Integrated Risk, Decomposition and Attribution in Historical Simulation Model

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Model used:

- Historical Simulation of Risk Factors

Principle:

- Calculation of potential portfolio value changes (expected distribution of returns) for scenarios which have been generated from the historical changes to the risk factors.

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Advantages:

- **Total coverage** of all instruments (linear and non linear).
- Integration of all **risk factors**, from credit risk to implicit volatility. Proprietary methodology for integrating default risk into Historical Simulation.
- **No distribution assumption** necessary (every kind of asymmetry, kurtosis and skewness is considered).
- Approach is **easy to understand** and to communicate.

Historical Simulation Method

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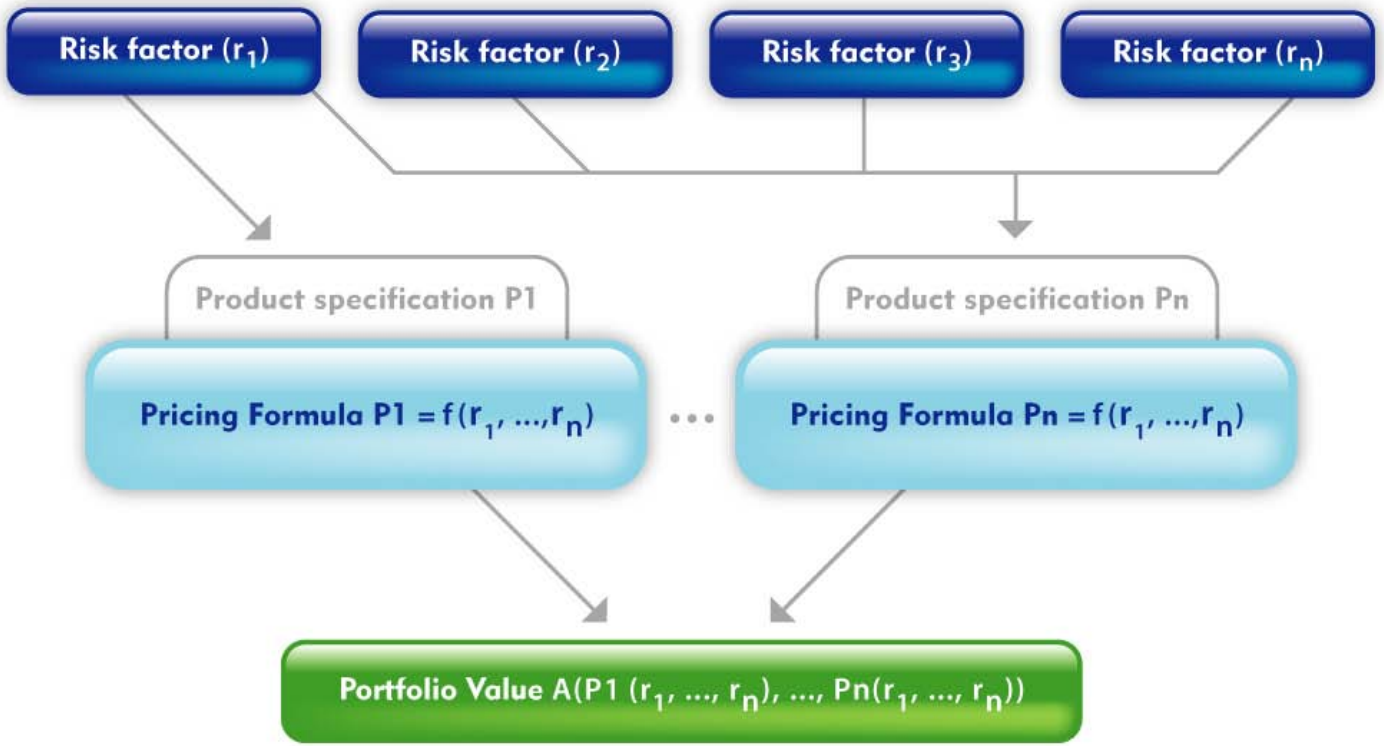

A Selection of Risk Factors

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Risk factors:

- Prices (Equities, Mutual Funds, Indices)
- Implied Volatilities
- Inflation Swap Curves
- FX Rates
- Interbank Interest Rate Curves
- Corporate Asset swap Indices (Investment grade and High Yield)
- Emerging Market Asset Swap Indices
- Credit Default Swap Spreads
- Implied Default Base Correlations
- Hedge Fund Indices
- …

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Pure Historical:

- Credit Risk Factor is the history of the credit spread of the specific issuer/issue maturity

