The 45-Minute Deposit Study

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The 45-Minute Deposit Study

- Develop and document key deposit assumptions used in most ALM models
  - Beta (EaR and EVE) Decay (EVE)
- Nonmaturity deposits (and CD betas)
- Quantitative: Can be measured using accepted methods
- Qualitative: Adjustments to quantitative analysis that can't be measured

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The 45-Minute Deposit Study

- Review accepted methods for supporting deposit assumptions
- Evaluate advantages and disadvantages
- Walk through each method with examples

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The 45-Minute Deposit Study

- Regulatory guidance: "The regulators remind institutions to document, monitor, and regularly update key assumptions used in IRR measurement models" (2010)
- Regulatory guidance: "At a minimum, institutions should ensure the reasonableness of asset prepayments, NMD price sensitivity (beta) and decay rates, and key rate drivers for each interest rate shock scenario" (2010)
- Good business practice: Opposite of "garbage in/ garbage out"

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The 45-Minute Deposit Study

- Pitfalls: Common weaknesses, oversights, or errors

- Big Picture: Certain decisions related to assumptions development can be simplified by considering what the assumptions represent, the impact on model output, and certain practical applications.

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The 45-Minute Deposit Study Provides:

- Documentation that is transparent and understandable to ALCO, board members, non-technical members of management, and examiners
  - Promotes discussion about deposit pricing and retention
- A reasonable quantitative baseline estimate of beta and decay assumptions
  - Different beta factors for rising/falling rate shifts
  - Minimum floor rates in the falling rate shifts
  - Same decay rates across all rate shifts

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The 45-Minute Deposit Study DISCLAIMER:

- The 45-Minute Deposit Study may take longer than 45 minutes!
- Quantitative deposit study results may require qualitative adjustments
- Deposit study results are always just estimates
- Assumptions are typically used for standard policy monitoring, including a single assumption set, simplified rate shifts/shocks, and static balance sheets (see next slide)

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The 45-Minute Deposit Study DISCLAIMER:

Strong programs recognize that selected beta and decay assumptions are estimates and incorporate additional analysis (aka: The Fun Modelling Stuff)

- Assumption sensitivity testing to evaluate a range of possible outcomes/exposures in isolated or combined scenarios
- Expected rate paths to evaluate expected performance; not necessarily the base case / rates unchanged scenario
- Adverse nonparallel rate shifts to evaluate exposure to yield curve risk (i.e. rising/flattening, falling/flattening, inverted, twisted, etc.)
- Dynamic balance sheet fluctuations to evaluate non-static balance sheet performance

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Common and Accepted Methods for Supporting Deposit Assumptions?

Beta

- Regression analysis
- Benchmarking ← 45-Minute Deposit Study Method
- Other: Management surveys, forward-looking pricing strategies, etc.

Decay

- Measure actual historical decay by balance
- Weighted Average Age ← 45-Minute Deposit Study Method
- Other: Opened/closed accounts, account balance trendlines, etc.

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Data for Beta Analysis

Best Data Sources for Historical Rates:

- Industry data widely available
- Old ALM/model reports (similar aggregation)
- Tracking reports (similar aggregation)
- Old rate sheets
- Regulatory Reports (UBPR)

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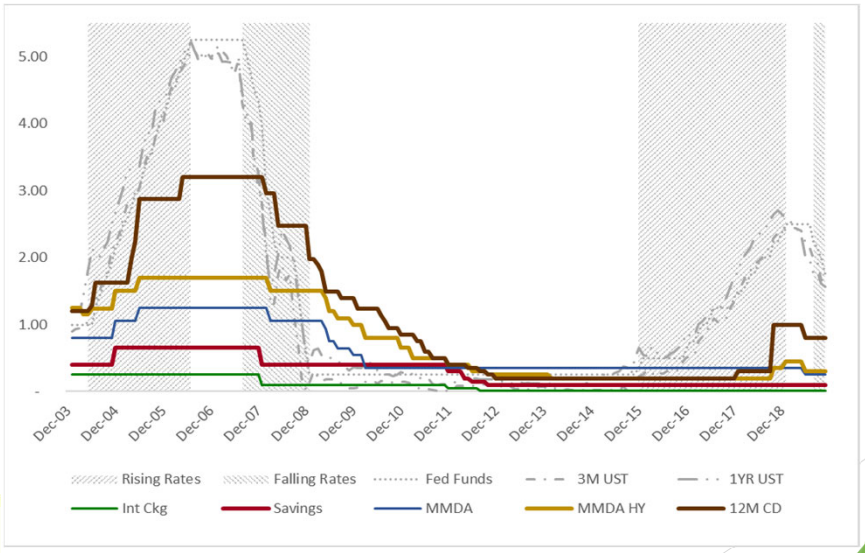
Beta Example



