On Measuring Bank Funding Liquidity Risk

By

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Agenda

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1. Introduction.
2. Existing models to assign cash-flows.
3. Survival approach to assign cash-flows.
4. Numerical illustration.
5. Concluding remarks.

Definition of Funding Liquidity Risk

Funding liquidity risk is the risk of an individual **economic agent** failing to fund its **net cumulative cash outflows** over a **specific period**.

Why This Study?

Two main challenges faced by banks in determining their funding liquidity risk metrics are:

1. Assigning cash flows to future time horizons on financial products with uncertain timing
2. Ascertaining the stable (core) and less stable (volatile) portion of financial products with uncertain cash-flow timing.

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Why This Study?

Similar problems are faced by regulators. For example,

under Basel III:

- Liquidity Coverage Ratio (LCR)

$$LCR = \frac{Stock\ of\ Highly\ Liquid\ Assets}{Total\ Net\ Cumulative\ Cash\ Outflow\ over\ 30\ days}$$

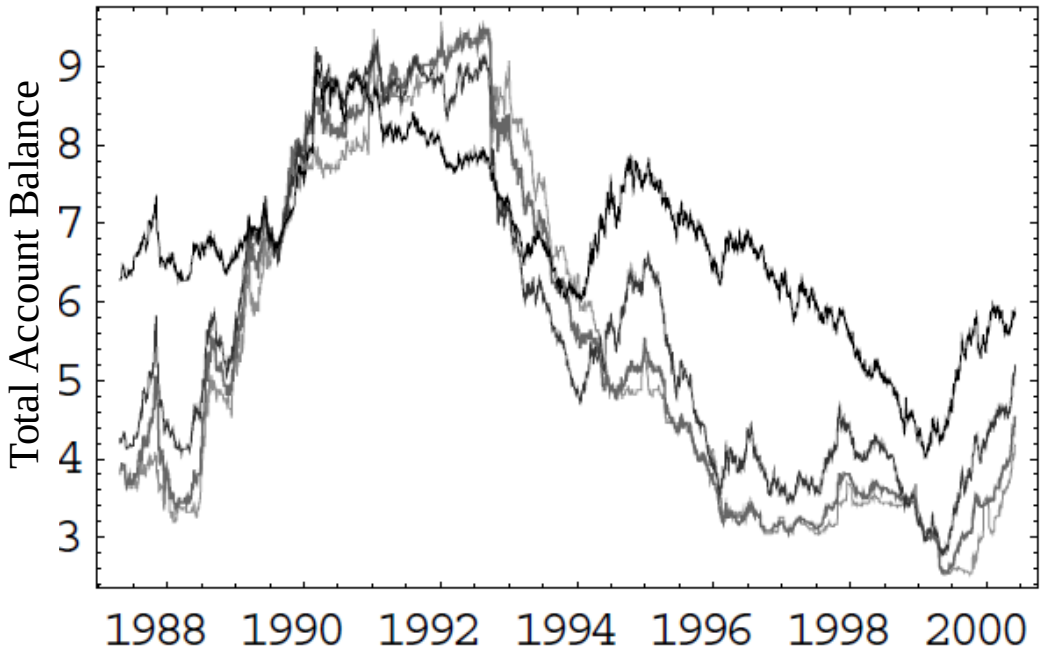
- Net Stable Funding Ratio (NSFR)

$$NSFR = \frac{Available\ Stable\ Funding}{Required\ Stable\ Funding}$$

Significance of Study

- Bank products with uncertain cash-flow timing constitute a significant portion of a bank balance sheet (Matz, 2013).
- Topical regulatory issue (run-off rates, stable portion).
- Valuing a bank's core deposits.
- Funding & liquidity risk management decision making.

Time Series Models



Neu, (2007); Bardenhewer, (2007); Vento and La Ganga, (2009).

