EUROPEAN INSURANCE
AND OCCUPATIONAL PENSIONS AUTHORITY

# Consistent generation of stress scenarios – normative and practical considerations

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The views presented are mine alone and do not necessarily represent those of my employer.

# Outline

- EIOPA and Stress testing
  - 2011 Insurance Stress Test
    - Objectives
    - Scenarios
    - Results
- Framework considerations
  - Coordination between relevant bodies
  - Modeling aspects
- Some observations
  - Methodologies
  - Scope
  - Consistency
  - Empirical example

# Stress testing mandate

- Observations from EIOPA regulation [articles 21(2), 23, 32(2)]:
  - Initiate and coordinate Union-wide stress tests
  - Assess and evaluate the effect of adverse market developments on the:
    - resilience of financial institutions
    - systemic risk posed by financial institutions (Insurance, reinsurance and occupational pensions
    - the potential for systemic risk to increase in situations of stress
  - Develop and Implement common:
    - methodologies for assessing the effects of economic scenarios
    - methodologies for assessing the effects of particular products and distribution processes
    - communication approaches for stress testing outcomes

# 2011 Stress test

- Objectives – in accordance with the mandate, to:
  - Assess the resilience of the EU insurance sector
  - Understand capital position of insurers in adverse situations
  - Evaluate if current available capital supports financial stability of the market
- EIOPA stress testing is seen as:
  - An important supervisory and risk management tool
  - A test of “what if” scenarios to explore insurance companies vulnerabilities
- The EIOPA stress test is not:
  - A solvency exercise
  - A second guess of capital requirements

# 2011 Stress test

- Framework:
  - Stress test based on EU future risk-based regulation - Solvency II
  - Assets and liabilities valued on a market consistent basis
  - Macroeconomic scenarios provided by the ECB
  - Shock scenarios developed by EIOPA to highlight risks of particular relevance to insurers
- Coverage:
  - 221 (re)insurance groups and companies in the European Union, European Economic Area, Switzerland
  - 58 groups and 71 individual undertakings reported results (aggregated group reporting)
  - Achieved goal of minimum coverage of 50% by premium income per country
  - Represents approximately 60% of the market share

# 2011 Stress test

- Scenarios:
  - Baseline (severe stress)
  - Adverse (more severe market deterioration in the main macroeconomic variables) Macroeconomic scenarios provided by the ECB
  - Inflation (increase in inflation -> rapid increase interest rates)
- Satellites:
  - Sovereign risk
  - Low yield environment
- Risks:
  - Market (interest rate, equity, real estate)
  - Credit (spread risk: investment grade, high yield)
  - Insurance (natural catastrophe, pandemic event, reinsurance)

# 2011 - Scenarios

| Risk modules | | Baseline scenario | Adverse scenario | Inflation scenario |
|---|---|---|---|---|
| **Market Risk** | | | | |
| **Interest rate** | <3M | -40 bps | -125 bps | +125 bps |
| | >3M | -20 bps | -62.5 bps | +62.5 bps |
| **Equities** | | -7.5% | -15% | 0% |
| **Real estate Residential** | | -3.8% | -11.6% | 0% |
| **Real estate Commercial** | | -12.5% | -25% | 0% |
| **Credit Risk** | | | | |
| **Spread risk** | | Spread increases as a function of rating (AAA to B), from 0.125-1.5%-points | Spread increases as a function of rating (AAA to B), from 0.25-3.0%-points | |
| **Investment Grade** | | +15.7% increase in spreads | +31.4% increase in spreads | 0% |
| **High-yield** | | +19.15% increase in spreads | +38.3% increase in spreads | 0% |

# 2011 - Scenarios

| Insurance Risks | |
|---|---|
| **Non-Life Insurance related stresses** | The greater of the following: (1) the largest one-in-two-hundred natural catastrophe probable maximum loss (PML), where only a 70% recovery rate from reinsurers can be assumed; (2) a shortfall arising for all non-life claims reserves by assuming a 2 percentage point higher claims inflation than presumed for existing best estimate calculations without recourse to reinsurers. |
| **Life Insurance related stresses** | The greater of the following: (1) An additional 1.5 deaths per thousand lives, assumed to follow from a pandemic event where the recovery rate from the two largest reinsurers on the panel is only 50%; (2) An increase of 23% in mortality improvement rates, over and above the developments already factored into the best estimates, with no recovery from reinsurers. |
| **Sovereign Risk** | Country specific yield curve movements were defined on the basis of macroeconomic assumptions for EU-Member States, Norway, Iceland, Switzerland and Liechtenstein. The magnitude of the resulting adverse yield curve movements was calibrated to reflect the outlook per country and would therefore affect the pricing of sovereign bond holdings in insurance undertakings asset holdings. |
| **Aggregation of Risks** | The risk sources market/credit risk and insurance risks are added using the following correlation matrix. |

