

## Session 026 IF - Model Risk Management

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# Model Risk Management Insurance Practices

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# Agenda

1. Audience Profile
2. Enterprise View to Model Risk
3. Focus of Insurance Practices:
  - Assumptions
  - Documentation
  - Independent Validation

This is a journey, not a race

# Enterprise View to Model Risk

## Model Risk Framework

### Examples of Key Processes

#### Risk Management

Identification -  
Inventory

Risk Assessment

Independent  
Validation

#### Design, Development, Implementation, Use

I. Methodology  
Design

II. Assumptions

III. Development  
Life Cycle

IV. Documentation

V. Ongoing  
Monitoring

VI. Change  
Management

### Governance

Policy and Procedures

Roles & Responsibilities

Awareness (Training)

Project Management

Oversight & Reporting

Huge effort, big reward, long journey

# Assumptions Practices

## Identification & Processes

- Assumptions link to Model Inventory & Purpose
- Key data elements (sound research; methodology rationalization)
- centralization of common assumptions
- Challenge forum: independent team or formal oversight committees

## Risk Assessment

- Uncertainty: relevance of data vs. judgment
- Sensitivity analysis and impact assessment

## Risk Management

- Effective oversight and challenge
- Change management
- Outcome analysis – reperformance; benchmarking; analytics
- Long term – enterprise sensitivity analysis

## Challenges

- *Interconnectedness*: other assumptions: economic, investment, consistency of forecasting
- *Strategic*: enterprise view of key data elements (consistency, accuracy, timeliness)
- *Operational*: implementation practices

Strategic Risk - Decision making facilitated by Assumption Management

# Documentation Practices

## Key Elements

### Inputs, Assumptions, Calculation, Output

- Intended use; model methodologies
- Model testing, uncertainties; limitations
- *Conservatism*: compensating controls
- Controls to assess sensitivity analysis;
- Interconnectedness risk – upstream and downstream.
- Output review controls (backtesting, benchmarking, overrides management)
- Model findings – risk ranked and materiality assessment

## Objectives

- Sufficient content for model functionality
- Risk based commensurate with inherent risk and model risk profile
- Replicability principle

## Challenges

- Version control – model code
- Consistency – standardized documentation
- Independent challenge review
- Cost vs. benefit: implementation effort

Documentation creates an environment of sustainability

# Independent Validation Practices

## Structure

- Independent reviewers – SR 11-7 also requires competence and incentives
- Evaluation of conceptual soundness and implementation testing
- Ongoing monitoring plan – detective vs. preventative (change management, changes in products, adjustments, redevelopment, benchmarking, override management)
- Outcome analysis (comparison of outputs to expected outcomes or range or outcomes; statistical tests or quantitative measures, expert judgement/overrides testing, assumption sensitivity testing)

## Challenges

- SR 11-7 expertise is limited in Insurance industry.
- Competition for talent within regulated entities (Limited PhDs and FSAs)
- Cost vs. benefits: Cost to maintain effective independent program. Benefits seen over time.
- Timing of compliance with requirements.
- Cultural shift from traditional collaborative review to independent risk.
- Risk profile and learning curves are steep

Validation Processes Creates Effective ERM over time



# Model Risk Management in Insurance Investment Management

2017 SOA Annual Meeting & Exhibit

Session 26: Model Risk Management

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# Overview of Investment Models

# Models for Insurance Investment Management

Functions	Models	Inputs/Assumptions
General Management	Investment planning	A/L cash flow projections, expected trading activities, yield forecast, FX forecast
Portfolio Management	Cash flow projection	Vary by assets
	Asset allocation	Returns or yields, risks, correlations, constraints such as duration, convexity, capital
Investment Performance	Total return	CFA Institute's GIPS methodologies
	Total return attribution	Methodologies to attribute excess return over benchmark to asset allocation/trading and relative risk positioning (e.g. duration)
	Investment income attribution	Lack commonly accepted methodology
Trading	Security valuation (Bloomberg, broker, proprietary valuation models)	Security attributes, secondary models
Lending	Underwriting, return/risk analysis	Attributes of the borrower or the investment opportunity
Investment Risk Management	Credit rating	Quantitative/qualitative analyses of the issuer or the borrower
	WARF	Ratings along with a mapping methodology
	C1 capital (credit risk)	Prescribed factors or company's own models
	Credit VaR, Conditional Credit VaR	Credit loss distributions, correlations
	Market/credit sensitivities	Security valuation models
	Liquidity	Estimates of liquidity demand and supply
	Stress testing	Scenarios, market shocks, correlations
Investment Accounting	Asset valuation	Mark to model based on the observable market price of comparable (Level 2); No observable market prices (Level 3)
	Investment income	Accounting principles

