

Integrating **Stress Tests** and **Scenario Analysis** for **Strategic Management** of a **Financial Institution**

**The comments expressed here are those of the authors and do not necessarily represent the view of DEXIA Group*

Integrating **Stress Tests** and **Scenario Analysis** for **Strategic Management** of a **Financial Institution**

João Garcia*

Head of Quantitative Credit and
Correlation Modelling Team
Treasury and Financial Markets

Dexia Group

London - Dec 4th 2006

**The comments expressed here are those of the authors and do not necessarily represent the view of DEXIA Group*

Capital: Regulatory versus Economic I

- **EC** is ...

The amount of capital supposed to be set aside in order to prevent the net asset value of a company to fall below a certain level that would prevent the normal operation of a company.

- **RC** is ...

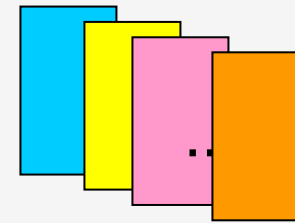
The minimum amount of capital a financial institution is supposed to set aside required by **regulators**.

RC (Basel II) Paradigm...

- Portfolio Independence:
 - The RC of position does **not** depend on the portfolio
- Additivity:
 - Assume a Portfolio with n positions

RC_i : Regulatory Capital for position i

Portfolio Total RC : $RC_{Port} = \sum_{i=1}^n RC_i$



n Positions
 A, B, \dots, X

Model Used: **Factor Analyses**

$$Y = \beta X_M + \alpha X_\epsilon$$

1 Factor represents the **whole Market** ...
... and determines the **Correlation**

Regulators used a **general portfolio** to come up with important parameters in the formulas

EC : a Correlation Paradigm

Return of the underlying asset:

Determines correlation with the **Market**

$$Y = \beta X_M + \alpha X_\epsilon$$

Idiosyncratic Factor

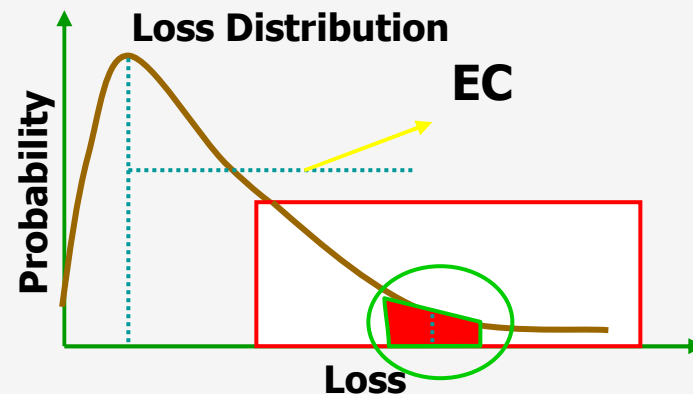
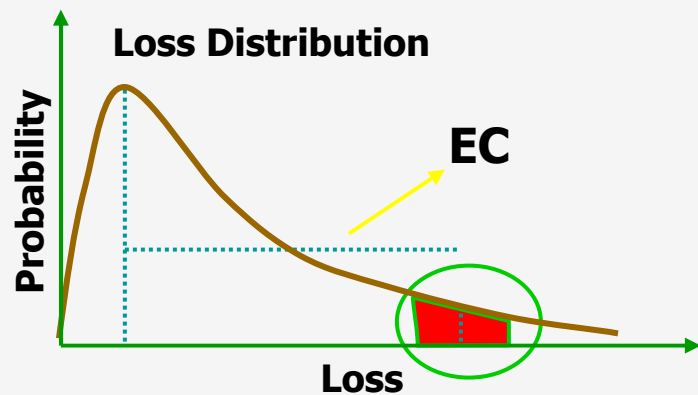
Independent
of the Market

Systematic Factors (the Market)

Correlation

Industry or **Sector**

Country or **Region**



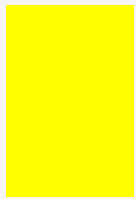
Correlation

Significant Impact
on the Tails

EC

EC Allocation: Coherent Risk Measures

A desirable property of a measure of risk (R) is that it is **Coherent** [3]:



A



B

Monotonicity: If $\text{Loss}(A) < \text{Loss}(B)$ then $R(A) < R(B)$

Homogeneity: If $R(A) = R(A)$ then $R(\lambda A) = \lambda R(A)$

Subadditivity: $R(A+B) \leq R(A) + R(B)$

Two very common used Risk measures are:

CVaR (Credit VaR):

$$CVaR(\alpha, L) = \inf \{x \geq 0 \mid P[X \leq x] \geq \alpha\}$$

→ **Not Subadditive**

ES (Expected Shortfall):

$$ES_{\alpha} = E[L \mid L > CVaR(\alpha, L)]$$

→ **Subadditive**

Allocation using ES Contribution to total VaR [4]:

$$ContrES_{\beta}^i = E[L_i \mid L > CVaR_T(\beta)]$$

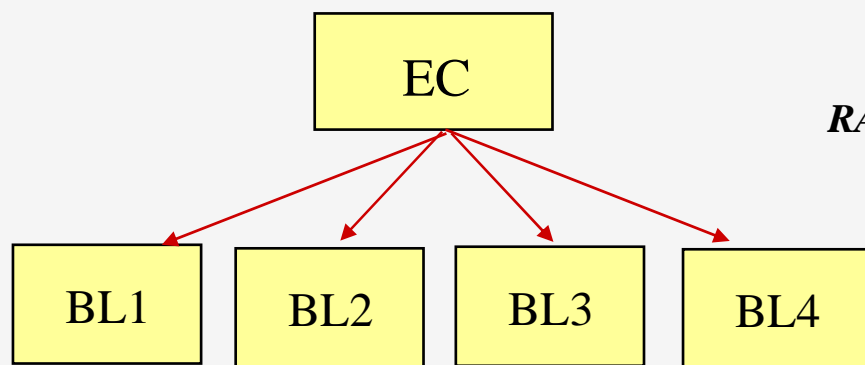
Subadditive

$$EC_i = \frac{ContrES_{\beta}^i}{ES_T(\beta)} \cdot CVaR_{\alpha}$$

EC Concept I ...

- **Portfolio Dependent:**
 - The EC of a certain position *depends* on the portfolio
- **No Additivity:**
 - The EC of a position is not necessarily additive
- **Realistic conditions**
 - EC is supposed to represent *economic* conditions
 - It should take into account *correlation* views.
- **Main requirement:**
 - The allocated EC for certain position should *not* depend on where the position is in the financial conglomerate.

EC Concept II ...



$$RAROC(BL_i) = \frac{\text{Generalized Revenues}_i - \text{Costs}_i}{EC_i}$$

Revenues + Add. Benefits

Includes Provisions

Evaluating Business Lines and Individual Positions:

- Which BL is bringing **business value** and which is not?
- Which client is worth keeping and which is not?
- If not **what** to put in place?

