

Stress & Reverse Stress from a Macro Viewpoint

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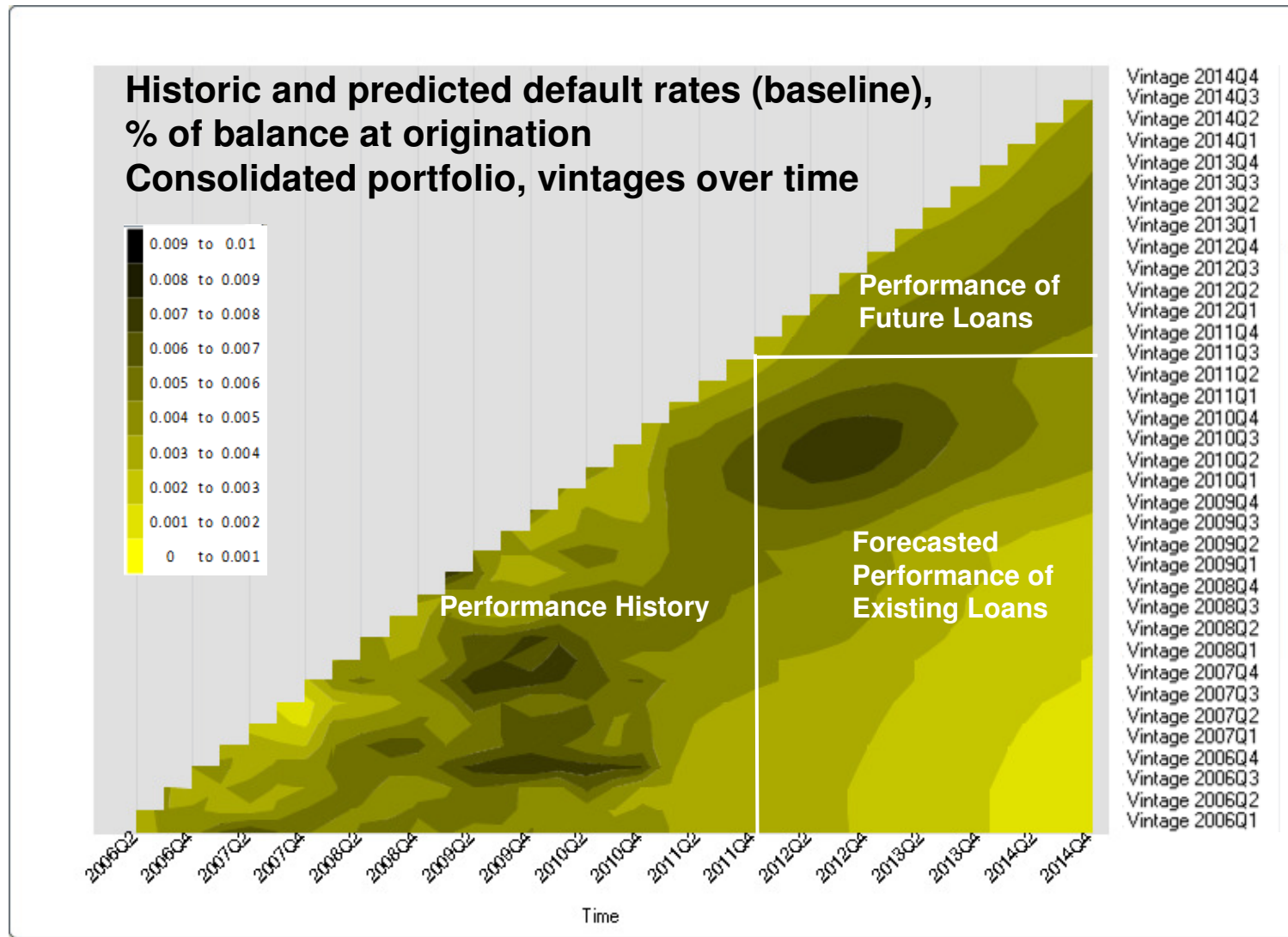
Head of Economic & Credit Analytics - EMEA

Stress & Reverse Stress Testing from a Macro Viewpoint

Key Stress Testing Challenges:

- 1- Dynamic vs. Static Approach to Stress Testing,
- 2- Partial vs. General Equilibrium,
- 3- Top-down vs. Bottom-up,
- 4- Modelling Methodologies: Stress Testing vs. Forecasting/Scoring,
- 5- Quantitative Reverse Stress Testing,
- 6- Looking beyond Capital & Solvency.

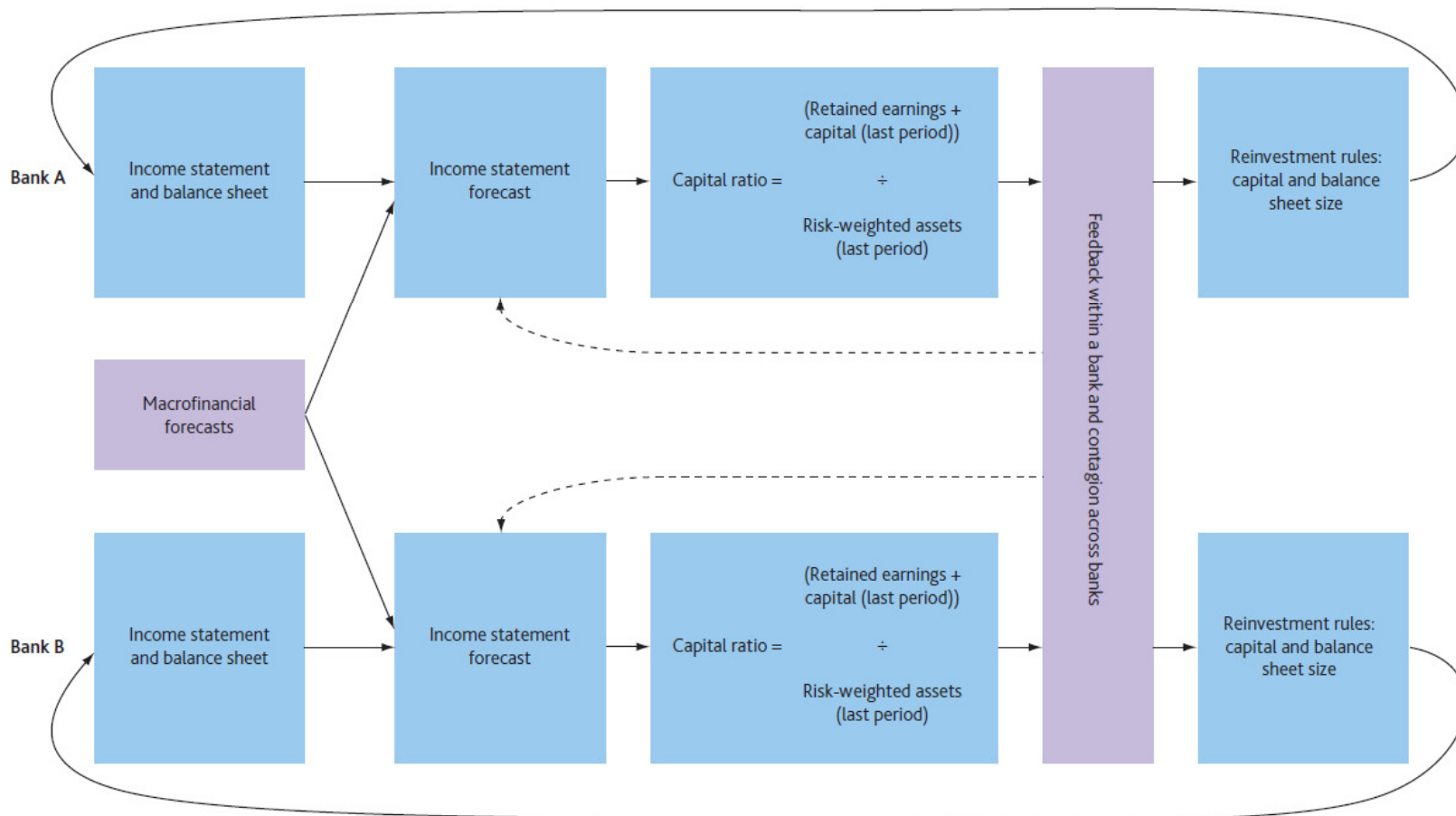
Stress Testing: 1- Dynamic vs. Static Approach



