Coping with IRRBB Challenges
Challenges of IRRBB Project Implementation in diversified Commercial Banks

This document outlines some of the challenges encountered by modern commercial banks during IRRBB implementation projects and is based on the experience of financial risk fitness in assisting our corporate clients in their IRRBB projects.

We will focus in this short essay on methodological issues relating to Interest Rate Risk Measurement.
Critical Challenges stemming from regulatory stipulations

As the regulatory framework describes, the measurement of banking book interest rate risk is based upon six stress scenarios (for the standardized approach) clearly outlined in the regulatory documents. The risk measurement itself is based on two complementary methods: the "earnings based measure" which purports to ascertain the changes in expected earnings over a pre-determined time period stemming from the bank’s exposure to the stress scenarios and "changes in the economic value of the institution’s equity".

The above measures are deemed as complementary as they both reflect the impact of changing cashflows arising from shocks in the term structures of interest rates. The change in expected earnings is indirectly reflected in the change of the economic value of Equity, which inversely impacts on profitability ratios.

The challenge is not so much related to the computation of the NPV of the balance sheet under various stress scenarios, although assumptions are to be made on the funding spreads during interest rate shocks as they affect the discount rates used.

More importantly, a decision is to be made about whether the outcome should be computed as a change in the theoretical economic value of equity (EVE) — in which case equity is either excluded from the EV calculation or included with a very short (GN) duration... or... whether the outcome should measure the change in economic value of net assets representing Equity, in which case equity may be either included with the same duration as the assets which it funds, or else, both the equity and the funded net assets are excluded ("earnings adjusted EVE").

Our observation (also aligned with the position of most supervisors and external auditors) is that to the extent that future earnings eventually affect balances of future equity, the two measures are well aligned, but the value changes estimated will include adjustments to net income which will occur beyond the predefined horizon of the earnings measure.

Another critical challenge relates to the time horizon pre-assigned for the earnings impacts. In our experience, many banks run balance sheet liquidity scenarios (a priori un-related to IRRBB regulatory calculations) on a "run-off" basis, keeping the balance sheet all-inclusive of existing assets and liabilities, but not accounting for new business.

This is done due to the rather cumbersome and often imprecise estimates of volumes and timing of cash flows occurrences under stress scenarios for potential new businesses under stressed assumptions. Indeed, the task of ascertaining cash flow volumes and timings of events relating to cash flows (prepayments, exercise of options, etc.) is quite daunting under severe stress scenarios even in a run-off balance sheet scenario, it becomes exponentially complex if accounting for new businesses.

Banks are well advised to align the calculations for the earnings changes under IRRBB stress scenarios with the liquidity stress calculations that already are part of the maturity gap reporting MIS in place. Nonetheless, one needs to be aware that the earnings based IRRBB measures cover only the short to medium term, and as such fail to capture the full impact on P&L of the stress scenarios beyond the period of calculation.

Very advanced institutions capture both liquidity measures as well as IRRBB earnings measures under a "dynamic balance sheet" but the assumptions relating to the dynamics of new business occurrence probabilities and the related impacts are often rather weak.
We at financial risk fitness would counsel our clients to choose the simpler paths (static balance sheets) while augmenting the weakness of not accounting for the balance sheet dynamics by recalculating the computations on a periodic basis (at least quarterly cycles). The longest horizon we have seen for both liquidity and interest rate earnings at risk calculations has been 5 years, but due to the reduction in complexity, many banks use a 3 years horizon.

Also, as already stated, the earnings based measures seem better aligned with the liquidity management practices in most banks and tend to be the focus of IRRBB calculations. Many banks use the measure: Net Interest Income at Risk under a pre-defined confidence level, itself aligned with the institution’s long term credit rating, risk appetite and risk culture.

The main challenge we observed (at least as related to methodical issues concerning IRRBB estimates) is related to the reflection of non-maturing products on both sides of the balance sheet.

Again, various external audits along with deep regulatory scrutiny into several IRRBB implementations (admittedly, mainly in Europe) point to dichotomies between the modeling of non-maturing products for liquidity management purposes and interest rate management purposes, but also methodological inconsistencies between the development of going concern scenarios versus stress scenarios.

As indicated in the supporting regulatory documents (BCBS), non-maturing products render themselves to modeling via “behavioral assumptions”…to include:

- The volume and type of new/replacement assets and liabilities expected to be originated over the evaluation period
- The volume and type of asset and liability redemptions/reductions over that period
- The interest rate basis and margin associated with the new assets and liabilities, and with those redeemed/withdrawn
- The impact of any fees collected/paid for exercise options

In practice, all this would imply a balance sheet modeling in 3 states:

- Run Off – where existing balance sheet items are not replaced as they mature (henceforth the balance sheet gradually declines to zero as items mature) – perhaps saving the funding needs of the existing assets over their contractual tenors.
- Constant Balance Sheet – where the entity’s balance sheet size and shape is maintained by assuming a like for like replacement of all items as they run off
- Dynamic Balance Sheet – which implies incorporating future business expectations, adjusted for the relevant scenario in a consistent manner

As already stated, it is common practice at European banks to only model the balance sheet in a run-off mode (compensating the deficiencies by repeating the analyses at regular intervals) – which in most cases is also consistent with the liquidity management practices.
Modeling implications

When ascertaining the change in economic value, an institution is asked to model the theoretical change in the net embedded market value of the entire banking book. As such, the net present value is determined from the contractual cash flows, discounted to reflect current market rates.