When answering the sort of questions above one needs to make a **distinction** on past measurements (**backwards looking**) and future projections /estimations (**forward looking**).

Managing a Financial Institution

Some basic Simple Questions:

How do we **invest** our capital?

How much **return** do we **plan** to have?

Which is my **horizon**?

How do I **monitor** if « things » are not going in the right direction?

How do I know it is not going as planned?

How to **adapt**?

All the questions above points in the direction of **multihorizon Capital Planning!**

Principle I: Capital Planning

Principle:

A financial institution should plan to have capital enough to **survive** a severe recession.

Objective: keep **improving** Capital Return ratios (**CRR's**) under different market conditions.

Consequence 1:

One should take into account the **evolution of capital** not only on a **mid term 1 year** horizon but for a **longer term horizon**.

Consequence 2:

One should have an idea of how business activities will evolve under different **economic scenarios**.

Capital Planning Implications I

Mentality and **hability** to answer the following **Strategic** questions:

Where are we?

Where do we want to be?

How do we come there?

When will we come there?

This is equivalent to answering:

Who are we ?

What do we want to do with our Capital?

How do we intend / plan to use it?

Capital Planning Implications II

Similar to a **change** in investment **Paradigms**.

From (an almost **Static** approach):

- 1) Credits are seen in **isolation**
- 2) **Ratings based approach** towards any investment.

To (a very **Dynamic** approach):

Credits are **correlated** and there is a **necessity** to **actively** manage that **correlation** risk!

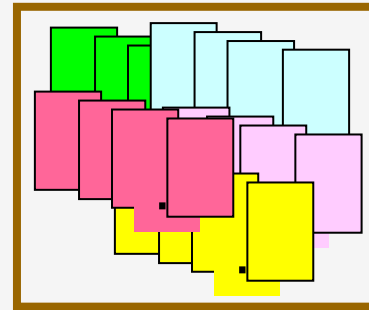
There is a **business cycle**: be **aware** and **act** upon it!

Capital Planning means: **capacity** / **hability** to implement:

- 1) **Long** Term **Strategic** goals
- 2) With **Short** and **Mid** term **tactical** adaptations: changes / hedges

Loss Distribution: The Key Portion

What do we have? →



Portfolio

What are we interested in?

Optimizing a **CRR** of that portfolio.

Primarily What do we need?



a) Generate the **Loss Distribution** !!!

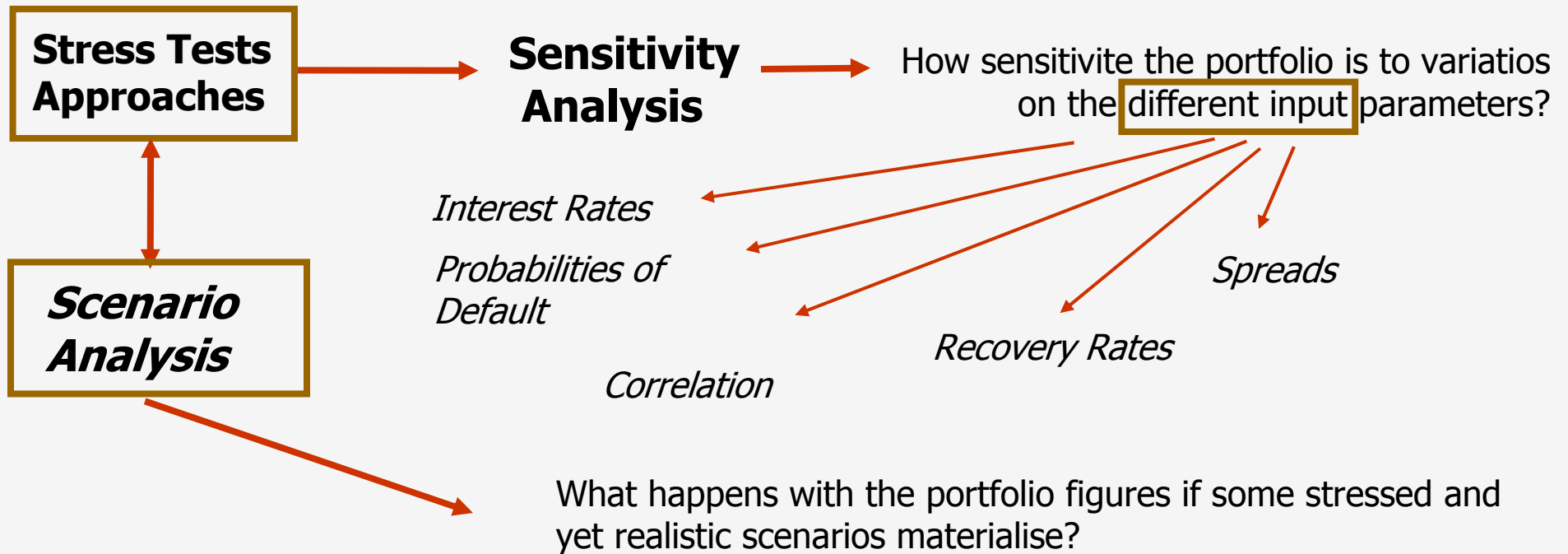
b) **Understand and Analyse** how the loss distribution has been generated:
Parameters + Scenarios !!!

