

## Understanding cash flow behavior: The key to managing bank liquidity and product pricing



### The Cash Flow View

Supply of money can be said to be the vital life line of an economy. It is the enabler of production, movement and consumption of goods & services that define the economy. The banking system, which is a core component of a country's economy, is essentially in the middle of all such monetary cash flows. In fact, a bank can be viewed precisely as a conduit that enables the cash flows of an economy. For an entity, the stock of all cash flows accumulated over time is represented by the balance sheet statement, and the net incremental cash inflows during the year are represented by the income statement. However, it is the cash flow statement that gives a complete view of nature of activities and all operations of the entity. Adopting a cash flow view of its assets and liabilities enables a bank to accurately and dynamically forecast its balance sheet and income as it is easier to analyse how various risks impact and modify cash flows. The cash flow view therefore gives a clearer picture of a bank's current state, the risks it faces and its long term outlook as opposed to a stock view. Hence, it is of utmost importance to understand precisely the nature and the mechanisms that help to manage these cash flows.

### Key Characteristics of Cash Flows

There are three parameters which primarily define a cash flow i.e. Amount, Tenor and Currency. Deriving from these three parameters and the market expectations are two key characteristics that define the riskiness and therefore the value of cash flows namely Time value and Liquidity. This assessment of riskiness excludes the idiosyncratic credit risk of the borrower associated with the cash flows.

**Time Value:** Time value of money measures the change in real value of the cash deployed due to economic inflation and the expected general market risk. This is quantified through the interest rate ascribed to the cash flow inferred from the term structure of market interest rate curve. The original cash flow from an issuer to a borrower is entirely composed of what is called the Principal amount, while the return cash flow from the borrower typically includes an interest component that represents the time value of the cash. If the borrower wants a single unchanged interest rate for the entire tenor, the interest rate is picked from the market rate term structure corresponding to the full tenor of the cash flow. However, if the borrower agrees to change the interest rate in line with the market expectations, then the frequency of rate change will be used as the tenor for picking the rate from the term structure. The idea is to ensure that, at a minimum, the real value of the money is retained throughout the tenor. The current term structure of interest rates may also price-in the impact of any expected near term market events and consequently, both real and expected movements in interest rates have the tendency to change the cash flows in the economy and in the banking system. As rate expectations change and the term structure evolves, borrowers may want to refinance their principal to take advantage of any favourable rate movements. Interest rate risk behavioural analyses attempt to assess the sensitivity of both principal and interest cash flows to market interest rate movements.