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Replicating Portfolio Methods

- Create replicating portfolio of bank product.
- Portfolio comprises of simple financial contracts e.g.: treasury bond, treasury bills and other short term money market instruments.
- Determine the weights of the different
- Allocate cash-flows based on the replicating portfolio.
- Bardenhewer, (2007); Maes and Timmermans, (2005)

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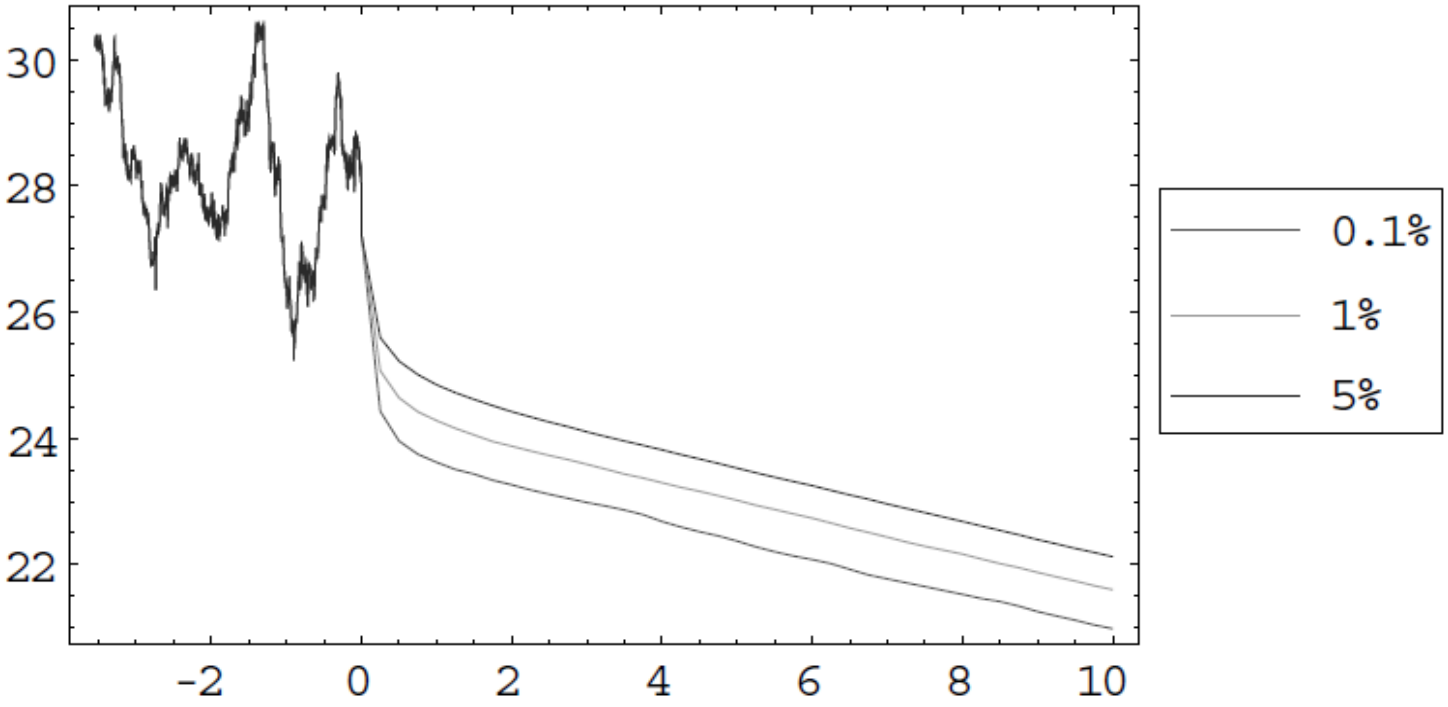
Simulation Methods



Kalkbrener and Willing (2005)