c) Agregate results

Create a Dashboard

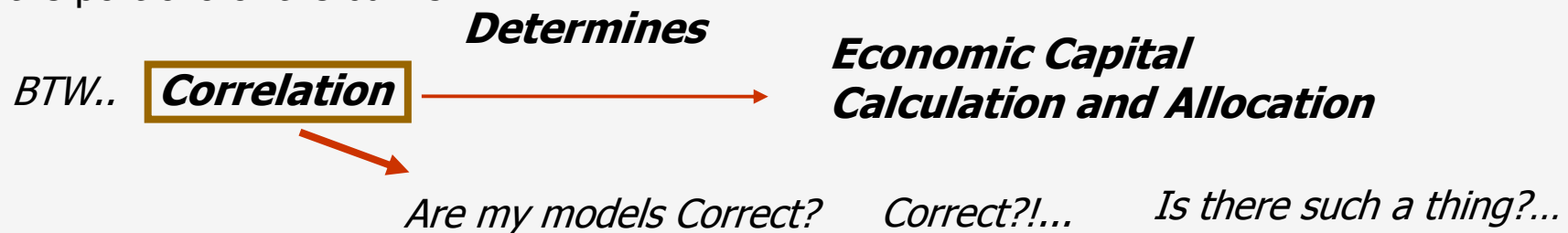
d) Use it for **Strategic Decisions**

Stress Test and Scenario Analysis in a Nutshell



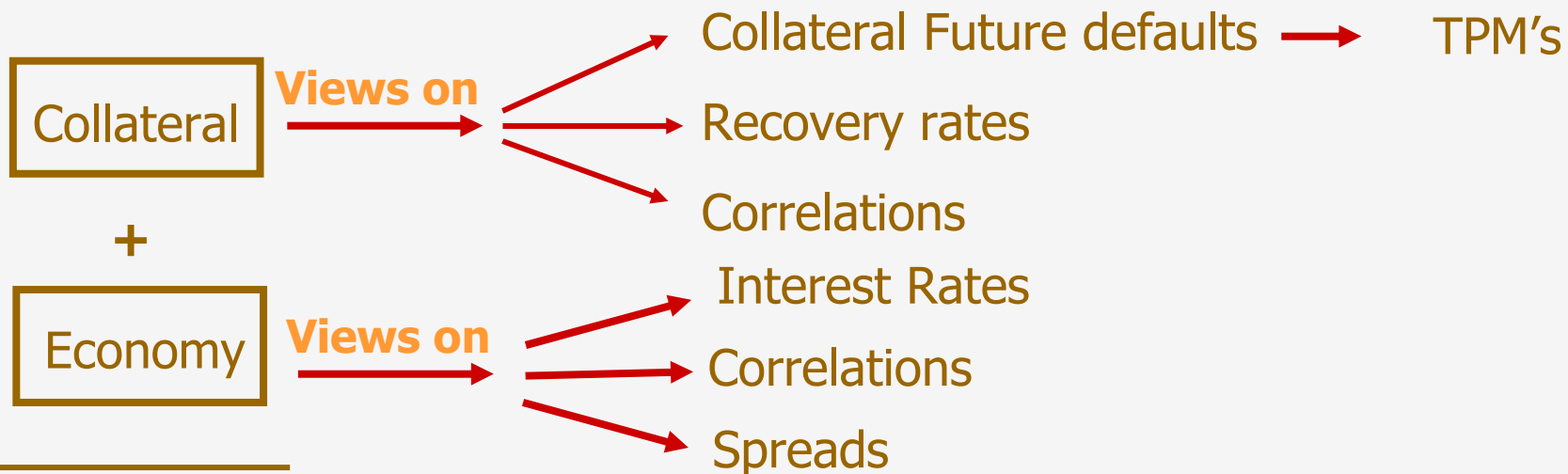
Suppose there is an **asset bubble** in the US (in special) or in the world in general.

How an **increase in mortgage defaults** will affect the CDO's, MBS's and ABS's that are in the portfolio of the banks?



Scenario Analysis I: General Idea in a Nutshell

Idea → Submit the collateral of the portfolio to **scenarios** that represent current future **economic** views



Projections → **Views on** Future Portfolio Returns → Agregate Results for Strategic Decision Making

E.g. $EC_{T=} = \sum_{i=1}^n \omega_i EC_i \rightarrow f(\text{Parameters} + \text{Scenarios})$

→ Knowledge Intensive

Scenario Analysis IIa: Approach in more detail

Step 1 Consider possible macroeconomic scenarios that affect the systematic risk factors.

Economic Cycle Dependent

Scenario	ΔIR	ΔGDP	ω
Bullish	-1%	+1%	30%
Neutral	-0%	+0%	40%
Bearish	+1%	-1%	30%

Step 2 Determine how scenarios affect input parameters (IP's).

PD's, LGD's, Correlations, Spreads, etc

Step 3 Determine how those changes affect the LD's at the different quantiles, industries, regions, asset classes and BL's.

For each of those IP's understand / check the impact of their **stressed** values.

Reported on a Simple **1 Page Dashboard**

Step 4 Identify the asset classes and portfolios most affected by those views.

Step 5 Have in place a Feedback loop → Compare the results with stablished business views !!!

Step 6 Be humble: Have in place a **green, yellow** and **red** light approach and determine a line of action based on those results.

Scenario Analysis IIb: Agregating Projections

Projections **Views on** Future Portfolio Returns \rightarrow Agregate Results for Strategic Decision Making

$$EC_{T=} \sum_i^n \omega_i EC^i \rightarrow f(\text{Parameters} + \text{Scenarios})$$



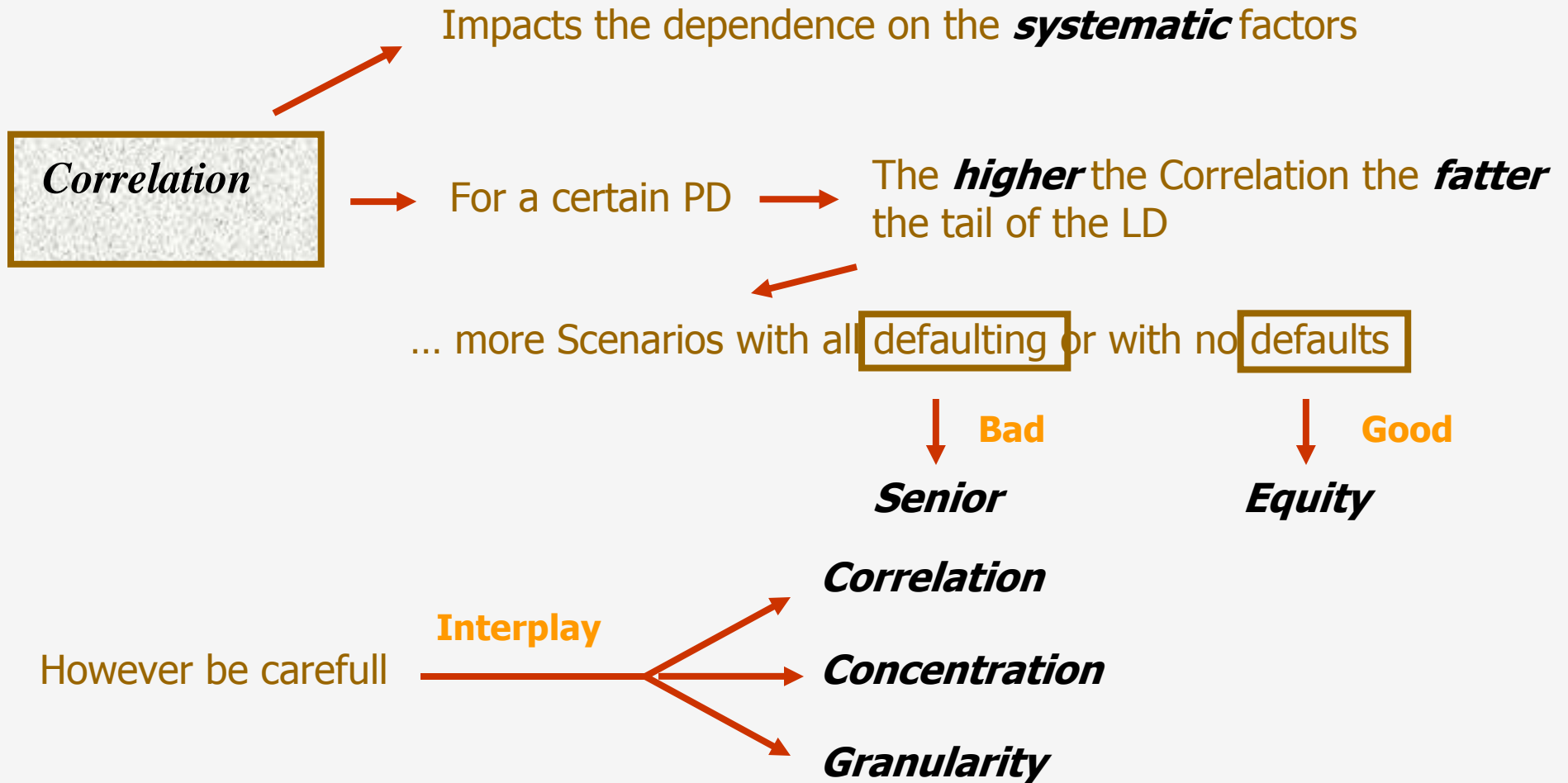
Contains the **Subjective** views on the realisation of the different scenarios.