Stress Testing: 2- Partial vs. General Equilibrium

Example of top-down stress testing approach, Bank of England's RAMSI model

Figure 1 Stylised overview of RAMSI



Stress Testing: 2- Partial vs. General Equilibrium

Examples of collateral type for RMBS/ABS deals

Illustrative

RMBS

- » Mortgage rate difference from origination
- » Unemployment rate
- » Employment growth
- » Income growth
- » House price growth
- » Home equity

Auto-Equipment Loan/Lease

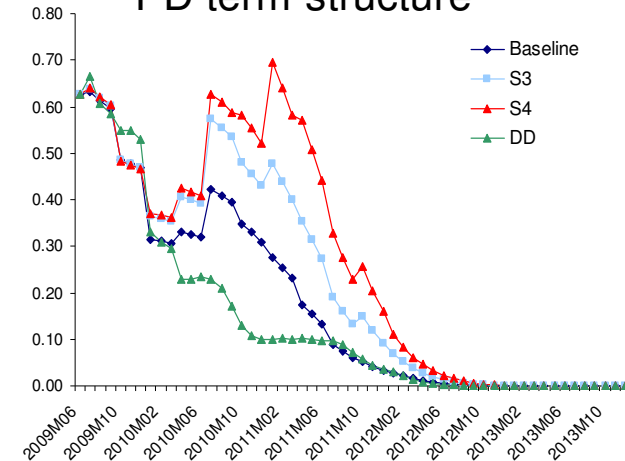
- » Interest rates
- » Unemployment rate
- » Commodity/oil prices
- » Price index for used cars

Small Business Loans

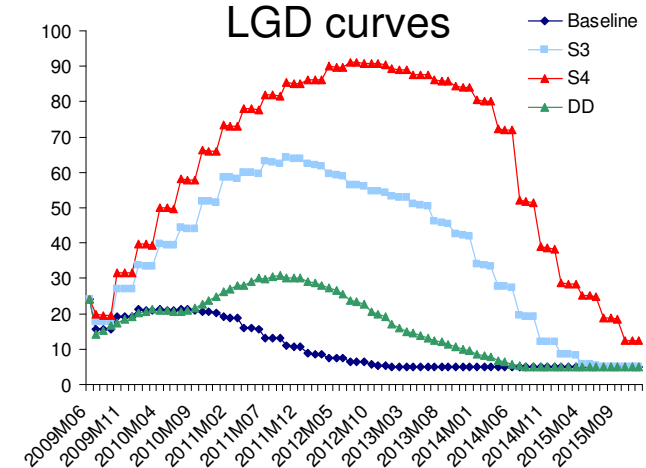
- » Interest rates
- » Unemployment rates
- » Income growth
- » Profits (National Accounts)
- » Share market



PD term-structure



LGD curves



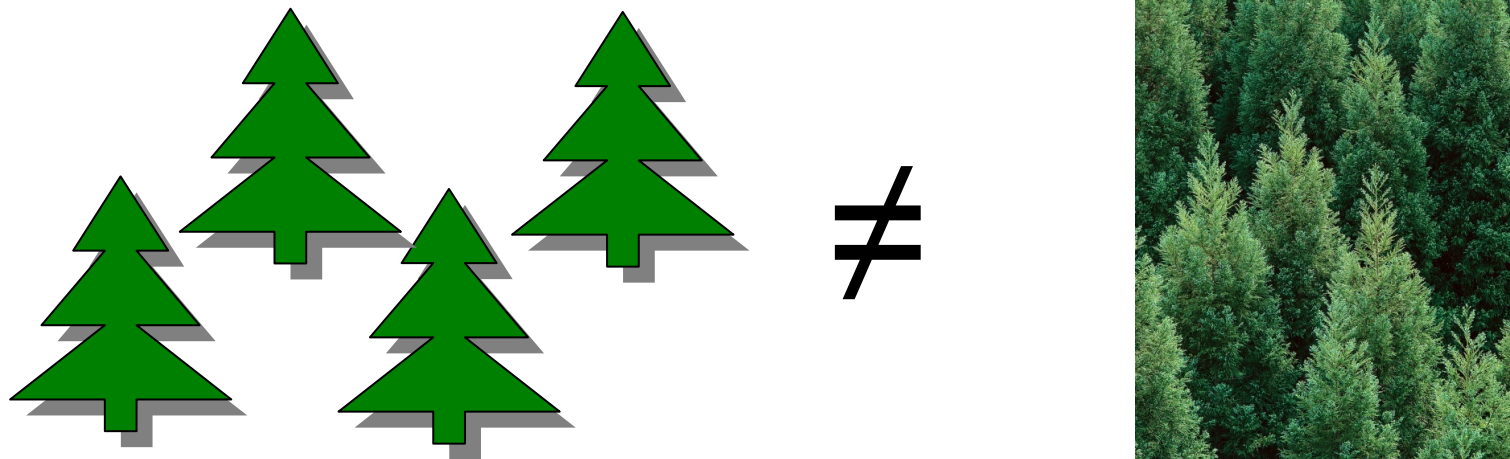
Stress Testing: 3- Top-down vs. Bottom-up

Issue: Loan level model can miss correlations and feedback effects

- » Individual performance depends on other loans
- » Difficult to model individuals within a system

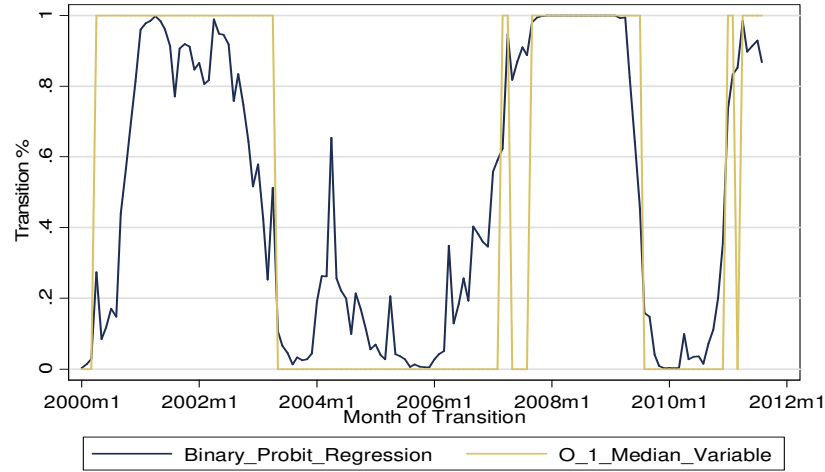
Risk models could miss the forest for the trees

- Why not model the forest, model the trees and then make sure the tree model agrees with forest projections?