As we will discuss later, the challenges here are the modeling of the embedded options inherent in many balance sheet items. As a first implication, instruments with short term or variable rate cash flows have a PV that is close to the face value (carry value).

Secondly, a change in market rates will hardly change the economic value of these instruments. And thirdly, the PV of an interest rate sensitive instrument with uncertain contractual cash flows can only be evaluated on the basis of assumptions about behavior and timing (volume and timing of cash flows).

What are the critical challenges here?

As already stated, banking books contain assets and liabilities that are accounted for “held to maturity” valuations, without the benefit of observable market prices. As such, there is often the case that they contain embedded over or under-valuations (when accounted on a mark to market basis), representing income or expenses which may emerge in future reporting earnings.

Margins on loans are notoriously heterogeneous, making determination of an appropriate discount rate quite problematic while the cash flows associated with such loans may be subject to variation depending on customer behavior in response to these changes.

And, experience has proven that customers rarely behave rationally (at least in the way the modern finance theory defines rationality) when large swings in market factors occur. There may also be structural positions (for example assets to stabilize the return on a non-maturing deposit or equity) which can produce a significant change in value under economic value measurement, but where the risk measured becomes intrinsically dependent of the risk mitigation/ reduction when analyzed from an earnings volatility perspective.
How do best practices international banks deal with these challenges?

To avoid the complexity of measuring total economic value for the entire enterprise, large banks focus on measuring the level of change to NPV of the relevant balance sheet items based on existing (sometimes augmented by adjustments) cash flows revalued in line with the interest rate shock and stress scenario in question.

The change in the valuation becomes a measure of IRRBB and is compared with the current value of equity to ascertain the change in the economic value of equity (sometimes by using a static scaling factor). What are the critical issues to consider in such an exercise?

1. Interest Rate Shocks/Scenarios
   a. The size and shape of the shock will determine the measured outcome and a range of shocks may be needed to identify all potential facets of IRRBB (example: basis risks may not be captured by shocks that only assume parallel shifts of similar quantum in all yield curves).
   b. Designing interest rate change scenarios that are relevant to the business and sufficiently stressful is key to effective IRRBB management.

2. Exercise of Options
   a. Automatic Options (here most banks assume that both the bank and the customer will exercise the options based on rational expectations – we, at financial risk fitness beg to differ based on our project experience and anecdotes from banking experience – and would counsel banks to use appropriate behavioral assumptions) are valued on the basis that exercise will always occur when there is a clear financial benefit
       i. The rational expectation that the option will be exercised can be readily fed into forward projections of interest margin under the earnings-based measure
   b. Behavioral Options (when behavior will be different from rational – one needs to use behavioral assumptions anchored in past experiences or anecdotes) require complex analyses of expected outcomes. One of the most daunting exercises relates to loans under prepayments – if there are prepayment penalties, their cost may not fully reflect the actual economic benefit (perhaps the “perceived economic benefit”) involved. We, at financial risk fitness have assisted several institutions in the design of such scenarios and conclude that the inclusion of “non-rational behavioral actions” can be conducive to remarkable results in IRRBB calculations.

3. Commercial Margins
   a. The use of economic value and earnings based measures involves estimating cash flows, nonetheless the content and treatment is different:
       i. For economic value measures, all existing balance sheet items (principal and coupon/interest cash flows) are discounted at a relevant rate
       ii. Net Interest Income measures include all cash flows, including all margins and principal flows from expected future business and are typically not discounted.
   b. Again, both external auditors and industry regulators/supervisory authorities like to see an alignment between the treatment of commercial margins between regular asset liability management practices and IRRBB
4. Treatment of non-maturing Deposits

a. Non-maturing deposit balances have historically proven to have been rather stable, even when market rates change – lost balances can usually be replaced with new deposits at the same rates.

b. Consequently, non-maturing deposits behavior differs from more rate sensitive funding instruments.

i. An interest paid on a non-maturing deposit is usually at rates significantly lower than the corresponding rate paid on wholesale deposits – meaning that non-maturing deposits have historically represented an important source of stable and cost-effective funding.

ii. This statement is currently challenged by the prevailing “zero rate policy” of the European Central Bank, where commercial banks falling under ECB supervision prefer to fund themselves in capital markets than via customer deposits as they shy away from passing on the negative rates to their loyal customers. We, at financial risk fitness, do not see a danger of such market distortions in the US at this time.

c. For IRRBB the focus is to manage the risk of earnings volatility arising from non-maturing deposits:

i. To achieve that, banks are challenged to identify core deposits, then discount those elements of transactional accounts subject to regular fluctuation (withdrawal followed by re-deposit) and overall seasonality effects.

ii. An example of best practices for evaluating the volumes of core deposits at a pre-determined confidence level congruent to a bank’s credit rating is exhibited in Fig 1 and 2.

