interest rates on changes in the economic value of equity. This impact is measured through the change in the present value of banking book items and the present equity value. The steps to calculate the effect on the economic value of Z Bank are:

Step 1: Determine the economic value of equity in the baseline scenario.

$$EVE_{baseline} = \sum GAP_k * e^{-r(t_k)*t_k} \quad (4)$$

In which:

EVEbaseline: the economic value of equity in the baseline scenario

GAPk: The repricing gap position for time bucket k

r(tk): the risk-free rate at the middle point of time for time bucket k

Step 2: Determine the economic value of equity in 6 interest rate shock scenarios

$$EVE_i = \sum GAP_k * e^{-r_i(t_k)*t_k} \quad (5)$$

In which:

EVEi: economic value of equity in interest rate shock scenario i, i ∈ {1,2,…,6}.

GAPk: The repricing gap position for time bucket k

ri(tk): risk-free rate at the middle point of time for time bucket k in interest rate shock scenario i

Step 3: Determine the change of the economic value of equity in 6 interest rate shock scenarios

$$\Delta EVE_i = EVE_{baseline} - EVE_i \quad (6)$$

The Change in the economic value of equity (ΔEVE) of bank Z is shown in Table 3:

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Table 3.
Change in the economic value of equity (ΔEVE) (unit: million VND).

	EVE	ΔEVE
Basic scenario	-2,791,185	
Scenario 1	-2,868,554	-77,369
Scenario 2	-2,708,249	82,936
Scenario 3	-2,742,633	48,552
Scenario 4	-2,840,413	-49,228
Scenario 5	-2,901,358	-110,173
Scenario 6	-2,721,248	69,937

From the results in Table 3, the worst and total impact of EVE is decreasing 82,836 million economic values of equity for Scenario 2. It aligns with previous studies (such as Sharma, M. 2012; Ozdemir & Sudarsana, 2016; Zijderveld, 2017; Wycisk & Blijlevens, 2018) in measuring IRRBB by the change in net interest income and the change in the economic value of equity. This study, however, provides a more detailed analysis of the steps that a bank needs to undertake

4.8. IRRBB Stress Test and Capital Requirement for IRRBB

IRRBB stress testing is implemented quarterly, combined with IRRBB measurement to supply a comprehensive view of the IRRBB of the bank; since then, there have been solutions to control and mitigate risk. Bank Z will undertake the IRRBB stress test for ΔNII and ΔEVE when there are interest rate shocks and stress scenarios. The stress scenarios in the stress test must be worse than when measuring IRRBB monthly.

IRRBB Stress test for ΔNII. The stress scenario to implement the IRRBB Stress test for ΔNII is a change in interest rate of 200 basis points. From Table 4, the worst and total impact of NII is decreasing 16,485 million interest rate income when there is a 200-basis point increase in the yield curve.

Table 4.
IRRBB Stress test for ΔNII.

Time buckets	GAP	Δr	ΔNIIi	Δr	ΔNIIi
0-1m	840,521	2.00%	16,110	-2.00%	-16,110
1-3m	2,224,837	2.00%	37,081	-2.00%	-37,081
3-6m	-7,892,219	2.00%	-98,653	-2.00%	98,653
6-12m	5,795,336	2.00%	28,977	-2.00%	-28,977
Total			-16,485		16,485

IRRBB Stress test for ΔEVE. The stress scenarios to implement the IRRBB Stress test for ΔEVE scenarios are shown in Appendix 5

To build interest rate shock scenarios for a Stress test, authors collected historical data on risk-free rates with 250 historical observations with different interest rate maturity frameworks. Determine the series of 6-month interest rate change rates for all risk-free rates for all terms collected. Determine the average series of change rates for the scenarios: parallel (all terms), short-term (up to 1 year), long long-term (from 1 year to 5 years). Determine the shock parameters of each scenario using the VaR method by estimating the 1% and 99% percentile of the average series for all scenarios. The shock parameter of each scenario is then determined by the more significant number between the 99% percentile and the absolute value of the 1% percentile.

Based on Basel's (2016) guideline, build the yield curve scenarios by combining each scenario's baseline scenario and shock parameter. There are six scenarios: (i) Scenario 1: parallel shock up; (ii) scenario 2: parallel shock down; (iii) scenario 3: steeper shock (short rates down and long rates up; (iv) Scenario 4: flattener shock (short rates up and long rates down); (v) scenario 5: short rates shock up; and (vi) scenario 6: short rates shock down.

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Table 5.
interest rate shock scenarios for a stress test.