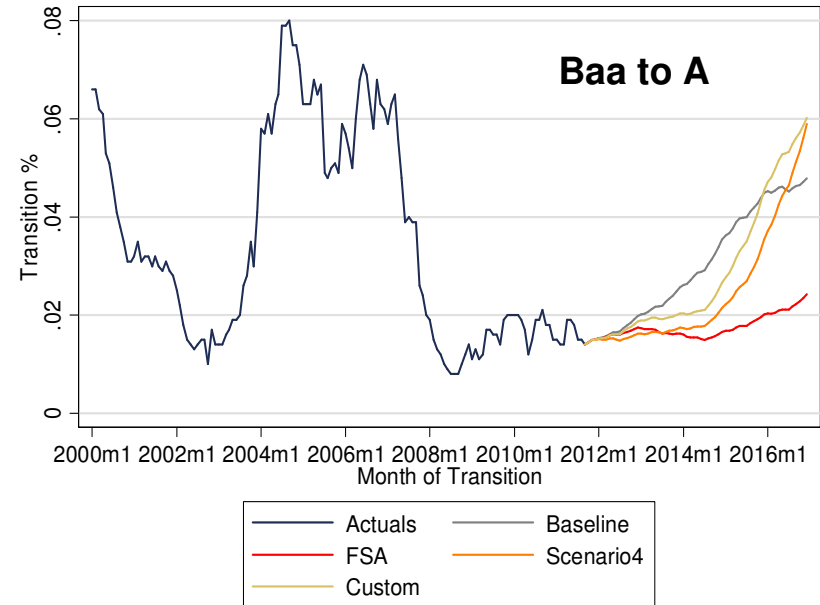
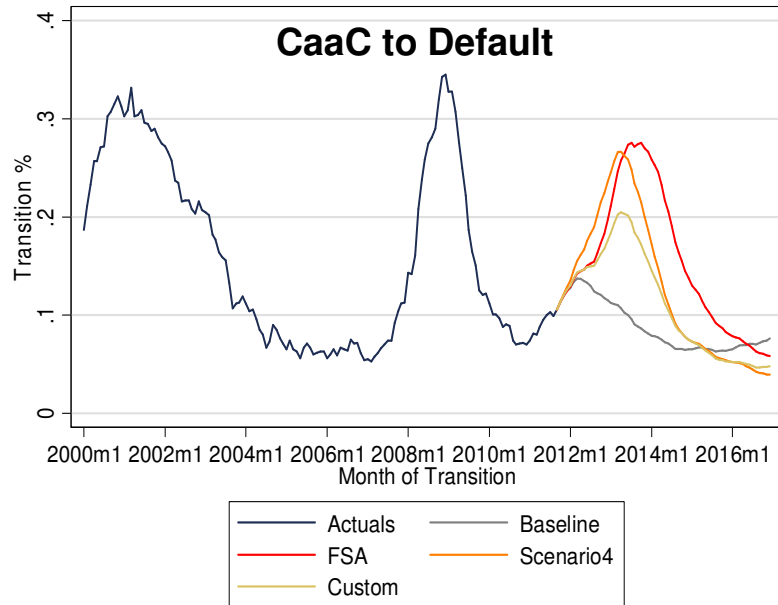
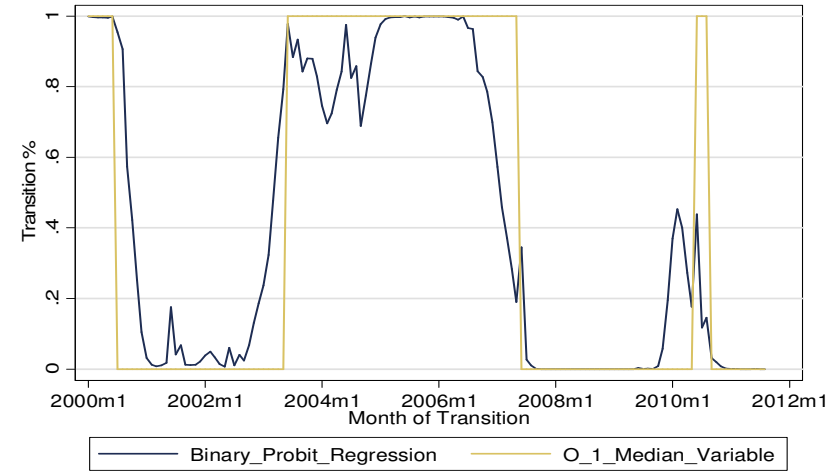