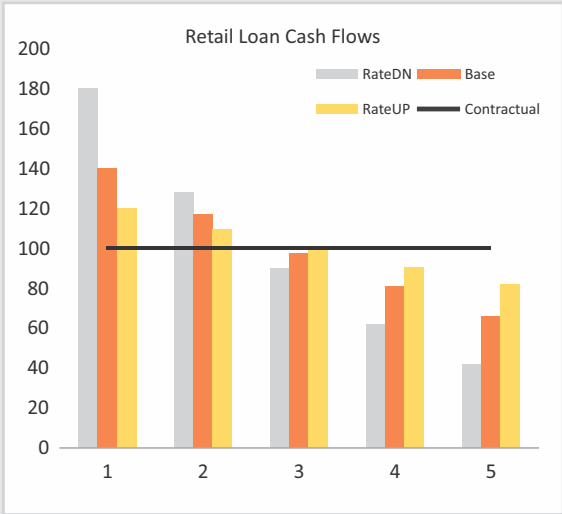
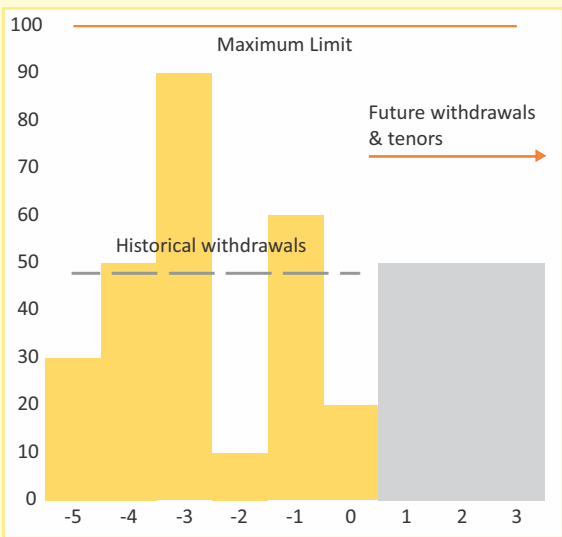
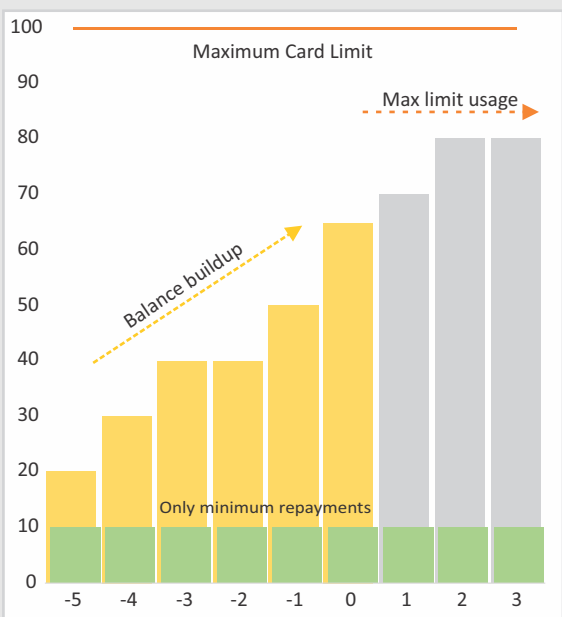
**Liquidity:** The value of cash can also be derived based on the existing supply of money in the market for the selected tenor. Some tenors may have excess demand while some tenor may have excess supply. For a bank, managing the cash inflows, outflows and the mismatch between them is a critical component of its daily activity and its inability to do so even for a short duration of time could potentially lead to bank failure. There are two prime sources of liquidity risk or illiquidity for a bank, one from the market and another from its own funding profile and term structure mismatches. On the asset side, the ease with which the bank can liquefy its stock of assets for cash without incurring significant haircuts or losses is called Market liquidity. On the liability side, the ease with which the bank can raise new funds from its customers either to repay other maturing deposits (including account balance run-offs) or to issue new financings is known as funding liquidity. The stability of the deposit base of the bank helps in minimizing the need to rollover the deposits and thereby helps with the liquidity of the bank. Hence, it is important to assess the liquidity characteristics of both assets and liabilities and their sensitivity to changes in market liquidity. These aspects are covered by liquidity behavioural modelling.

It goes without saying that the behaviour of cash flows and their slotting will be different when looked through a rate perspective as compared to a liquidity perspective. So it becomes important to not only understand the behaviour but also be able to attribute the behaviour separately to rate movements and liquidity movements. Once a relationship between the cash flow behaviour and various rate and liquidity factors are analysed and understood, it would be possible to forecast run-offs and future balances under different combinations of rate and liquidity scenarios. In addition to interest rate movements and liquidity considerations, there may be numerous other reasons ranging from systemic to individual that may alter the nature of cash flows from their contractual terms. An understanding of the real behaviour of cash flows is required to not only effectively manage the liquidity and interest income of a bank but also allow a more realistic cash flow forecasting basis for planning and strategic purposes.

## Balance Sheet Categories

Banks' balance sheets consist of a wide variety of financial and non-financial categories and products that differ widely in both contractual and behavioural terms. There are quite a few products which do not have any contractually defined cash flows while the cash flows of many other products deviate materially from their contractual terms. Modelling of such non-deterministic cash flows will require drafting of various statistical and quantitative methodologies. An overview of various balance sheet products for which the cash flows are largely non-deterministic i.e. they either do not have any contractual maturity or they differ materially from contractual terms is described below.