# Nature and Challenges of Investment Models

Nature of Investment Models	Challenges
Most investment models are external	External models may lack transparency and end-user control. Access to external models may be limited due to license cost
One model may depend on one or several other models	Complex modeling structure, ripple effect
Investment models could be highly technical	Modeling results could be misinterpreted or misused if not carefully communicated or fully understood
Investment decisions based on modeling results could have an immediate financial impact	Some investments require long-term commitment. The long-term financial impact of an investment may not be fully known in the near term



# Examples of Investment Model Risks

# Ratings of New Bonds Do Not Vary With Maturities<sup>1</sup>

Sector	Company	Rank	Coupon	Issuance Date	Maturity Date	Year to Maturity	Moody's Rating at Issuance	S&P Rating at Issuance
AUTO	GM	Sr Unsecured	4.20	08/02/2017	10/01/2027	10	Baa3	BBB
AUTO	GM	Sr Unsecured	5.40	08/02/2017	04/01/2048	30	Baa3	BBB
ENERGY	BP CAPITAL	Sr Unsecured	1.77	09/14/2017	09/19/2019	2	A1	A-
ENERGY	BP CAPITAL	Sr Unsecured	3.28	09/14/2017	09/19/2027	10	A1	A-
P&C	ALLSTATE	Sr Unsecured	3.28	12/01/2016	12/15/2026	10	A3	A-
P&C	ALLSTATE	Sr Unsecured	4.20	12/01/2016	12/15/2046	30	A3	A-
RETAIL	AMAZON	Sr Unsecured	1.90	08/15/2017	08/21/2020	3	Baa1	AA-
RETAIL	AMAZON	Sr Unsecured	4.05	08/15/2017	08/22/2047	30	Baa1	AA-
RETAIL	COSTCO	Sr Unsecured	2.30	05/09/2017	05/18/2022	5	A1	A+
RETAIL	COSTCO	Sr Unsecured	3.00	05/09/2017	05/18/2027	10	A1	A+
TECHNOLOGY	APPLE	Sr Unsecured	1.50	09/05/2017	09/12/2019	2	Aa1	AA+
TECHNOLOGY	APPLE	Sr Unsecured	3.75	09/05/2017	09/12/2047	30	Aa1	AA+

- Same credit rating for shorter- and longer-term corporate bonds at issuance because of the comparable expected credit losses modeled
- A longer-term credit outlook is inherently less certain, in particular for the fast evolving sectors. To what extent do the ratings reflect this?

1. Data from Bloomberg

# Credit Loss Charges vs. Actual Impairments

- Insurance companies use credit loss charges for various applications including cash flow testing, asset adequacy analysis, investment relative value analysis, and deal pricing
- Insurance companies may assess credit loss charges based on rating migration, default, and recovery data<sup>1</sup>
- How do your company's credit loss charges compare with the actual impairments?

Annual Impairment of Bonds (bps)	
Year	Median of Sample Insurance Companies*
2007	13
2008	130
2009	95
2010	30
2011	22
2012	14
2013	6
2014	2
2015	6
2016	7
Average 2007-2016	36
Volatility 2007-2016	46
Average 2010-2016	13
Volatility 2010-2016	11