Stress Testing: 4- Modelling Methodologies

Binary (Probit) Model Downgrade

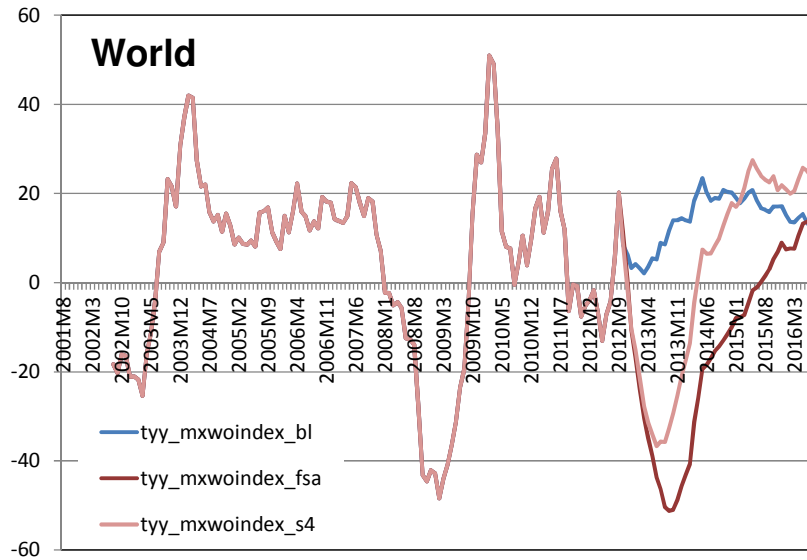


Binary (Probit) Model Upgrade

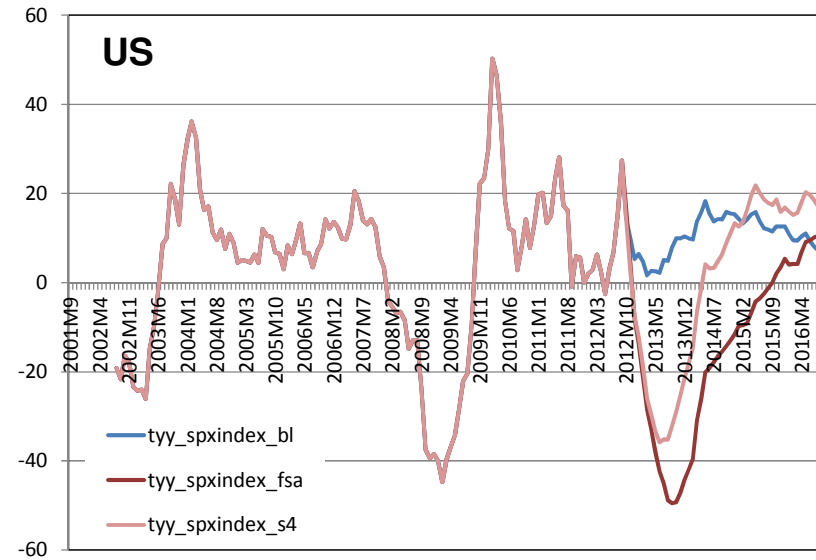


Stress Testing: 4- Modelling Methodologies

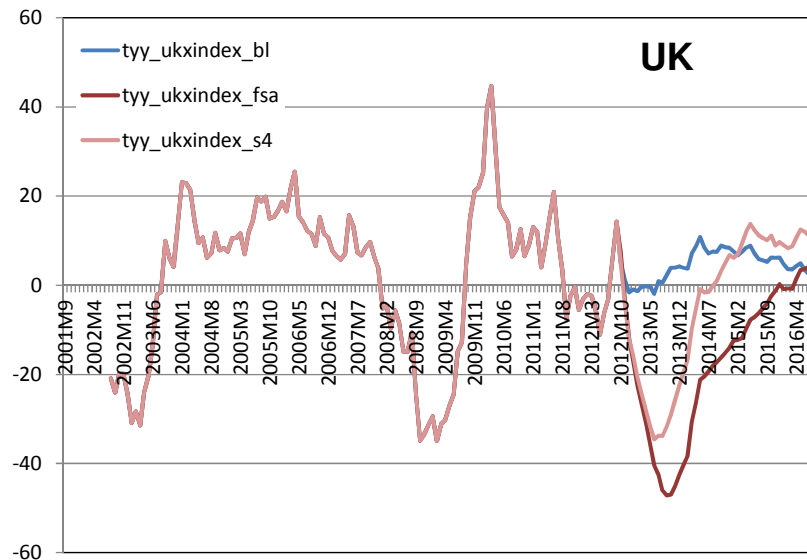
Equity Forecasts, Annual Returns



Equity Forecasts, Annual Returns



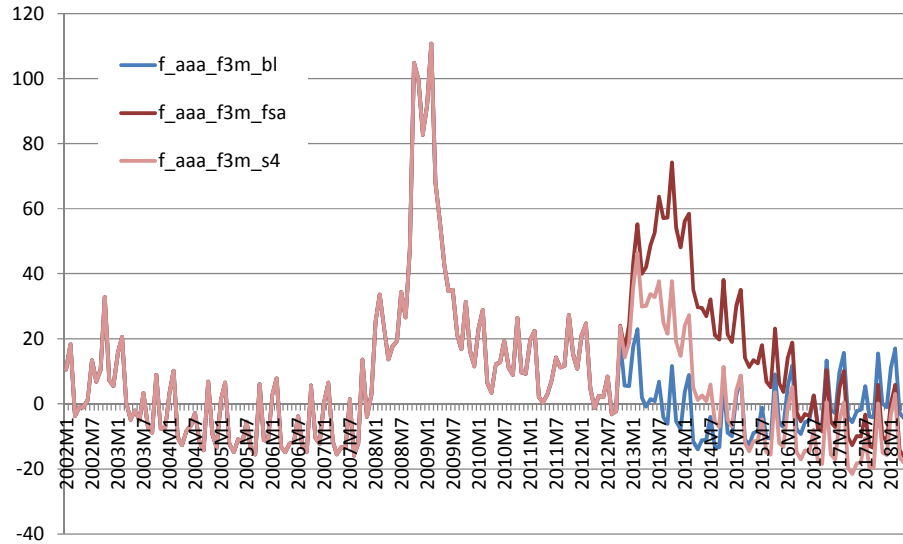
Equity Forecasts, Annual Returns



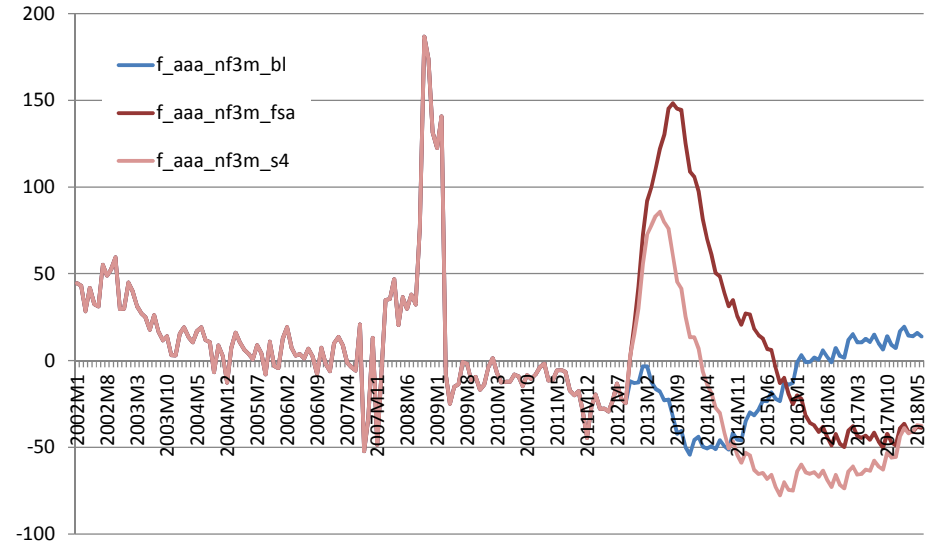
Equity Indexes, annual growth rate
History and forecasts

Stress Testing: 4- Modelling Methodologies

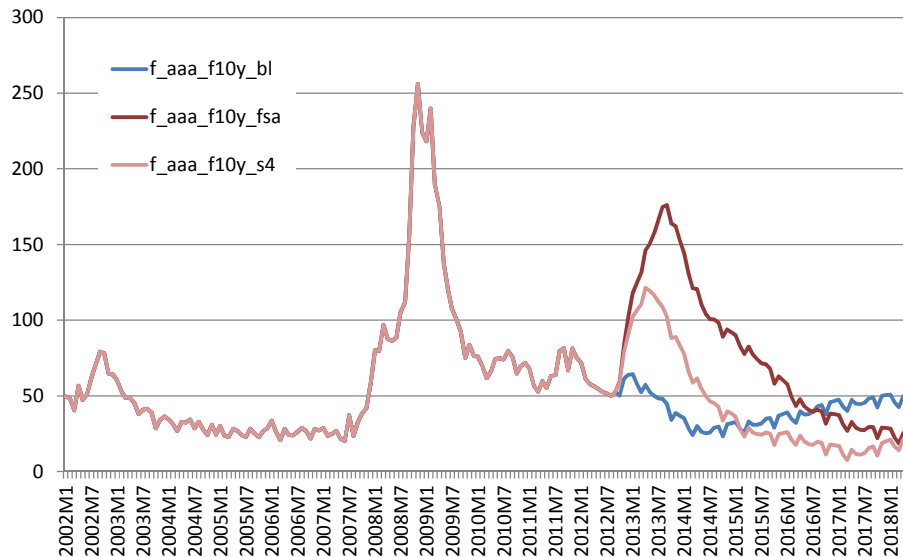
Corporate Spread, Aaa Financials, 03m



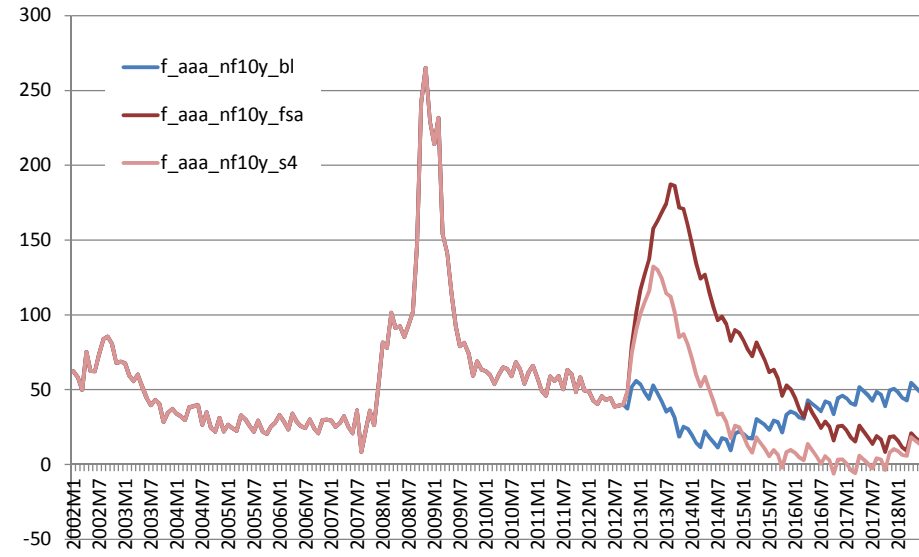
Corporate Spread, Aaa Non-Financials, 03m