Time bucket	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
0-1m	3.02%	0.02%	3.50%	-0.47%	0.23%	3.10%
1-3m	3.52%	0.52%	3.93%	0.10%	0.81%	3.53%
3-6m	4.22%	1.22%	4.54%	0.90%	1.62%	4.12%
6-12 m	4.88%	1.88%	5.04%	1.73%	2.46%	4.61%
1-5y	6.40%	3.40%	5.96%	3.84%	4.63%	5.47%
> 5y	8.30%	5.30%	7.02%	6.58%	7.46%	6.44%

From Table 6, the total impact of EVE is decreasing 266,49 million VND in Scenario 2.

Table 6.
IRRBB stress test for ΔEVE.

	EVE	ΔEVE
Basic scenario	-2,791,185	
Scenario 1	-3,007,517	-216,332
Scenario 2	-2,524,694	266,491
Scenario 3	-2,597,552	193,633
Scenario 4	-2,992,974	-201,789
Scenario 5	-3,146,408	-355,223
Scenario 6	-2,476,905	314,280

According to Circular No.13/2018/TT-NHNN, commercial bank Z must calculate and maintain capital adequacy for all material risks, including IRRRBB, and the methodology to determine capital for IRRBB would be based on the selection of the bank. Bank Z evaluates the level of capital that should be held for IRRBB every six months, combined with capital for other material risks, such as credit risk, market risk, operational risk, and concentration risk, and then would build the capital plan and capital management for bank Z. For bank Z, the capital needed for IRRRBB is the higher loss between ΔNII and ΔEVE after stress testing. As a result, the capital requirement for IRRBB is 266,491 million VND.

Differing from the interest rate stress test of Fiori and Iannotti (2006), Esposito et al. (2013), Curcio et al. (2022), and Platte (2023), this study paid more attention to the IRRBB stress test, which is a stress test for interest rates in banking books only. The IRRBB Stress test is the model that commercial banks should apply rather than the interest rate stress test. This study aligns with ClauBen and Platte (2023) when measuring IRRBB by the change of EVE and NIII. However, the target of this study is to develop a model to calculate the economic capital for IRRBB, not only to find the robust risk measure of IRRBB like ClauBen and Platte (2023).

5. Conclusion and Recommendation

The research demonstrates that the level of IRRBB management among commercial banks in Vietnam is generally relatively complete or inadequate, with the highest levels observed in international commercial banks and those implementing Basel II. Most commercial banks in Vietnam have not effectively and comprehensively implemented IRRBB management. Furthermore, the study includes a simulation of the entire IRRBB management process at a specific commercial bank, detailing each step involved in IRRBB management. This simulation is applied to a Vietnamese commercial bank implementing Basel II, utilizing Basel II interest rate scenarios to calculate the economic capital requirement for IRRBB. This simulation can support Vietnamses commercial bank, especially banks that have not yet effectively implemented IRRBB management im applying the IRRBB modes and simulation so they can save resources and reduce costs in their IRRBB management.

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Based on the current situation of IRRBB management at the commercial banks in Vietnam and a simulation of the IRRBB management at a commercial bank, the paper has proposed several recommendations to the SBV and commercial banks to effectively implement the IRRBB management at the commercial banks in Vietnam. Recommendations to the State Bank of Vietnam is to continue to improve the legal corridor to create favorable conditions for the IRRBB management and to contemplate standardizing developing and establishing scenarios to assess IRRBB. The recommendations to the commercial banks are to change the awareness of the Board of Directors for the employees about the IRRBB management; to set up a risk management system aligned with international standards with a model of 3 protection lines; to improve and update their knowledge of IRRBB management for the leaders and staff of relevant professional departments by regularly organizing short-term training courses on the IRRBB.

We recommend that future studies develop more complex interest rate scenarios when conducting IRRBB stress tests, rather than six interest rate scenarios outlined in Basel II. Additionally, by applying the proportionality principle of the Bank for International Settlements (BIS, 2022), future research could create models and simulations for IRRBB management tailored to the nature, scale, size, and complexity of the activities of commercial banks.

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Appendix 1: The questionnaire.

This survey is conducted to study the implementation of interest rate risk in banking book (IRRBB) management among Vietnamese commercial banks to propose recommendations for completing IRRRBB management policies and framework in Vietnam. The collected information will be kept confidential, served for research purposes, and not shared with third parties.

Thank you.

1. Has your bank implemented Basel II standards?

a. Not yet b. Yes, In progress c. Completed

2. When did your bank start adopting Basel II standards?

.....

3. Concerning Basel II standards, your bank has implemented

a. Pillar 1 b. Pillar 1 and Pillar 2

c. Pillar 1, Pillar 2 and Pillar 3 d. Other:…….....

4. Did your bank establish ALCO?

a. No b. In progress c. Completed

5. Which part of your bank is in charge of interest rate risk in banking book (IRRBB) management?

a. ALCO b. Risk Management Committee

c. Risk management division d. Other :……..