Assets Related

Category	Description	Cash Flow Profile																														
Retail loans	<p>Retail loans tend to see repayments earlier than expected schedule due to various market and customer related factors. For fixed rate loans, and to a smaller extent for floating rate loans, the rate environment has a control effect on the level of prepayments. This behaviour has implications from both rate and liquidity perspectives. The cash flow chart on the right shows a simple repayment schedule of a retail loan. The repayments are always higher than the contractual schedule and repayments are highest under rate down scenario</p>	 <p><b>Retail Loan Cash Flows</b></p> <table border="1"> <thead> <tr> <th>Period</th> <th>RateDN</th> <th>Base</th> <th>RateUP</th> <th>Contractual</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>180</td> <td>140</td> <td>120</td> <td>100</td> </tr> <tr> <td>2</td> <td>130</td> <td>115</td> <td>110</td> <td>100</td> </tr> <tr> <td>3</td> <td>90</td> <td>100</td> <td>100</td> <td>100</td> </tr> <tr> <td>4</td> <td>60</td> <td>80</td> <td>90</td> <td>100</td> </tr> <tr> <td>5</td> <td>40</td> <td>65</td> <td>80</td> <td>100</td> </tr> </tbody> </table>	Period	RateDN	Base	RateUP	Contractual	1	180	140	120	100	2	130	115	110	100	3	90	100	100	100	4	60	80	90	100	5	40	65	80	100
Period	RateDN	Base	RateUP	Contractual																												
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2	130	115	110	100																												
3	90	100	100	100																												
4	60	80	90	100																												
5	40	65	80	100																												
Corporate working capital facilities	<p>Revolving facilities are typically approved on an annual basis and the facilities tend to get rolled over continuously and become evergreen. Such products need to be assessed for core portion that will remain outstanding during the shorter tenors. This behavioural analysis is largely required from a liquidity perspective. However, such analysis helps with pricing decisions as well. Infographic shows historical limit utilisation and repayments done by the customer based on which a core portion and the tenor it is expected to be on books is estimated</p>	 <p><b>Maximum Limit</b></p> <table border="1"> <thead> <tr> <th>Period</th> <th>Historical Withdrawals</th> <th>Future Withdrawals &amp; Tenors</th> </tr> </thead> <tbody> <tr> <td>-5</td> <td>30</td> <td>0</td> </tr> <tr> <td>-4</td> <td>50</td> <td>0</td> </tr> <tr> <td>-3</td> <td>90</td> <td>0</td> </tr> <tr> <td>-2</td> <td>10</td> <td>0</td> </tr> <tr> <td>-1</td> <td>60</td> <td>0</td> </tr> <tr> <td>0</td> <td>20</td> <td>0</td> </tr> <tr> <td>1</td> <td>0</td> <td>50</td> </tr> <tr> <td>2</td> <td>0</td> <td>50</td> </tr> <tr> <td>3</td> <td>0</td> <td>50</td> </tr> </tbody> </table>	Period	Historical Withdrawals	Future Withdrawals & Tenors	-5	30	0	-4	50	0	-3	90	0	-2	10	0	-1	60	0	0	20	0	1	0	50	2	0	50	3	0	50
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Credit cards	<p>Limit usage and repayment behaviour needs to be analysed to understand cash flow of credit cards. Not all customers repay the entire outstanding during every billing cycle. Some typically revolve the balances and only repay the minimum amount due. First, a Transactor-Revolver analysis is needed to assess repayment behaviour of customer and then a limit usage analysis is needed to understand balance build-up. This analysis is largely from a liquidity perspective as credit card pricing is policy driven and is not changed often. Infographic shows balance build-up and minimum repayments made by a “revolver” type customer</p>	 <p><b>Maximum Card Limit</b></p> <table border="1"> <thead> <tr> <th>Period</th> <th>Balance Buildup</th> <th>Max Limit Usage</th> </tr> </thead> <tbody> <tr> <td>-5</td> <td>20</td> <td>10</td> </tr> <tr> <td>-4</td> <td>30</td> <td>10</td> </tr> <tr> <td>-3</td> <td>40</td> <td>10</td> </tr> <tr> <td>-2</td> <td>40</td> <td>10</td> </tr> <tr> <td>-1</td> <td>50</td> <td>10</td> </tr> <tr> <td>0</td> <td>65</td> <td>10</td> </tr> <tr> <td>1</td> <td>0</td> <td>70</td> </tr> <tr> <td>2</td> <td>0</td> <td>80</td> </tr> <tr> <td>3</td> <td>0</td> <td>80</td> </tr> </tbody> </table>	Period	Balance Buildup	Max Limit Usage	-5	20	10	-4	30	10	-3	40	10	-2	40	10	-1	50	10	0	65	10	1	0	70	2	0	80	3	0	80
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## Liabilities Related