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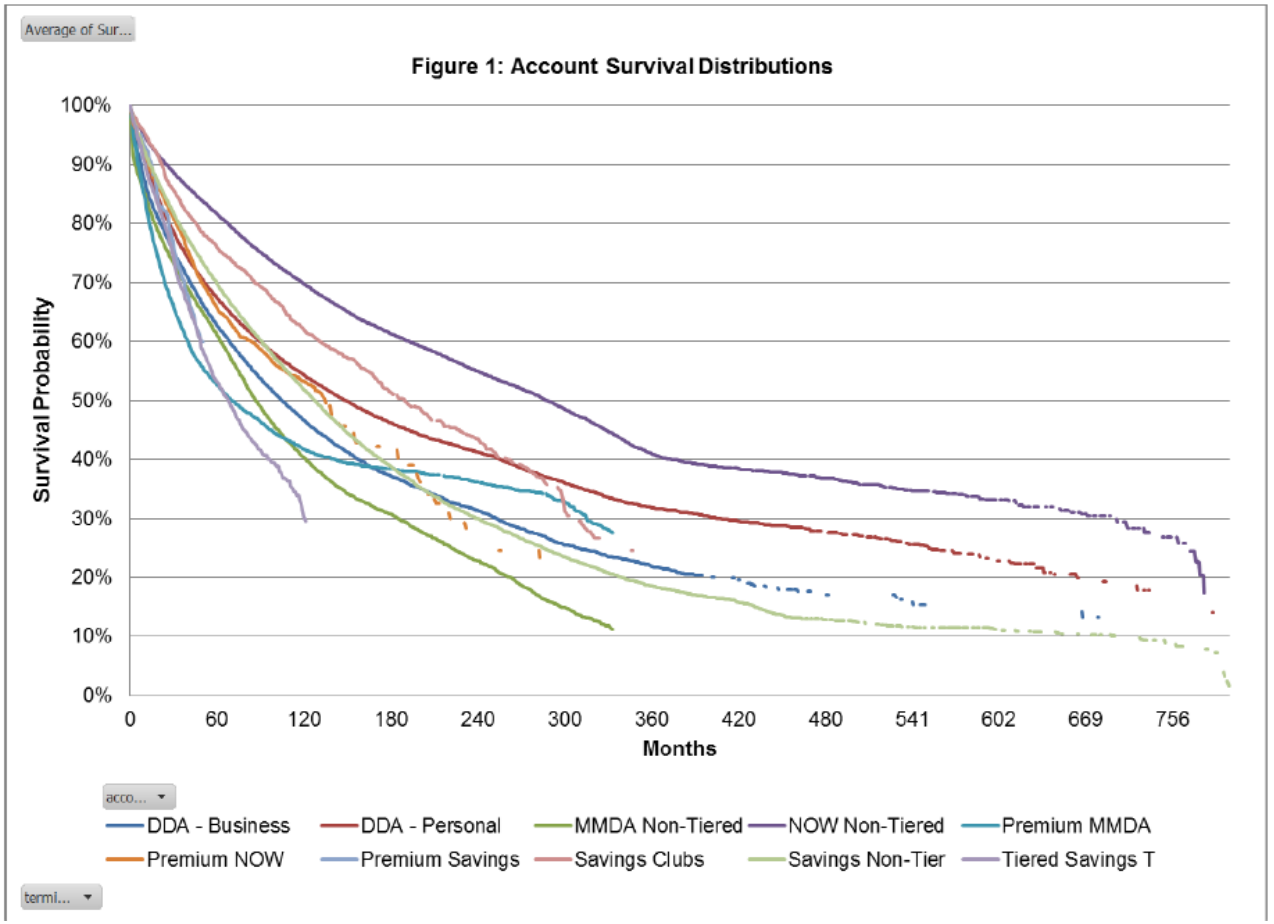
Retention curve methods



Source: Poorman and Stern (2012)