“Static” Method:

- The Credit Risk Factor is the Asset Swap Spread Index of the node Rating/Sector (with the appropriate maturity) to which the issuer/issue belongs

“Dynamic” Method:

- The Credit Risk Factor is created dynamically, based on the level of Credit Default Swap spread quoted by the market for the reference issuer/maturity

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Generation of expected returns

Example of Generation of Expected Returns

Calculation of absolute and relative risk

Example of Portfolio Risk Computation

Dynamic Credit Spread Distribution

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SRS creates a credit spread distribution dynamically each day for every asset (when issuer has CDS)

Credit spread is created as follows:

- Look at issue's maturity and issuer
- Find the CDS spread of the issuer for that maturity
- Transform CDS spread into z-spread (zero vol spread)
- Find the ratings with higher and lower spread than reference z-spread
- Interpolate between the 2 ratings historical series to create "on-the-fly" the specific issue's "credit spread history".
- This distribution is a function of the CDS quote and of the implicit default probability

Suppose we have issuer XYZ, 5Y issue. CDS = 100 bps.
Suppose for simplicity that, z-spread = 100 bps

Sector = INDUSTRIAL/Manufacturing

Assume that in that Sector

- Rating A = 75 bps,
- Rating BBB = 125 bps

Z-spread falls exactly in the middle,

- issue spread distribution = 50% A + 50% BBB

Interpolated Spread Distribution

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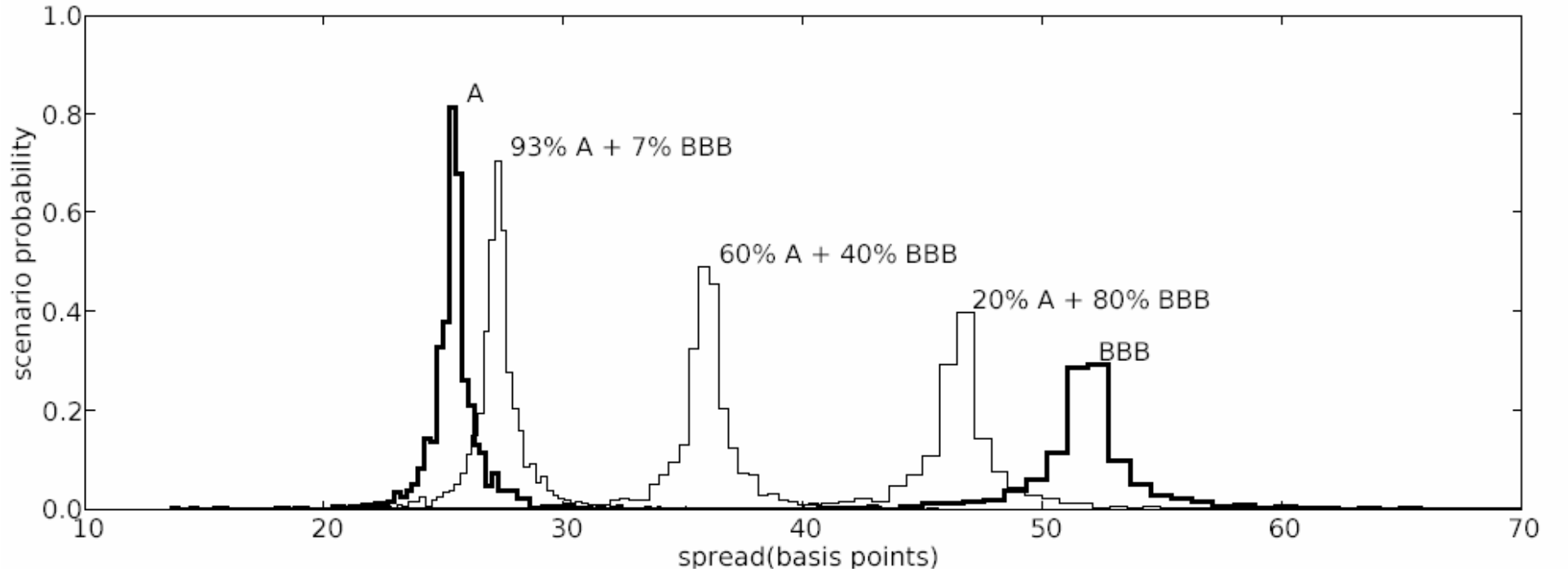

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Summary of Pros and Cons

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Historical Method

- PROs: Idiosyncratic Risk Captured
- CONs:
  - Jumps in Credit Risk are not fully captured as they happen
  - Need to have credit history per issuer (and maturity)