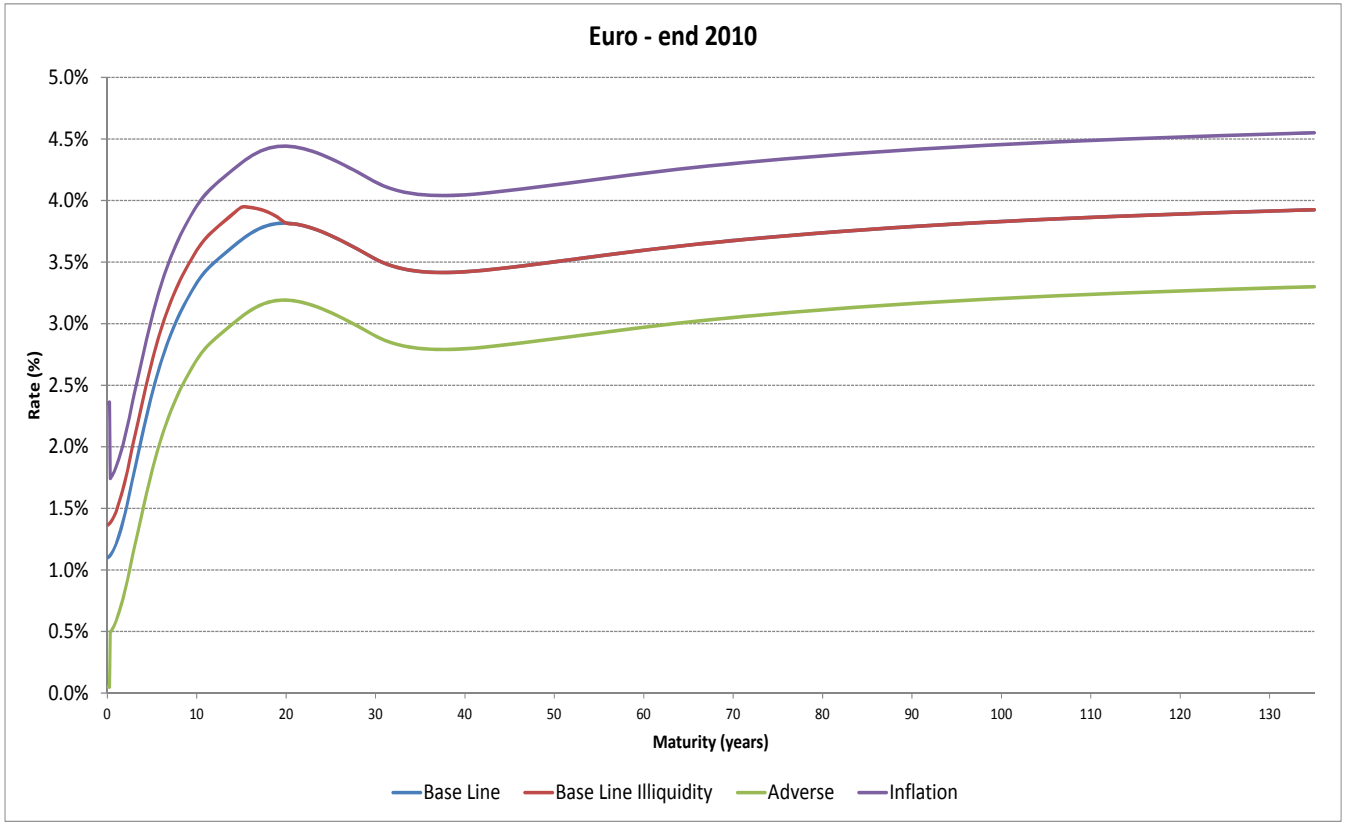
| *i* \ *j* | Market and Credit | Life | Non-Life |
|---|---|---|---|
| **Market and Credit** | 1 | | |
| **Life** | 0.25 | 1 | |
| **Non-Life** | 0.25 | 1 | 1 |

# 2011 – Discount Curves

- Methodology similar to QIS5
- QIS5 curves were produced by the industry
- The following procedure is used to derive stress-test curves:
  - Swap rates are bootstrapped into forward rates
  - Credit risk adjustment of -10bp is implemented
  - Zero rates are calculated from forwards:
    - Interpolation is done using cubic splines
    - Extrapolation is done with Smith-Wilson
  - Illiquidity premiums per currency are then added to the calculated zero curves

# 2011 Stress test

## Discount Curves – an example:



# 2011 Stress test

## Results - Capital

| Aggregated Figures | | | |
|---|---|---|---|
| | in EUR billion | in % | |
| Eligible capital before stress | 577 | | |
| Minimum Required Capital (MCR) before stress | 152 | | |
| Solvency Surplus | 425 | | |
| MCR coverage ratio | | 380% | |
| MCR coverage ratio in baseline scenario | | 320% | |
| MCR coverage ratio in adverse scenario | | 281% | |
| MCR coverage ratio in inflation scenario | | 342% | |
| **Impact on eligible capital** | **in EUR billion** | **as a percentage of eligible capital** | **Solvency deficit of undertakings not meeting the MCR (in EUR billion)** |
| Baseline scenario | 92 | 15.9 | 2.6 |
| Adverse scenario | 150 | 26.0 | 4.4 |
| Inflation scenario | 58 | 10.0 | 2.5 |
| Sovereign Stress Scenario | 33 | 5.6 | 3.4 |

# 2011 – MCR thresholds

| Scenarios | Number of insurers failing MCR | Number of insurers failing MCR in % | Solvency deficit of undertakings not meeting the MCR (in EUR billion) |
|---|---|---|---|
| Baseline scenario | 11 | 9% | 2.6 |
| Adverse scenario | 13 | 10% | 4.4 |
| Inflation scenario | 10 | 8% | 2.5 |
| Sovereign Stress Scenario | 6 | 5% | 3.4 |