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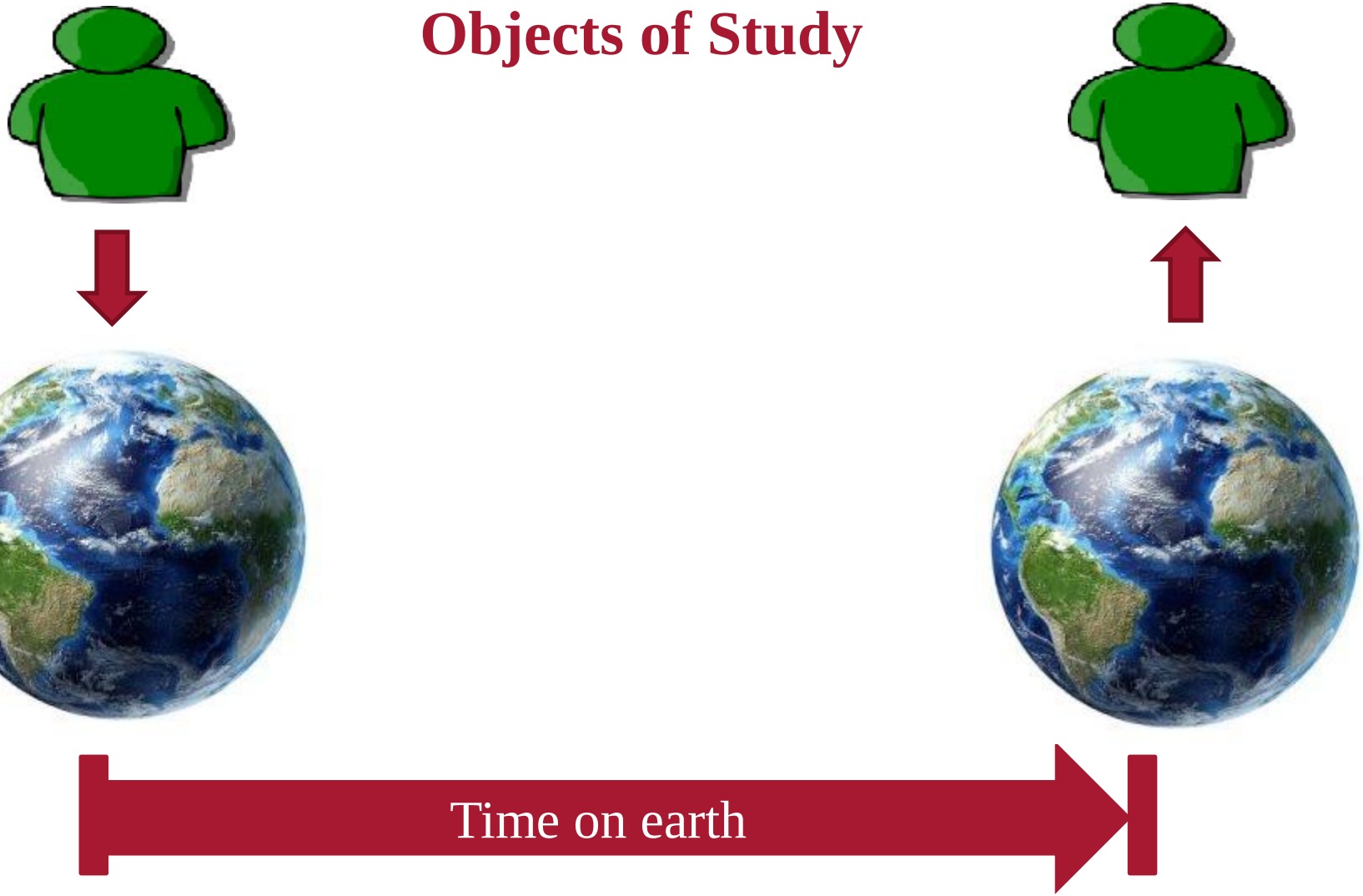
Objects of Study



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Objects of Study

Time that the bank retains the position

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Correlated Survival Times

Account 1 

Account 2 

Account 3 

⋮ ⋮

Account N 

Williams, R. L. (1995)

Bias? **No**

Variance? **Increases**

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Time Origin

Time origin = time corresponding to the furthest local maxima of the account balance when moving backward in time from the base date.