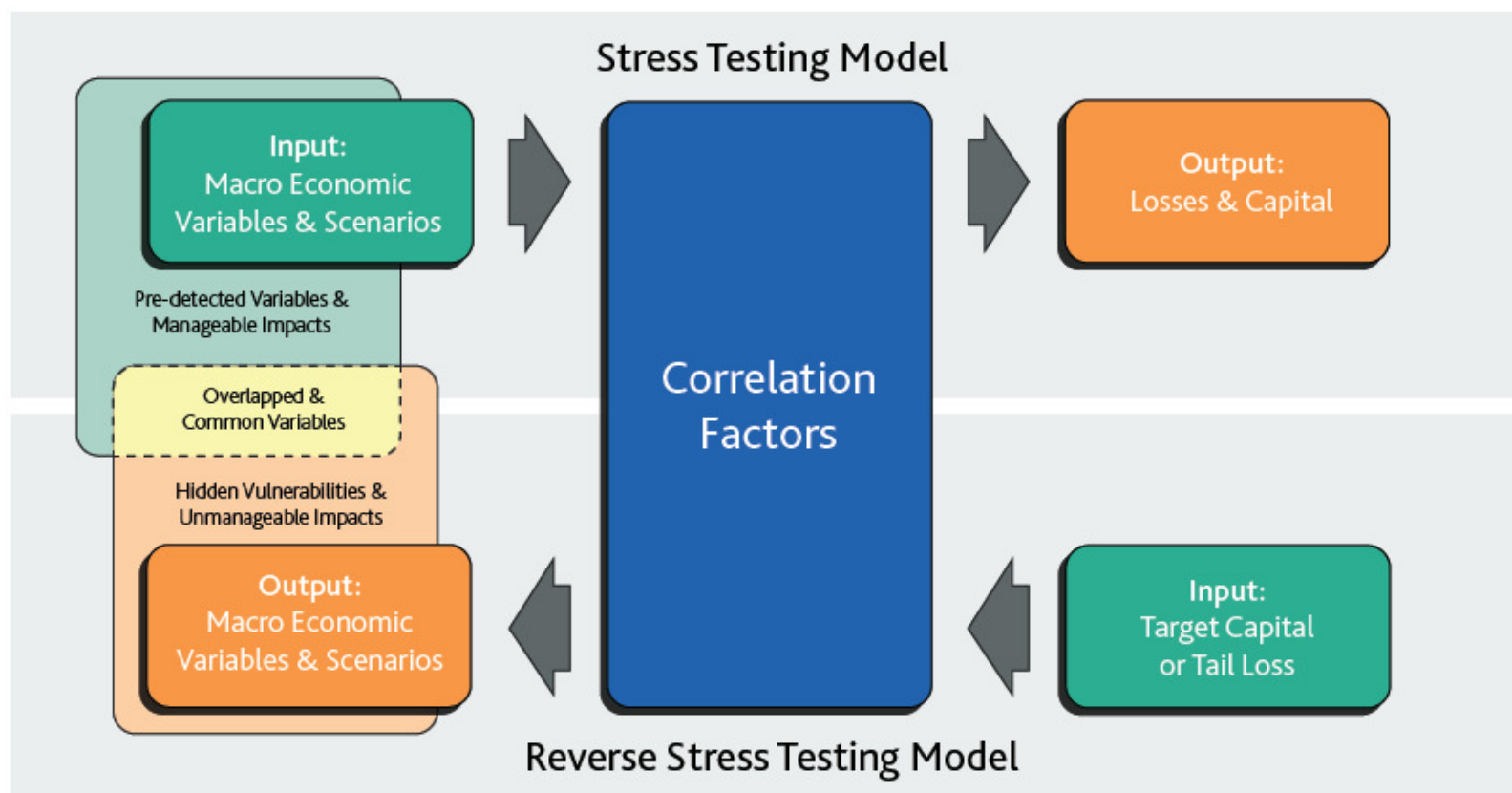
Corporate Spread, Aaa Financials, 10y



Corporate Spread, Aaa Non-Financials, 10y

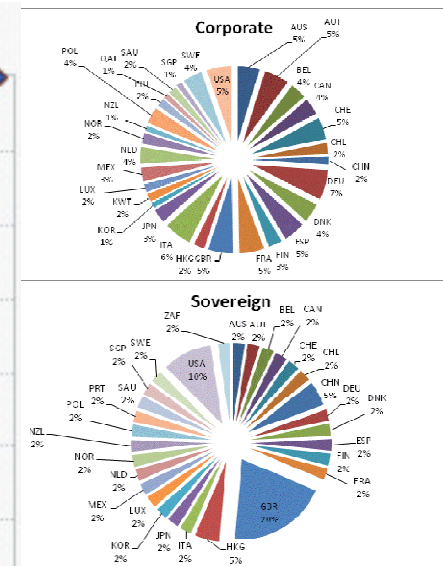
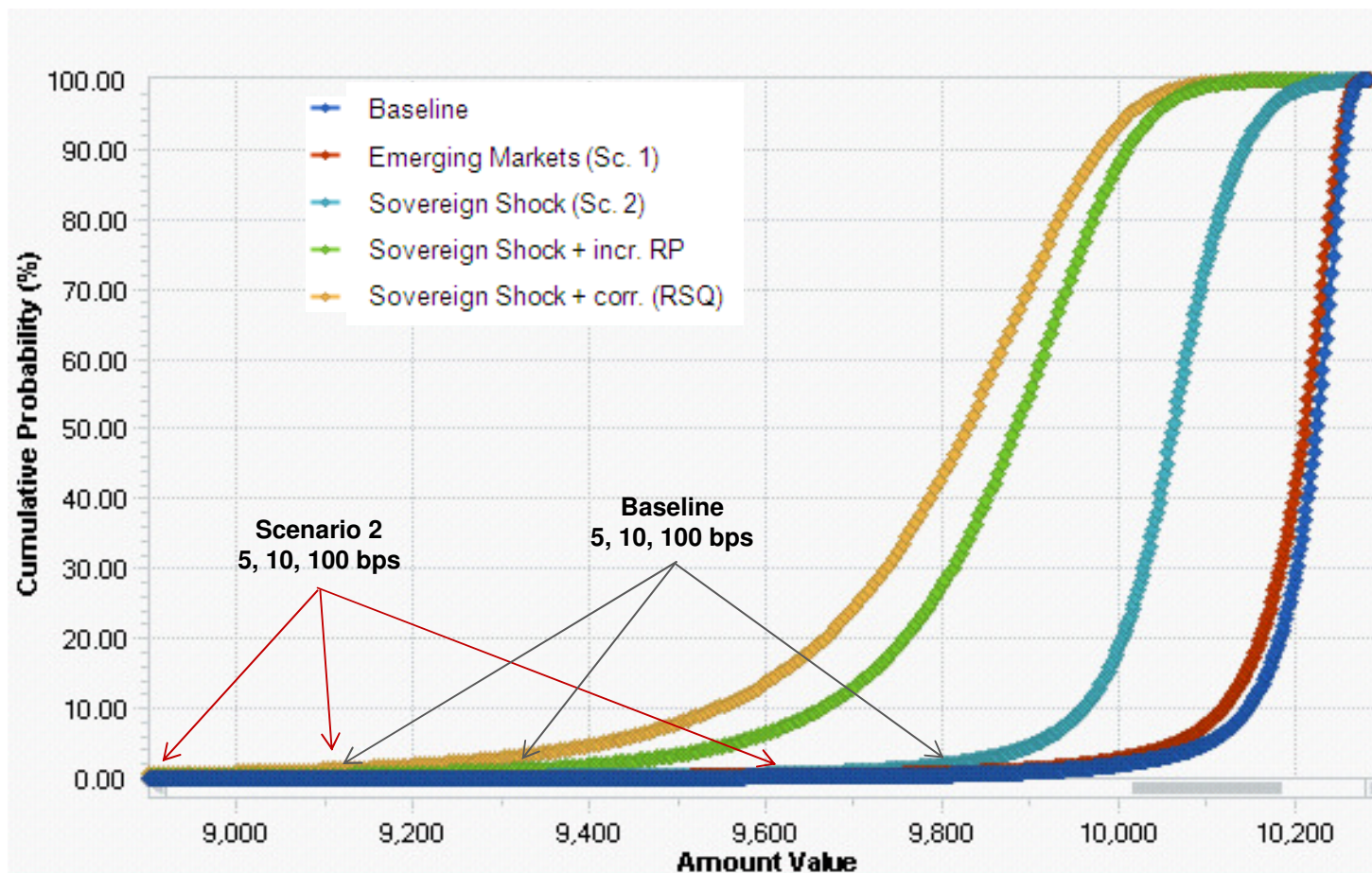