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Beta Example – Regression Analysis

Strengths

- Most sophisticated method
- Most common method used by ALM firms and big banks

Weaknesses

- Often poorly designed data sets (e.g. using entire date set)
- Calculation errors common (e.g. switching dependent/independent variables
- Requires more data points than benchmarking
- Less intuitive than benchmarking
- What to do when significance indicators not met?
- What to do when results fail reasonableness tests?

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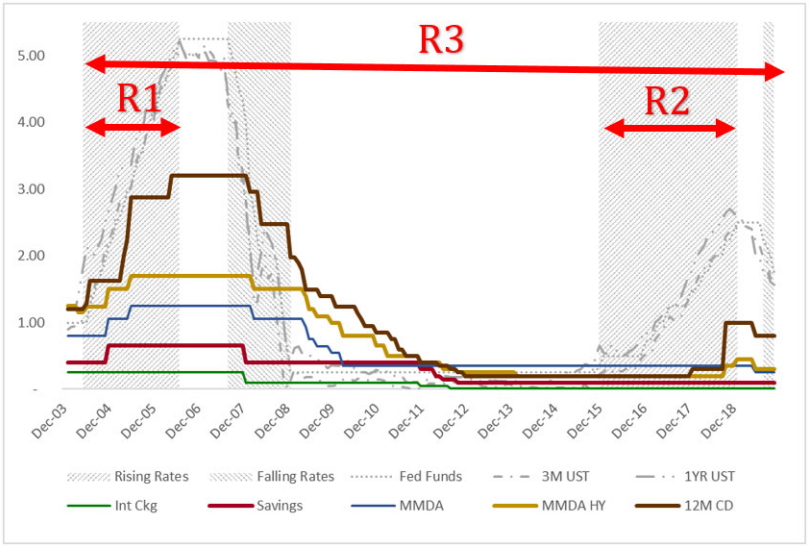
Beta Example – Regression Analysis



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Beta Example – Regression Analysis (with Reasonableness Test)

	Regression Analysis Beta Results*		
Deposit Category	Rising Rates '04-'06	Rising Rates '15-'18	Full Data Set '04-19
Interest Checking	0%	0%	4%
Savings	6%	0%	9%
MMDA	13%	0%	18%
MMDA - HY	14%	5%	26%
12M CD	49%	27%	55%

*Red font indicates significance indicators not met

Simulated +350bp Deposit Rates**		Historical Maximum	Variance
MMDA at 13% beta	0.71%	1.25%	-0.54%
MMDA at 14% beta	0.78%	1.70%	-0.92%
12M CD at 49% beta	2.50%	3.25%	-0.75%

** +350bp represents difference between current FF and peak FF from data set

Do these results pass reasonableness testing?

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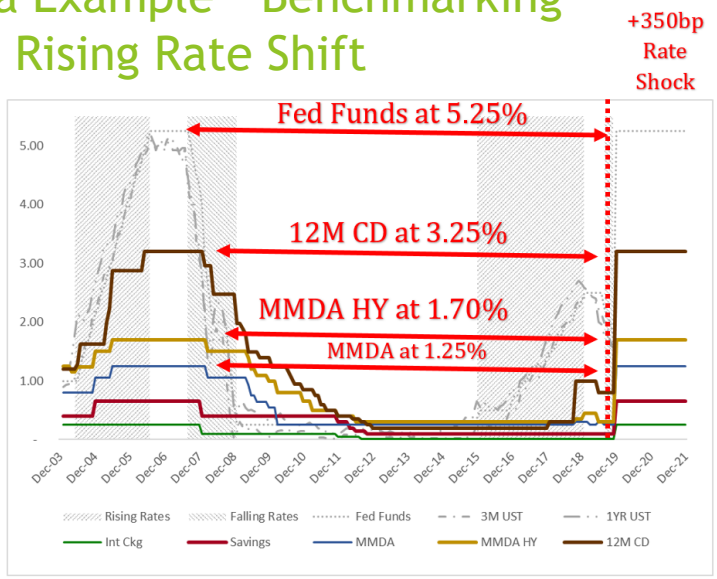
Beta Example – Benchmarking in a Rising Rate Shift



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Beta Example – Benchmarking in a Rising Rate Shift

