1. Executive Summary

This documentation serves as a reference to the Interest Rate Risk on Banking Book (IRRBB) within Bank of China New York Branch (BOCNY), to estimate and monitor potential interest rate risk under stressed scenarios, and Treasury (TRY)’s roles and responsibilities to support IRRBB Management process. Two major Key Risk Indicators (KRIs) are Net Interest Income (NII), and Economic Value of Equity (EVE), both of which are calculated through PROFITstar® from Jack Henry & Associates, Inc.

TRY policy and procedure is designed to follow the guidance as prescribed by BOCNY Model Risk Management procedure (MRM) [6], OCC Bulleting 2011-12 Supervisory Guidance on Model Risk Management [1], and the OCC Interest Rate Risk Handbook [2]. TRY will periodically estimate and monitor those KRIs in accordance with U.S. regulatory compliance. Any material implementation and revision will be reflected in this documentation timely.

This documentation also specifies the practice of stress scenarios—including yield curve parallel shift and non-parallel shift—and practice of model validation process. This documentation is comprised of the following sections:

Section 2: Background illustrates regulatory compliance, and peer business practices.

Section 3: Model Data outlines data input and data governance.

Section 4: Model Procedure and Methodology provides information of model input, methodologies and model output.

Section 5: Model Validation generalizes verification of offering rate, stationary test of beta, and back-testing of NII.

Section 6: Model Limitation specifies current and temporary deficiencies embedded in the model.

Section 7: Model Enhancements outlines the remediation to the limitation and potential alternatives.

1. Background—Regulatory requirement, risk management framework within the Bank

Per OCC Interest Rate Risk Handbook [2], Interest Rate Risk (IRR) is the risk “to the bank’s current or projected financial condition or projected financial condition and resilience arising from movements in interest rates”. The goal of BOCNY’s IRR management is to minimize the impact of interest rate volatility on current earnings and net portfolio value.

Specifically, Treasury Department (TRY) is assigned the responsibility to proactively identify, quantify, monitor and report the NII and EVE to the related second line of defense, Market and Liquidity Risk Committee (MLRC), and Asset Liability Committee (ALCO) in a timely manner.

Risk measures are quantified as the ($ or %) change of an interest rate shock relative to the base scenario. TRY measures Net Interest Income (NII) with Interest Rate Sensitivity Analysis as the cumulative change in net interest income over the 12-month horizon divided by the annualized net interest income by given 100, 200, 300, 400, -100 and -200bp rate shocks. TRY also measures Economic Value of Equity (EVE) sensitivity by given the same rate shocks as NII. The basic tools to monitor the interest rate risk exposure are the gap analysis, earnings and market value sensitivity modeling. BOCNY sets its policy limits on NII over one-year horizon and EVE for a 200 bps parallel and immediate shock scenario.

1. Modeling Data

The scope of IRRBB covers the entire banking book, and items that have IRR component are projected. Generally these items are on balance sheet interesting bearing assets and liabilities such as loans and deposits, but Off balance sheet items relating to the banking book such as Swap[[1]](#footnote-1) may also be included. Asset items include all loans, Due from bank, Security Investment, and any other banking book interest earning assets accounts (such as Reverse Repo). Liabilities items include all customer deposits, brokered deposits, due to bank, and any other banking book interest bearing liabilities accounts (such as Repo).

Generally, the categorization of product is based on the bank’s accounting definition and data are mapped using FMD’s TB line structure.

* 1. Data input/collection

Data files are first obtained from BOC’s core system and/or other sources including T24 and Opics. The PROFITstar® download setup setting identifies the location of the data file, and the data mapping transfer data into specific PROFITstar® account. It is through the uses of the key data field(s) such as TB lines that data are mapped into each PROFITstar® account.

There are three main types of data files needed to run the Asset and Liability Management (ALM) model: Databank file data, General Ledger file data, and Application file data. Databank file data are information such as index rate that are used to help PROFITstar® with calculating certain important parameters. General Ledger file data are Balance Sheet and Income Statement data, they are the data foundation used by the model as they reflect the institution’s Assets and Liabilities Profile. Application file data provide detailed information relating to specific asset/liabilities accounts that are not captured by the General Ledger data. Generally, these data represent instrumental details of the General Ledger data.

