Moody's | Better decisions

Moody's Analytics

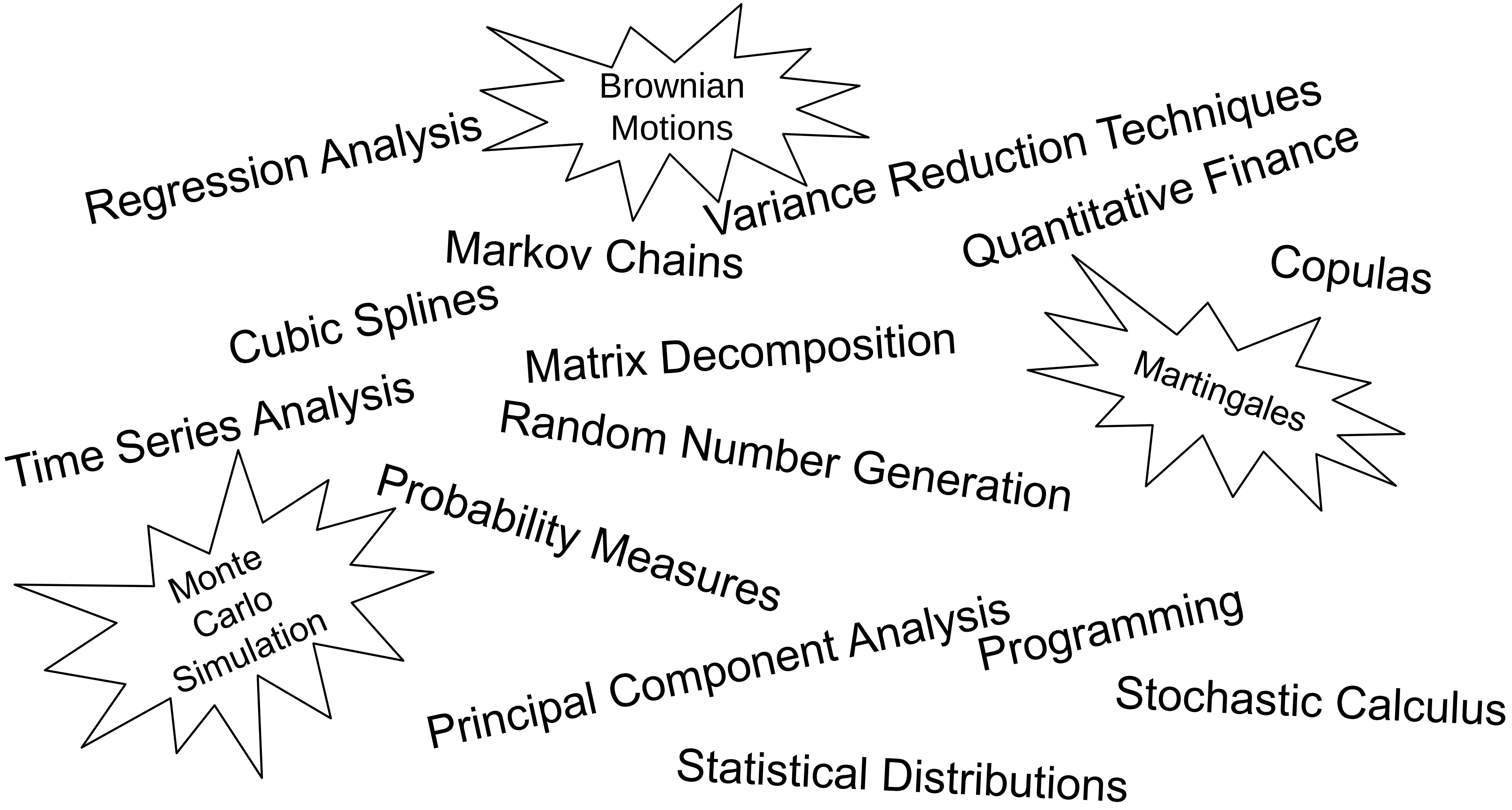
The University of Edinburgh

Amalie Fabricius-Vieira, Advisory Services

November 2020

Do you want to apply your knowledge and skills to solve challenging problems in the real world?

Moody’s day to day work requires the use of a wide range of expertise and knowledge directly related to technical learnings at Edinburgh University



Agenda

1. About Moody’s
2. ERS Insurance
3. ESG Models & Case Study
4. Working at Moody’s Analytics ERS
5. Moody’s Analytics ERS Graduate Programme
6. Q+A

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About Moody's

Moody's by the Numbers

Beyond ratings

MOODY'S INVESTORS SERVICE

$79+ trillion[1]
in rated debt

39,000+[1]
rated entities and transactions

100+ million[8]
financial statements representing more than 20 million global private firms

18+ million[3]
US properties in our commercial real estate database

MOODY'S ANALYTICS

500+ million[6]
economic, financial, and demographic time series

350+ million[4]
companies in our private company database

22,000+[7]
global events and outreach activities

67,000+[2]
research pieces, indicators and analyses published annually

1+ million[5]
facilities with Climate Risk Scores

Sources: 1. ir.moodys.com (Nov 2019) | 2. Moody's Research (Dec 2019) | 3. reis.com | 4. Bureau van Dijk (Dec 2019) | 5. Four Twenty Seven | 6. Moody's Analytics | 7. Moody's Events & Moody's Investors Service | 8. Moody's Analytics Data Alliance

Moody's Analytics companies

Moody's + K·M·V Corporation = Moody's | K·M·V + Economy·com + Wall Street Analytics = Moody's Analytics

2002 | 2006 | 2007 | 2008

Some of our later acquisitions

enb — 2008
Fermat — 2009
Copal Partners — 2011
barrie+hibbert — 2012
LEWTAN — 2014
WebEquity solutions — 2014
GGY axis — 2016
REIS — 2018
RiskFirst — 2019

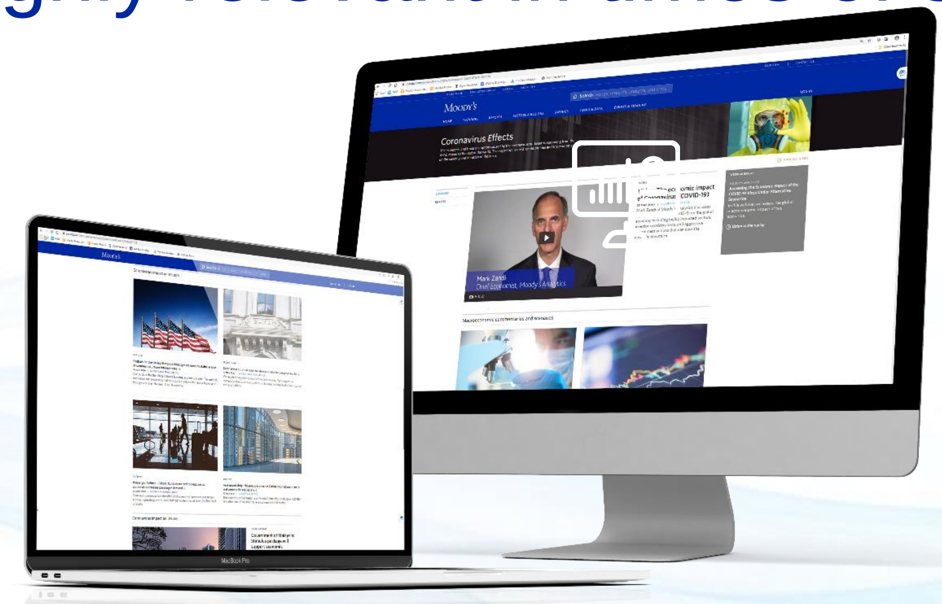
MA brands

Canadian Securities Institute, A Moody's Analytics Company — 2010
Bureau van Dijk, A Moody's Analytics Company — 2017
Moody's Analytics | omega performance, Learning Solutions — 2018

Our risk assessments are highly relevant in times of stress

Monitoring the effects of Coronavirus

View at moodys.com/coronavirus



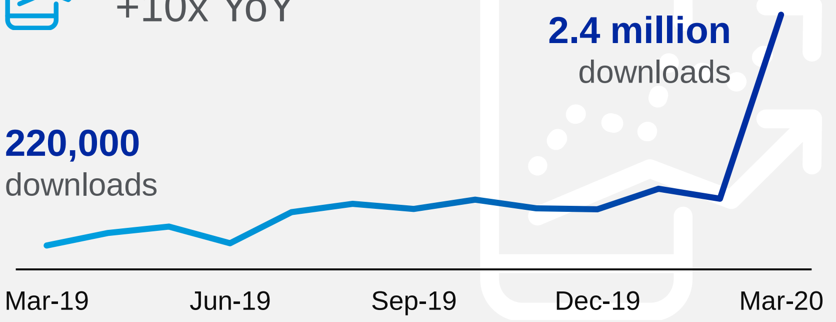
120%
YTD increase in usage -- moodys.com and credit scoring tools

110,000+
total visits to COVID-19 website

30,000+
people participated in Moody's events

900+
reports published relating to COVID-19

Economic data downloads
+10x YoY



Our Culture and Values

We play an important role in this world

Purpose

WHY WE EXIST

To bring clarity, knowledge and fairness to an interconnected world

Mission

WHAT WE DO

To provide trusted insights and standards that help decision makers act with confidence

Vision

OUR ASPIRATION

To promote progress through better decisions

Employee Resource Groups (ERGs)

Diversity & Inclusion at Moody's has been largely defined and acknowledged through ERGs

MOODY'S WOMEN'S ERG

MOODY'S LGBTA ERG

MOODY'S MULTICULTURAL ERG

MOODY'S GENERATIONAL ERG

MOODY'S VETERANS ERG

MOODY'S MINDS ERG

We've been recognized for how we value our team members, whether they're LGBTQA+, working parents, or veterans etc..

We provide Employee Resource Groups (ERGs) to support team members who find their diversity in gender, sexual orientation, multi-culturalism, generational divides, military duty and mental health. We will add accessibility & disability in Q4

We are consistently recognized as a Top Employer

2

ERS Insurance

ERS Insurance

ERS Insurance teams are located in:

- Edinburgh
- London
- Paris
- Grenoble
- New York
- Hong Kong
- Tokyo

There are around 150 people involved in the development, implementation and support of our products, including

- Quantitative PhDs
- Software & Quality Assurance Engineers
- Economists, Actuaries, CFAs and FRMs
- Product Managers, Project Managers and Business Analysts
- Data & Operations Specialists

Trusted advisor to the Global Financial Markets

More than just insurers

While many of our customers are insurance companies we also work with:

- Asset Managers
- Pension Funds
- Consultancies
- Financial Regulators
- Banks

A market leader in insurance solutions

Moody’s Analytics have over 175 Insurance relationships across the globe. Our products and services are used by:

- 60% of Insurers on the Global Fortune 500
- 80% European Insurance CRO Forum
- 65% European Insurance CFO Forum

What we do

Insurance ERM

Description

Award winning capital and regulatory reporting solutions.

Advanced internal model solutions using cutting-edge proxy modelling techniques.

Products

» Proxy Generator
» RiskIntegrity™
» Capital Aggregator

Scenario Generation

Description

Market leading scenario generation products using advanced stochastic modelling for market risks.

Used for liability valuation, real-world projection and risk aggregation.

Products

» Economic Scenario Generator (ESG)
» Risk Scenario Generator (RSG)

Wealth & Pensions

Description

Asset Liability Modelling for pension funds.

Helping product providers understand their products and communicating risk profile to retail customers.