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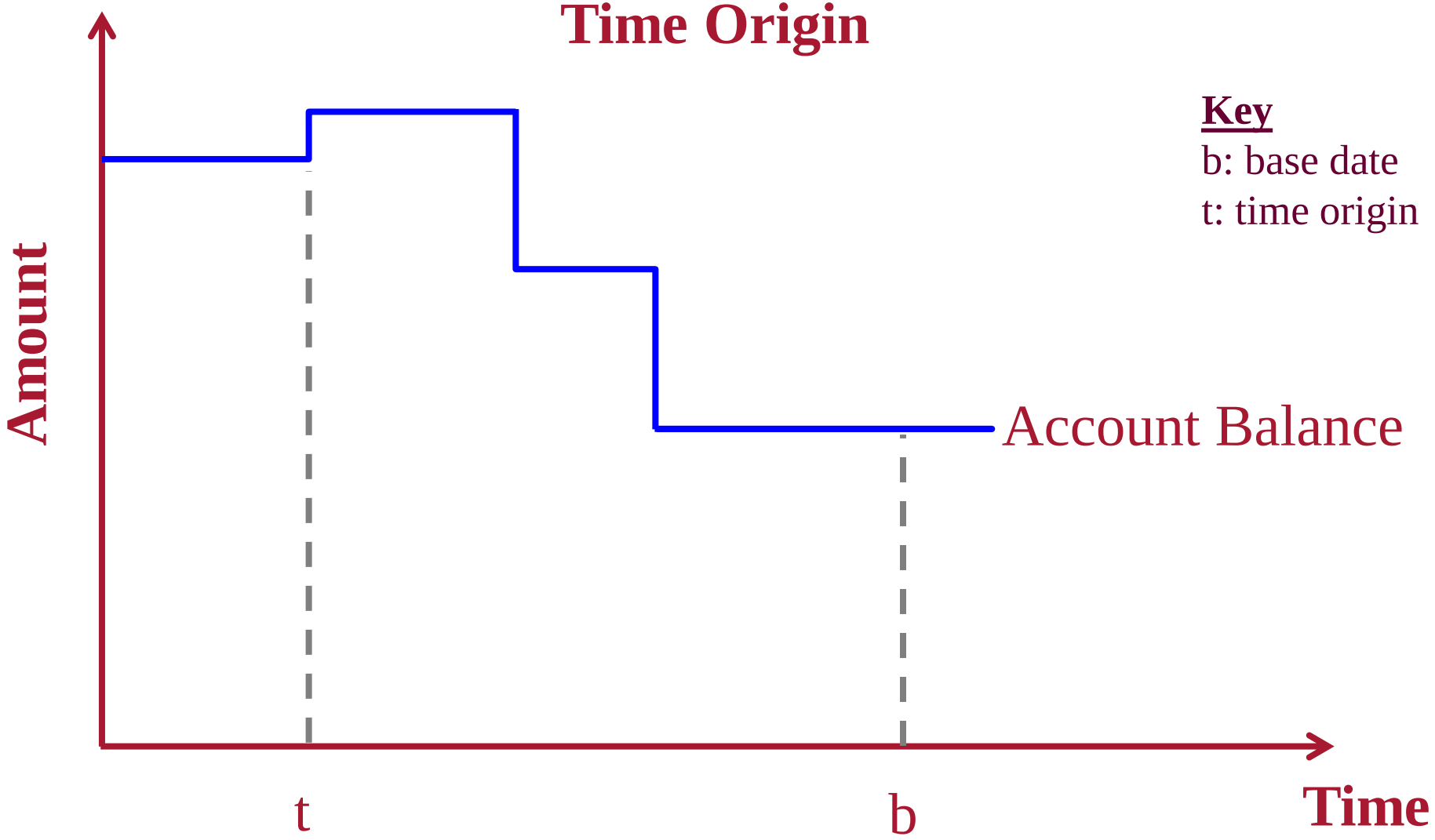
Time Origin