Every month data files are uploaded into the system using the Update Wizard, the main data transfer interface. There are four main modules in PROFITstar®: History, Maturity/Repricing, Projection, and Budget. The modules function from left to right. With the History Module as the data foundation of the model, the data upload process first imports balance sheet (General Ledger Data) and other important data such as key index rate (Databank Data) into system. Then, application level data are populated into the Maturity/Repricing Module. The more granular details from the application data help to calculate information such as the portfolio rate more accurately and further fine tune projections. Once these data are properly imported into the system, user can adjust assumptions in the Projection model and conduct analysis to determine the impact to NII and EVE.

In more technical terms, data files are first obtained from BOC’s core system and/or other sources including T24 and Opics. The PROFITstar® download setup setting identifies the location of the data file, and the data mapping transfer data into specific PROFITstar® account. It is through the uses of the key data field(s) such as TB lines that data are mapped into each PROFITstar® account.

For detail relating to the setup and mapping of the data, please refer to PROFITstar® setup procedure: Download Setup in Appendix A.

* 1. Data Governance

The data used for upload are obtained by ADC via email monthly. These data are reviewed, reconciled and archived into TRY shared folders.

To ensure the accuracy of the data, the followings are executed:

* Ensure data file’s asset and liabilities balances
* Identify new accounts or product that might not have been setup into the system
* Review exception file reports
  + Balance/verify the History Module
  + Balance/Verify the Maturity/Repricing Module

1. Model Procedure and Methodologies

Bank of China uses third-party IRR models from Jack Henry’s PROFITstar® to measure and manage interest rate risk. Data are imported into the system monthly to generate report on IRR risk, specifically relating to NII and EVE.

To generate these IRR measurements, the bank runs the Interest Rate Sensitivity Analysis (IRSA) for NII and the Fair Value (FV) for EVE measurement. These two analyses are under PROFITstar®’s Projection Module. Using the bank’s current financial position data, which are stored in the History and Maturity/Repricing module of PROFITstar®, the Projection module allows user to create different scenarios using different assumptions that would alter the cash flow or characteristic of the balance sheet, a projected scenario with its own unique NII and EVE risk profile.

Because this is a 3rd party model, certain calculation process are proprietary and therefore the user might not able to fully replicate some of the calculations. As per OCC’s guidelines, it is not expected for the bank to duplicate the mechanics and mathematics of the third-party model. A general model certification that attests to the accuracy of the mathematics and logic of the model has been provided by PROFITstar®. The report was conducted by an independent third party, Angel Oak Consulting, date December 2017 [3]. To further enhance the understanding of the model, Bank of China has supplemented additional analysis and documentation relating to mathematical calculation of some of the more essential calculation in the model.

* 1. Model Input

To properly run IRSA and FV, the following inputs are generally needed for each of the interest bearing accounts.

* Key Rate Ties: The key rate ties link the account to a suitable index and then define the beta between the offering rate and the index rate that allows the system to project future offering rate. Key Rate tie is important to both IRSA and FV.
* Prepayment: the defined prepayment behavior of asset accounts that will affect the weighted average life as well as the amount of new volume projected. The prepayment is based on the historical Conditional Prepayment Rate (CPR). This parameter is important to both IRSA and FV.
* Decay: the defined runoff behavior of Non-Maturity Deposit accounts that will impact the estimated value of those accounts. This parameter is important to FV.
* Fair Value Treatment: selected treatment that will determine how value of the account would be determined -- whether it is through a quoted value, book value, or calculated value using discount method. This parameter is critical to the FV.
* Offering Rate Projection: Projection assumption relating to offering rate obtained from FLUs.
* Interest Rate Projection: Projection assumption relating to key interest rates obtained from SRD.
* Balance Growth Projection: Assumption correspond to the business plan relating to growth in balance sheet and changes in asset/liability mix structure.
  1. Model Methodology

Methodology of IRR Measurement is quite straightforward for the IRSA and FV. Through the specification of the chart of accounts and income statement, and the incorporation of economic and behavior assumptions, it provides cash flow modeling capabilities necessary to generate estimates for NII and EVE.

* + 1. Interest Rate Sensitivity Analysis (IRSA)

General methodology to calculate risk relating to NII, at the most basic level, involves the sum of multiplication of projected average rates by projected average balances within a time horizon such as 12 months. PROFITstar® using the IRSA would calculate NII in this fashion. The projected rate is determined mostly by the key rate tie relationship and the assumption about future interest rates. The projected average balance is derived from the bank’s current position, adjusted by the assumption relating to growth, and prepayment behavior that affect the new volume.