Products

» DBALM
» Pensions Risk Analytics
» Investment Governance
» Wealth Scenario Generator (WSG)

Moody’s Analytics
Scenario Generator (SG)

Moody’s Analytics Scenario Generator

200
Clients Globally

100
Employees focused on the SG

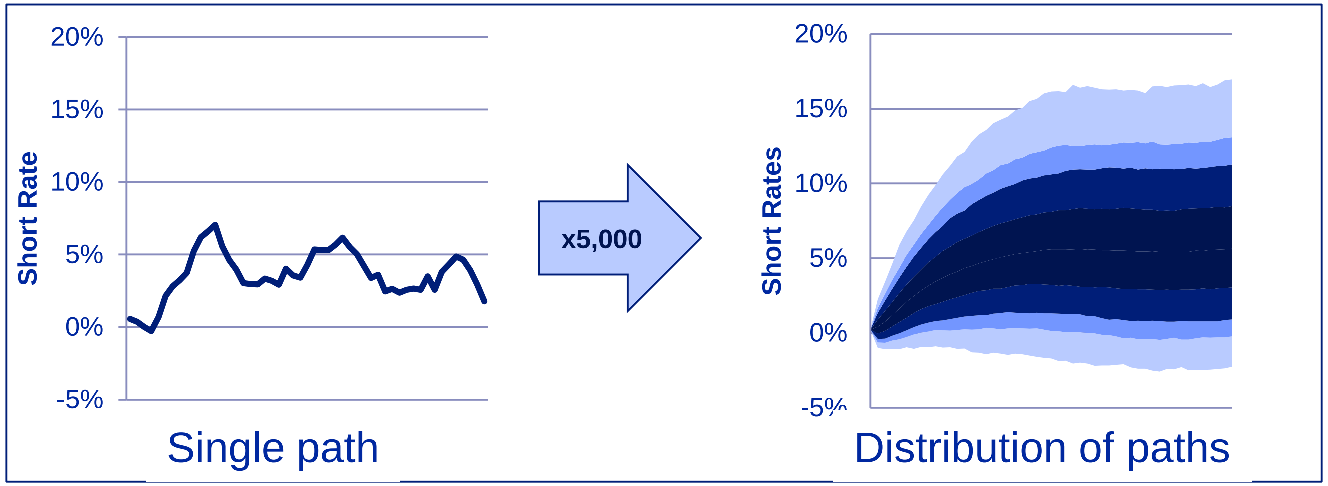
20
Years in the ESG Market

ESG Trusted by Regulators

Over 90% of Approved Internal Model firms in Europe use our ESG

What is an Economic Scenario Generator?

» Generates scenarios for various economic variables and asset returns using Monte Carlo simulation
  – A simulation is a collection of many paths (trials)
  – Generate 1000s of different paths of an economy by stochastically modelling many different risk drivers
  – Interest rates, equity returns, corporate bond returns
» Two main uses:
  – Real-world projections for risk management
  – Market-consistent valuation for pricing



Market Consistent Modelling

What our clients use it for?

Market Consistent modelling

Liability Valuation

Many of our clients need to calculate the value of their liabilities as part of Market Consistent Embedded Value (MCEV) reporting. Where the value of the liabilities needs to represent their market value.

Stress Testing

In many cases our users want to understand the sensitivity of their liabilities to different risk factors. For that purpose they produce different stress scenarios.

Proxy Functions

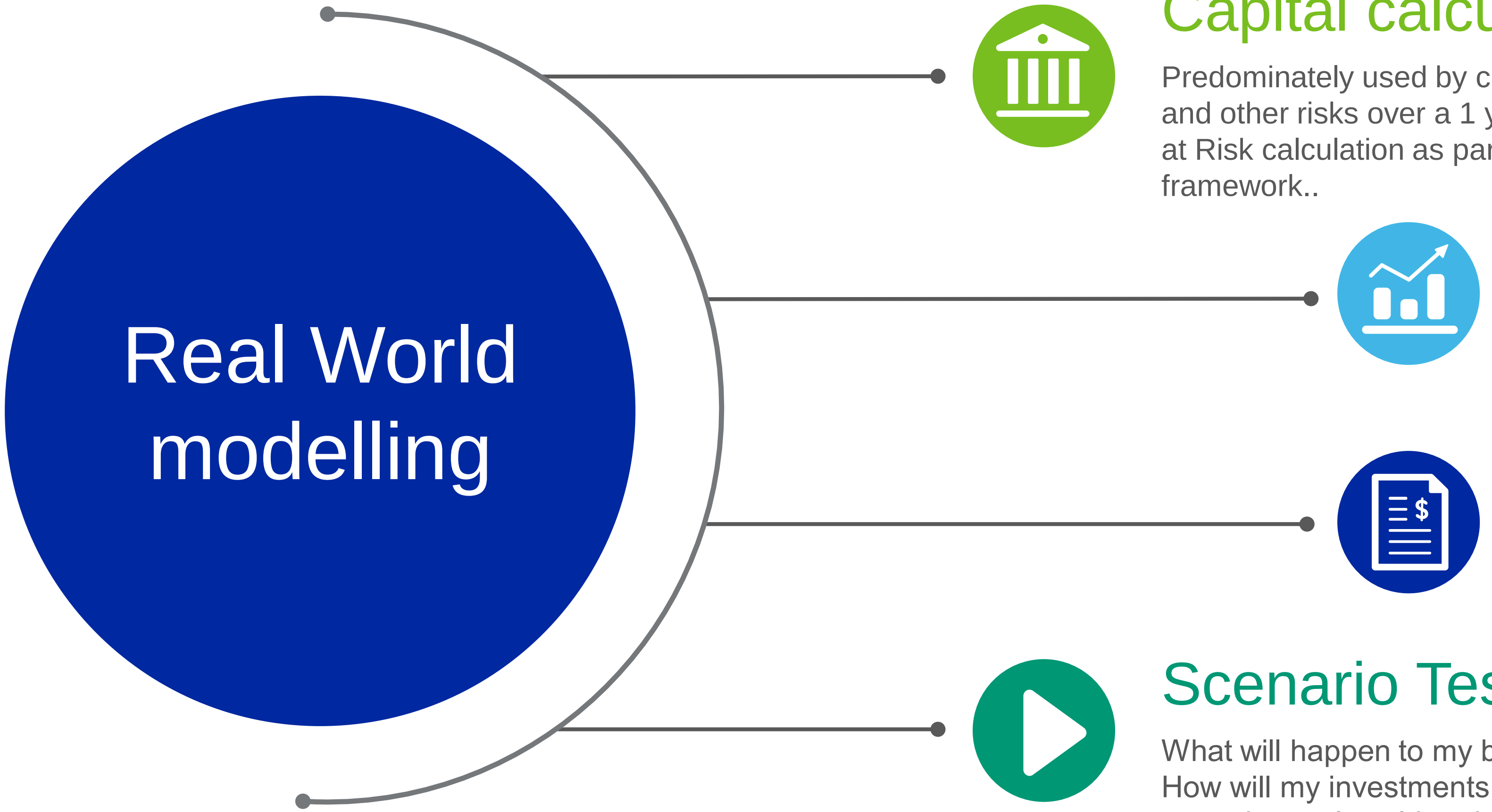
Valuing insurance liabilities with guarantees is a deeply nested stochastic process requiring both Market Consistent and Real World Scenarios. LSMC methods that utilize MC modelling make it much easier problem.

Hedging

Market Consistent modelling can also be used for valuing derivatives and hence hedge values and their sensitivities (Greeks).

Real World Modelling

What our clients use it for?



Capital calculation

Predominately used by clients for projection of credit, default, market and other risks over a 1 year or a similar short term horizon for Value at Risk calculation as part of Regulatory or Economic Capital framework..

SAA and Investments

Our asset and portfolio capabilities help our clients assess the performance of their investment strategies under a range of conditions.

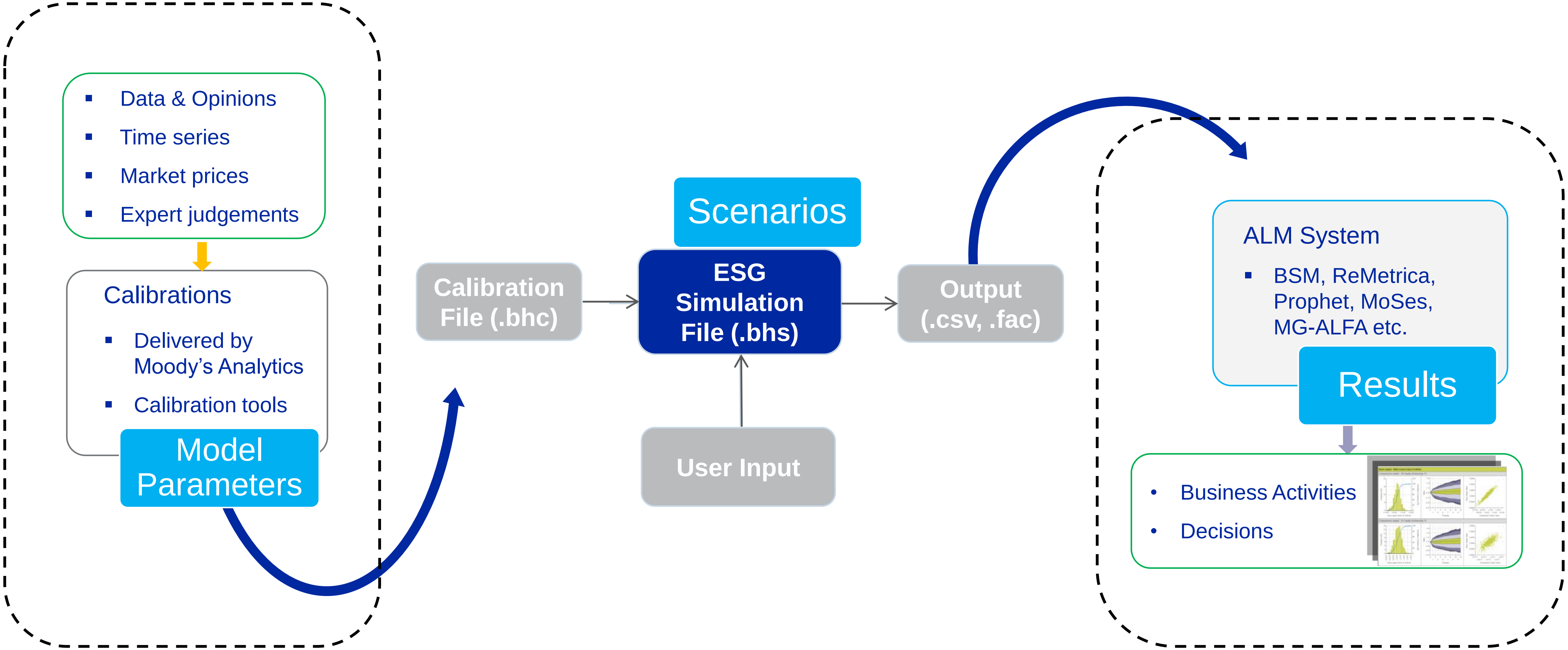
Product design/pricing

Many insurance contracts are dependent on the level of interest rates or asset returns. That’s why our clients use our models to produce realistic distributions.