Key
b: base date
t: time origin

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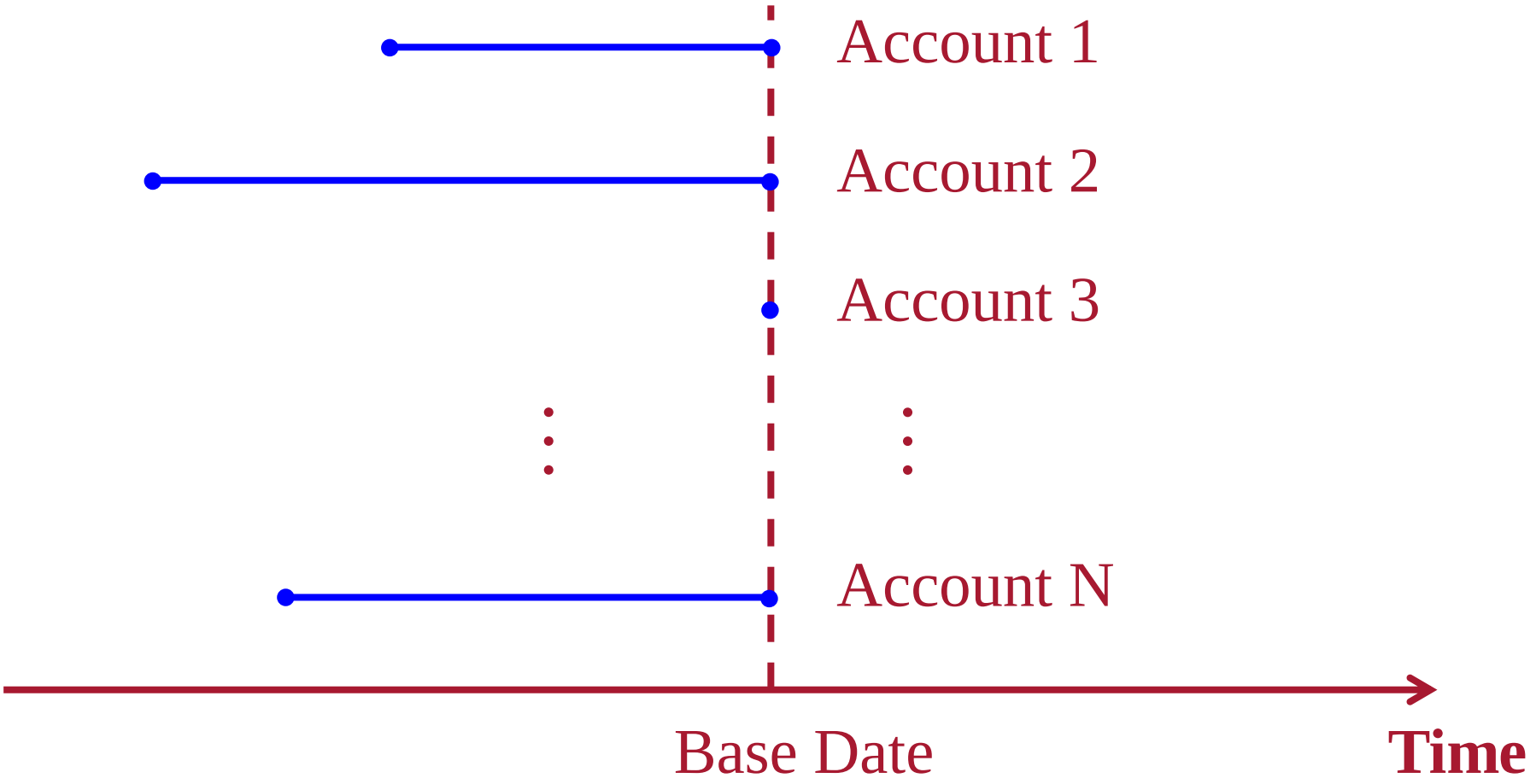
Time Origin



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Run-off Base Date

This is the date that we start tracking the run-off of a portfolio.

Run-offs can be tracked from multiple base dates.

Individual Account: State Independent

Data Collected			Runoff Base Day												
Day	Account Balance	Time Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1000	1	1 000													
2	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
3	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
4	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
5	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
6	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
7	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020	1 020			
8	800	2	800	800	800	800	800	800	800	800	800	800	800			
9	800	2	800	800	800	800	800	800	800	800	800	800	800			
10	800	2	800	800	800	800	800	800	800	800	800	800	800			
11	500	2	500	500	500	500	500	500	500	500	500	500	500			
12	2000	12	500	500	500	500	500	500	500	500	500	500	500	2 000	2 000	2 000
13	2000	12	500	500	500	500	500	500	500	500	500	500	500	2 000	2 000	2 000
14	2000	12	500	500	500	500	500	500	500	500	500	500	500	2 000	2 000	2 000