Static Method

- PROs:
  - Can be applied to any issuer that can be mapped into a rating/sector node
  - Captures Event Risk linked to Rating Events
- CONs:
  - No Idiosyncratic Risk
  - No Event Risk different from Rating Events

Dynamic Method

- PROs:
  - Captures in full Event Risk and Jump-to-Default
  - Integrates that into other Market Risks
  - Idiosyncratic Risk is captured (Issuer and Maturity
- CONs:
  - Correlations remain based on Sector Levels
  - Need to have a CDS curve for the reference issuer

Risk Decomposition in Asymmetric Model

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Numerical method

- Segment Portfolio by Attributes
- Shock each Segment of One Unit of Currency and Recompute Simulated Risk ($Risk^S$)
- Marginal Risk = $Risk^S$ - Risk

From Marginal Risk to Contribution

- Marginal Risks need to be “Normalized”
- Risk Contribution = $MRisk_i * W_i / Sum (MRisk_i * W_i)$

Risk Decomposition in Asymmetric Model

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VaR - Pot. Gain | Exp. Shortfall - Exp. Upside | Volatility

Portfolio: Sample Equity Portfolio View: All Hierarchies

Segments	Exposure	% Weight	Marg. VaR	% Comp. VaR	Marg. Gain	Comp. Gain
H1: ENERGY EQUIPMENT & SERVICES	€ 865,905.448	1.145%	0.756%	0.208%	7.704%	1.867%
H1: CHEMICALS	€ 1,250,725.871	1.653%	5.063%	2.014%	3.804%	1.332%
H2: US2605431038(Dow Chemical Co)	€ 141,651.949	0.187%	5.679%	0.256%	6.317%	0.250%
H2: JP3371200001(Shin Etsu Chemical Co Ltd)	€ 1,109,073.923	1.466%	4.985%	1.759%	3.483%	1.081%
H1: METALS & MINING	€ 508,794.019	0.673%	4.374%	0.708%	5.330%	0.759%
H1: BUILDING PRODUCTS	€ 285,750.000	0.378%	6.388%	0.581%	4.564%	0.365%
H1: AUTOMOBILES	€ 633,700.000	0.838%	4.646%	0.937%	4.945%	0.877%
H1: HOUSEHOLD DURABLES	€ 849,614.747	1.123%	6.172%	1.668%	2.768%	0.658%
H1: HOTELS RESTAURANTS & LEISURE	€ 990,232.880	1.309%	4.602%	1.449%	6.606%	1.831%
H1: MULTILINE RETAIL	€ 1,389,174.583	1.836%	5.836%	2.579%	2.805%	1.090%
H1: HEALTH CARE PROVIDERS & SERVIC	€ 464,369.326	0.614%	3.874%	0.572%	5.415%	0.704%
H1: BIOTECHNOLOGY	€ 359,058.610	0.475%	2.248%	0.257%	3.507%	0.352%
H1: CONSUMER FINANCE	€ 444,572.225	0.588%	3.518%	0.498%	7.159%	0.891%
H1: OFFICE ELECTRONICS	€ 309,689.078	0.409%	3.191%	0.314%	6.448%	0.559%
H1: WIRELESS TELECOMMUNICATIONS SE	€ 1,481,279.818	1.958%	4.802%	2.263%	1.775%	0.736%
H1: ELECTRIC UTILITIES	€ 373,040.000	0.493%	3.587%	0.426%	3.966%	0.414%
H1: MULTI-UTILITIES	€ 893,500.149	1.181%	3.217%	0.914%	3.488%	0.872%
H1: CASH	€ -2,017,359.448	-2.667%	1.847%	-1.185%	-0.178%	0.100%
H1: PAPER & FOREST PRODUCTS	€ 617,353.612	0.816%	5.652%	1.110%	3.586%	0.620%
H1: BEVERAGES	€ 1,337,298.226	1.768%	2.832%	1.205%	4.430%	1.658%
H1: TOBACCO	€ 953,029.178	1.260%	2.948%	0.894%	3.350%	0.894%
H1: HOUSEHOLD PRODUCTS	€ 1,929,660.883	2.551%	2.917%	1.790%	3.651%	1.972%
H1: PHARMACEUTICALS	€ 5,358,352.830	7.084%	3.560%	6.068%	3.786%	5.677%
H1: REAL ESTATE	€ 1,479,264.323	1.956%	5.138%	2.418%	3.746%	1.551%