# 2011 – Drivers of results

•Overall the European insurance sector remains robust in the occurrence of major shocks

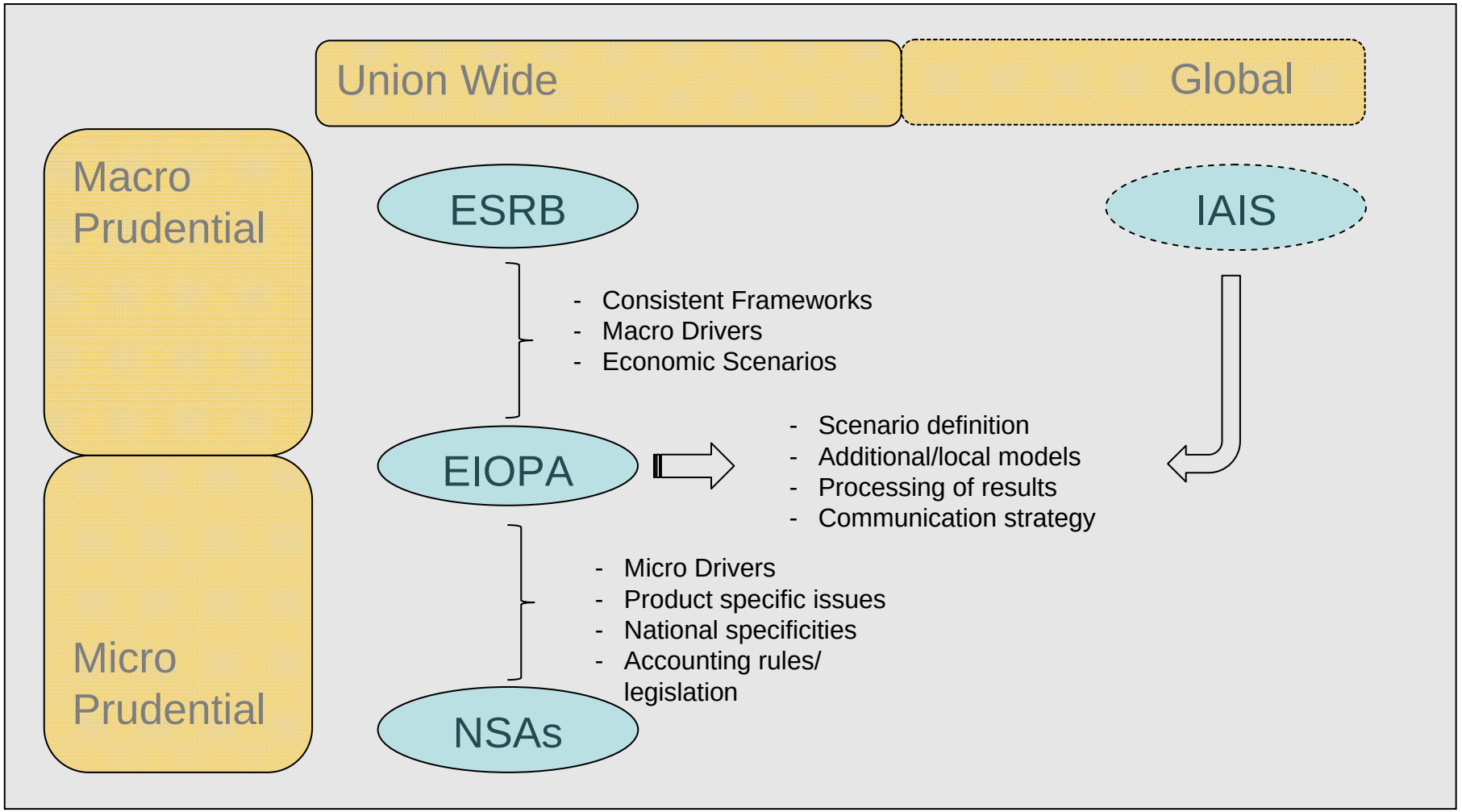
•90% of the groups/undertakings tested continue to comply with the Minimum Capital Requirements even in the most adverse scenario

Main vulnerabilities identified:

•Adverse developments in yield curves and sovereign bond markets

•Higher than expected rate of severe natural catastrophes combined with limited recourse to reinsurance facilities

# Framework considerations – Cooperation



# Framework considerations – Modeling aspects

- Some initial considerations:
  - Is a joint and consistent modeling framework needed – like a regulators version of Economic Scenario Generators know from corporate vendors?
  - Agreement on underlying drivers or simply on the framework as such?
  - How to translate fundamental drivers into consistent adverse frameworks for banking and insurance?
  - Will a joint framework lead to model risk – and does this call for local models?
  - Link between banking and insurance stress
- On the drawing board of the FS-area of EIOPA:
  - A simulation engine for financial asset returns and prices
  - Built on a no-arbitrage yield curve factor model
  - Pricing of other asset classes as spreads to the long-term yield
  - Multi currencies can be covered
  - Business-cycle interactions