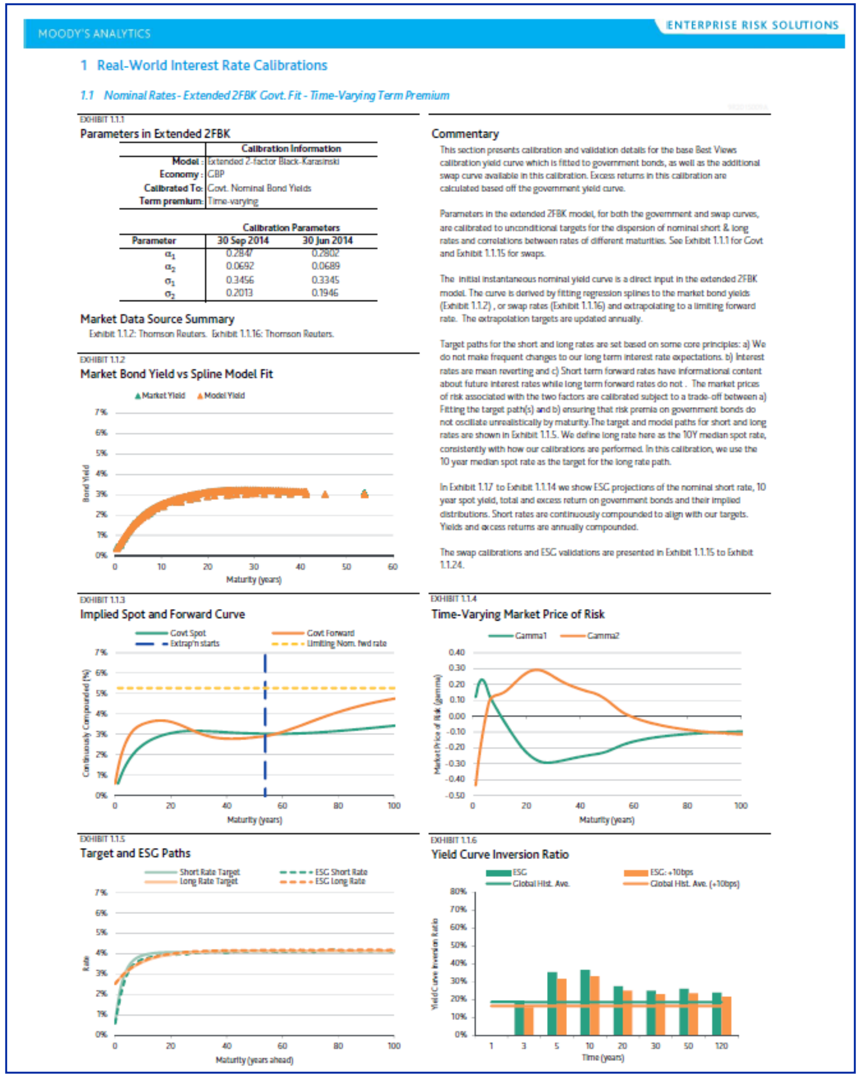
Scenario Testing

What will happen to my business under a “hard Brexit” scenario?
How will my investments perform under a “stagflation” scenario?
Narrative real world projections provide our clients with that insight.

ESG Production Process



Calibration Services



MOODY'S ANALYTICS — ENTERPRISE RISK SOLUTIONS

1 Real-World Interest Rate Calibrations

1.1 Nominal Rates - Extended 2FBK Govt. Fit - Time-Varying Term Premium

EXHIBIT 1.1.1

Parameters in Extended 2FBK

	Calibration Information
Model :	Extended 2-factor Black-Karasinski
Economy :	GBP
Calibrated To:	Govt. Nominal Bond Yields
Term premium:	Time-varying

Parameter	30 Sep 2014	30 Jun 2014
	Calibration Parameters	
α_1	0.2847	0.2802
α_2	0.0692	0.0689
σ_1	0.3456	0.3345
σ_2	0.2013	0.1946

Market Data Source Summary

Exhibit 1.1.2: Thomson Reuters. Exhibit 1.1.16: Thomson Reuters.

Commentary

This section presents calibration and validation details for the base Best Views calibration yield curve which is fitted to government bonds, as well as the additional swap curve available in this calibration. Excess returns in this calibration are calculated based off the government yield curve.

Parameters in the extended 2FBK model, for both the government and swap curves, are calibrated to unconditional targets for the dispersion of nominal short & long rates and correlations between rates of different maturities. See Exhibit 1.1.1 for Govt and Exhibit 1.1.15 for swaps.

The initial instantaneous nominal yield curve is a direct input in the extended 2FBK model. The curve is derived by fitting regression splines to the market bond yields (Exhibit 1.1.2) , or swap rates (Exhibit 1.1.16) and extrapolating to a limiting forward rate. The extrapolation targets are updated annually.

Target paths for the short and long rates are set based on some core principles: a) We do not make frequent changes to our long term interest rate expectations. b) Interest rates are mean reverting and c) Short term forward rates have informational content about future interest rates while long term forward rates do not . The market prices of risk associated with the two factors are calibrated subject to a trade-off between a) Fitting the target path(s) and b) ensuring that risk premia on government bonds do not oscillate unrealistically by maturity.The target and model paths for short and long rates are shown in Exhibit 1.1.5. We define long rate here as the 10Y median spot rate, consistently with how our calibrations are performed. In this calibration, we use the 10 year median spot rate as the target for the long rate path.

In Exhibit 1.17 to Exhibit 1.1.14 we show ESG projections of the nominal short rate, 10 year spot yield, total and excess return on government bonds and their implied distributions. Short rates are continuously compounded to align with our targets. Yields and excess returns are annually compounded.

The swap calibrations and ESG validations are presented in Exhibit 1.1.15 to Exhibit 1.1.24.

EXHIBIT 1.1.2

Market Bond Yield vs Spline Model Fit

EXHIBIT 1.1.3

Implied Spot and Forward Curve

EXHIBIT 1.1.4

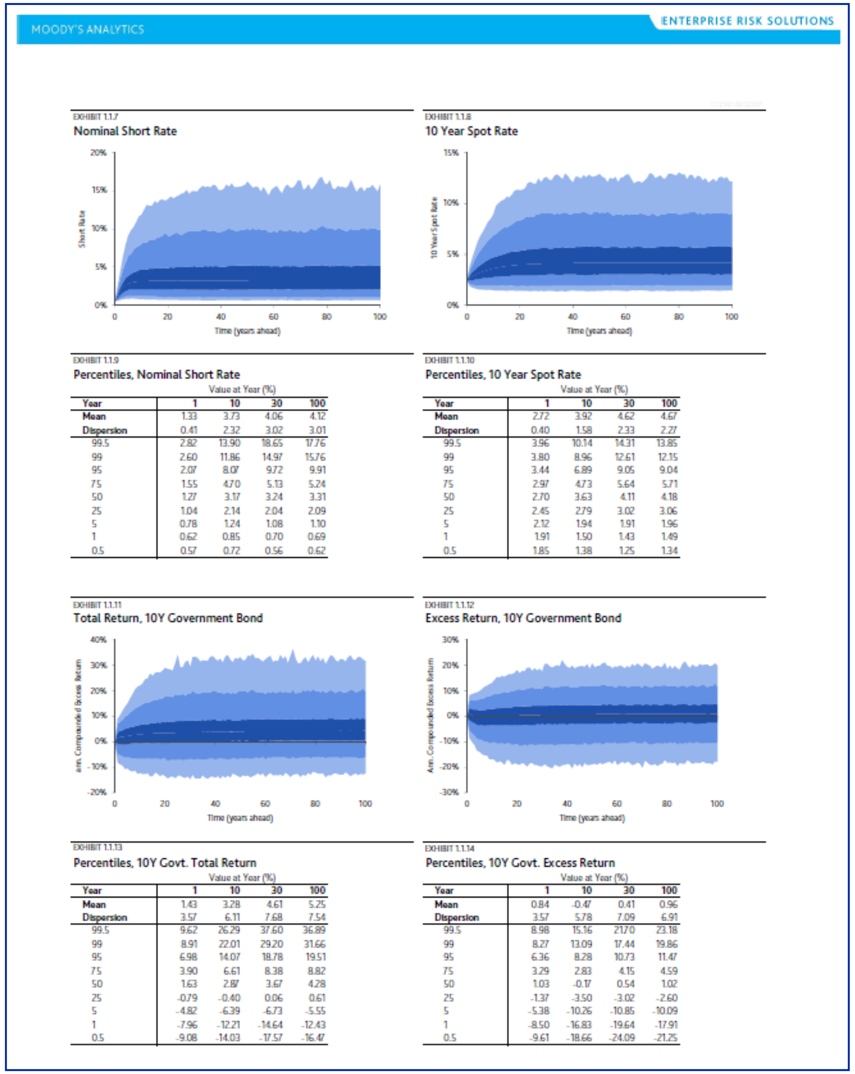
Time-Varying Market Price of Risk

EXHIBIT 1.1.5

Target and ESG Paths

EXHIBIT 1.1.6

Yield Curve Inversion Ratio



MOODY'S ANALYTICS — ENTERPRISE RISK SOLUTIONS

EXHIBIT 1.1.7

Nominal Short Rate

EXHIBIT 1.1.8

10 Year Spot Rate

EXHIBIT 1.1.9

Percentiles, Nominal Short Rate

Year	1	10	30	100
	Value at Year (%)			
Mean	1.33	3.73	4.06	4.12
Dispersion	0.41	2.32	3.02	3.01
99.5	2.82	13.90	18.65	17.76
99	2.60	11.86	14.97	15.76
95	2.07	8.07	9.72	9.91
75	1.55	4.70	5.13	5.24
50	1.27	3.17	3.24	3.31
25	1.04	2.14	2.04	2.09
5	0.78	1.24	1.08	1.10
1	0.62	0.85	0.70	0.69
0.5	0.57	0.72	0.56	0.62

EXHIBIT 1.1.10

Percentiles, 10 Year Spot Rate

Year	1	10	30	100
	Value at Year (%)			
Mean	2.72	3.92	4.62	4.67
Dispersion	0.40	1.58	2.33	2.27
99.5	3.96	10.14	14.31	13.85
99	3.80	8.96	12.61	12.15
95	3.44	6.89	9.05	9.04
75	2.97	4.73	5.64	5.71
50	2.70	3.63	4.11	4.18
25	2.45	2.79	3.02	3.06
5	2.12	1.94	1.91	1.96
1	1.91	1.50	1.43	1.49
0.5	1.85	1.38	1.25	1.34

EXHIBIT 1.1.11

Total Return, 10Y Government Bond

EXHIBIT 1.1.12

Excess Return, 10Y Government Bond

EXHIBIT 1.1.13

Percentiles, 10Y Govt. Total Return

Year	1	10	30	100
	Value at Year (%)			
Mean	1.43	3.28	4.61	5.25
Dispersion	3.57	6.11	7.68	7.54
99.5	9.62	26.29	37.60	36.89
99	8.91	22.01	29.20	31.66
95	6.98	14.07	18.78	19.51
75	3.90	6.61	8.38	8.82
50	1.63	2.87	3.67	4.28
25	-0.79	-0.40	0.06	0.61
5	-4.82	-6.39	-6.73	-5.55
1	-7.96	-12.21	-14.64	-12.43
0.5	-9.08	-14.03	-17.57	-16.47

EXHIBIT 1.1.14

Percentiles, 10Y Govt. Excess Return

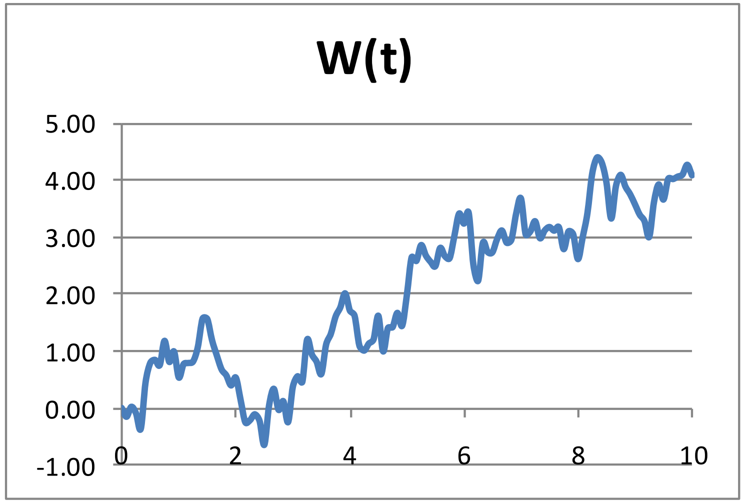
Year	1	10	30	100
	Value at Year (%)			
Mean	0.84	-0.47	0.41	0.96
Dispersion	3.57	5.78	7.09	6.91
99.5	8.98	15.16	21.70	23.18
99	8.27	13.09	17.44	19.86
95	6.36	8.28	10.73	11.47
75	3.29	2.83	4.15	4.59
50	1.03	-0.17	0.54	1.02
25	-1.37	-3.50	-3.02	-2.60
5	-5.38	-10.26	-10.85	-10.09
1	-8.50	-16.83	-19.64	-17.91
0.5	-9.61	-18.66	-24.09	-21.25