Elaborated in tandem with the **experts** and **approved/understood** by **management** (who are supposed to be experts themselves in some areas).

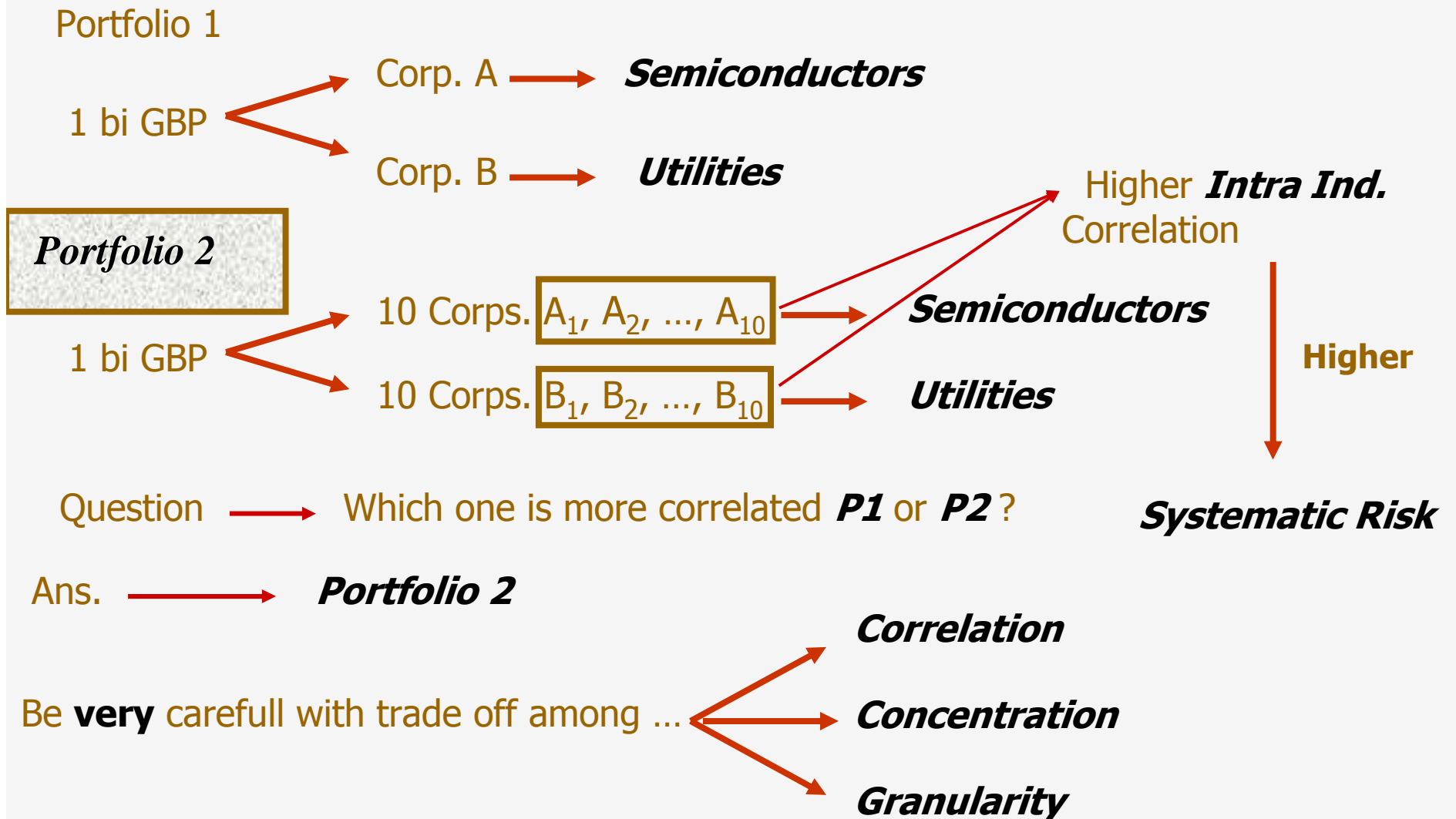
Those figures are published on a regular basis on a **dashboard** containing **long, mid** and **short** term **results** plus **sensitivity** parameters.

The **short** and **mid** term **sensitivity parameters** are used for **tactical corrections** and **sanity checks** on the feasibility of the **long** term **strategy**