Stress Testing: 5- Reverse Stress Testing



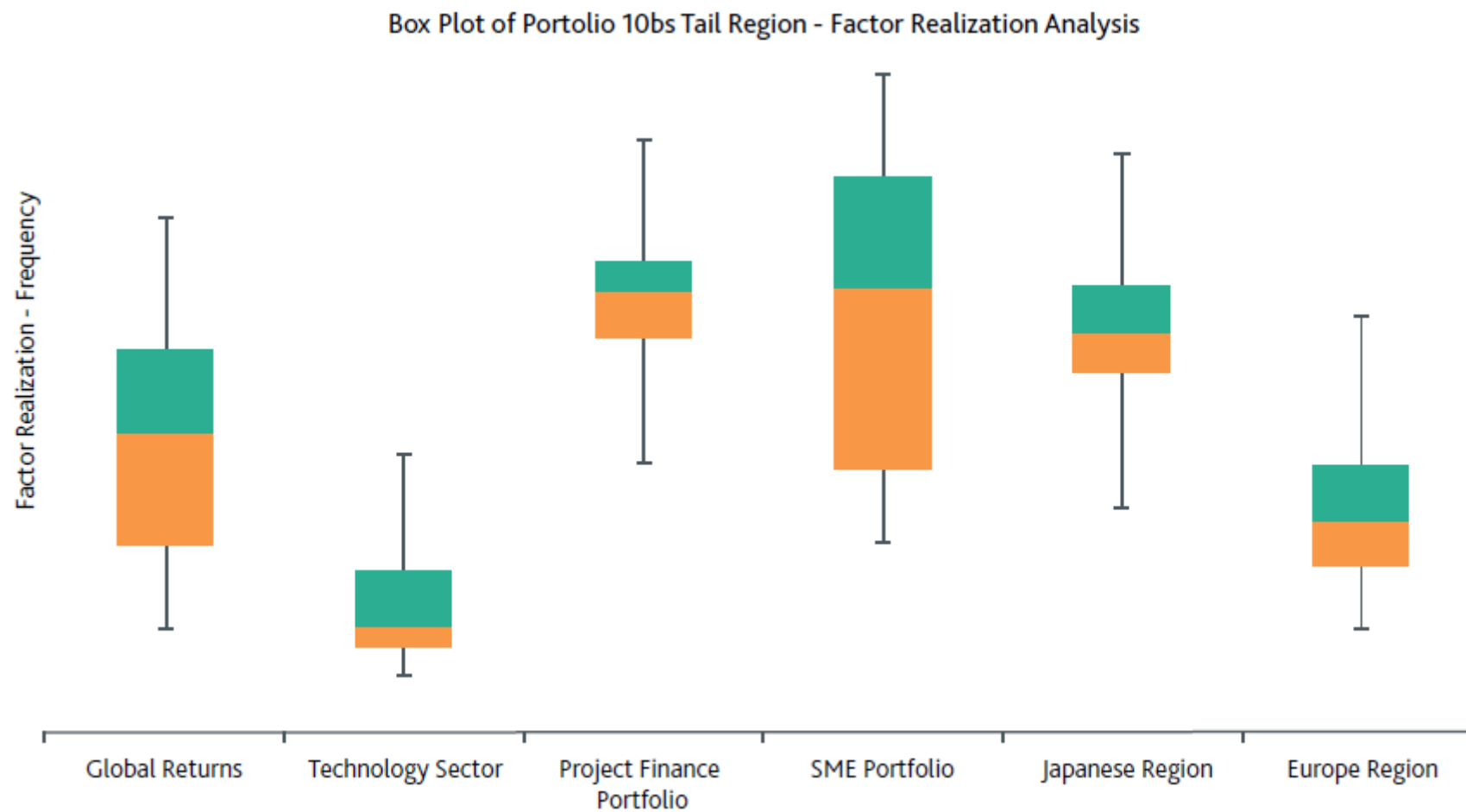
Stress Testing: 5- Reverse Stress Testing

Portfolio Expected Values – Defining Severity



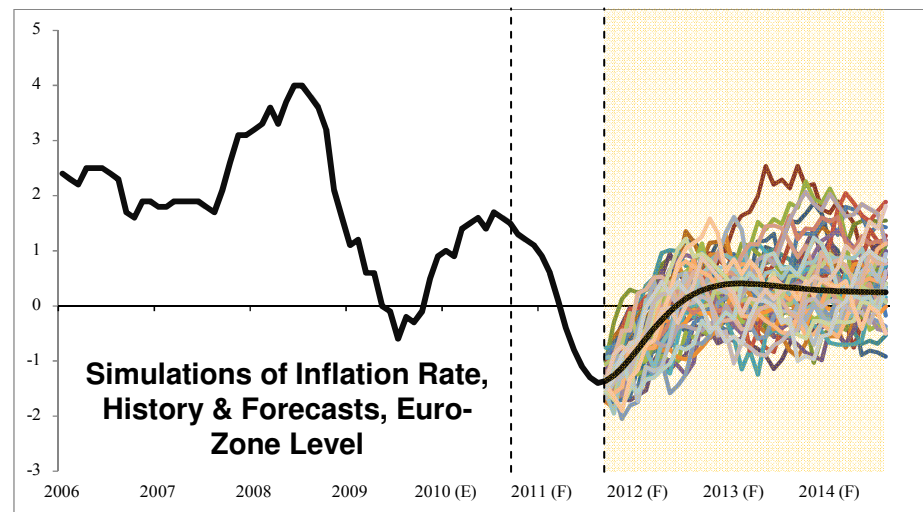
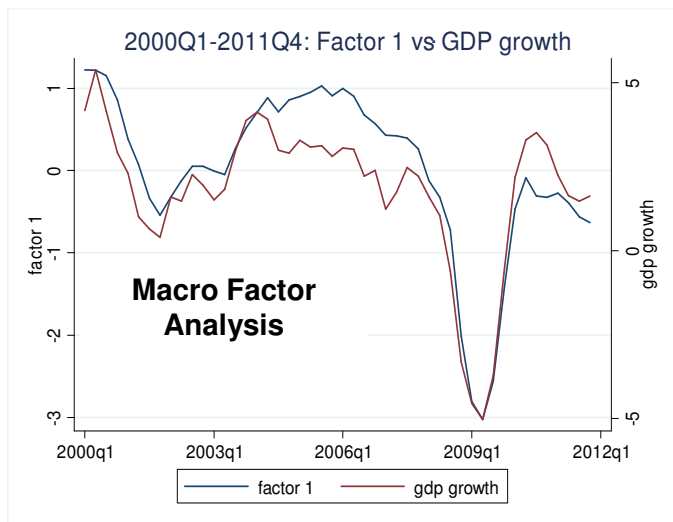
Stress Testing: 5- Reverse Stress Testing