# Framework considerations – Modeling aspects

In effect the general form of the transition equation can be written as:

$$X_t = c + A * X_{t-1} + e_t \tag{1}$$

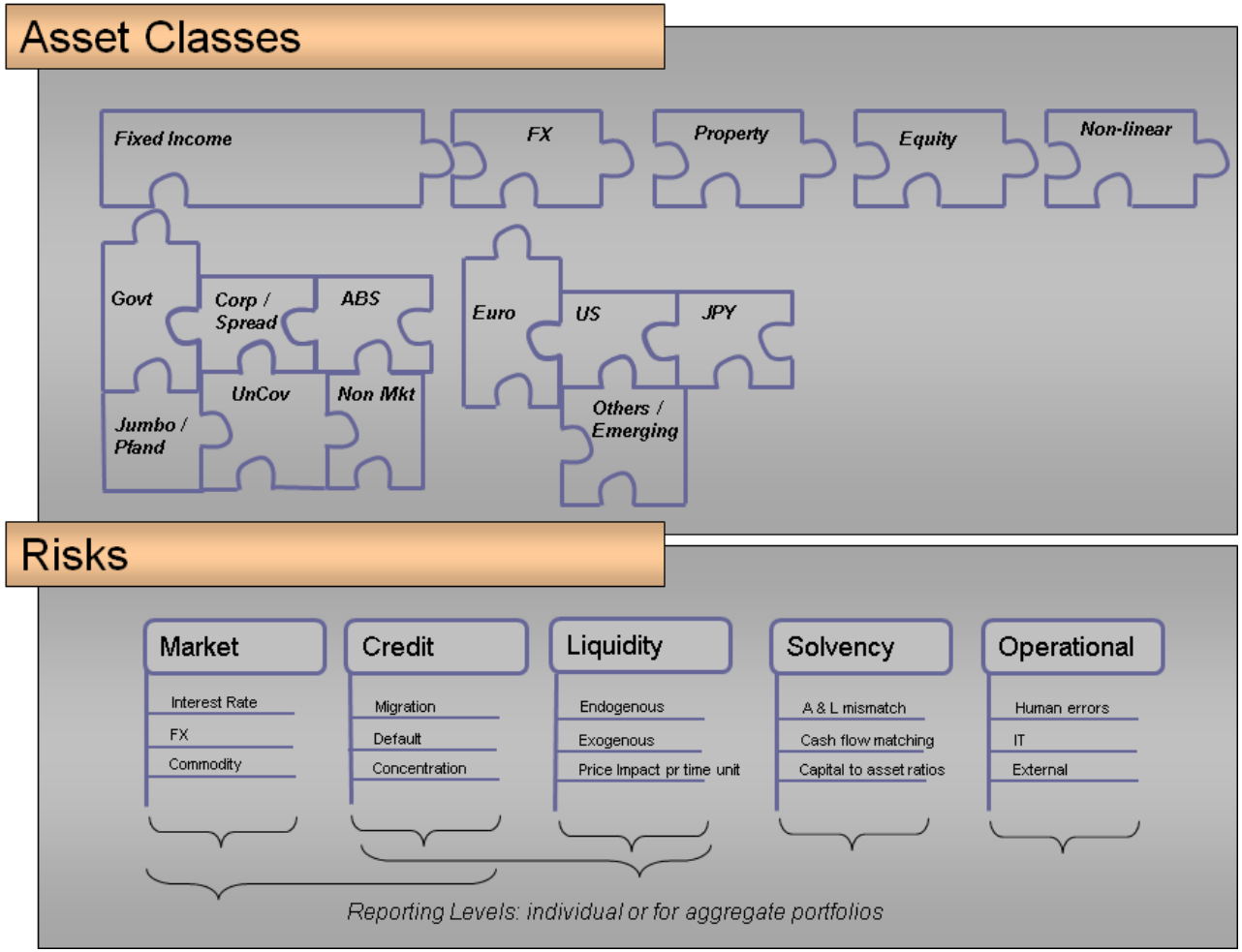
where $X$ stacks the relevant variables, i.e. $X_t = [gdp_t^j, cpi_t^j, \beta_t^j, \Gamma_t^j]$ for $j \in \{EUR, US, JPY, Other\}$, $e$ is the error term, $c$ is a vector of constants of dimension $N - by - 1$ and $A$ is a matrix of autoregressive parameters of dimension $N - by - N$, where $N$ denotes the number of variables. As-

Let $Z_t$ stack the relevant obsevation-equation variables, we can then write the system as:

$$Z_t = k + H * X_t + v_t, \tag{2}$$

where H is a block-composite matrix holding the relevant factor loadings that translate the underlying factors from the transition equation into observables.