The Importance of Correlation I: Lessons from CDO's



The Importance of Correlation II

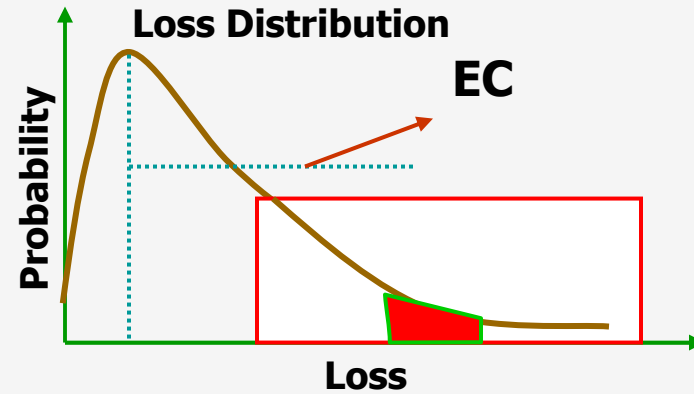
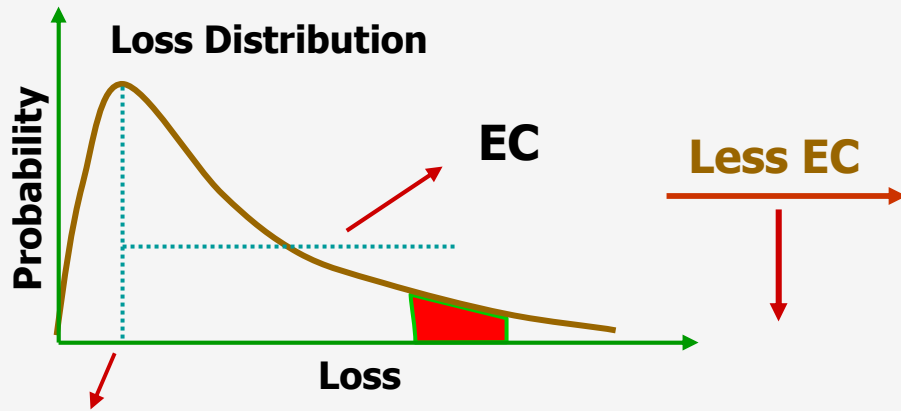


Simple and Practical Example I

Bank A

Before → Heavily Invested in Bonds

After → Heavily Invested in Securitization instruments

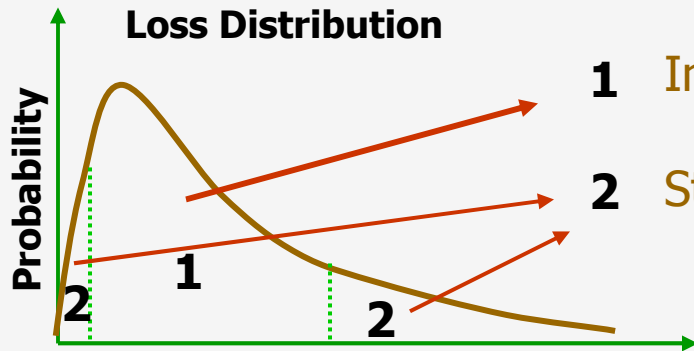


Less EC

EL

Business Strategy

Securitization



- 1** Investors
- 2** Stays in the **Bank**

Download **single name** instrument...

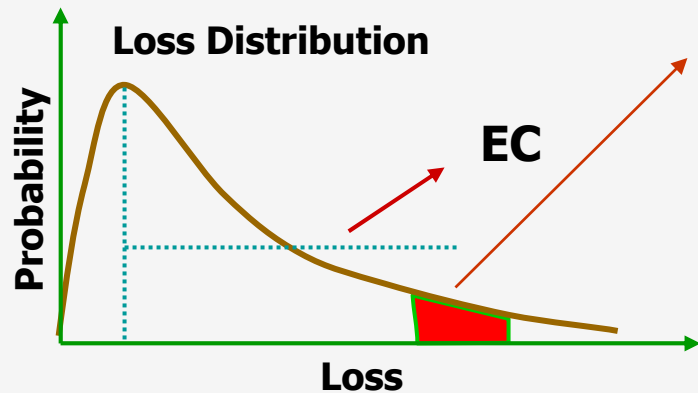
Upload **multi name** instrument...

Logic: **Less** RC and EC

Simple and Practical Example II

Bank A

Before → Heavily Invested in Bonds



We know: **Correlation affects the tail !!!**

The **Correlation** used for EC on the issuer side is the one of the CDO collateral (normally bonds or loans).

In the place of the bonds the bank will put a CDO...

Question 1: Which **correlation** is being used among the structured products in the **collateral**?

Question 2: How the housing market in the US can affect the **structured products** in the books of banks?

Question 3: Are those correlation the **same** as the ones in **bonds**?

Ans. Probably **not**.

This is a very important and up to date issue to be treated in the **stress test** and **scenario analysis** approach just mentioned.

Simple and Practical Example III

Consider **Bank A** in question has a **non-negligible** exposure to notes of securitization products (say **CDO's, ABS's, MBS's**).

Question 1: How could one hedge **Systematic** risk coming from possible deterioration of the housing market?

Ans 1: **One possibility** is taking position(s) in convenient **standardised** (and **liquid**) **credit index(es)** (tranching or not).

Question 2: How to choose the index? Ans. Solve the problem of **Correlation Mapping!**

Question 3: How much to buy? Ans. Project the **dynamics** of portfolio in question on the **dynamics** of the index.

And evaluate **sensitivities!!!** (Thomas has shown it!)

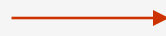
Question 4: How can one test efficacy? Ans. **Stress test** and **scenario analysis!!!**

Question 5: How to decide maturities? Ans. Decided within the **mid** and **long** term **strategic planing** framwork.

Behind the answer of all those questions is a technological implication
Question 5: How to decide maturities?

Banks: High Tech Companies

Behind all the questions made in the last slide is one important technology:



Monte Carlo Simulation

Quickness, Reliability and flexibility ...



Constraints ideal for a Parallel Architecture!


... plus ability the maximum amount of lines ... means

In the end of this whole exercise one will have created a top notch team being able to analyse very well where risks affecting the institution will come from!

The issue of Capital planning will come up as a natural extension of the whole exercise of using a full blown parallel system to make stress tests and scenario analysis!

On Recovery Rates

Carefull analysis of the sort of debt instruments in the collateral portfolio.

Class Type  Recovery Assumptions

Corporate Debt Recovery Rate Assumptions

Stress (%)	IG Companies				Sub-IG Companies							
	Unsecured		Subordinated		Senior Secured		Junior Secured		Senior Unsecured		Subordinated	
	AAA	B	AAA	B	AAA	B	AAA	B	AAA	B	AAA	B
US	44	55	24	30	56	70	24	30	36	45	24	30
France	28	35	20	25	32	40	24	30	20	25	8	10
Germany	28	35	20	25	44	55	32	40	17.5	22.5	4	5
Spain	28	25	20	25	32	40	24	30	20	25	4	5
UK	32	40	24	30	60	75	40	50	14.4	17.5	0	0

Note: These recovery rates are valid as of the publication date of this report. Recovery rate assumptions may change over time. The current recovery rate assumptions will always be available in the latest VECTOR model, available at www.fitchresearch.com. For senior secured bonds, Fitch will apply a senior unsecured recovery rate. Source: Fitch

Market assumptions embedded on CDS / CDO prices:

Current : **40%**

In 2002 : **20%**

Average Empirical Recovery Rates for the US (%)

Senior Secured Loans	65 – 75
Senior Unsecured Debt	40 – 50
Subordinated Debt	20 – 35

Note: these recovery rates are valid as of the publication date of this report. Recovery rate assumptions may change over time. The current recovery rate assumptions will always be available in the latest VECTOR model, available at www.fitchresearch.com. For senior secured bonds, Fitch will apply a senior unsecured recovery rate. Source: Fitch

Where are we on Recovery Rates ?