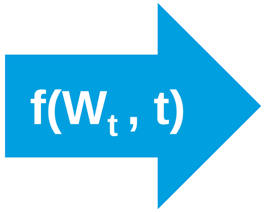
3

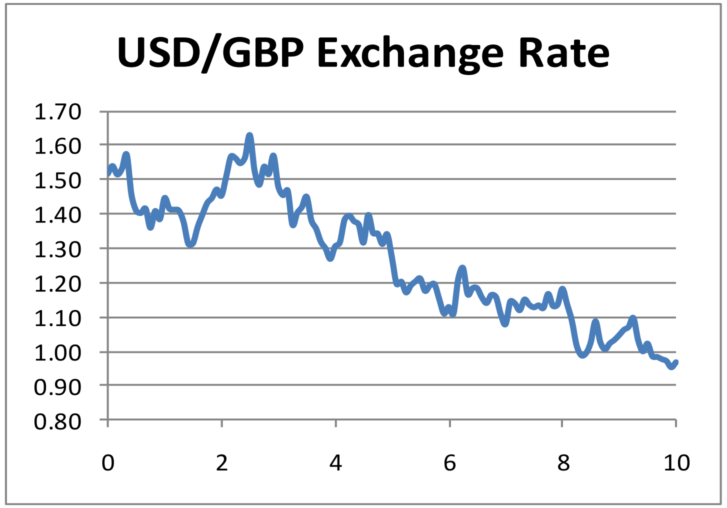
ESG Models
& Case Study

Randomness in our Models

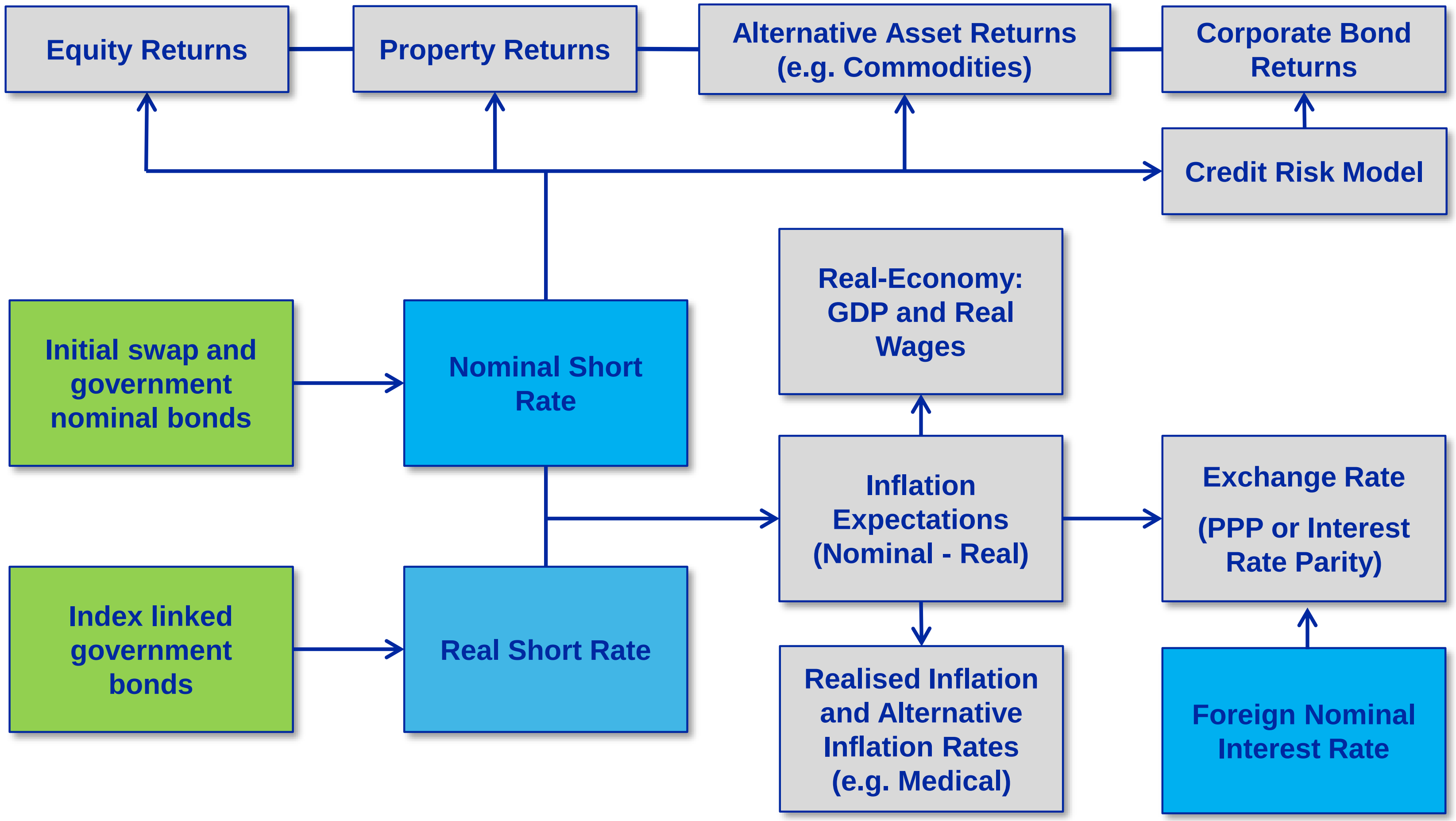
- A Brownian motion $W(t)$ is a process for describing the evolution of a normally distributed random variable.
- $dW(t)$ represents the normally distributed increments of a Brownian motion (aka “Shocks”)
- Brownian motions in our stochastic equations result in the stochastic evolution of our economic variables, e.g. equity returns, interest rates and exchange rates.
- We need to sample from a normal distribution to obtain our Brownian Motion shocks
  - We do this using pseudo random numbers







ESG Economy Model Structure



Structural relationships and correlations ensure plausible dependencies between asset classes

Example:
SVJD Equity Model

SVJD Model Motivation

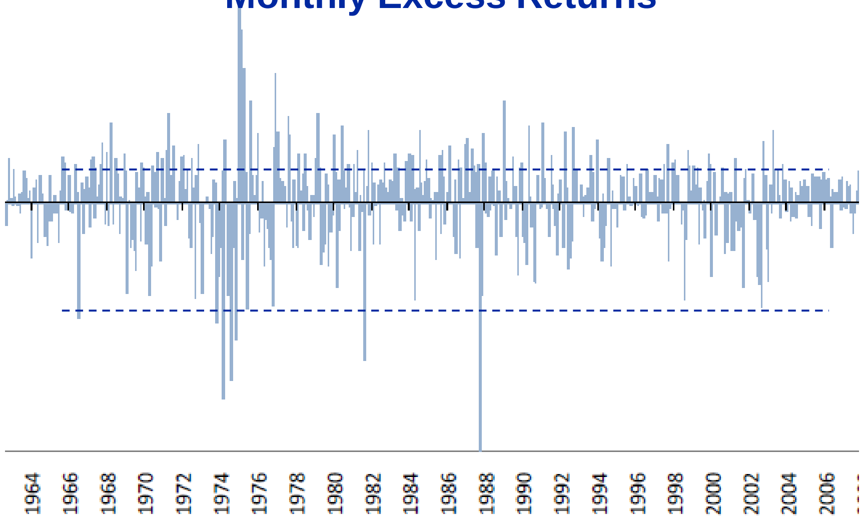
Firms need to perform liability valuations that have characteristics that are similar to options (often complex):

analytical valuation impossible → need MC scenarios

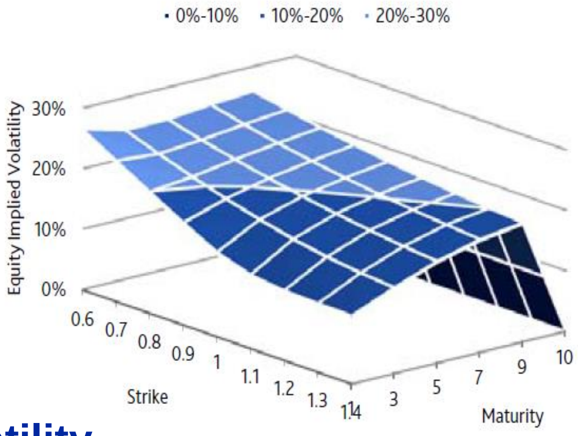
Equity Returns

- Large asset returns are more likely to be negative
- Returns are correlated across economies – Tail Correlations
- Negative skew in equity return distributions

Monthly Excess Returns



Market Implied Volatility Surface

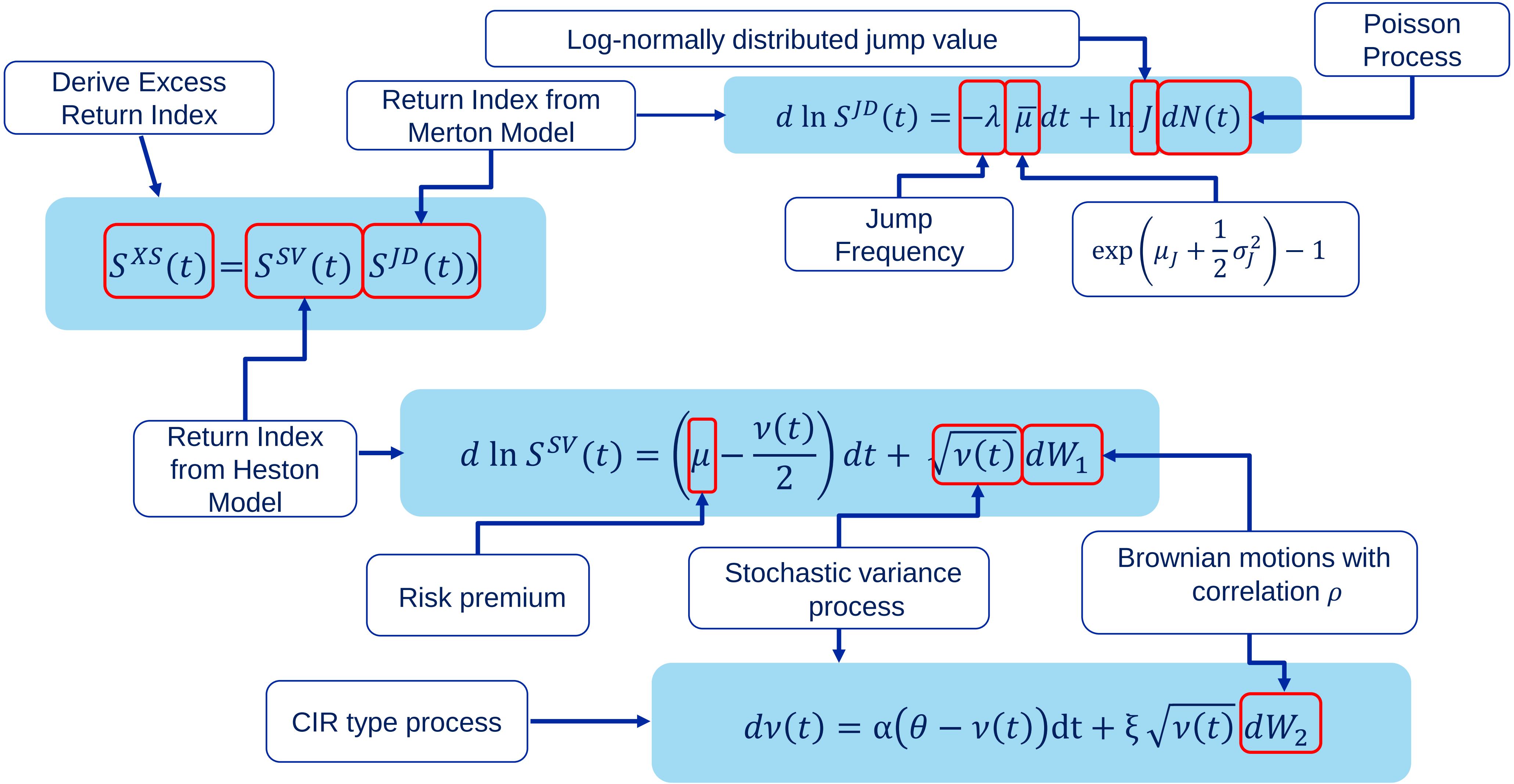


Volatility

- Asset returns do not display constant volatility
- Large asset returns tend to be associated with large volatility
- Volatility tends to be mean reverting
- Asset returns exhibit volatility clustering
- Implied volatilities can vary by option term and strike (Volatility smile)