Cashflow Models for NMPs - Fig 1
Some banks employ a quantitative framework for estimating cash flows for non-maturing products under stochastic processes. A simplified illustration is exhibited below.

**Cashflow Models for NMPs – The Quantitative Framework**

- The future volumes are modelled over a log-normal diffusion process:
  \[ \log V(t) = \alpha + \beta t + \sigma \varepsilon_t \]
  - \( \alpha, \beta \) are estimated via an OLS linear regression (by mapping historical time series)
  - \( \varepsilon_t \) is normally distributed and stochastic, analogous to a Wiener process
  - \( \sigma \) is the volatility of the time series (constant?)

- In order to ensure a confidence level of “q” to the term structure of liquidity:
  \[ \log V(t) = \alpha + \beta t - \sigma \Phi^{-1}(q) \sqrt{t} \]
  - \( \Phi^{-1}(q) \) is the inverse cumulative normal distribution function.
  - The core component is determined with \( \alpha = V_0 \) and \( t = 1 \) Month.
  - \( V_0 \) is the current volume

- The term structure of liquidity is modeled as the 99% quantile line of the balance run off:
- Prob (Deposit Balance at 6 months = Core Balance) = 1.99%
- The core level of the balance can be defined as the balance amount that will not run off within the first month, e.g., a 99% confidence interval.
- Typically, the core level is then modeled in rolling tranches with different maturities.
5. The bank's own shareholder equity

a. Equity represents an important source of structural risk and endowment return
   i. In accounting terms, equity is the net value of assets minus liabilities. As such it represents
      assets for which there are no funding liabilities
   ii. The "cost of equity" is the dividend (not the case for mutual cooperative banks).

b. One needs as such to define the net equity capital eligible for behavioral treatment:
   i. Some assets are not interest bearing (property, car pools, etc.) and can be considered
      directly funded by equity
      1. The value of equity available for behavioral treatment can be accordingly reduced
      2. Here, again, from practical experience, we at financial risk fitness encourage banks
         to align these processes to the routinely performed ALM modeling assumptions
   ii. Since equity capital has no contractual price reset date, banks determine their own
      strategies for managing the earnings volatility arising from using similar techniques to
      non-maturing deposits
      1. Given that equity may be written down as a result of incurred losses, regulators/industry
         supervisors will normally focus on the economic value of equity risk
         associated with any earnings profile ascribed to equity that materialize as losses
         under stressed events
As discussed very briefly, implementation of IRRBB can present some challenging tasks, starting with the methodology employed in undertaking the prescribed stress scenarios and evaluating their impacts. We strongly counsel banks to team up with institutions who have been through such iterative cycles in the attempt to optimize and catalyze the processes of complying with IRRBB regulation and derive the most benefit from the laborious projects.

About us

financial risk fitness is a management consulting firm specializing in providing strategic advice and implementation services to financial institutions in the domains of applied quantitative finance, including valuation and risk management challenges.

The company has a world-wide reach, with offices in Munich and Tel Aviv and continues to liaise with global financial institutions and regulators, leveraging their staff’s broad best practices experience and industry expertise. Since its founding in 2006, it has been successfully active in Europe, the Middle East, Africa, Asia, North and South America.
Our area of expertise

- Design and Implementation of Customer Behavioral Models
- Establishment of Group Funds Transfer Pricing Policies and Strategic Organization of the Group’s Funding Center
- Implementation of Basel III compliant Internal Credit Rating Models for commercial/retail banking operations
- Pricing Libraries for Credit Derivatives and Structured Credit Products for Hedge funds and Commercial/Investment Banks
- Establishment of Performance Monitoring “Cockpits” for Asset Management Companies
- Development and Implementation of Basel III compliant Internal Market Risk Models for Banks and Institutional Investors
- Development and Implementation of Basel III compliant Internal Credit Risk Models for Banks and Institutional Investors
- Strategic Organization, Limit Framework and Methodological Toolkits for counterparty risk (CVA, DVA, FVA) for OTC traded Derivative Products
- Development and Implementation of Funding Liquidity Monitoring Systems for large commercial and investment banks – as well as the establishment of a Liquidity Limit systems congruent with the institutional risk appetite
- Development and Implementation of Basel III compliant capital allocation models
- Development and implementation of risk and/or valuation engines for various asset classes.

What makes us different

2. Team players - we consider ourselves to be a part of the bank’s resources for the lifetime of the project, not external consultants.
3. Full transparency – we always deliver to our clients all the tools derived and/or used within the scope of the project, including, valuation engines, risk analysis engines, data engines, or any other written code.
4. Flexibility – we always align ourselves to meet with the banks’ unique requirements, including the bank’s defined processes and procedures, the bank’s systems’ data structures and others.
5. Predefined project tenors – we are avoiding projects where clients are dependent on us for future application. In fact, we measure our successes in projects by the client’s ability to apply our solution independent from us.