6. Has your bank defined its risk appetite?

Please rate the extent of setting risk appetite in your bank using the following scales:

- 0: None (0%);
- 1: Very few (less than 10%);
- 2: Yes, but still limited/inadequate (less than 50%);
- 3: relatively completed (from 50% to less than 100%);
- 4: Full/completed (100%).

Contents	Scales	Your answer
- Define risk appetite framework. Principle: Board-set risk appetite statement (qualitative and quantitative indicators), overall risk tolerance defining, key risk indicators developing, tolerance threshold determining for each significant risk indicator	(0-4)	
- Apply risk appetite into business practice (incorporating risk appetite into the bank's strategic policies, processes, and credit limit management systems consistent with business plans and controls through management reports)	(0-4)	

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6.1. Has your bank clearly defined its risk appetite for IRRBB?
a. Not yet
b. In progress
c. Yes, completed
If you choose a, move to question 7.
If you choose c, move to question 6.2.
6.2. Has your bank's risk appetite statement for IRRBB provided qualitative or quantitative information?
a. Qualitative information
b. Quantitative information
c. Both
d. Other:…….....
If you choose a, move to question 7.
If you choose b or c, move to question 6.3.
6.3. Your bank's quantitative IRRBB statement has provided:
a. Changes in interest rate-sensitive assets and liabilities gap
b. Changes in net interest income (ΔNII)
c. Changes in the economic value of equity (ΔEVE)
d. Other:…….....
7. Has your bank treated IRRBB as a material risk?
a. Not yet
b. In progress
c. Yes
8. Has your bank implemented IRRBB management?
Please rate the extent of implementing IRRBB management in your bank using the following scales:

- 0: None (0%);
- 1: Very few (less than 10%);
- 2: Yes, but still limited/inadequate (less than 50%);
- 3: relatively completed (from 50% to less than 100%);
- 4: Full/completed (100%).

No	Contents	Scales	Your answer
1	Fully issue IRRBB regulations and internal processes	(0-4)	
2	Define risk appetite for IRRBB	(0-4)	
3	Implement IRRBB management:		
3.1	+ Identify IRRBB	(0-4)	
3.2	+ Measure IRRBB	(0-4)	
3.3	+ Monitor and control IRRBB	(0-4)	
4	Report IRRBB	(0-4)	
5	Measure adequate capital for IRRBB	(0-4)	

9. Has your bank measured IRRBB properly?
a. Not yet
b. Ongoing research
c. Yes
If you choose a, move to question 9
If you choose b, c moves to question 9.1
9.1. Which part of your bank is in charge of identifying and measuring IRRBB?
a. ALCO
b. Department of Treasury
c. Other:…….....

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9.2. Which approach has been used to measure IRRBB in your bank?
a. Repricing Gap
b. EVE
c. Duration Gap
d. VaR
e. Other:…….....
9.3. Which indicators have been used to measure the impact of interest rate changes on the Banking book in your bank?
a. Changes in net interest income (ΔNII)
b. Changes in the economic value of equity (ΔEVE)
c. Both
d. Other:…….....
10. Has your bank adopted the IRRBB stress test?
a. Not yet
b. Ongoing research
c. Yes
If you choose a, please move to 11.
If you choose b or c, please move to 10.1
10.1. Please describe the scenarios applying in the IRRBB stress test in your bank.

Types of scenarios	Describe briefly the scenarios.

Types of scenarios: (i) historical scenarios, (ii) hypothetical scenarios, (iii) others
11. What tool has your bank used to control IRRBB?
a. ΔNII
b. ΔEVE
c. Others:…….....
12. Please describe the roles of your bank's senior management, Committees, and related departments concerning IRRBB management.

No	Levels of authority	Functions
1	Board of directors	
2	Risk management committee	
3	ALCO	
4	CEO	
5	Department of risk management	
6	Treasury (ALM)	
7	Department of Sales	
8	Internal control and supervisory Board	
9	Department of Compliance and Legal	
10	Department of finance and accounting	
11	Department of technology	
12	Internal audit	

13. Your bank's IRRBB reports have been submitted to
a. Board of Directors
b. Senior management
c. Department of Sales
d. Department of Compliance
đ. Department of Risk
e. Other:…….....
14. What difficulties has your bank faced in implementing IRRBB management?
a. Unclear perspective for implementing IRRBB management and lack of support from senior leaders
b. Lack of data system and technology infrastructure

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c. Difficulties in developing risk models, selecting risk assessment tools, and calculating capital adequacy
d. High implementing cost
e. High cost to meet capital adequacy
f. Lack of quality human resources in this field
g. Incomplete SBV guidelines
h. Others:…….....

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