Debt Instrument	2005	2004	1982-2005
<i>Loans</i>	81	86	68
Secured Bonds	79	78	51
Senior Unsecured Bonds	55	53	36
Subordinated Bonds	43	58	31
<i>All Bonds</i>	55	59	35

*Recovery rates are estimated on an issuer-weighted basis using 30-day post default prices.

Source Moody's

When building scenarios one should be aware of the different assumptions made by the **data providers**.

Management needs to form / have its own view!!!

E.g. We are currently on an environment of very **low default rates** and **very high recoveries!!!**

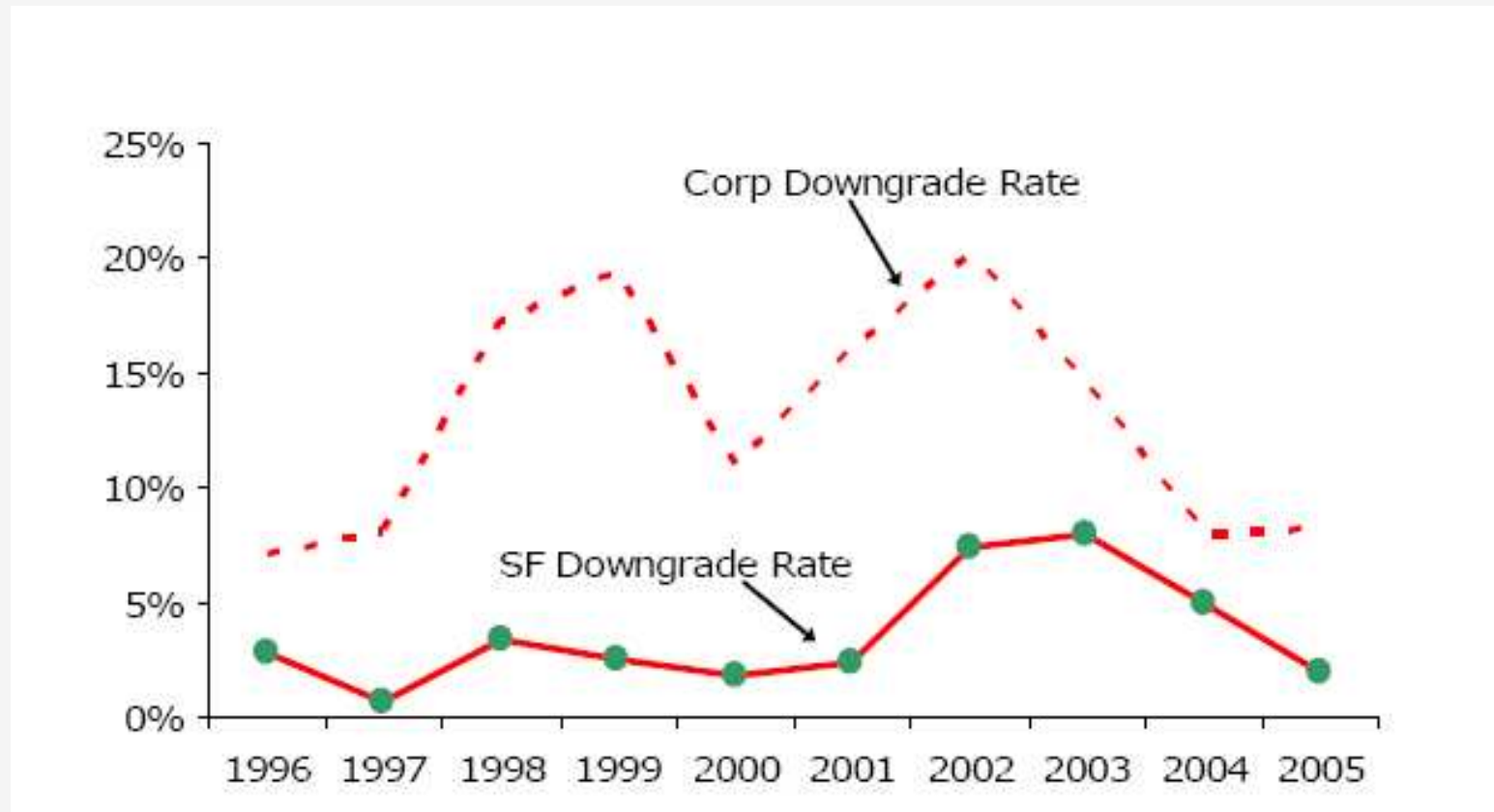
Average Empirical Recovery Rates for the US (%)

Senior Secured Loans	65 – 75
Senior Unsecured Debt	40 – 50
Subordinated Debt	20 – 35

Note: these recovery rates are valid as of the publication date of this report. Recovery rate assumptions may change over time. The current recovery rate assumptions will always be available in the latest VECTOR model, available at www.fitchresearch.com. For senior secured bonds, Fitch will apply a senior unsecured recovery rate.
Source: Fitch

On Downgrades and Asset Classes

Portfolio Downgrades are dependent not only on business cycle but also on the asset type of the portfolio!



Source Moody's

Moody's Idealized PD's

Rating	1 Year	2 Years	3 Years	4 Years	5 Years	6 Years	7 Years	8 Years	9 Years	10 Years
Aaa	0.000	0.000	0.001	0.002	0.003	0.004	0.005	0.007	0.008	0.010
Aa1	0.001	0.003	0.010	0.021	0.031	0.042	0.054	0.067	0.082	0.100
Aa2	0.001	0.006	0.026	0.047	0.068	0.089	0.111	0.133	0.164	0.200
Aa3	0.003	0.019	0.059	0.101	0.142	0.183	0.227	0.272	0.327	0.400
A1	0.006	0.037	0.117	0.186	0.261	0.330	0.406	0.480	0.573	0.700
A2	0.011	0.070	0.222	0.345	0.467	0.583	0.710	0.829	0.982	1.200
A3	0.039	0.150	0.360	0.540	0.730	0.910	1.110	1.300	1.520	1.800
Baa1	0.090	0.280	0.560	0.830	1.100	1.370	1.670	1.970	2.270	2.600
Baa2	0.170	0.470	0.830	1.200	1.580	1.970	2.410	2.850	3.240	3.600
Baa3	0.420	1.050	1.710	2.380	3.050	3.700	4.330	4.970	5.570	6.100
Ba1	0.870	2.020	3.130	4.200	5.280	6.250	7.060	7.890	8.690	9.400
Ba2	1.560	3.470	5.180	6.800	8.410	9.770	10.700	11.660	12.660	13.500
Ba3	2.810	5.510	7.870	9.790	11.860	13.490	14.620	15.710	16.710	17.660
B1	4.680	8.380	11.580	13.850	16.120	17.890	19.130	20.230	21.240	22.200
B2	7.160	11.670	15.550	18.130	20.710	22.650	24.010	25.150	26.220	27.200
B3	11.620	16.610	21.030	24.040	27.050	29.200	31.000	32.580	33.780	34.900
Caa	26.000	32.500	39.000	43.880	48.750	52.000	55.250	58.500	61.750	65.000