# Framework considerations – Modeling aspects



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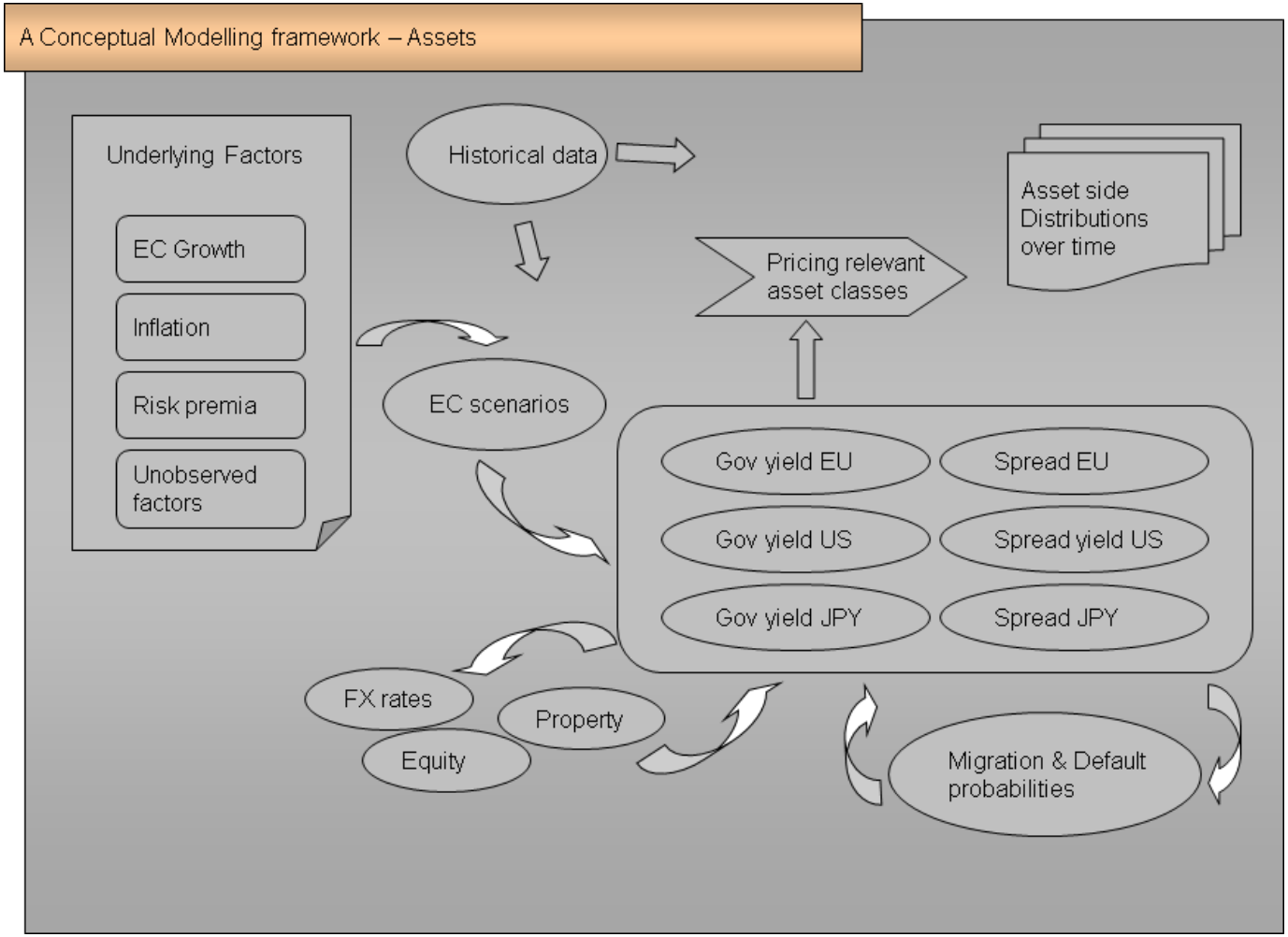

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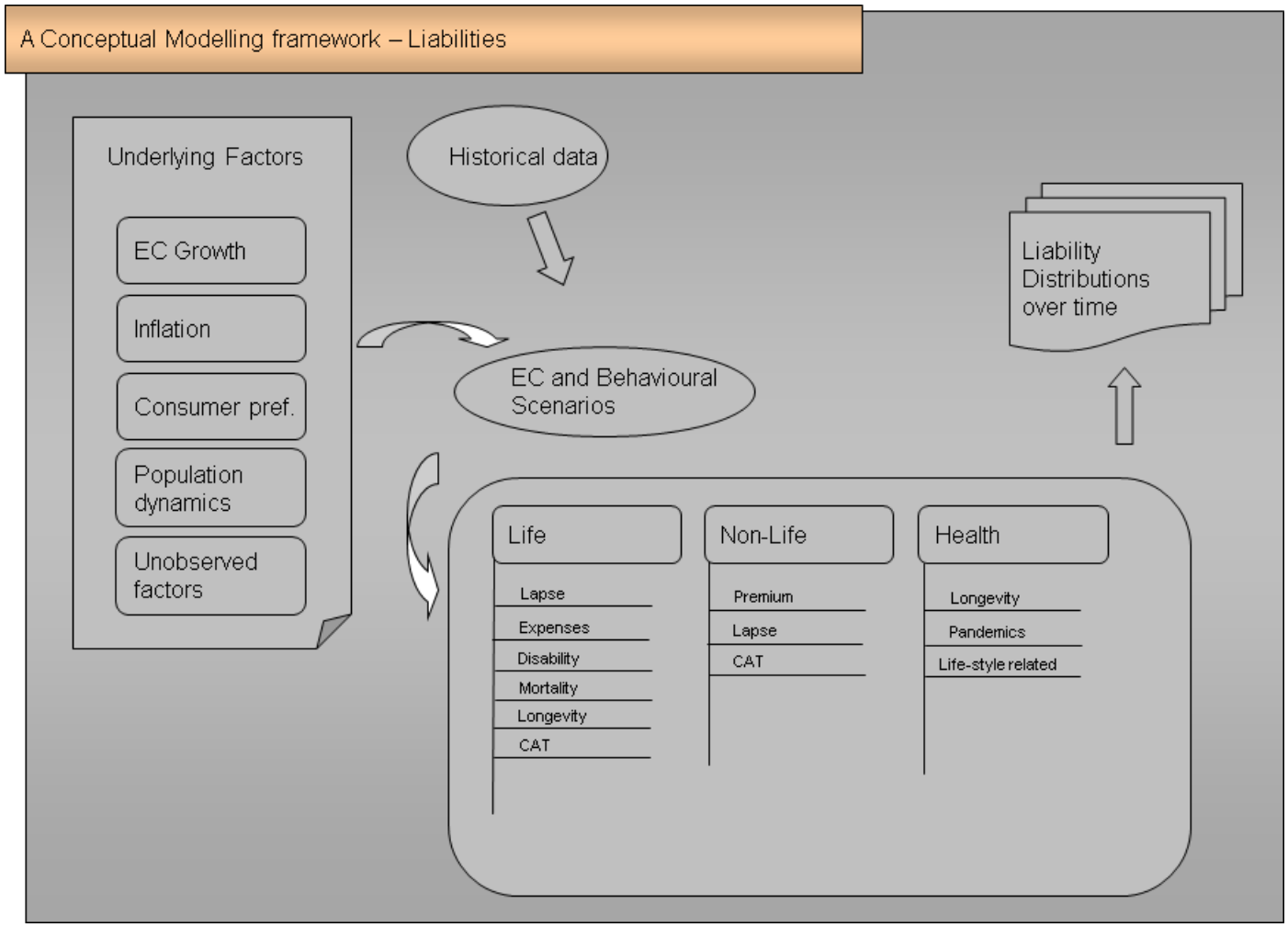