Analyzing Factors' Realizations Across Tail Events

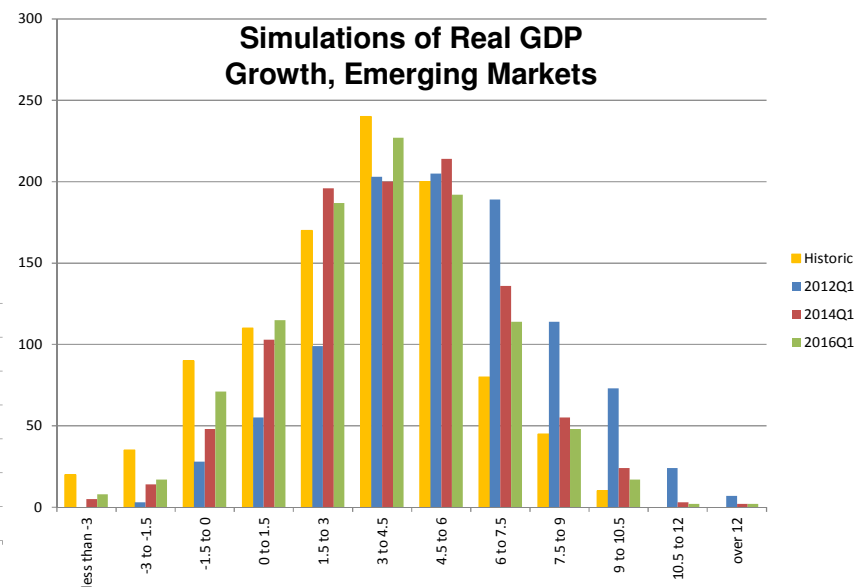
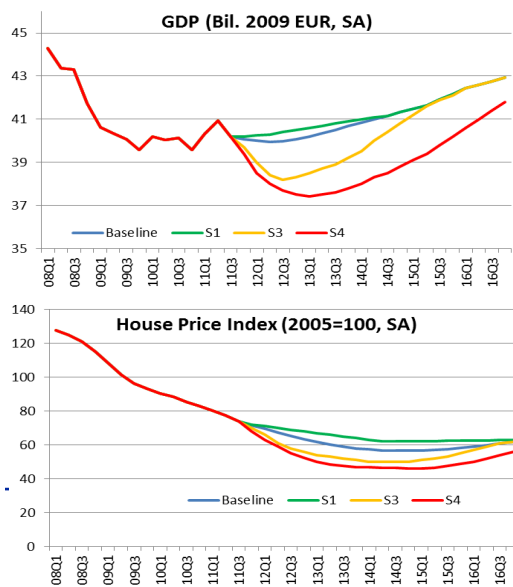
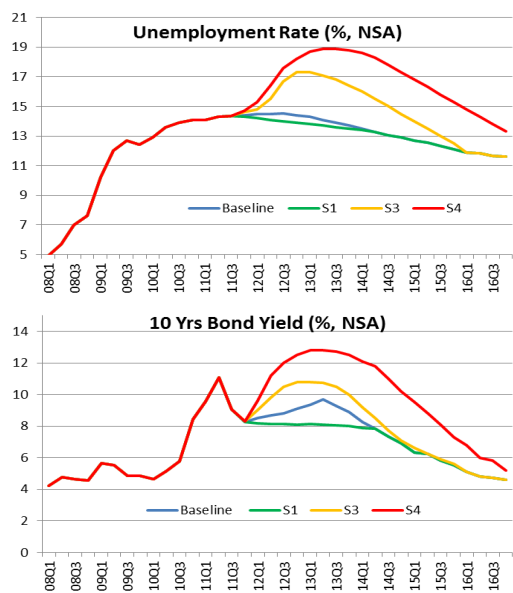


Stress Testing: 5- Reverse Stress Testing

Linking Factors' Realizations to Macro Scenarios



Standard Alternative Scenarios



Stress Testing: 5- Reverse Stress Testing

Linking Factors' Realizations to Macro Scenarios

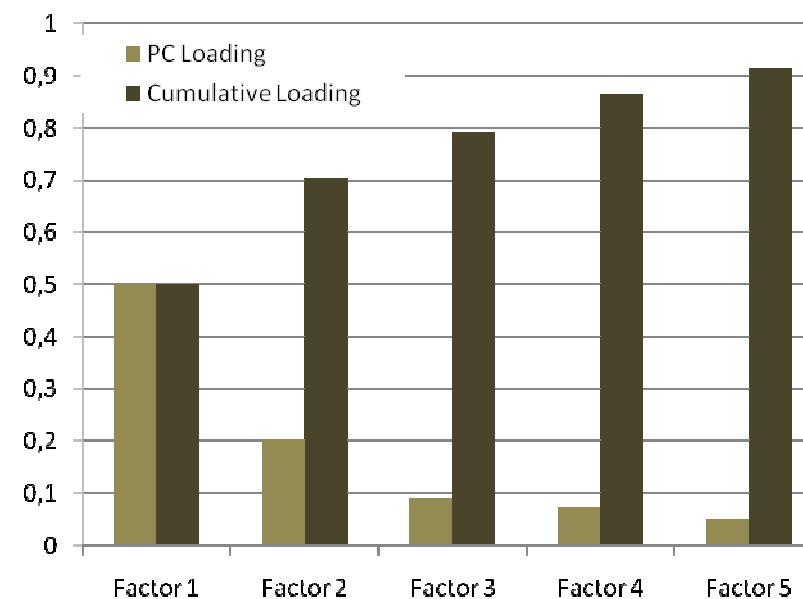
UK factor analysis – 21 macroeconomic series

Factor analysis/correlation Number of obs = 48
 Method: principal factors Retained factors = 14
 Rotation: (unrotated) Number of params = 203

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	9.58311	5.68839	0.4995	0.4995
Factor2	3.89472	2.17554	0.2030	0.7025
Factor3	1.71918	0.32750	0.0896	0.7921
Factor4	1.39168	0.42675	0.0725	0.8646
Factor5	0.96493	0.34703	0.0503	0.9149
Factor6	0.61790	0.18001	0.0322	0.9471
Factor7	0.43789	0.15421	0.0228	0.9700
Factor8	0.28368	0.07129	0.0148	0.9847
Factor9	0.21239	0.06647	0.0111	0.9958
Factor10	0.14592	0.08320	0.0076	1.0034
Factor11	0.06272	0.02724	0.0033	1.0067
Factor12	0.03548	0.01399	0.0018	1.0085
Factor13	0.02149	0.01927	0.0011	1.0097
Factor14	0.00222	0.00844	0.0001	1.0098
Factor15	-0.00622	0.00523	-0.0003	1.0095
Factor16	-0.01145	0.00397	-0.0006	1.0089
Factor17	-0.01542	0.00627	-0.0008	1.0081
Factor18	-0.02169	0.00980	-0.0011	1.0069
Factor19	-0.03149	0.01253	-0.0016	1.0053
Factor20	-0.04402	0.01326	-0.0023	1.0030
Factor21	-0.05728	.	-0.0030	1.0000

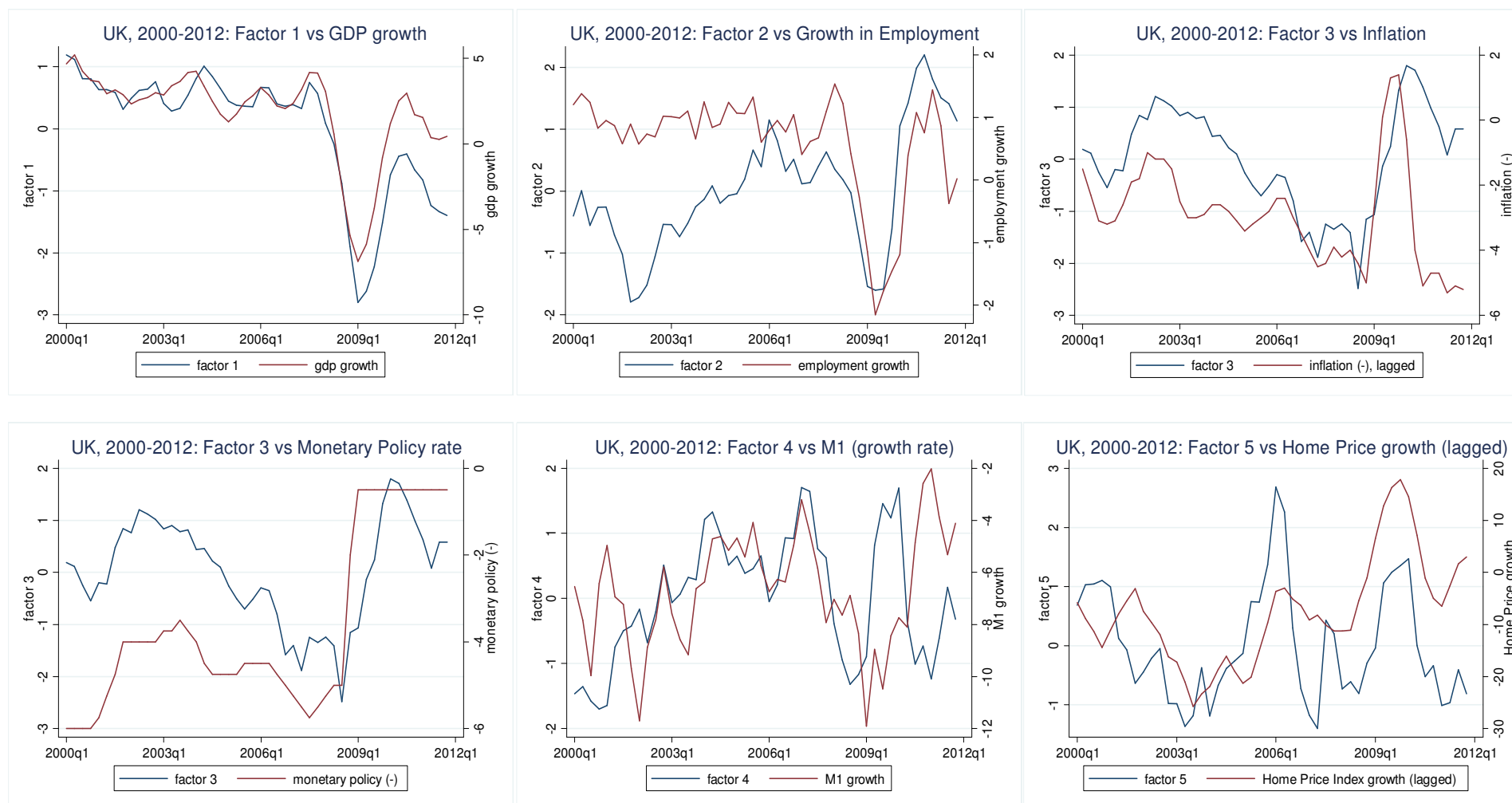
LR test: independent vs. saturated: $\chi^2(210) = 1443.70$ Prob> $\chi^2 = 0.0000$