SVJD Model Structure

» A model of “excess” return, being the additional return over the risk free (i.e. cash) return



SVJD Implementation

» Stochastic volatility part is implemented using a biased Euler scheme:

$$S_{t+\Delta t}^{SV} = S_t^{SV} \exp\left\{\left(\mu - \frac{(v_t)_+}{2}\right)\Delta t + \sqrt{(v_t)_+}\sqrt{\Delta t} Z^{(1)}\right\}$$

$$v_{t+\Delta t} = v_t + \alpha(\theta - (v_t)_+)\Delta t + \varepsilon\sqrt{(v_t)_+}\sqrt{\Delta t} Z^{(2)}$$

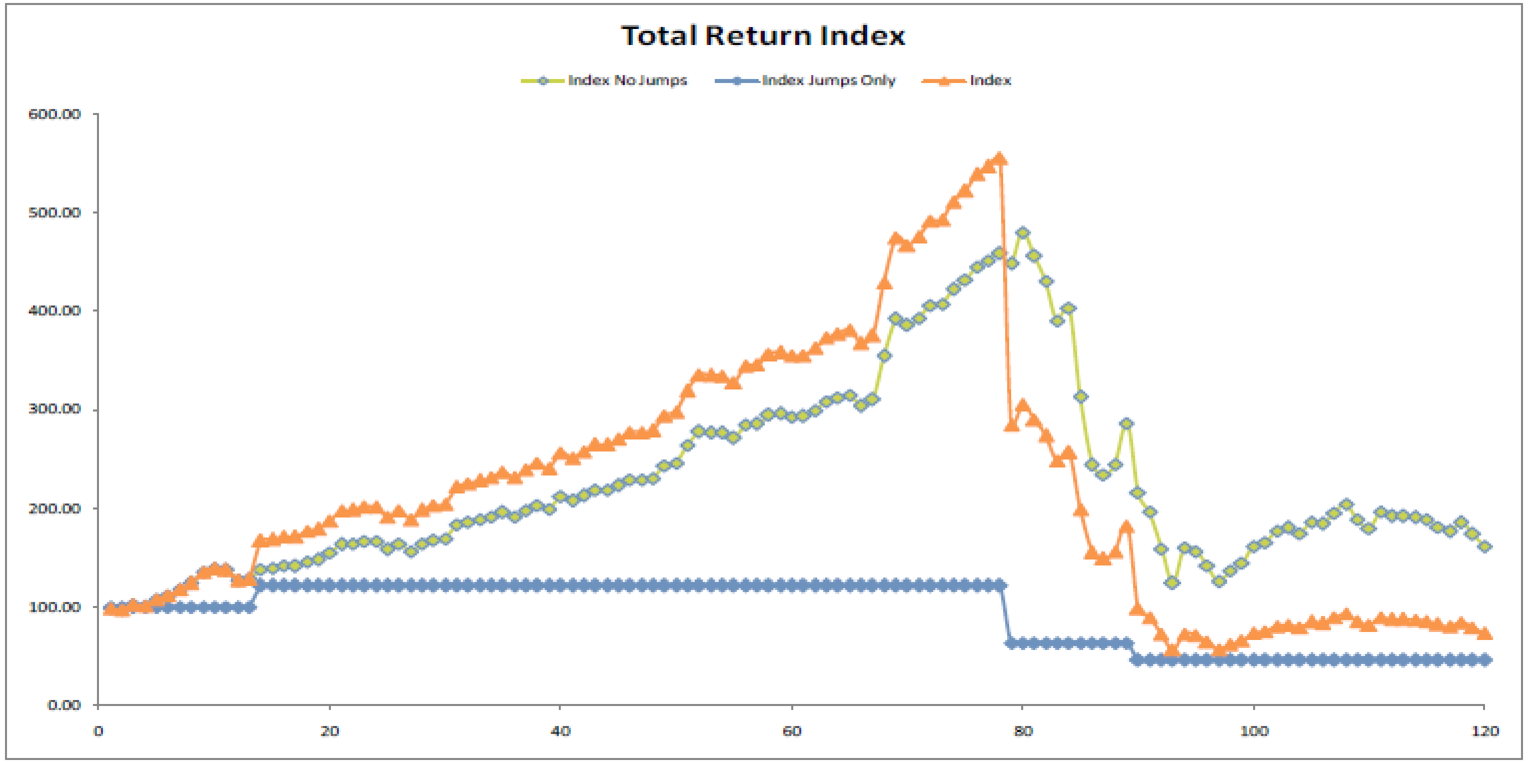
» The jump diffusion part is implemented as:

$$S_{t+\Delta t}^{JD} = S_t^{JD} \exp\{-\lambda\bar{\mu}\Delta t\} \prod_u^{N(\Delta t)} J_u$$

$$N(\Delta t) \sim \text{Poisson}(\lambda\Delta t)$$

$$J_u \sim \text{LogNormal}\left(\mu_J, \sigma_J^2\right)$$

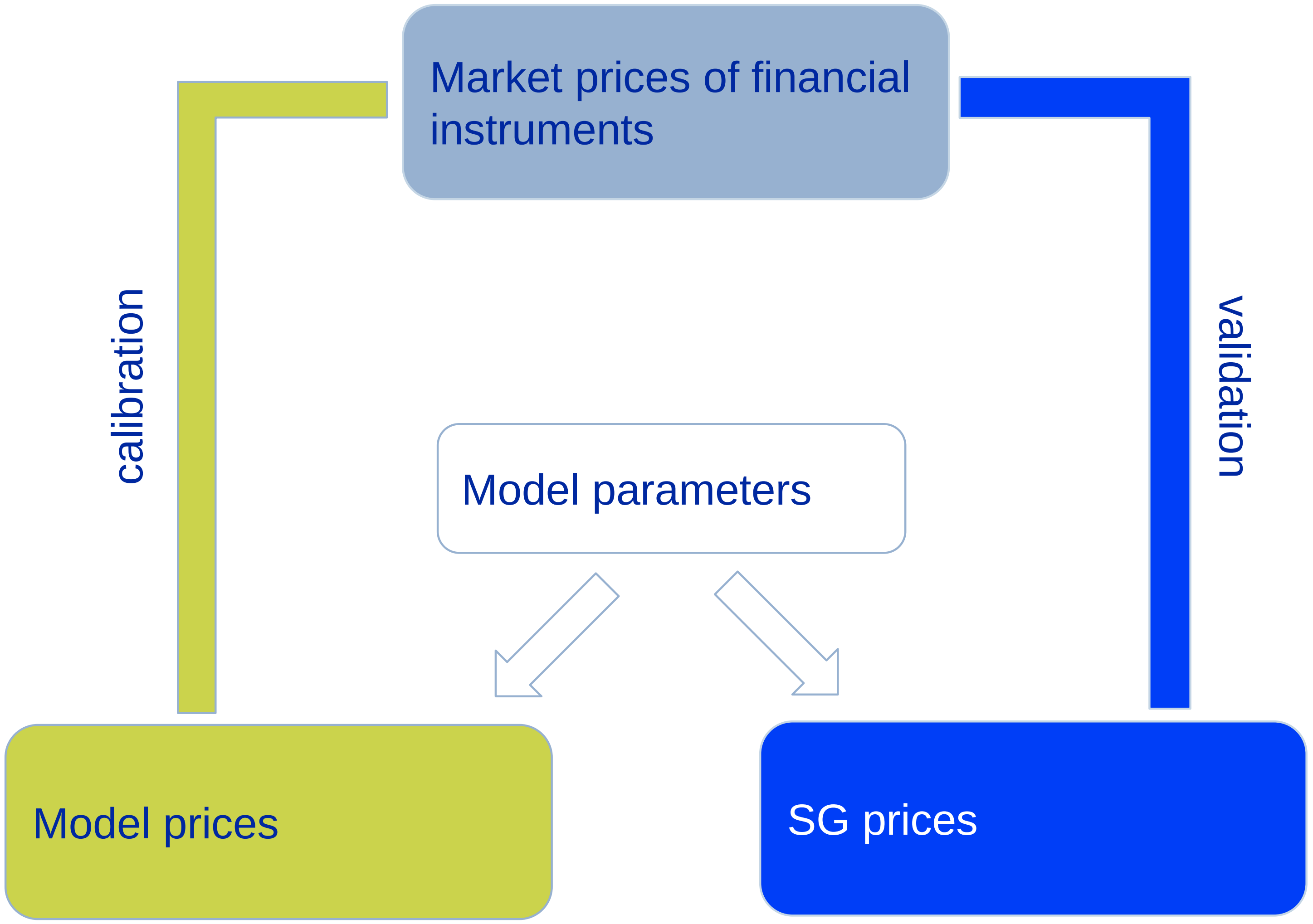
SVJD Model - Results



Desired properties captured:

- » Large jumps are rare and most likely negative
- » Volatility in returns is stochastic
- » Volatility clustering

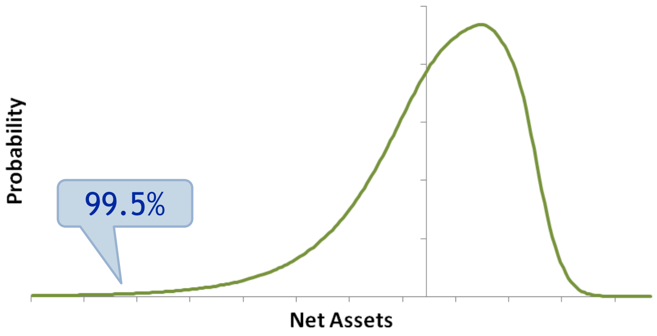
Market Consistent (MC) Calibration & Validation



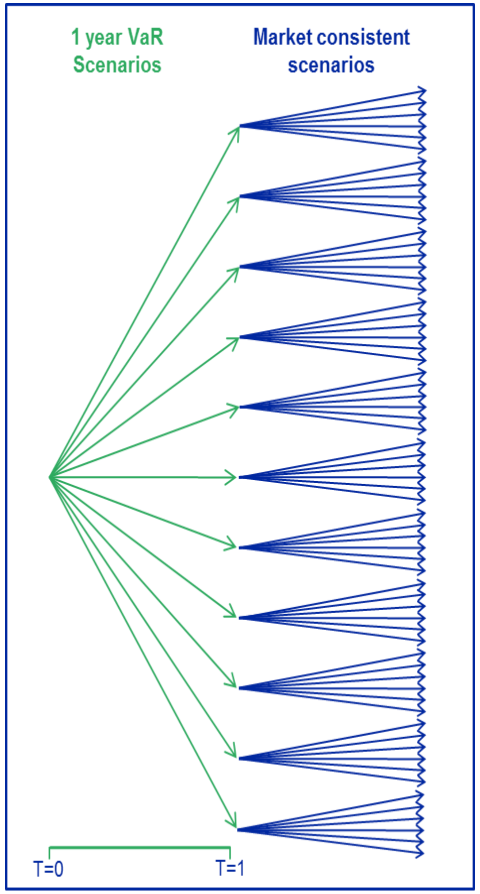
Proxy Generator & Case Study

Objective

» Calculate full probability distribution of net assets under 1 year of economic risk at all points in the corporate hierarchy.