Category	Description	Cash Flow Profile																																								
Non Maturing Deposits (NMD)	Non maturing deposits need to be assessed for vintage balance run-off behaviour from a liquidity perspective first to identify the stable portion. Then the sensitivity of the run-offs to rate movements needs to be assessed to identify core portion. In addition, a rate pass through analysis needs to be performed to understand how closely the offer rates on these products have tracked the market. For non-interest bearing accounts a volume-rate analysis needs to be performed to understand rate sensitivity.	<p><b>NMD Balance run-off</b></p> <table border="1"> <caption>Estimated data for NMD Balance run-off</caption> <thead> <tr> <th>Days</th> <th>Retail Savings (%)</th> <th>Retail Current (%)</th> <th>Corporate Savings (%)</th> <th>Corporate Current (%)</th> </tr> </thead> <tbody> <tr><td>0</td><td>100</td><td>100</td><td>100</td><td>100</td></tr> <tr><td>10</td><td>90</td><td>80</td><td>60</td><td>40</td></tr> <tr><td>20</td><td>75</td><td>55</td><td>35</td><td>20</td></tr> <tr><td>30</td><td>65</td><td>45</td><td>25</td><td>15</td></tr> <tr><td>40</td><td>58</td><td>38</td><td>18</td><td>12</td></tr> <tr><td>50</td><td>52</td><td>32</td><td>15</td><td>10</td></tr> <tr><td>60</td><td>48</td><td>28</td><td>12</td><td>8</td></tr> </tbody> </table>	Days	Retail Savings (%)	Retail Current (%)	Corporate Savings (%)	Corporate Current (%)	0	100	100	100	100	10	90	80	60	40	20	75	55	35	20	30	65	45	25	15	40	58	38	18	12	50	52	32	15	10	60	48	28	12	8
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Time deposits	Retail term deposits need to be assessed for early termination and rollover behaviour to understand behavioural maturities. Similar to loans, rate environment plays a control role that drives early terminations. While both early terminations and rollovers have liquidity implications, only early terminations have rate implications as rollovers typically get priced at prevailing rates. Infographic shows that in shorter tenors, rollovers dominate early terminations and average tenors are always extended. However in longer tenors, early terminations dominate rollovers and tenors are shortened. Tenors further shorten in upward rate environment.	<p><b>TD Tenor Modifications</b></p> <table border="1"> <caption>Estimated data for TD Tenor Modifications</caption> <thead> <tr> <th>Tenor</th> <th>Orig Tenor</th> <th>Beh Tenor</th> <th>RateUP</th> <th>RateDN</th> </tr> </thead> <tbody> <tr><td>TD 3M</td><td>3</td><td>7</td><td>6</td><td>9</td></tr> <tr><td>TD 12M</td><td>12</td><td>13</td><td>10</td><td>16</td></tr> <tr><td>TD 3Y</td><td>36</td><td>28</td><td>23</td><td>34</td></tr> </tbody> </table>	Tenor	Orig Tenor	Beh Tenor	RateUP	RateDN	TD 3M	3	7	6	9	TD 12M	12	13	10	16	TD 3Y	36	28	23	34
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### Central Bank Reserve Requirements:

Central Banks typically require a portion of deposits taken by banks to be held with them to ensure that banks maintain a minimum level of liquidity to withstand any deposit run-offs scenarios. These reserves are linked to the deposit balances and central banks monitor the balances on a weekly or a more frequent basis. Banks do not have the option to utilize these balances to fulfil their liquidity requirements at all times and will have to be limited to the proportion of expected deposit run-offs. So central bank reserves will also need to be slotted in to latter buckets as per deposit run-off schedule. This analysis is largely from a liquidity perspective and has negligible rate implications as these accounts are not interest bearing.