Deposit Category	Current Rate (4Q'19)	Historical Minimum Rate (≈ 4Q'15)	Historical Maximum Rate (≈ 4Q'06)
Fed Funds Rate	1.75%	0.25%	5.25%
Change from Current		-1.50%	+3.50%
Interest Checking	0.01%	0.01%	0.25%
Savings	0.10%	0.10%	0.65%
MMDA	0.25%	0.25%	1.25%
MMDA - HY	0.30%	0.30%	1.70%
12M CD	0.80%	0.20%	3.25%

Benchmarking Method (12M CD Rising):

Historical Maximum Rate	3.25%	<-- Benchmark Rate	
Less: Current Rate	0.80%		
Expected increase in +350bp	2.45%	div. by 3.50% =	70%

Check: 70% beta times 3.50% rate shock plus 0.80% current rate equals 3.25%

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Beta Example – Benchmarking in a Falling Rate Shift

Deposit Category	Current Rate (4Q'19)	Historical Minimum Rate (≈ 4Q'15)	Historical Maximum Rate (≈ 4Q'06)
Fed Funds Rate	1.75%	0.25%	5.25%
Change from Current		-1.50%	+3.50%
Interest Checking	0.01%	0.01%	0.25%
Savings	0.10%	0.10%	0.65%
MMDA	0.25%	0.25%	1.25%
MMDA - HY	0.30%	0.30%	1.70%
12M CD	0.80%	0.20%	3.25%

Benchmarking Method (12M CD Falling):

Historical Minimum Rate	0.20%	<-- Benchmark Rate	
Less: Current Rate	0.80%		
Expected decrease in +150bp	-0.60%	div. by -1.50% =	40%

Check: 40% beta times -1.50% rate shock plus 0.80% current rate equals 0.20%

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Benchmarking - Additional Considerations

- Consistent beta in rising and falling rate shifts
  - Example: 12M CD beta = 70% (all rising) and 40% (all falling)
- Benchmark rates should represent estimate of maximum/minimum simulated rates at the extreme rate shocks
- Use floors for falling rate shift scenarios that represent zero or negative rates

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Benchmarking - Additional Considerations

- Benchmark rates do not need to be actual historical rates
  - Peer rates at appropriate percentile ranking
    - Can be used for more relevant sensitivity/stress testing
  - Estimate of future pricing in extreme rate shocks
  - Actual historical rates best for documentation purposes, but alternate benchmarks may be more appropriate in some cases
- Interpolate/extrapolate for other rate shocks
  - Model will do this, but may be useful to create a "butterfly" table to double check model (see next slide)

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Butterfly Table

Reconcile with Model Output

Fed Funds	Shock	Sim. Rate	Incr. Beta	Cum. Beta	
0.00	-400	0.20	0%	15%	Floors at 0.20%
0.00	-300	0.20	0%	20%	
0.00	-200	0.20	0%	30%	
0.25	-150	0.20	40%	40%	Benchmark (Low)
0.75	-100	0.40	40%	40%	
1.75	0	0.80	-	-	Current Rate
2.75	+100	1.50	70%	70%	
3.75	+200	2.20	70%	70%	
4.75	+300	2.90	70%	70%	
5.25	+350	3.25	70%	70%	Benchmark (High)
5.75	+400	3.60	70%	70%	

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Beta Maintenance

- If deposit rates remain unchanged, rising-rate betas will decrease as interest rates decrease using the benchmarking method (and vice versa)
  - Example: If Fed Funds rate falls to 1.00% and the 12M CD rate remains at 0.80%, then the beta will decrease from 70% to 58% in our example
- Institution may elect to keep betas unchanged so historical model output will be more relevant for trend analysis

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Beta Maintenance

- Beta assumptions should be reviewed at least annually per regulatory guidance, but do not necessarily need to be changed.
- Beta assumptions do not need to exactly match benchmarking results
  - This is just the starting point for documenting the quantitative analysis
  - Qualitative adjustments may be applied to quantitative analysis results

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Benchmarking Method - Summary

Strengths

- Simple and transparent
- Intuitive for wide audience and promotes discussion about pricing strategies
- Generally accepted by regulators

Weaknesses

- May result in less favorable beta assumptions than regression analysis

  Note: This makes benchmarking useful for reasonableness testing of assumptions developed using regression analysis

- May have trouble identifying appropriate benchmarks
  - Pricing strategies in '06 may not reflect current pricing strategies
  - Rate increases from '15-'18 totaled just 225bp with limited deposit pricing response