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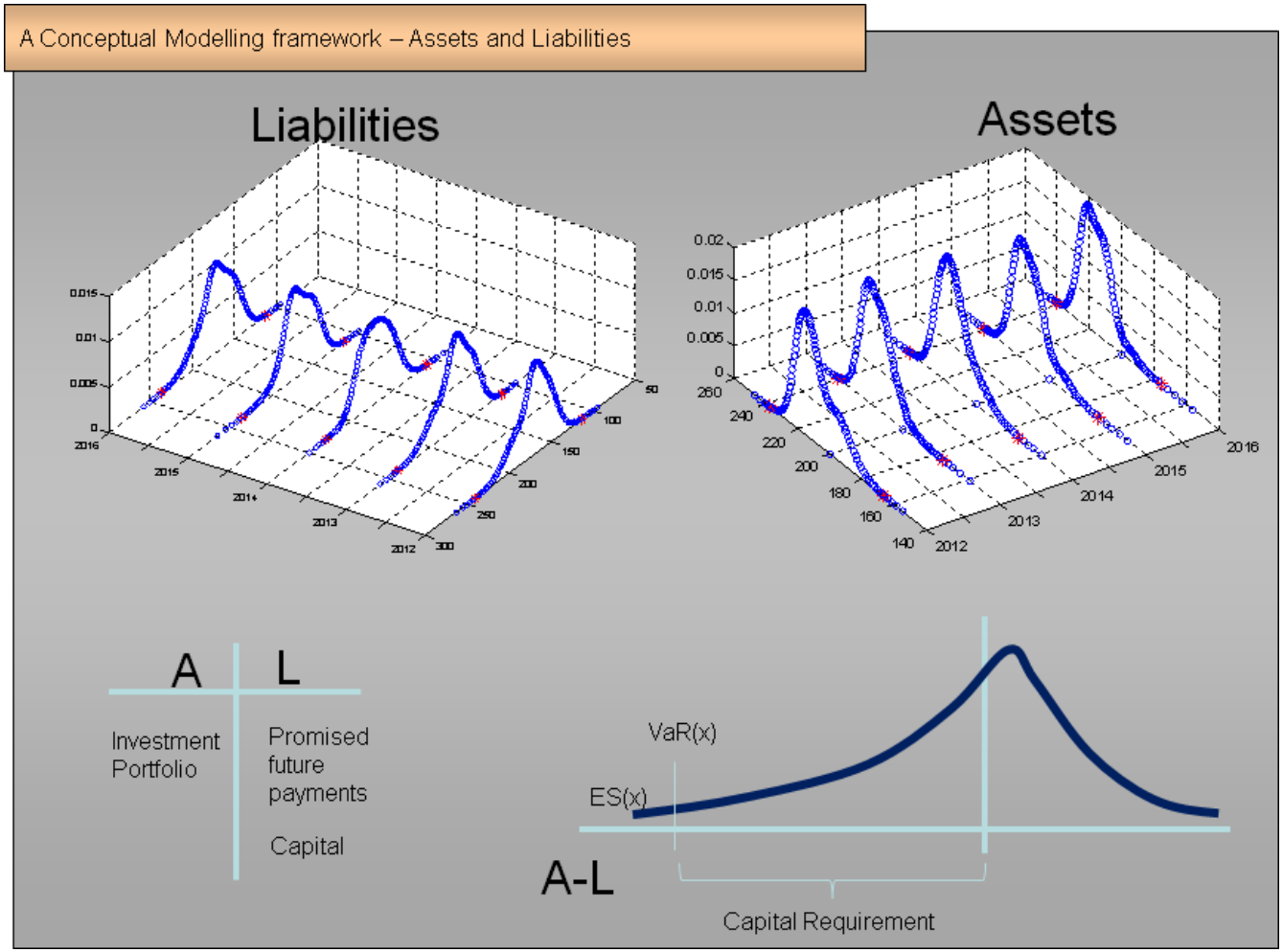