## Off-balance Sheet

Category	Description
Trade related	Products typically include Letters of Credit (LCs) and Letters of Guarantee (LGs). These products have liquidity implications as the bank make have to make payments on behalf of the customer when the LCs devolve or the LGs get called.
Credit commitments	Banks offer its customers with credit liens which can be drawn at any time for a limited period of time. These may or may not be revocable. Assumptions regarding utilisation and time will need to be made in cases where the drawdown schedule is not known.
Liquidity facilities	Banks often offer fee based liquidity facilities to corporates. They are mostly revocable in nature but do have liquidity implications.

In this blog we shall be looking at Non-maturing deposits which form the major part of non-deterministic cash flows both from rate sensitivity perspective and from liquidity perspective for a bank.

### Non-maturing Deposits (NMDs)

NMDs comprise of various types of products including demand deposits, checking accounts, saving accounts, custody accounts, cash management accounts, margin accounts etc. They form a major chunk of deposit base of banks and are also the biggest source of non-deterministic cash flows for banks. The term "non-maturing" arises due to the fact that these accounts do not have a contractual maturity date and they can only be understood from a cash flow perspective. NMDs typically are considered stable over a long period of time and have relatively lower interest rates compared to term deposits. Hence, understanding the cash flows of NMDs and the impact that interest rates and market liquidity have on these cash flows is critical to managing the cost of funds and liquidity of a bank. Before applying any modelling techniques to analyse the deposit run-off behaviour, it is important to understand that NMDs are highly heterogeneous in terms of products, types of customers, business models and other market factors that drive their behaviour and therefore a one-size-fits-all approach cannot be used for their analysis. Hence it is important to look at the composition of these balances and the key parameters that drives their behaviour. That being said, it is not necessary to look at balance movements at an individual account level as certain cohorts of accounts behave in a similar way and there is a diversification effect that transforms short and unsteady individual accounts into longer tenor stable deposits.

At a high level, there are two primary optionalities that drive the volumes of NMDs. While customers have the option to withdraw balances as per their requirements, banks have the option to adjust interest rates on the deposit balances. And market rate and liquidity environment plays a key role in exercise of options by either party. Hence, modelling of NMDs requires an understanding of the evolution of the interplay between these two options driven by changes in market environment. To understand the first option, i.e. the option of the depositor to withdraw funds, lets first look at some key characteristics that drive the customer behaviour.

## Factors Driving Cash Flow Behaviour

### Depositor Characteristics

Product Type/End use: Banks offer various deposit products to address different cash management and savings needs of customers. Current accounts are typically aimed at addressing the regular transactional and payment processing needs of customers. They do not typically pay any interest or pay only a marginal rate as the cash in these accounts is expected to be transitory. There are other similar deposit categories like call accounts or margin accounts which are transactional in nature and typically do not pay any interest. On the other hand, banks offer Savings accounts for customer to park their savings and these accounts pay a small rate that covers for inflationary devaluation. Balances in savings accounts are typically more stable and have longer duration. It makes obvious sense to look at product wise balance run-offs separately for modelling purposes as their typical behaviour and rate sensitivities are significantly different.

Transactional Accounts: Lot of retail accounts despite their product type are used for regular utility payments or have salary credits and other standing instructions. These accounts are considered as transactional as customers use these account for payment purposes. Similarly, wholesale accounts which are attached to various cash management products offered by the bank are considered transactional. It is important to assess the transactional nature of accounts as these types of accounts are more likely to be stable over the long term despite having short term volatility in balances and are less rate sensitive. From a rate sensitivity perspective, these accounts need to be looked at separately.

Business or Customer Segment: The other most common classification of deposits uses the customer segmentation. Banking business typically is classified into retail and wholesale business based on the customer needs and characteristics. While retail side targets individuals and has larger number of customers with small balances and is driven by microeconomic factors, wholesale targets corporates and other institutional entities and has smaller customer base with larger balances and is driven by macroeconomic factors. For banks, retail accounts are more desirable due to increased customer base and tenor diversification and as they typically tend to be less rate sensitive. Below this business segmentation, there might be further customer segmentation based on salary level (affluent, general) or Industry (FI, Govt.) etc. which can be utilized for modelling purposes, if volumes are material.