- Requires nested stochastic approach.
- Presents runtime issue.



» Led to introduction of approximation techniques: Least Squares Monte Carlo (LSMC) and curve fitting.
» Proxy functions allow significantly faster actuarial revaluation.
» Proxies are used to estimate economic capital and to asses extent of hedge effectiveness.

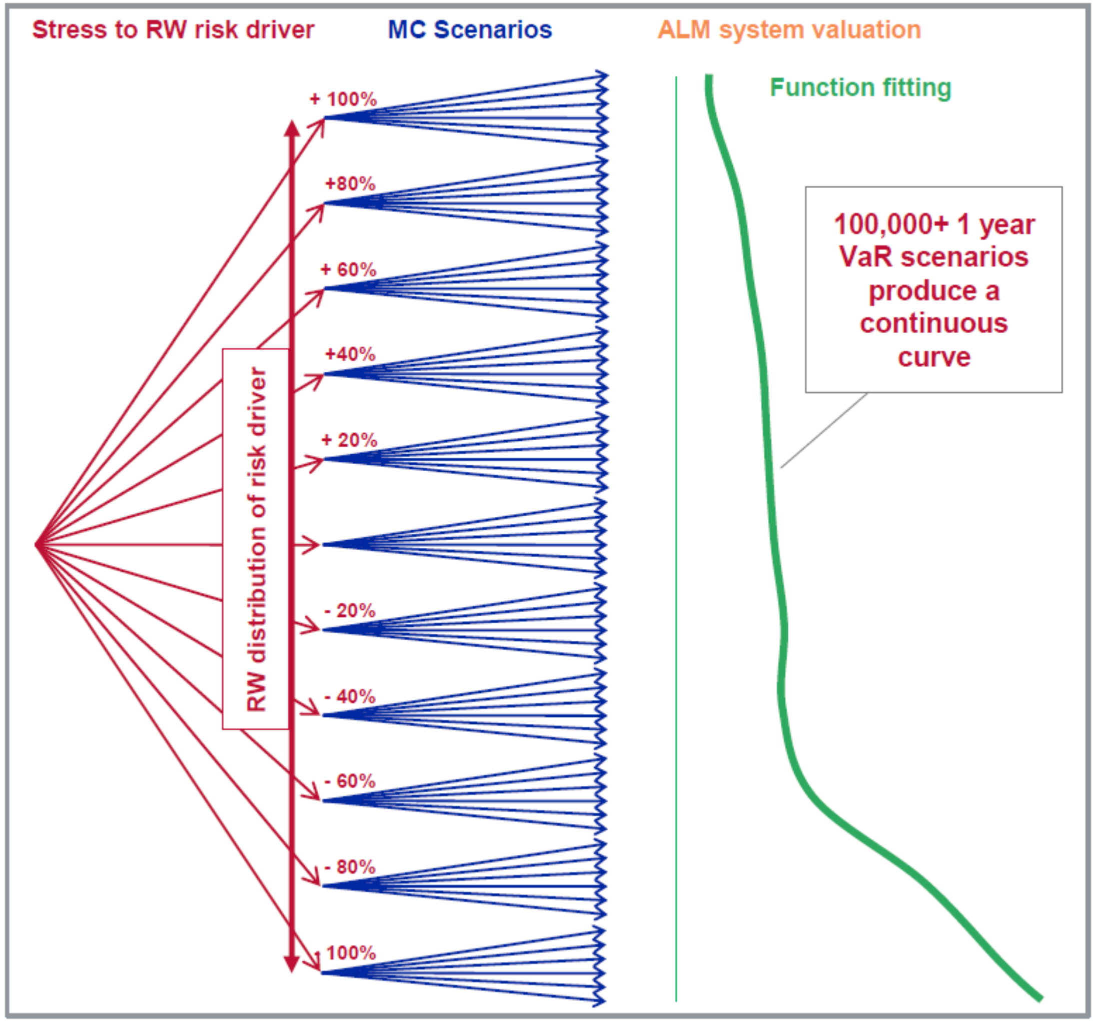
Proxy Methodology

Full Nested Stochastic

The full nested stochastic approach requires a full set of market consistent scenarios for each 1 year VaR scenario.

This is not practical for life insurer ALM models.

Scenario Budget	
1 year VaR Scenarios	100,000+
Market Consistent Scenarios	5,000
Total Scenarios	**500,000,000+**



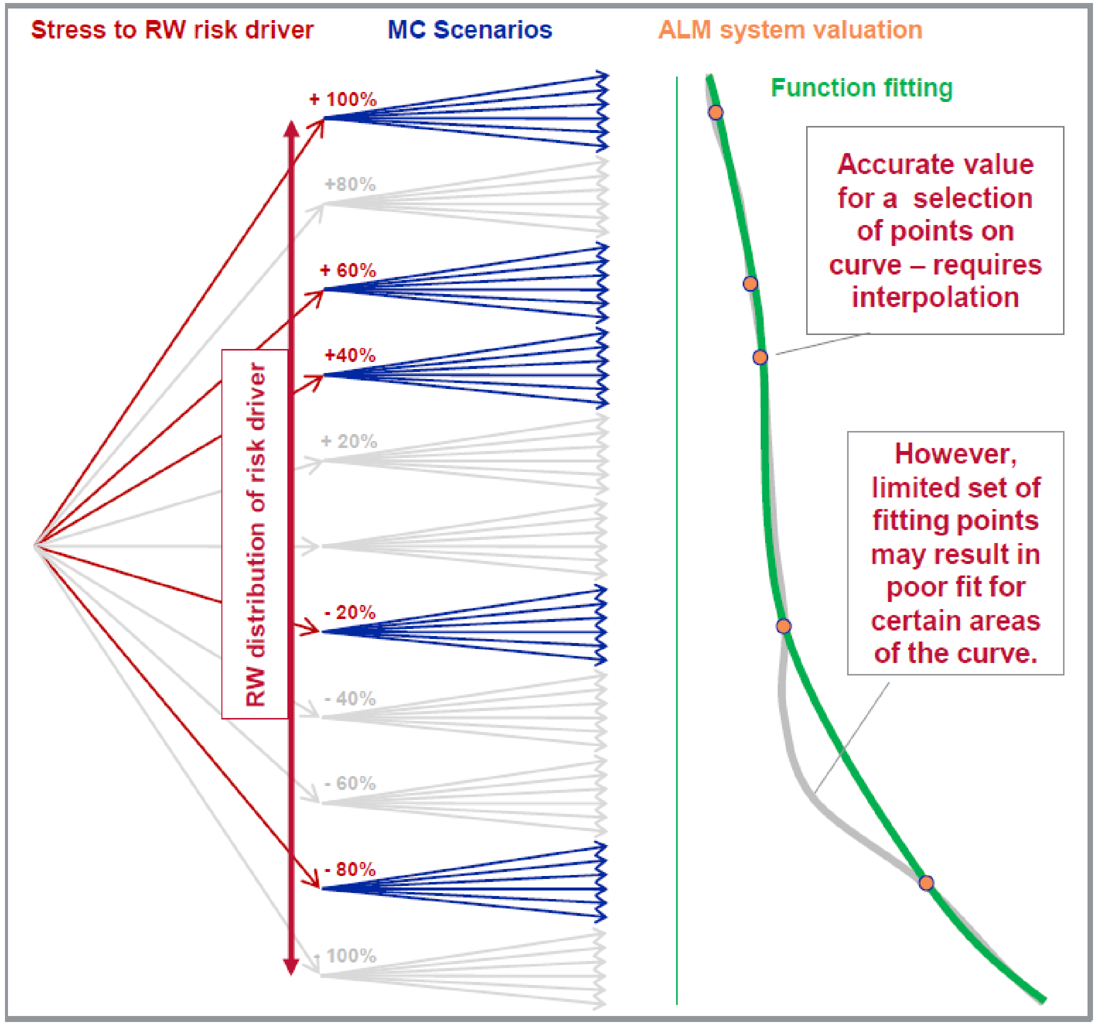
Proxy Methodology

Curve Fitting

The curve fitting approach fits a polynomial function (i.e. multi-dimensional surface) through a set of chosen points with associated accurate valuations (using 5,000 market consistent scenarios).

This is not an efficient use of the overall scenario budget. The ALM model is still a constraint and an insurer may only be able to fit through a few hundred points using this approach.

Scenario Budget	
1 year VaR Scenarios	50
Market Consistent Scenarios	5,000
Total Scenarios	**250,000**



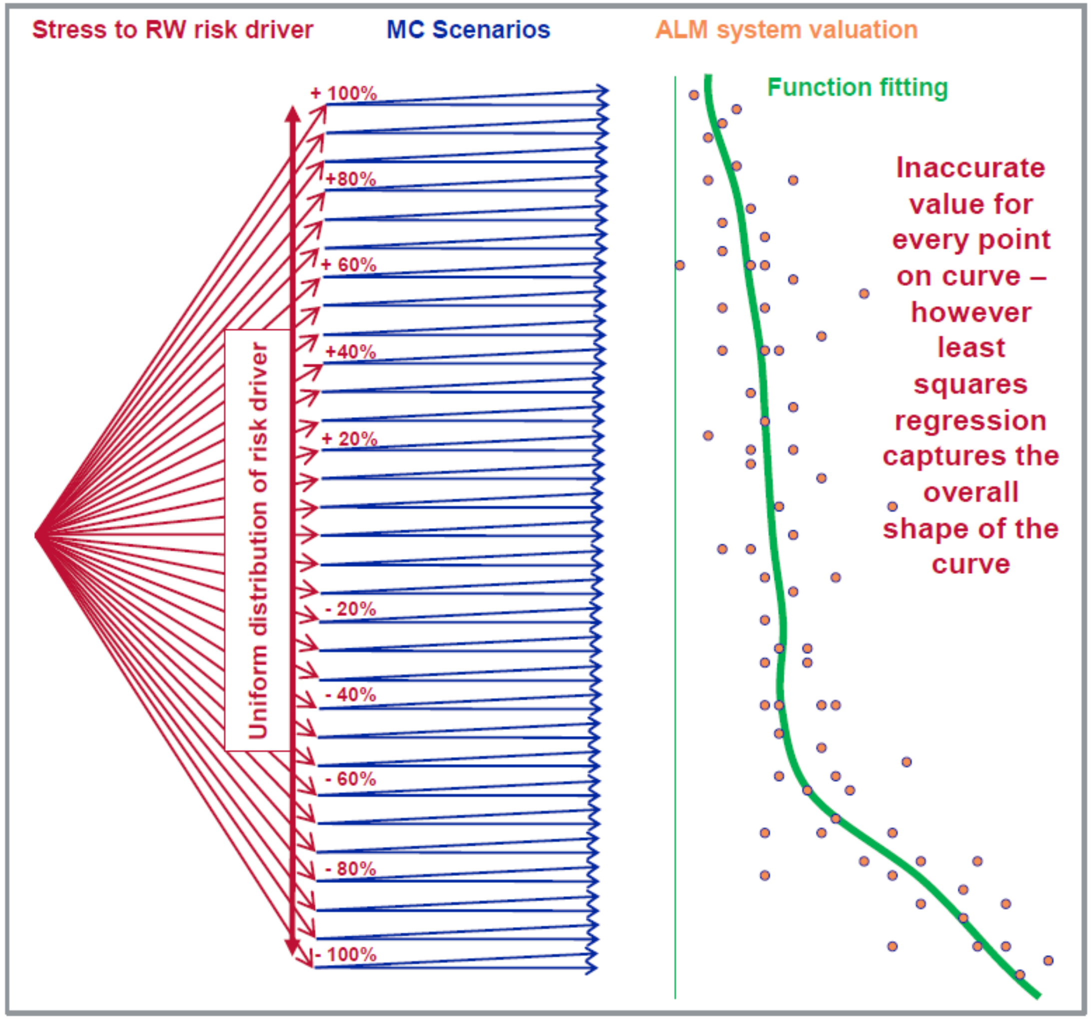
Proxy Methodology

LSMC

The LSMC approach increases the number of fitting points but gives up the accuracy of the associated valuations due to the reduced number of market consistent scenarios.