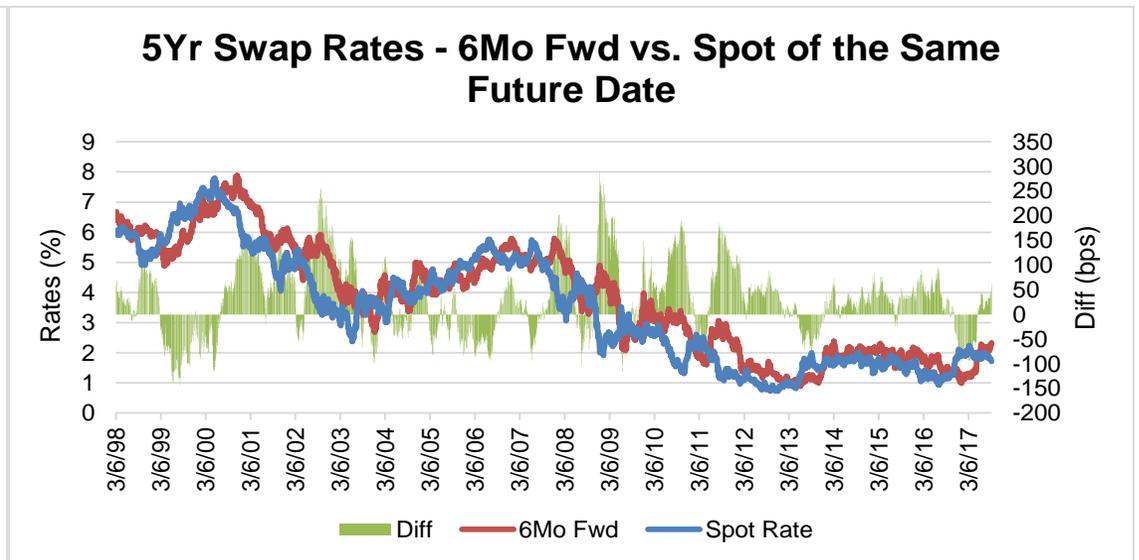
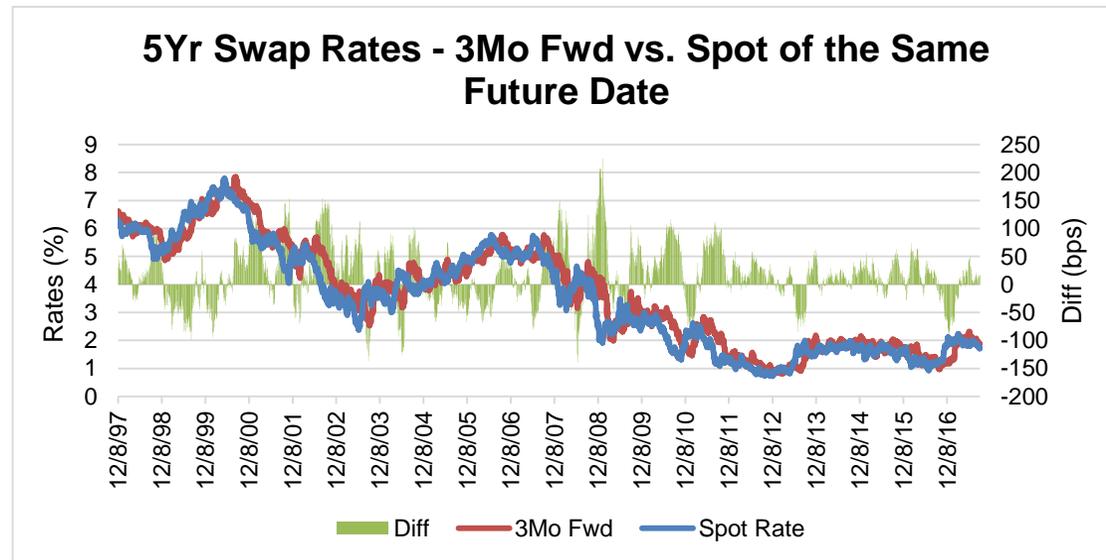
\* Data based on companies' 10K

1. Annual Default Study: Corporate Default and Recovery Rates, 1920-2016, Moody's, 15 February 2017

# Forward Swap Rates Tend to Overestimate Spot Swap Rates of the Same Future Date

Difference (Forward Swap Rate - Spot Swap Rate)			
	3Mo	6Mo	1Yr
Average difference (bps)	16	32	65
Average difference (%)	7.8%	15.9%	32.6%
Volatility of difference (bps)	49	71	98
Freq of positive difference	65%	68%	74%
Freq of negative difference	35%	32%	26%
Avg given positive difference (bps)	43	69	109
Avg given negative difference (bps)	-34	-45	-62