  Note: These issues also apply to regression analysis

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Data for Decay Analysis

Best Data Sources for Balances:

- Historical Trial Balances
  - How much history makes sense to analyze?
  - Pre-2013 versus Post-2013
    - Economic factors
    - Rate environment
- Decay Measurement versus Wtd. Average Age (WAA)
  - WAA only needs most recent trial balance

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Decay Example – Measure Actual Historical Decay by Balance

Strengths

- Most accurate method
- Calculated across multiple time horizons
- Useful for monitoring actual deposit retention

Weaknesses

- Requires more data than the weighted average age (WAA) method
- Requires more computing power than the WAA method
- What to do when data set doesn't include -200bp or +400bp rate shift?
- What to do when actual decay is very low or negative?

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Decay Example – Measure Actual Historical Decay by Balance

Account Number	Balance 01/01/2018	Balance 12/31/2018
**********2345	24,851	26,583
**********2346	50	50
**********2347	164,055	108,848
**********2348	679	30,718
**********2349	8,882	12,466
	198,517	178,665

Change in Beginning Account Balances:	(19,852)
Annual Decay:	10%
Average Life (Years):	10

Note: Ignore new accounts opened during the year

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Decay Example – Measure Actual Historical Decay by Balance

+ Years	Jan 1, 2014	Jan 1, 2015	Jan 1, 2016	Jan 1, 2017	Jan 1, 2018
	Vintage Date				
0	228,134,530	251,535,766	268,579,553	408,614,414	449,778,844
1	220,458,060	248,580,099	254,275,889	369,138,927	419,995,158
2	218,474,610	231,472,587	242,721,760	353,025,549	
3	202,144,601	223,467,151	239,038,492		
4	202,334,573	219,968,956			
5	197,243,948				

+ Years	2014	2015	2016	2017	2018
	Annual Decay Rate				
1	3%	1%	5%	10%	7%
2	1%	7%	5%	4%	
3	7%	3%	2%		
4	0%	2%			
5	3%				
				Simple Average -->	4.0%

5 Years of annual data = 15 annual periods

Note: Can also calculate average by vintage or decay year

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Decay Example – Measure Actual Historical Decay by Balance

Decay Rate	Est Average Life (Years)[1]
1%	26
5%	16
10%	10
15%	7
20%	5
25%	4

Very low or negative decay often capped at X years WAL

[1]Truncated at 30 years.

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Decay Example – Measure Weighted Average Age

Account Number	Balance 12/31/2018	Opened Date	Avg. Age (Years)	Wtd. Avg. Age Calc.
**********2345	26,583	03/04/92	27	713,590
**********2346	50	12/30/18	0	0
**********2347	108,848	10/30/16	2	236,186
**********2348	30,718	05/15/79	40	1,218,200
**********2349	12,466	07/20/03	15	192,728
	178,665			2,360,704

Wtd. Average Age (Years): 13.2

Still capped at X years WAL?

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Wtd. Average Age - Additional Considerations

- Decay/WAL assumptions do not need to exactly match the analysis
  - Explain variances with qualitative factors
- Consistent decay/WAL across all rate shifts
  - Example: If cap of 6YR WAL applied to example above, then that decay/WAL assumption would be used across all rate shifts
  - Reduces "noise" in model output that is unrelated to balance sheet
  - Difficult to find relevant data to support different decay assumptions across rate shifts
- Decay assumptions are typically changed less frequently than beta assumptions

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Weighted Average Age - Summary

Strengths

- Simple to calculate and understand
- Intuitive for wide audience and promotes discussion about retention strategies
- Sufficient for decay/WAL documentation at many institutions
  - Discussion on next slide

Weaknesses

- Not appropriate for all institutions including those with:
  - Elevated risk profile
  - High deposit balance volatility
  - Recently acquired deposits
  - Very low WAA (e.g. de novo)
- Typically requires significant qualitative adjustments
- Calculating actual historical decay rates is a superior method and more useful to bank management
  - Provided resources are available to measure and track

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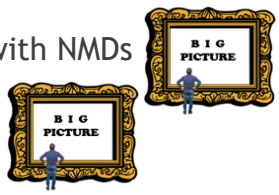
Weighted Average Age - Summary

Weighted Average Age method most appropriate for institutions with:

- Asset duration < 5 years
- Deposit base with high WAA, strong retention, and low decay
  - Decay/WAL caps in place
- Small percentage of funding with NMDs
- Low risk profile based on EVE
  - Decay does not impact EaR in most models



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