Size of the Customer Deposit: Big ticket deposits tend to be placed by institutional clients and high net worth individuals who are more sophisticated and responsive to market-wide and idiosyncratic stress than regular retail depositors. They can also represent discretionary funds placed for non-transactional purposes. For these reasons, high value deposits can be subject to higher and faster outflows in either an idiosyncratic or market-wide stress scenario. To identify high value deposits banks can use the threshold derived from the local regulatory deposit guarantee amount or the amount above which the interest rate is negotiated or the deposit is part of top 20 deposit list or deposits comprising a certain percentage of total deposit base.

Length of relationship: It is accepted knowledge in the market to consider customer balances with longer history of relationship with the bank to continue to remain with the bank as opposed to recent balance growth either due to a new product or a new campaign.

Other customer characteristics like sub-segmentation, residence, significant currency, country of deposit etc. can be considered for building further cohorts of homogenous portfolios.

### **Bank Considerations**

As stated earlier, banks have the option to adjust the interest rates offered on their deposit products. Banks can do this through many ways as discussed below.

Interest Bearing vs Non-interest Bearing: Products which are tailored for meeting the cash management and settlement needs of customers are typically not offered any interest rate. Instead banks issue free of cost check books and other free of charge quick payment mechanisms. However, in some countries with excess liquidity, customers place their savings balances in non-interest bearing accounts. It is important to segregate interest bearing and non-interest bearing accounts as their behaviour will be different from a rate sensitivity perspective. Non-interest bearing accounts which are not transactional may see decline in volumes during periods of rising rate environment as other products offer better rates. Even within interest bearing accounts, there may be pricing differential between products that enable the bank to achieve certain ideal funding mix and level of balances in each product category.

Managed Rate vs Programed Rate: Banks offer special profit rates or negotiate with customers on the offer rate for managing special or strategic relationships. Sometimes banks may also offer special rates for clients who are sophisticated or to retain large ticket deposits in times of tight liquidity. Managed rate deposits are typically highly rate-driven and have high probability of running off if market environment changes and therefore these accounts need to be segregated for analysis purpose.

Gap and lag on offered rate with market benchmark: Savings rate paid by banks typically tracks a market benchmark albeit with a lag and may not match the rate to the full extent. The gap between the savings rate and the market rate drives the volume behaviour from a rate sensitivity perspective. This analysis is required to assess the rate pass through offered by the bank. Banks manage the level of the offer rate depending on the volume sensitivity, competitor pricing and its own cost of funds and interest rate risk.

### **Market Factors**

The most obvious market factor that drives balances is the market interest rate. Other than rates, the general economic environment represented by factors like GDP growth, unemployment rates, stock market performance, other market liquidity indicators also have an impact on the deposit cash flows. Business cycle induced seasonality may also be observed in the balances.

### **Modelling Approach**

Banks have traditionally employed the Replicating Portfolio approach where the sensitivity of the deposit base is modelled after an investment portfolio of fixed income securities of various tenors to estimate the balance run-off profile of interest paying non maturing deposits. As the replicating portfolio matures, it is reinvested into various tenors based on a fixed reallocation rule until the composition of the investment portfolio stabilises. A statistical fitting approach is used to determine the appropriate composition and reinvestment rule that most closely replicates the cash flows of the deposit product. An alternative and more effective approach is to use historical data to model balance run-offs on the deposits and then further analysing the run-off profile as being dependent on various

product characteristics, customer characteristics and market factors including interest rate movements and market liquidity indicators. This approach enables the bank to ascribe specific factors to rate sensitivity and liquidity characteristics separately and therefore would provide more realistic cash flow forecasts under various rate and liquidity scenarios.

Setting up the Data: For NMD modelling, ideally a ten-year history of data is required to capture a whole range of cash flow behaviours as it would cover at least two business cycles in most industries. In terms of the market environment, it would be ideal if the time period covers at least one upward rate scenario, one downward rate scenario, a medium to severe liquidity squeeze and a period of excess liquidity. The average cash flow profile from such a data sample would be a representative of the base line run-off behaviour of the accounts based on which further cohorts can be segregated based on customer or product characteristics. While looking at the historical data, it is important to use the monthly average balance data for most accurate modelling purpose as it would avoid any inter-month volatility. An alternative indicator would be the mid-month balance which would also give a decent indication as to the balance levels as compared to beginning/end of month balances which may either be too high as salaries get credited or be too low as expenses are paid for. In addition, data fields should capture all the product and deposit characteristics defined above so that homogenous pools of deposits can be created.