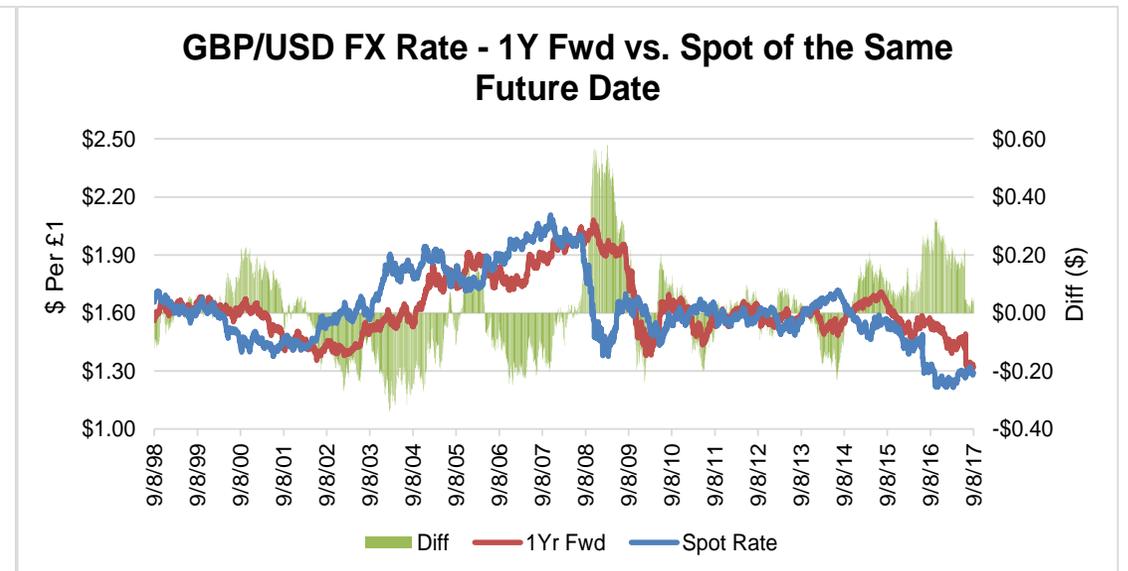
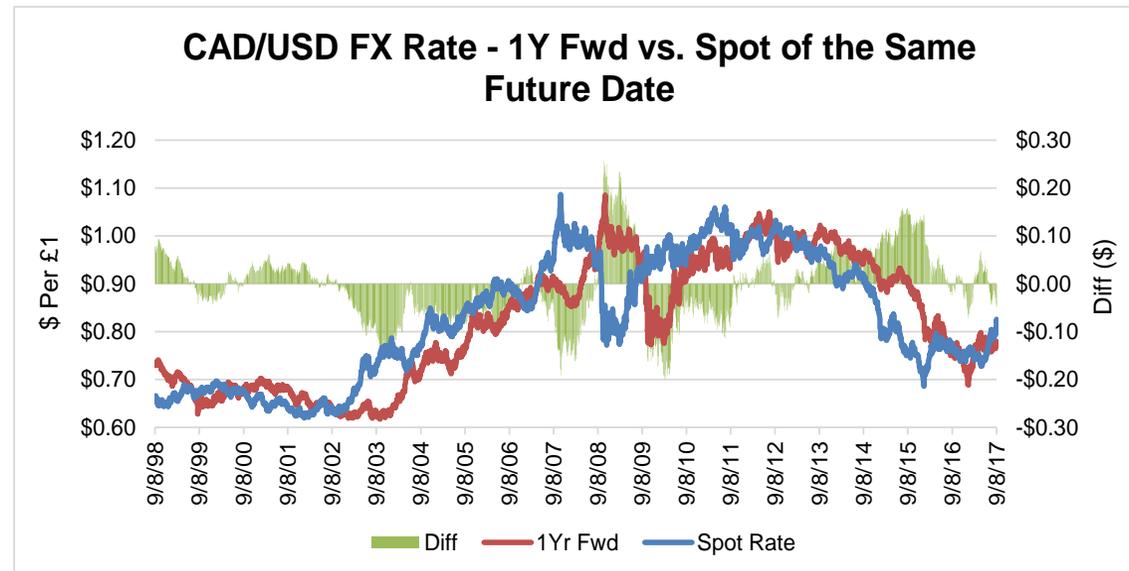
- Forward swap rates appear to be a poor estimator of the actual spot rates of the same future date
- How much may be influenced by the central banks' monetary policies and market liquidity?



# Forward FX Rates May Be Better Estimator of Spot FX Rates of the Same Future Date

Difference (Forward FX Rate - Spot FX Rate)		
	CAD/USD	GBP/USD
Average difference (\$)	\$0.00	\$0.01
Average difference (%)	-0.25%	1.10%
Volatility of difference (\$)	\$0.07	\$0.15
Freq of positive difference	48%	53%
Freq of negative difference	52%	47%
Avg given positive difference (\$)	\$0.05	\$0.12
Avg given negative difference (\$)	-\$0.06	-\$0.12

- Certain forward FX rates outperform forward swap rates as an estimator of the respective spot rates of the same future date
- Better market liquidity and less central banks' intervention?



# Other Examples of Investment Model Challenges

- Forecast of inflation
  - TIPS implied vs. Econometric models
- Models involving human behavior
  - mortgage and credit card prepayment models used for RMBS and ABS
- Correlation of asset returns
  - may vary by the collective risk appetite of investors



# **Investment Model Risk Management**

# Ways to Manage and Mitigate Investment Model Risk

- Inventory models
- Rank models based on potential financial impact
- Ensure to have adequate model accesses and modeling expertise
- Be knowledgeable about the models, modeling process, assumptions, inputs, constraints and limitations
- For external models that require user inputs, establish robust processes and procedures to ensure that the inputs are up-to-date and provided according to the procedure
- When making investment decisions based on modeling results, look at a range of possible results instead of a single point
- Couple modeling results with sound judgment and experiences
- Conduct periodical review and validation of critical models
- Disclose and communicate model constraints and limitations clearly