Individual Account: State Dependent

Data Collected			Runoff Base Day												
Day	Account Balance	Time Origin	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1000	1	1 000													
2	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020							
3	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020							
4	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020							
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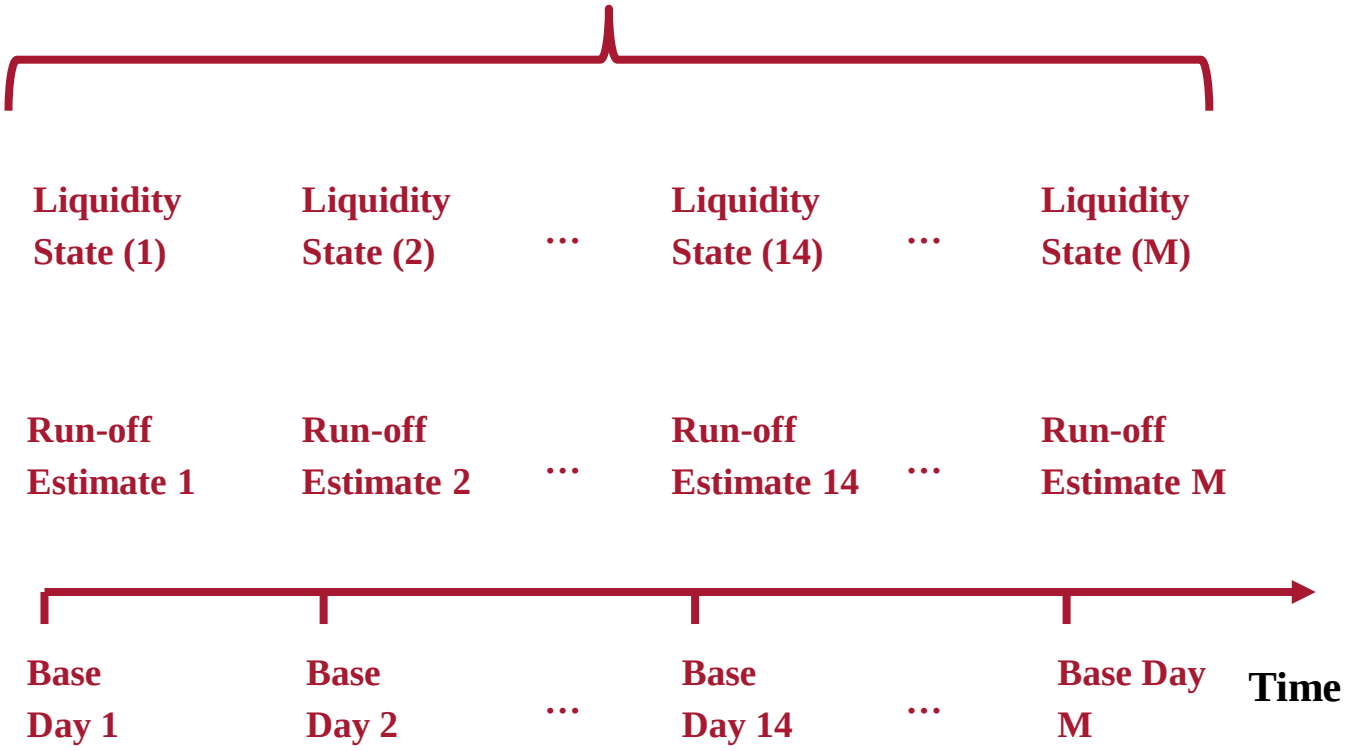
6	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020							
7	1020	2	1 000	1 020	1 020	1 020	1 020	1 020	1 020							
8	800	8								800	800	800	800			
9	800	8								800	800	800	800			
10	800	8								800	800	800	800			
11	500	8								500	500	500	500			
12	2000	12								500	500	500	500	2 000	2 000	2 000
13	2000	12								500	500	500	500	2 000	2 000	2 000
14	2000	12								500	500	500	500	2 000	2 000	2 000