Source Moody's and MS

Fitch CDO PD's

Fitch CDO Default Matrix

(Cumulative Default Probabilities in %)

Rating	Years									
	1	2	3	4	5	6	7	8	9	10
AAA	0.00	0.00	0.02	0.03	0.05	0.08	0.10	0.13	0.16	0.19
AA+	0.00	0.02	0.05	0.13	0.19	0.26	0.33	0.40	0.48	0.57
AA	0.01	0.02	0.07	0.16	0.26	0.38	0.49	0.62	0.75	0.89
AA-	0.01	0.05	0.13	0.23	0.36	0.51	0.66	0.82	0.98	1.15
A+	0.03	0.11	0.22	0.37	0.56	0.76	0.98	1.20	1.43	1.65
A	0.04	0.13	0.26	0.43	0.62	0.84	1.07	1.32	1.58	1.85
A-	0.08	0.23	0.42	0.66	0.92	1.20	1.49	1.80	2.12	2.44
BBB+	0.12	0.32	0.57	0.87	1.20	1.55	1.93	2.32	2.72	3.13
BBB	0.21	0.54	0.91	1.32	1.89	2.30	2.67	2.97	3.34	3.74
BBB-	0.42	1.07	1.87	2.74	3.63	4.48	5.27	6.00	6.66	7.26
BB+	0.72	1.89	3.20	4.52	5.74	6.85	7.84	8.75	9.47	10.18
BB	1.46	3.08	4.79	6.51	8.11	9.48	10.69	11.78	12.71	13.53
BB-	2.80	5.19	7.48	10.63	12.50	14.06	15.36	16.44	17.46	18.46
B+	4.15	8.81	12.54	15.02	17.09	18.86	20.05	21.51	22.22	22.84
B	5.71	11.75	16.29	19.12	21.36	23.36	24.51	26.26	26.98	27.67
B-	10.55	16.81	20.89	24.60	27.08	29.20	29.99	32.12	33.50	34.98
CCC+	15.83	22.52	26.14	30.86	33.64	35.90	37.38	38.87	41.00	43.36
CCC	17.83	25.20	29.25	34.53	37.64	40.16	41.82	43.50	45.87	48.52

Source: Fitch

S&P CDO PD's

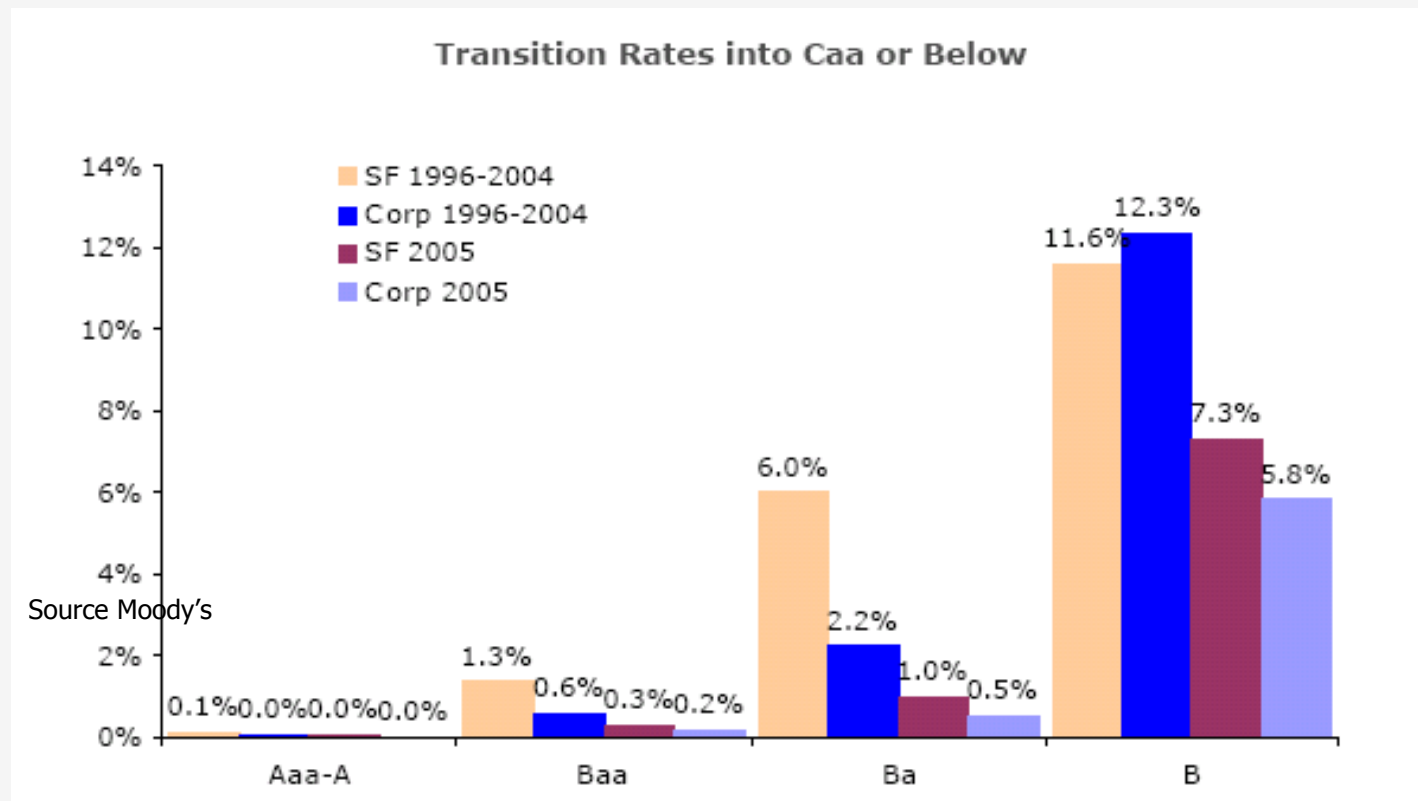
Year	AAA	AA+	AA	AA-	A+	A	A-	BBB+	BBB	BBB-	BB+	BB	BB-	B+	B	B-	CCC+	CCCCC-	
1	0.0002	0.001	0.008	0.014	0.018	0.022	0.033	0.195	0.294	0.806	1.484	2.296	3.457	4.100	5.295	8.138	23.582	45.560	66.413
2	0.005	0.009	0.039	0.048	0.064	0.080	0.121	0.427	0.684	1.805	2.915	4.506	6.624	8.124	10.833	16.559	38.046	59.087	79.205
3	0.016	0.027	0.085	0.102	0.138	0.172	0.262	0.701	1.162	2.899	4.312	6.597	9.516	11.903	15.940	23.729	46.605	64.704	82.840
4	0.034	0.056	0.144	0.178	0.240	0.298	0.451	1.023	1.713	4.034	5.681	8.567	12.164	15.388	20.479	29.578	52.040	67.875	84.478
5	0.061	0.098	0.219	0.276	0.371	0.459	0.686	1.391	2.323	5.179	7.020	10.424	14.595	18.571	24.463	34.333	55.809	70.042	85.513
6	0.097	0.153	0.310	0.397	0.531	0.655	0.966	1.805	2.980	6.316	8.327	12.175	16.832	21.462	27.947	38.234	58.626	71.685	86.285
7	0.144	0.224	0.420	0.543	0.719	0.887	1.287	2.261	3.672	7.434	9.598	13.826	18.895	24.083	30.999	41.476	60.850	73.005	86.907
8	0.204	0.311	0.549	0.713	0.937	1.152	1.648	2.756	4.390	8.529	10.831	15.387	20.800	26.457	33.680	44.209	62.672	74.105	87.429
9	0.276	0.414	0.700	0.909	1.184	1.451	2.047	3.284	5.127	9.598	12.025	16.862	22.563	28.610	36.046	46.543	64.204	75.041	87.877
10	0.362	0.536	0.872	1.130	1.458	1.782	2.479	3.842	5.876	10.637	13.179	18.258	24.197	30.565	38.145	48.559	65.517	75.853	88.268
11	0.463	0.678	1.066	1.377	1.761	2.143	2.943	4.425	6.634	11.649	14.295	19.580	25.717	32.346	40.016	50.320	66.657	76.565	88.614
12	0.581	0.839	1.284	1.650	2.092	2.534	3.434	5.029	7.396	12.631	15.371	20.834	27.132	33.973	41.694	51.871	67.659	77.197	88.921
13	0.715	1.020	1.525	1.947	2.448	2.952	3.952	5.651	8.160	13.587	16.410	22.025	28.453	35.463	43.206	53.248	68.548	77.762	89.197
14	0.867	1.223	1.790	2.270	2.830	3.396	4.491	6.287	8.923	14.515	17.414	23.157	29.689	36.832	44.575	54.481	69.343	78.271	89.447
15	1.037	1.447	2.078	2.617	3.237	3.864	5.051	6.936	9.684	15.418	18.383	24.234	30.849	38.096	45.822	55.592	70.060	78.732	89.674
16	1.225	1.693	2.389	2.988	3.666	4.353	5.628	7.593	10.441	16.296	19.320	25.262	31.940	39.265	46.962	56.599	70.710	79.154	89.882
17	1.433	1.961	2.724	3.382	4.117	4.862	6.221	8.258	11.193	17.152	20.226	26.243	32.969	40.351	48.009	57.517	71.304	79.541	90.074
18	1.661	2.250	3.080	3.798	4.588	5.390	6.826	8.928	11.940	17.985	21.103	27.181	33.941	41.363	48.976	58.359	71.848	79.898	90.250
19	1.908	2.561	3.458	4.234	5.078	5.934	7.442	9.602	12.680	18.798	21.952	28.081	34.862	42.310	49.872	59.134	72.350	80.229	90.414
20	2.175	2.893	3.858	4.690	5.586	6.493	8.068	10.279	13.414	19.591	22.777	28.944	35.737	43.198	50.706	59.851	72.816	80.538	90.568