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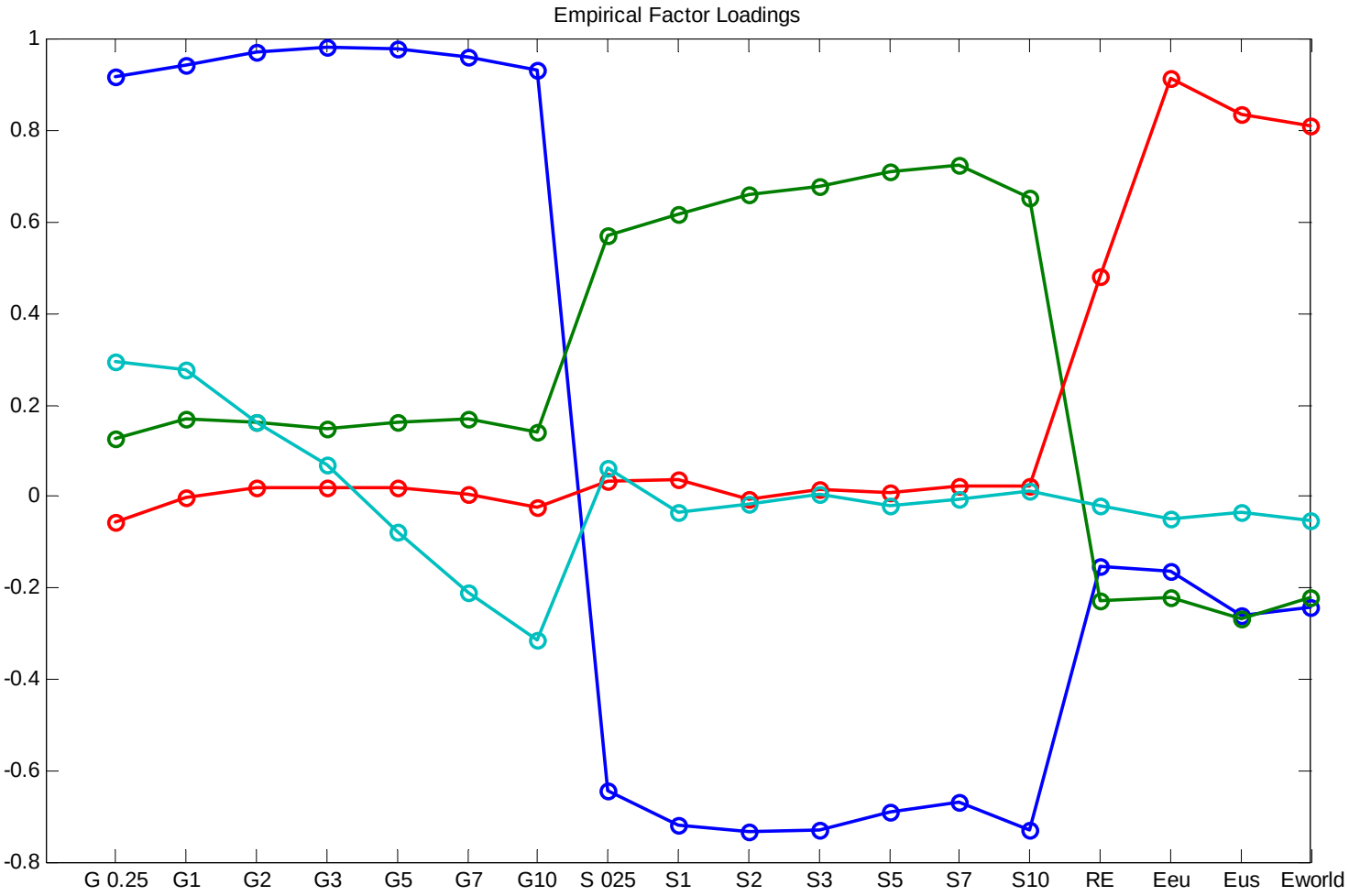
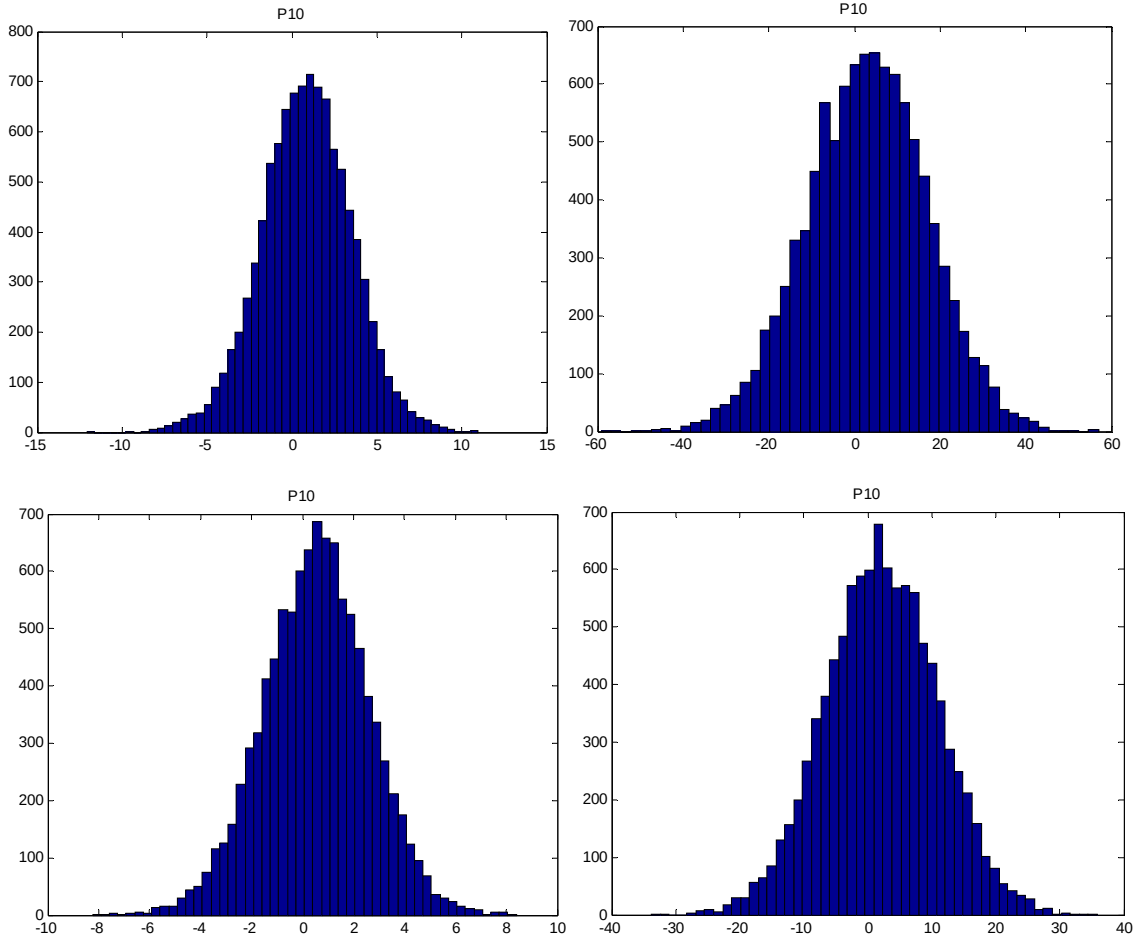