Risk Attribution in Asymmetric Model

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Ex Ante Allocation Effect

- Segment Portfolio by Attribute
- Create Pseudo-Allocation Portfolio (PAP). Segments contain the same assets of the benchmark with same weights. Allocation weights of the portfolio are maintained.
- Risk of the PAP portfolio is computed to isolate allocation bets

Ex Ante Selection Effect

- Create Pseudo-Selection Portfolio (PSP). Segments are allocated according to benchmark weight. Segments contain the assets effectively held in the real portfolio
- Risk of the PSP portfolio is computed to isolate Selection bets

Ex Ante Interaction Effect

- Interaction Effect is in reality the residual risk
- Interaction = Risk – $Risk^{PAP}$ – $Risk^{PSP}$

Risk Attribution in Asymmetric Model

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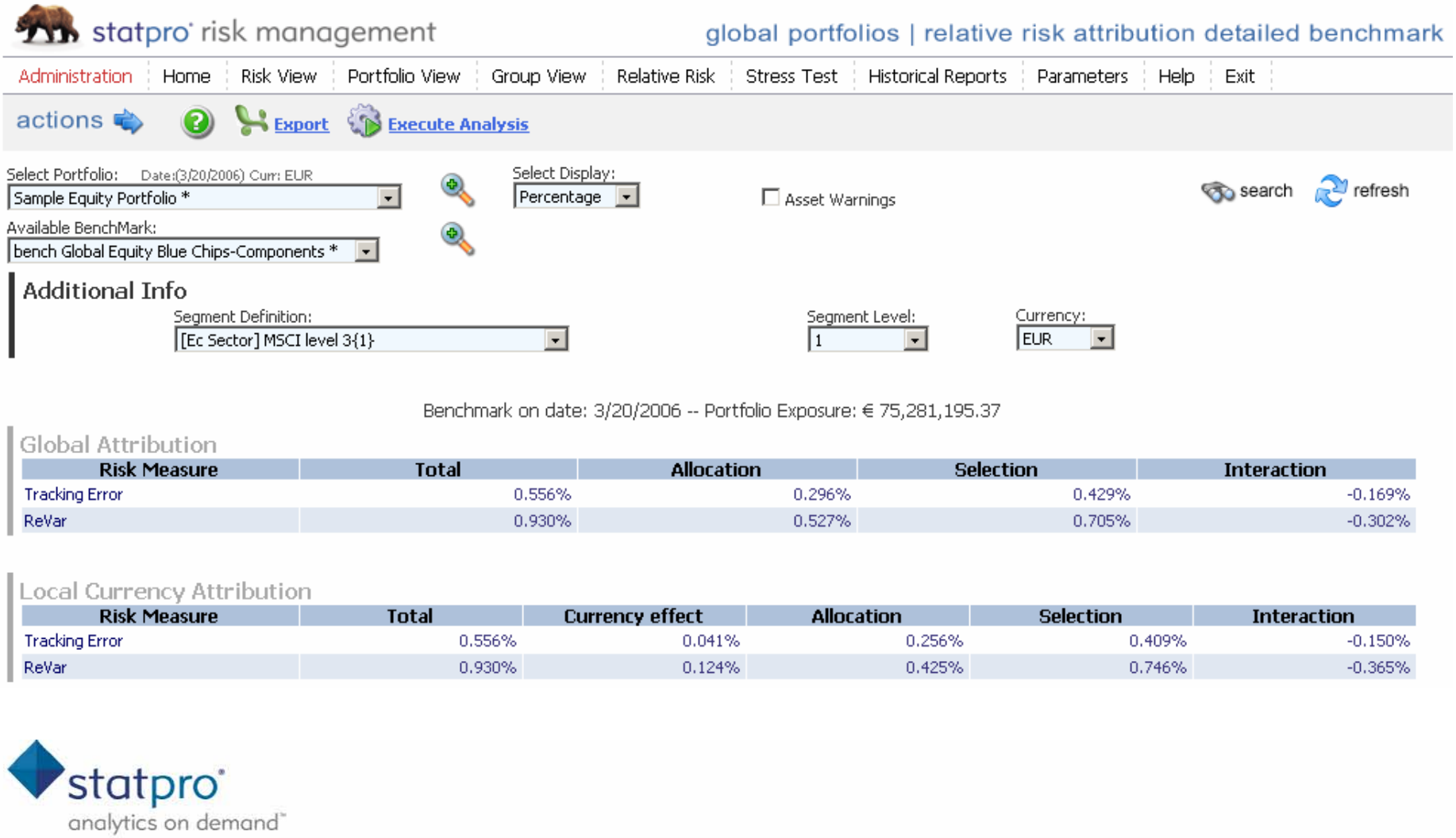

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