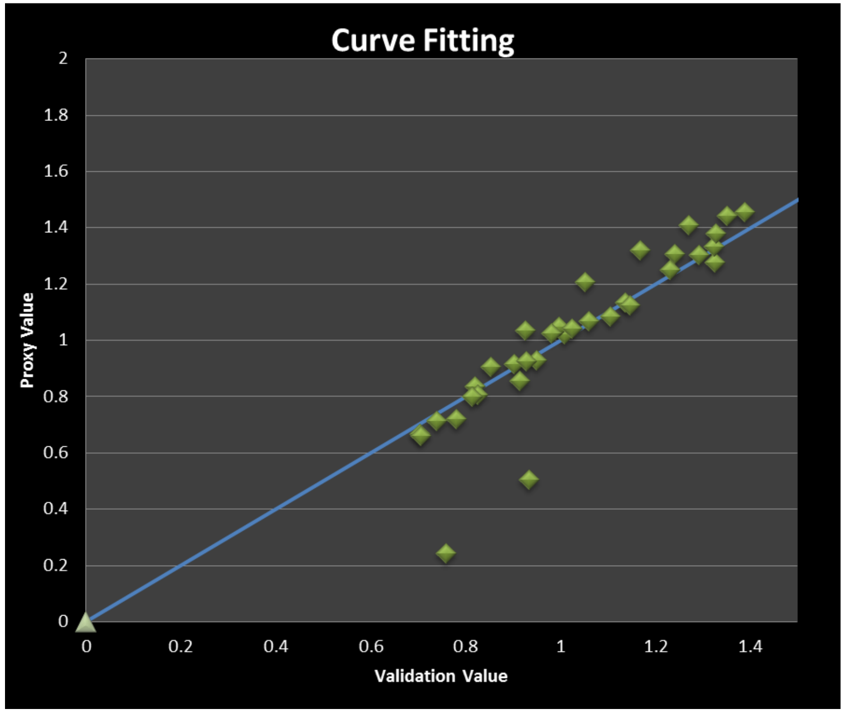
The clever bit is that as long as market consistent scenarios are independent the fit is much better than curve fitting for the same scenario budget.

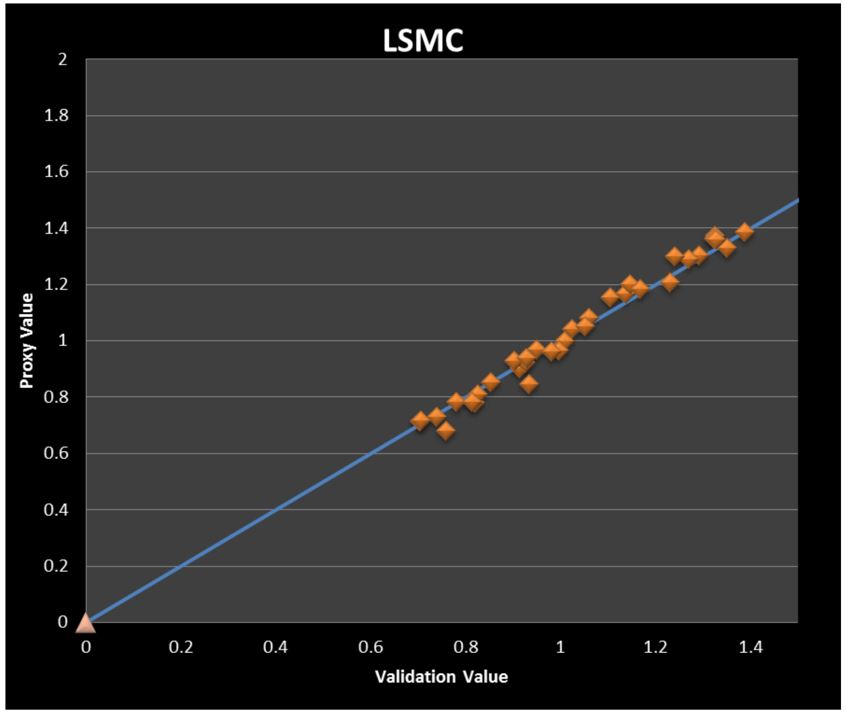
Scenario Budget	
1 year VaR Scenarios	50,000
Market Consistent Scenarios	2
Total Scenarios	**100,000**



Case Study Results

Validation of the proxy function





» LSMC provides a better fit across the whole distribution. In the curve fitting example there are several points which have a very poor fit. These are primarily the high interest rate scenarios which were not covered by a fitting point. This illustrates one of the weaknesses of curve fitting – choice of the fitting points is critical.

ESG Demo

4

Working at Moody's Analytics ERS

Roles within MA Insurance

MA Insurance analysts work in many different roles across MA Insurance

Calibration Services

Perform analysis on market and historical data to set targets for economic variables. Produce and validate calibrations to these targets. Apply expert judgment in review of results.

Research

Research and design solutions for emerging requirements/themes in the industry. Often driven by changes in regulatory requirements like SII or IFRS17.

Product Management

Understand our clients' requirements and how they are using our solutions. Implement upgrades to our solutions to meet clients' needs.

Advisory Services

Work with clients to understand their objectives. Implement solutions to meet clients' objectives and provide technical expertise to solve clients' modelling problems.

How do mathematical skills help me do my job?

- **Technical Skills**
  - Understanding statistical distributions and stochastic models
  - Perform analyse to provide recommendations and advice to clients
  - Knowledge of financial instruments our clients sell in the market and invest their assets in.
- **Modelling**
  - Use different modelling software to perform analysis.
  - Understanding modelling best practice, e.g. documentation, audit trails.
- **Communication**
  - Presenting of results to clients and internally
  - Delivering client training on technical topics
  - Writing reports for clients on our analysis methodology and results
- **Industry Awareness**
  - Understanding what our clients do and what their challenges are.
  - Knowledge of regulatory environment that clients operate in.

5

Moody’s Analytics ERS Graduate Programme

Moody’s ERS Graduate Programme – wider opportunities

- Current program is in its 9th year
- Graduates have been recruited and developed in the insurance business over the last nine years
- In this period we have recruited 15-20 graduates with all moving into permanent roles
- These graduates have developed and moved into a variety of roles in the organization:
  - Advisory Services Teams
  - Modelling and Calibration Services
  - Product Management
  - Research Teams
- Career progression is a focal points for us

Director – Advisory Service

Leading Advisory Team in Edinburgh Office

Associate Director - Modelling Operation

Leading client projects and engagements in US Office (WTC)

Assistant Director - Advisory Services

Product manager responsible for delivery of our ESG software in Edinburgh Office

Snapshot of Assignments

Partnered with a senior consultant on projects such as:

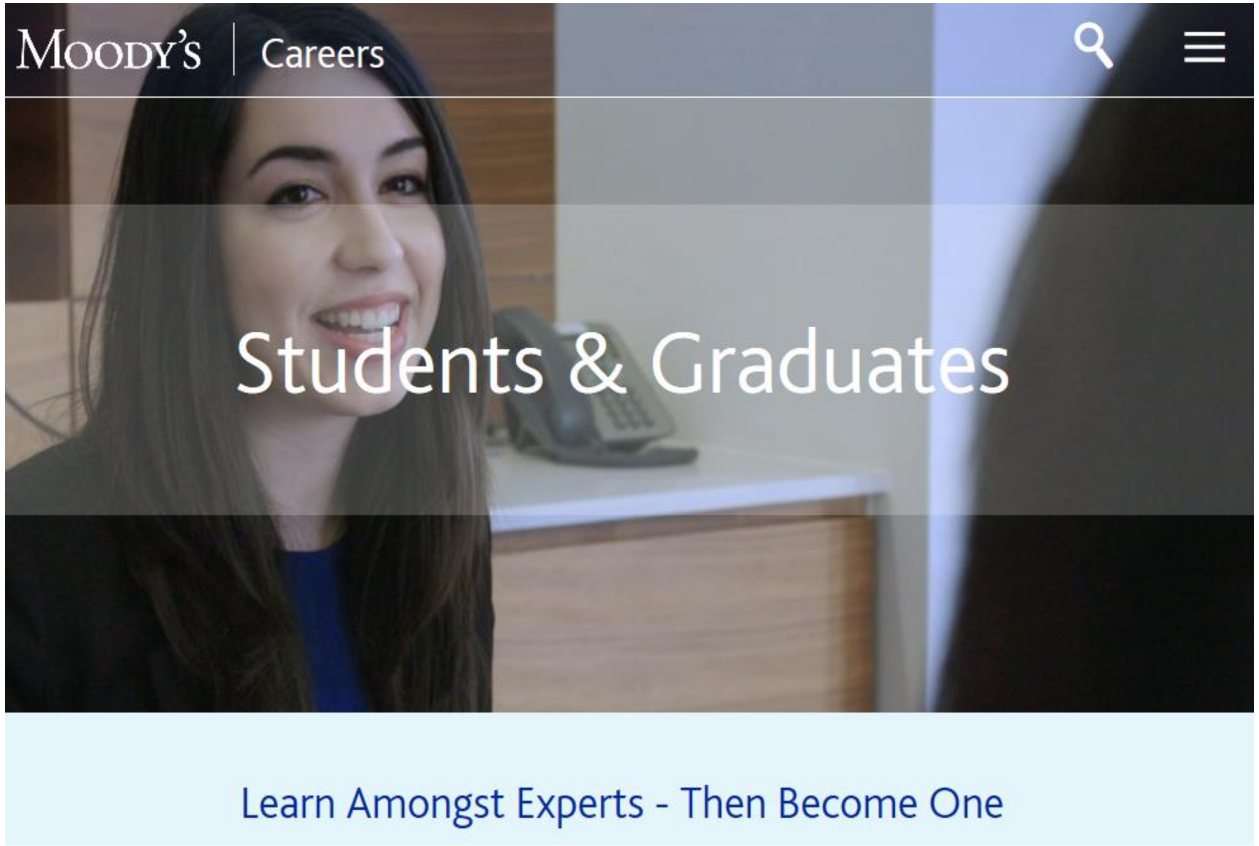
- Product Implementation – configuring the ESG software to produce scenario sets used in liability valuation, capital analysis, portfolio optimization and general risk management
- Product Customisation/Parameterisation
- Model and Calibration Method Development
- Business Analysis in Implementation projects related to the Solvency II
- Calibrating economic models to new data or market conditions
- Answering technical questions from customers to help them understand models or methods
- Implementing new services (such as economic scenario or model calibration services) to a customer's specific requirements
- Developing and implementing new methods, tools or infrastructure to enhance our propositions
- Providing training to internal teams and clients on the use of our software and the underlying quantitative models and techniques

What we are looking for

- Higher education within Finance, Actuarial, Maths or Physical Sciences
- Quantitative aptitude and proven analytical skills
- Good communication skills – both verbal and written
- Able to work to tight deadlines and manage own workflow/priorities
- Strong attention to detail
- Initiative and Result driven
- Fluency in English is essential
- Other European language is beneficial

The General Application Process

- Visit our career page: https://careers.moodys.com/students-and-graduates/ma-graduate-program/
- Select our Students and Graduates page to learn about working as a graduate at Moody's
- Or Select our search job function to look for roles globally
- Upon receiving your application, our recruitment team will review your CV and covering letter, assessing your suitability for the programme alongside other applicants



Q+A

Submit questions to

Campus.Emea@moodys.com

Moody's | Better decisions

Amalie Fabricius-Vieira
7 Exchange Crescent
Conference Square
Edinburgh EH3 8RD
E: amalie.vieira@moodys.com

Appendices

Example –
SVJD & Equity Modelling

Key Features of the SVJD Model

» The SVJD model is a combination of two well known models

Heston Stochastic Volatility Model

- Produces stochastic volatility – seen in historical observations
- Defines a negative correlation between asset return shock and stochastic variance shock
  - Leverage effect
  - Creates negative skew in RW asset returns
- Volatility is mean reverting
- Exhibits volatility clustering
- Heston model creates the overall shape of the implied volatility surface – variation by maturity and strike