Liquidity Scenarios

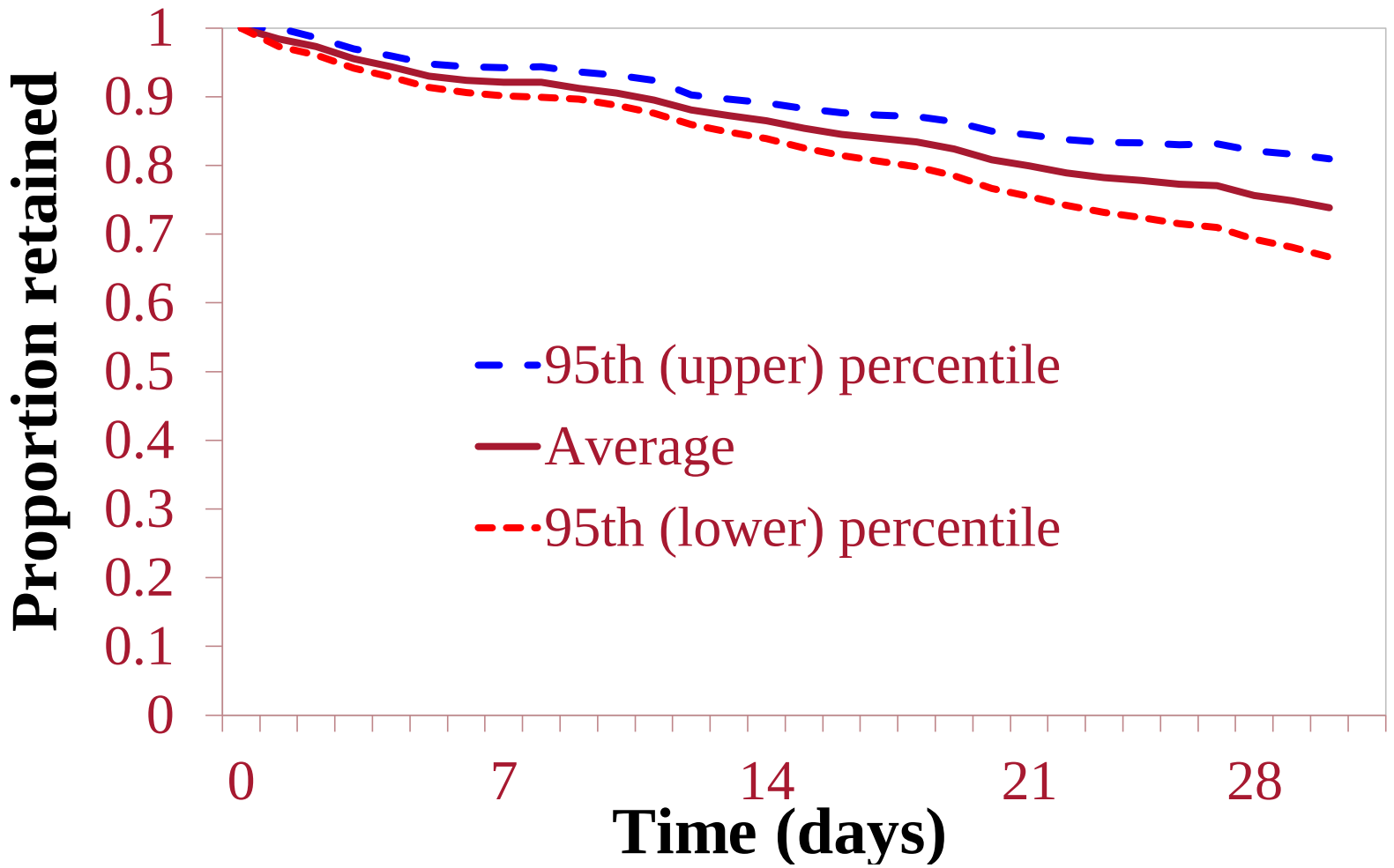
Market stress scenario	Bank-specific Stress Scenario: No	Bank-specific Stress Scenario: Yes
No	Scenario 1	Scenario 2
Yes	Scenario 3	Scenario 4

Estimating State Dependent Run-off Profiles

$$\text{Liquidity State}(j) \in \{\text{Scenario 1, Scenario 2, Scenario 3, Scenario 4}\}$$



All Accounts: Run-off Profiles



Concluding Remarks

- This study developed a non-parametric survival model of time that positions on indeterminate maturity products are retained on a bank's book.
- The problem of time origin is handled by an algorithm.
- Calibration of model is state-dependent.
- Basel III debate on prescribed run-off rates has virtually been empirical without duly considering the method employed to derive state-dependent run-off rates. The methodology developed in this study shows that regulators can consider an internal model approach to determine a bank's liquidity risk metric.

Future Research

- Correlation between run-off profiles of different assets and liabilities, e.g. via copulas.
- Association of liquidity scenario attributes to run-off profiles.
- Incorporating future new business.
- Modelling the evolution of run-off profiles over time.

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Thank You

Any Questions?