Building the Historical Cash Flow Profile: Once the data history is obtained, accounts need to be segregated based on the above mentioned deposit and product parameters based on materiality of the balances. As a rule of thumb, if a data cohort does not consist of at least 5% of total deposit base then the parameter that is used for segregation should be ignored. Within each of the cohorts the primary objective of the balance runoff methodology is to segregate balances based on historical tranches. Essentially each tranche consists of accounts that were opened in a particular month. So all the tranches in a cohort are segregated based on the length of customer relationship with the bank. For each tranche, balance run-offs are calculated over various run-off horizons e.g. 1 month, 3 months, 6 months etc. until a 6year horizon which is the maximum recommended tenor of slotting NMD cash flows.

<b>Cohort1</b>	Retail/Interest bearing/Savings/Transactional/Small ticket sized							
<b>Tranche1</b>	Jan11							
<b>Description</b>	This tranche includes all accounts that were opened during the month of Jan-11 and belonging to Cohort1 as described above							
	Jan/11	Feb/11	Mar/11	Apr/11	May/11	Jun/11	Jul/11	Aug/11
Avg Bal.	11,068	19,600	10,295	13,672	17,425	12,086	18,619	18,181
1M Horizon run-offs		77.1%	-47.5%	32.8%	27.5%	-30.6%	54.1%	-2.4%
3M Horizon run-offs				23.5%	-11.1%	17.4%	36.2%	4.3%

Since the objective of the analysis is to understand the run-offs, only negative movements in balances are considered as any positive percentage represents new volumes. For each run-off horizon, a series of run-off rates (run-off balance as a percentage of previous balance) will be computed for all the tranches. A weighted average run-off rate series is created by adding the run-off balances across the



tranches. For example, for the monthly horizon run-offs, a series of 119 monthly run-off percentages will be generated for each cohort. Similar run-off percentages are generated for various other run-off horizons like 3m and 6m as well. In the end, we are left with a time-series of run-off rates for each cohort and run-off horizon combination.

Identifying Significant Behavioural Drivers: Once the run-off time series matrix is created, averages of run-off rates for all the horizons are computed for each cohort, which will give a raw balance decay profile for the cohort. A simple average or a weighted average can be used based on the nature of rate environment prevailing during the historical period. Further, functions like negative exponential or piece-wise linear functions can be applied to smoothen out the raw decay profile. The smoothened run-off profiles can be compared for similarity by using certain statistical tests or by using judgement. Key parameters that result in run-off profiles which are different are retained while the others are dropped.

Segregating Term Risk vs Rate Risk: From a risk measurement point of view, it is important to understand the balance run-offs both from a rate and term risk perspective. From term risk perspective, balances can be said to be stable if they remain with the bank for the longest period of time. A simple definition like balances staying over a one-year horizon can be used to denote stable balances. Alternatively, a statistical threshold like a 95% confidence level of the balance retaining during the next month can be used to define stable balances. While the final smoothened run-off profile represents the term risk of the NMDs, the cohort wise run-off time series can be used to understand the behaviour in relation to the rate movements. A suitable market benchmark like a Treasury rate, interbank offer rates, Retail deposit rate or any other benchmark used by the bank as a reference for deposit pricing can be used to perform regression with the run-off time series data. A separate rate benchmark can be used with each run-off horizon related time series to accurately reflect the pricing basis. For relations which are statistically significant, the beta of the regression can be used to assess the rate pass through or sensitivity and thereby determine the balances which are less sensitive to rates i.e. the core portion. The run-off profile in conjunction with the benchmark rate regression analysis finally segregates balances into three main types by their behaviour. Non-stable balances which are volatile from a term risk perspective will be slotted into the shortest term bucket for both liquidity and repricing bucketing. Secondly, stable but non-core balances will be slotted as per their term run-off profile under liquidity bucketing while they will be slotted in the appropriate repricing bucketing based on the index with which they are mostly correlated with. Finally, the stable and core balances will be slotted as per their run-off profile under both bucketing. From a performance measurement perspective as well, the base rate will be assigned based on the repricing bucketing and liquidity premium will be assigned based on liquidity bucketing as shown below.