Merton's Jump Diffusion Model

- Jump process can be viewed as a model of rare events
- Jump size is typically large and negative
  - Jump can be viewed as break in the typical market conditions
- In the Market Consistent environment, the jump model is responsible for short term skew features
- In the Real World, it is responsible for skew and kurtosis in return distribution

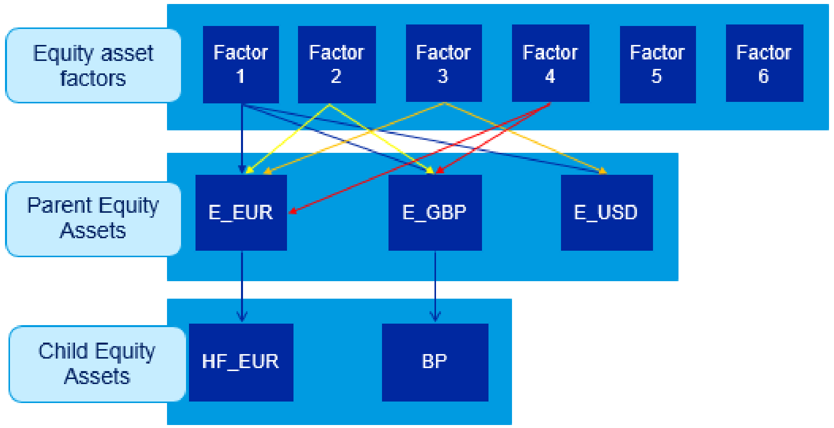
Equity Modelling: Our Approach

1

- Parent Equity Assets
- Child Equity Assets

2

- RW – Factor Model
- MC – Correlation Model



3

- Calibration
  - RW – calibrate to historical targets
  - MC – calibrate to market prices

Equity Modelling: Our Approach

1) Choose appropriate correlation approach

RW- Factor Model

MC - Correlation Model

2) Choose model of Total Returns

Capital returns = Total Returns - Dividends

Parent Equity Assets

- RW: Total returns = sum of returns from exposure to equity factors plus asset specific
- MC: Total returns modelled for each asset and correlated using matrix

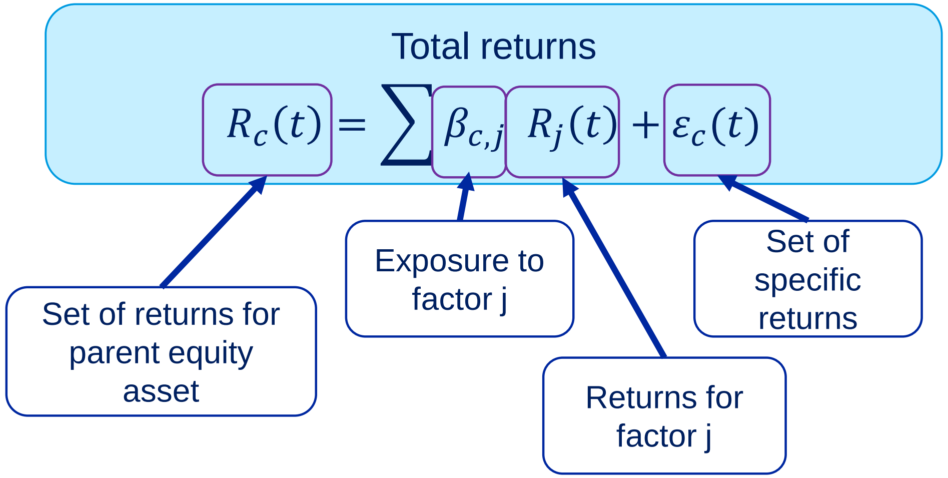
Child Equity Assets

Modelled using CAPM approach - total return derived from exposure to parent, asset specific return and asset specific volatility

3) Model Dividends

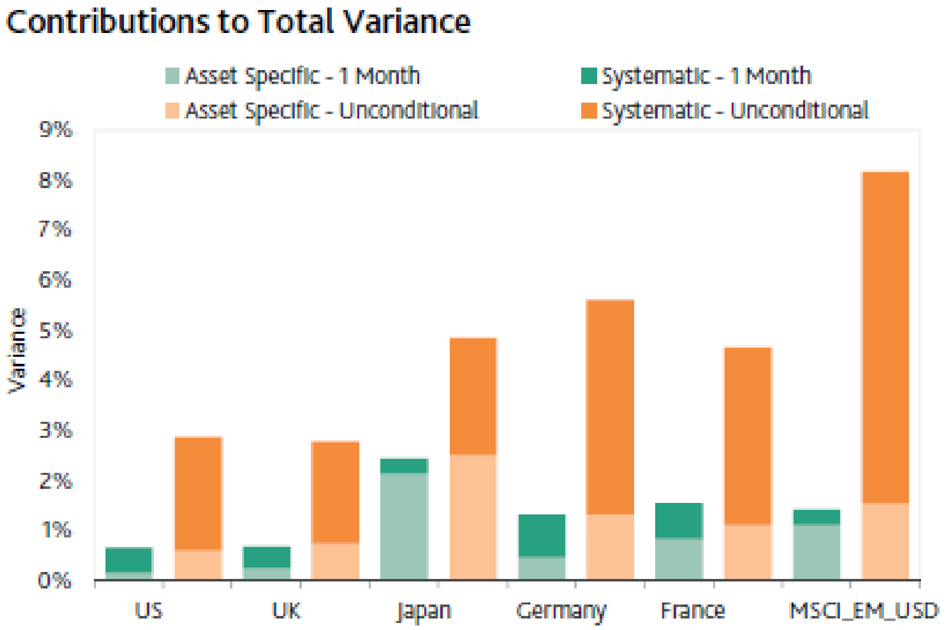
Modelled using one factor Black-Karasinski model

Equity Factor Approach – Key Features

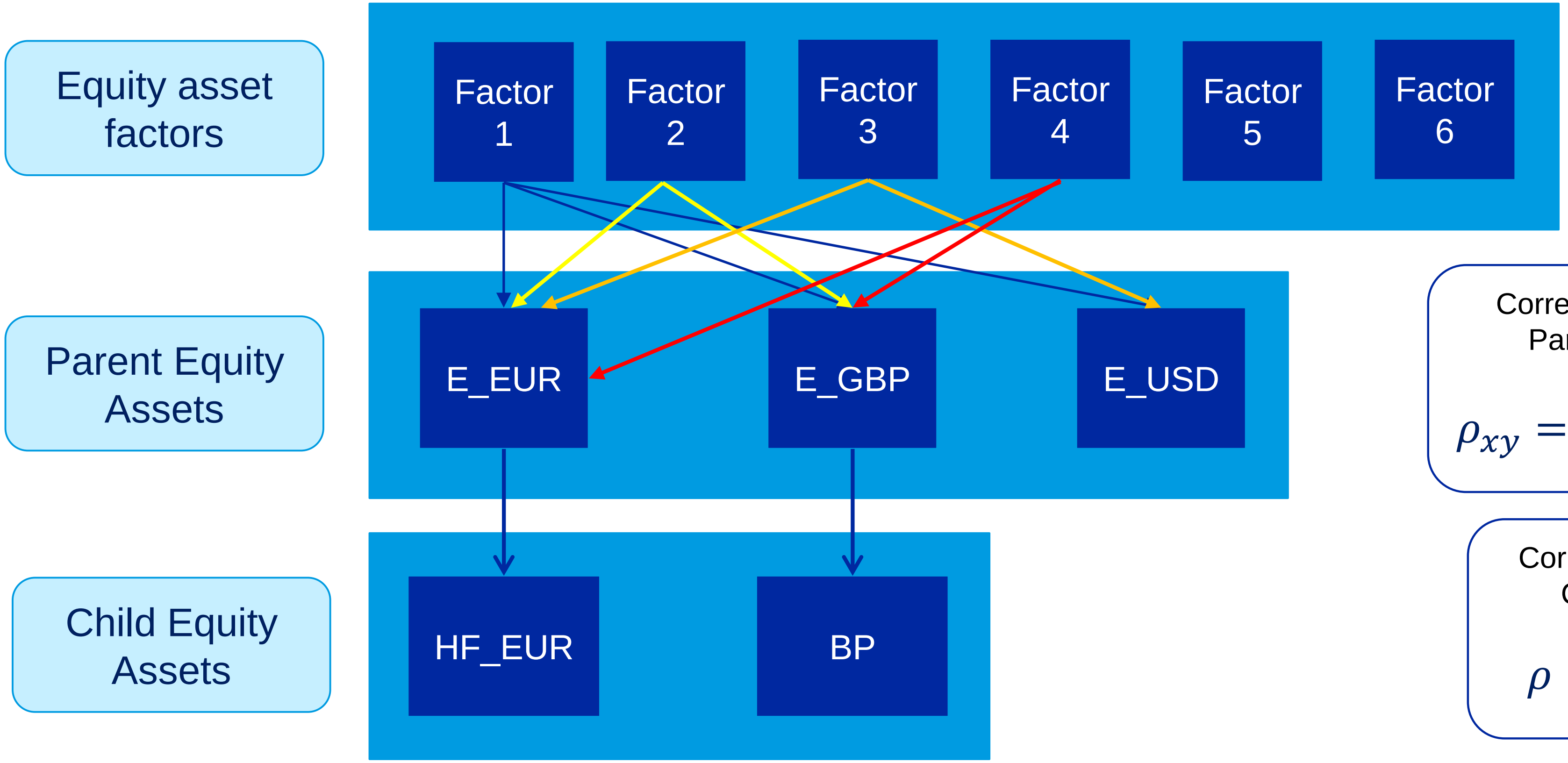


- Factor one acts as a ‘global’ equity factor, with all assets being exposed to it
- Weight on factor 1 also drives tail correlation - Not explicitly targeted, but monitored
- Systematic risk through the factor drives correlation in the model
- Specific risk ensure we can target index-specific volatility targets

- Used to model log excess return
- Each asset exposed to a number of systematic factors
- Total return given by the sum of return derived from exposure to factors (j) and specific returns



Equity Factor Approach - Model Structure



Correlation between Parent Equities

$$\rho_{xy} = \frac{\sum_i \beta_i^X \beta_i^Y \sigma_i^2}{\sigma_X \sigma_Y}$$

Correlation between Child Equities

$$\rho = \frac{\beta \sigma_{parent}}{\sigma_{child}}$$

Suggested volatility model choices

	Factor 1	Factor 2-6	Specific
Stochastic Volatility Jump Diffusion (SVJD)	SVJD	Fixed	SV

SVJD Real World Calibration

Biennial

Quarterly

Factor 1 Stochastic Volatility

- **Volatility of Variance** calibrated to 1 month IV historical distribution
- **Mean Reversion Rate** estimated based on Auto-regression of 1 month IV data
- **Correlation** between changes in 1 month IV and equity return data
- **Mean Reversion Level** calibrated to maximise contribution of Factor 1 to hit unconditional volatility targets.

βs (Factor loadings)

- Calibrate **Factor Loadings** to hit long term unconditional volatility and correlation targets
- Derived using Principal Components Analysis (PCA)
- **Risk Premium** set by establishing beta to global equity portfolio with XS return of 4%
- The **Specific Mean Reversion Level** are calibrated to hit unconditional volatility targets for all economies

Factor 1 Jump Parameters

- **Jump Mean** and **Jump Volatility** fitted to unconditional 1 month return skew and kurtosis targets
- **Jump Intensity** pinned to 0.2 (approx. every 5 years)

Factor 1 Stochastic Initialisation

- **Initial Value** fitted to maximise contribution of Factor 1 to hit conditional volatility targets for 5 economies

Specific Volatility

- The **Specific Initial Value** are fitted to conditional volatility targets for each economy