# Framework considerations – Modeling aspects

| Asset Class | P1 | P2 | P3 | P4 | P5 |
|---|---|---|---|---|---|
| y_g_0.25 | 0.05 | 0.15 | 0.15 | 0.00 | 0.00 |
| y_g_1 | 0.05 | 0.15 | 0.00 | 0.00 | 0.00 |
| y_g_2 | 0.05 | 0.15 | 0.00 | 0.00 | 0.00 |
| y_g_3 | 0.05 | 0.15 | 0.00 | 0.00 | 0.00 |
| y_g_5 | 0.05 | 0.15 | 0.00 | 0.00 | 0.00 |
| y_g_7 | 0.05 | 0.15 | 0.00 | 0.25 | 0.00 |
| y_g_10 | -1.00 | -1.00 | -1.00 | -1.00 | -1.00 |
| s_0.25 | 0.05 | 0.00 | 0.00 | 0.00 | 0.10 |
| s_1 | 0.05 | 0.00 | 0.20 | 0.10 | 0.15 |
| s_2 | 0.05 | 0.00 | 0.00 | 0.00 | 0.15 |
| s_3 | 0.05 | 0.00 | 0.00 | 0.00 | 0.15 |
| s_5 | 0.05 | 0.00 | 0.00 | 0.00 | 0.15 |
| s_7 | 0.05 | 0.00 | 0.00 | 0.25 | 0.15 |
| s_10 | 0.20 | 0.00 | 0.00 | 0.25 | 0.15 |
| property | 0.05 | 0.10 | 0.20 | 0.15 | 0.00 |
| r_eu | 0.05 | 0.00 | 0.20 | 0.00 | 0.00 |
| r_us | 0.05 | 0.00 | 0.20 | 0.00 | 0.00 |
| r_w_eur | 0.05 | 0.00 | 0.05 | 0.00 | 0.00 |

| | | | | | |
|---|---|---|---|---|---|
| Mean | 1.6 | 0.6 | 3.8 | 2.7 | 0.8 |
| VaR 99.5 | -10.3 | -10.4 | -26.3 | -6.7 | -6.4 |
| VaR 99.0 | -8.9 | -9.2 | -23.0 | -5.9 | -5.6 |
| VaR 95.0 | -5.8 | -6.1 | -14.7 | -3.1 | -3.5 |
| ES 99.5 | -11.7 | -12.1 | -30.8 | -7.9 | -7.5 |
| ES 99.0 | -10.6 | -10.9 | -27.6 | -7.1 | -6.7 |
| ES 95 | -7.8 | -8.0 | -19.9 | -4.7 | -4.8 |



# Summary

- A simulation based framework would allow for:
  - Consistent evolution of macro and financial variables in the design of stress test exercises
  - Back testing of bottom-up stress-test results
  - Comprehensive financial market modelling
  - Having a yard-stick to measure ad-hoc scenarios against
- Together with behavioral assumptions on the investment strategies of undertakings more interesting issues can be examined
- Consistency with other stress-tests can be ensured
  - Liability stresses at a certain confidence levels can be devised
  - Banking sector stresses in terms of drivers and confidence levels
- Common understand of stress-testing could be facilitated

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# Thank You.

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