Run-off Component	Rate Correlation Component		Term Risk Treatment	Rate Risk Treatment
	Correlation	Reference Rate		
Stable	Non-correlated component		Slotted as per run-off profile	Long term
	Correlated component	Long term rates		Long term
		Medium term rates		Medium term
		Short term rates	Short term	
Volatile			Short term	Short term

Modelling Balance Forecasts: From a liquidity and economic value analysis perspective, looking at balance-runoffs makes sense. However, for planning and forecasting purposes which uses a going-concern approach, it is required to estimate future balance growth as well. While we have discussed the balance run-off behaviour of the NMDs, the same data set can be used to build balance growth forecasts under various scenarios. Instead of using only negative movements in the balances, the above methodology can be replicated to look at balance growth as influenced by various product and customer characteristics in addition to their relation with market rates and other macro-economic variables. Apart from understanding the run-off profiles, it is also important for banks to understand inter-product cannibalisation. Especially in a rising rate environment balances from deposits which do not pay interest rate may get transferred to other interest paying deposit products. A regression based approach between monthly balance history of each product can be adopted to understand such linkages. Coupled with the balance movement profiles and product linkage analysis, accurate product wise balance forecasts can be generated.

Testing the assumptions: It is important to back test the model through either random sampling of accounts and tracking their run-off or through forecasting latest month balances and comparing it with actual balances both from rate and liquidity perspectives. Specifically, the model needs to be tested under stress conditions observable in the data to check if the assumptions still hold. If not, the assumptions need to be made conservative enough to hold even under stress situations. These stress tests on assumptions complement the stress tests that are applied on the level of interest rates and market factors while measuring IRRBB and liquidity ratios. In addition, it is recommended to assess the sensitivity of the end results to changes in the assumptions.

## Conclusion

NMD modelling gives banks a clear understanding on the rate and liquidity profile of their deposit base and helps accurately measure the rate and liquidity risks associated with the accounts. Using judgmental run-off estimates or simplistic models can lead to incorrect risk measurement and may lead the bank to get into loss making hedging positions. From a performance measurement perspective as well, inappropriate incentives may be given to the wrong products there by driving balance sheet to suboptimal state. Modelling assumptions thus derived must be used consistently for calculating NII statement, EVE sensitivity, balance forecasting and performance measurement. Balance sheet forecasting is a critical aspect of the planning and budgeting function of the bank and the ability to build accurate cash flow forecasts under various rate and liquidity scenarios not only enables the bank to set realistic targets but also model future stress scenarios more accurately. Hence NMD modelling can be a source of value creation and return enhancement for the bank.



Feel free to send your IRRBB related queries to:

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## About **Aptivaa**

Aptivaa is a vertically focused finance and risk management consulting and analytics firm with world-class competencies in Credit Risk, Market Risk, Operational Risk, Basel III, IFRS-9, IRRBB, Risk Analytics, COSO, ALM, Model Risk Management, ICAAP, Stress Testing, Risk Data and Reporting. Aptivaa has emerged as a leading risk management solutions firm having served over 100 clients across 22 countries comprising of highly respected names in the financial services industry.

We can help you through our bouquet of services listed below

- Review of governance and internal risk management framework for identification, measurement, and monitoring of interest rate risk on banking book (IRRBB).
- Review of methodology for EVE and NII sensitivity calculations, updating interest rate shock and stress scenarios and key underlying assumptions driving the IRRBB analysis.
- Development of Interest rate risk behavioral models (Core Deposit Analysis and Prepayment Modeling).
- Assist in developing balance sheet optimizing strategies and arrive at the right balance sheet mix.
- Development of Funds Transfer Pricing (FTP) methodology which can help measure profitability and economic value-added of each business unit.
- Development of methodology to assess and monitor Credit Spread Risk on Banking Book (CSRBB).
- Agile and off-the-shelf analytical solutions that leverage existing ALM solutions to perform on the fly risk analytics to enable better decision making.
- Development of qualitative and quantitative disclosures as required by the regulators.

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