UK Factor Analysis – Top 5 Factors



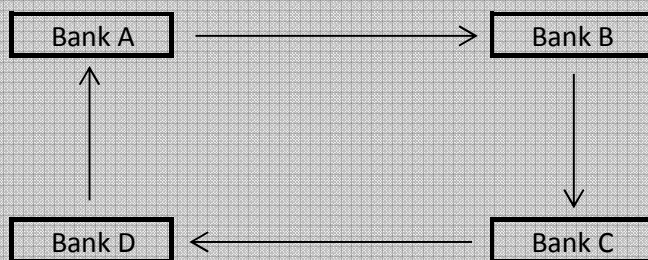
Stress Testing: 5- Reverse Stress Testing

Linking Factors' Realizations to Macro Scenarios, UK Top Factors

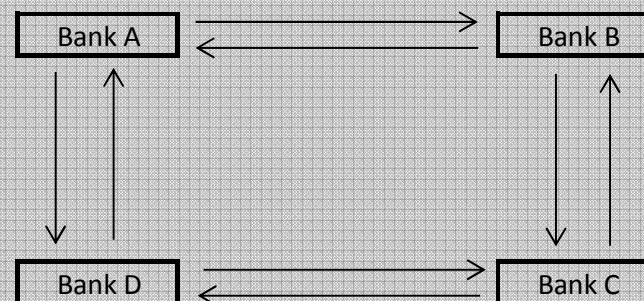


Stress Testing: 6- Looking beyond Capital & Solvency

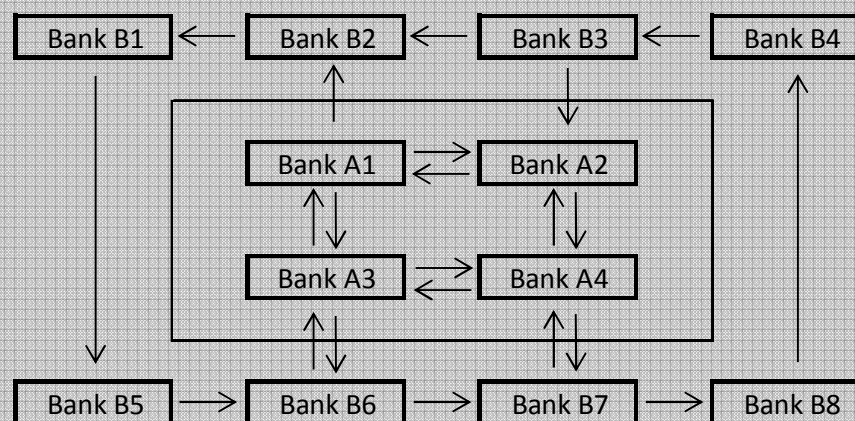
Case 1: Incomplete Markets



Case 2: Complete Markets



Case 3: A Hybrid Market Structure

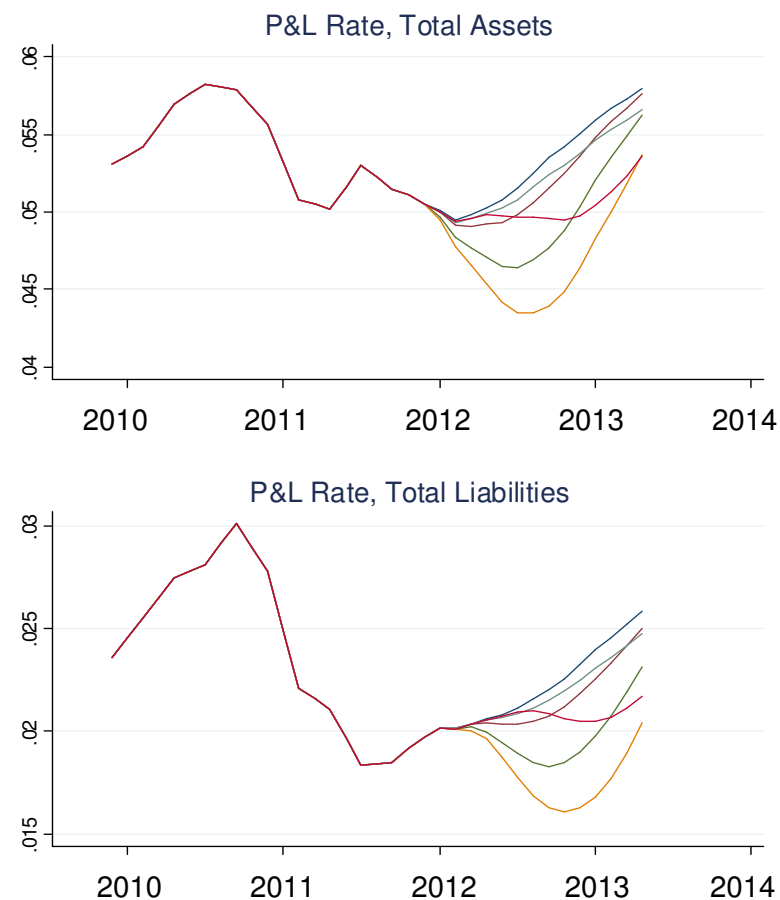


Stress Testing: 6- Looking beyond Capital & Solvency

(1) If a **small institution fails**, other peripheral banks are likely to suffer asset-liability mismatches. But the systemic risk involved is not as high. Large institutions should be able to absorb the original shock and stop the domino effects once it enters the core banking area.

(2) If the shock is to one of the **large financial institutions**, there is a secondary effect through the overall health of the financial economy that could put all institutions under tremendous pressure.

Though the core banking sub-sector is complete (bi-directional flows), the fact that it is highly concentrated poses severe challenges to the banking sector as a whole. It is not so much a direct domino effect between, say, Bank A1 and Bank A2, but an **indirect contagion risk**: (2.a) Bank A1 affects the overall economy (as it is a big financial institution whose failure can put pressure on the local financial and labor markets), (2.b) the economy affects Bank A2 as an external shock, (2.c) Bank A2's failure worsens the economic picture even more, (2.d) the economy affects Bank A3, etc.



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