More specifically, in a static balance sheet, the month end balance is assumed to stay constant. So the month end balance of the subsequent month would equal to the month end balance of the prior month. Since the asset or liability would still amortize or run off, to maintain at a constant balance, the new volume would just be added in amount to replace the matured and prepaid amount. Interest income would then be separated into two components: Interest income/expense from current volume which generate income using existing portfolio rate, and those from the new volume which generate income using the projected offering rate. In a dynamic balance sheet, the composition of the balance sheet does not stay constant. So the month end balance will be based on projection of balance sheet growth. Therefore new volume may exceed or be less than the amount matured or prepaid. For a decreasing projection, the resulting projected month end balance would be constrained by the existing contractual maturity of account items. If there is not sufficient amount of amortization, there would not be any new volume and the balance may not decrease sufficiently enough to reach the target balance. Generally new volume would make up the short fall between the target value and the resulting balance after maturity and prepayment. Interest income would then be calculated in the same way as the static based on current volume and new volume.

Interest rate shocks would impact offering rate through key rate tie relationship and new volume through the prepayment parameter.

* + 1. Fair Value (FV)

General methodology for FV is to calculate the net present value of rate-sensitive assets, liabilities, and off-balance-sheet positions. If an observable market value is available, it would provide a more accurate picture of the fair value of the instrument. When that is not available, NPV can be used to estimate its value. Since NPV is especially sensitive to discount rate, NPV might not produce a value that reflect the fair value, but only the next best approximation. Specifically the value of those accounts are determined by calculating the NPV of all the projected cash flow using a discount rate. Since quoted and Book Value methodology are taken as is from data or user input, user would need to ensure treatment selected is appropriate and that the value derived is sound and supportable. User should be aware that for specific account type, certain treatment might be more appropriate than the discounted cash flow method (Discount). For example: account that exhibit greater optionality might be better valued using quoted value from market or service providers if they are available. When discount method is used, a spread between the account offering rate and index rate is applied to better capture the cost associate with the instrument. This spread, which is assumed constant through time and scenarios, is then added to the index rate for scenario analysis during discounting.

Interest rate shocks would impact offering rate and index rate which would affect discount rate. Also depending on the complexity of the product, shock could also alter the resulting FV through prepayment and decay speed.

* 1. Standard Parallel Interest Rate Shock Scenarios (±100 bps, ±200 bps, +300bps, +400bps)

Using the above methodology, IRSA and FV would calculate each risk measures using the different interest rate scenarios. By default, the interest rate shock scenarios used are immediate parallel interest rate shock with 100 bps interval. For example: the current interest rate scenarios used are +/- 100bps; +/- 200bps, + 300bps, +400 bps, and the base scenario with no rate shock.

The NII at the base scenario and shocked scenarios are calculated separately. The difference of NII between the shocked scenarios and base scenarios is the NII sensitivity. The NII sensitivity at 200 bp parallel up scenarios divided by the NII of the base scenario is defined as BOCNY NII KRI, which has a limit of 20% and warning line of 15%.

Similarly, the EVE sensitivity at 200 bp parallel up scenario is defined as the KRI on EVE, which has a limit of $350 mil and warning line of $280 mil.

Additional options and control are available to user, which allow further customization of interest rate scenarios. For example: Capability to conduct yield curve twist and non-parallel interest rate scenarios; sensitivity analysis through adjustment of change in decay and/or prepayment speed.

Result are produced in matrix form, showing the risk measure and its changes and sensitivity under the different interest rate scenarios. User may then compare the result and access the risk in relation to their risk limits.

Model Output

NII (IRSA), +200 bps parallel shift stress-testing sensitivity (%)

EVE, +200 bps parallel shift stress-testing sensitivity (absolute value)

1. Model Validation
   1. Offering rate—comparison to previous month result
      1. Scope—several TB line under different FLUs
      2. Procedures
   2. Beta—stationary test
      1. Scope—Deposit (with maturity date)
      2. Procedures
   3. NII Back-testing—on-going monitoring
      1. Scope—Difference between actual NII and projected NII
      2. Procedures
2. Model Limitation and remediation
3. Model Enhancement
   1. Non-parallel shift stress-testing
   2. IBOR Transition
4. Appendix

1. As of 7/21/2021, both IRS SWAP and FV SWAP uses the same TB line, without more granular detail income and expense on trading book and banking book items could not be separated. Therefore both are currently included into the model. [↑](#footnote-ref-1)