Source S&P

Comparing Asset Classes II...

Corps versus SF

Different asset classes will have different TPM's as well.



Transition Probability Matrices I : Different Sectors

Sov's

Average One-Year Whole Letter Rating Transition Rates, 1983-2005

(Percentage of Issuers)

Beginning of Year Rating	End of Year Rating								WR
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	
Aaa	94.65	5.21	0.00	0.00	0.00	0.00	0.00	0.00	0.15
Aa	4.43	92.28	1.38	0.00	0.00	0.00	0.00	0.00	1.90
A	0.00	2.90	91.73	3.19	0.52	0.00	0.00	0.00	1.66
Baa	0.00	0.00	8.88	79.02	6.85	0.85	0.00	0.00	4.40
Ba	0.00	0.00	0.00	4.28	85.93	8.29	0.73	0.62	0.15
B	0.00	0.00	0.00	0.00	3.50	87.18	2.09	3.89	3.34
Caa-C	0.00	0.00	0.00	0.00	0.52	28.18	53.12	18.18	0.00

Corp's

Average One-Year Corporate Whole Letter Rating Migration Rates, 1920-2005*

Beginning of Year Rating	End of Year Rating								WR
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	
Aaa	88.365	6.994	0.760	0.165	0.021	0.001	0.000	0.000	3.694
Aa	1.242	85.498	6.521	0.709	0.179	0.037	0.006	0.060	5.748
A	0.076	2.851	85.279	5.359	0.717	0.117	0.028	0.073	5.500
Baa	0.045	0.306	4.666	80.898	5.290	0.795	0.170	0.287	7.542
Ba	0.007	0.084	0.522	5.975	73.632	6.982	0.641	1.316	10.840
B	0.004	0.060	0.181	0.709	6.439	71.200	5.498	4.225	11.683
Caa-C	0.000	0.027	0.054	0.200	0.944	6.806	66.583	13.885	11.502

* Percentage of Issuers calculated using monthly cohort spacing

Source Moody's

Transition Probability Matrices II : Same Sectors Different Time Horizons

Average One-Year Corporate Whole Letter Rating Migration Rates, 1970-2005*

Beginning of Year Rating	End of Year Rating								WR
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	
Aaa	89.899	6.724	0.540	0.191	0.013	0.002	0.000	0.000	2,632
Aa	1.036	87.885	6.918	0.269	0.053	0.017	0.000	0.008	3,814
A	0.055	2.573	88.124	4.946	0.516	0.102	0.022	0.021	3,641
Baa	0.045	0.208	4.920	84.716	4.436	0.793	0.246	0.177	4,461
Ba	0.009	0.056	0.483	5.652	76.678	7.605	0.623	1.178	7,715
B	0.009	0.049	0.169	0.412	5.549	74.539	5.442	5.367	8,463
Caa-C	0.000	0.036	0.036	0.196	0.738	7.166	60.648	19.523	11,659

* Percentage of Issuers calculated using monthly cohort spacing

Average One-Year Corporate Whole Letter Rating Migration Rates, 1920-2005*

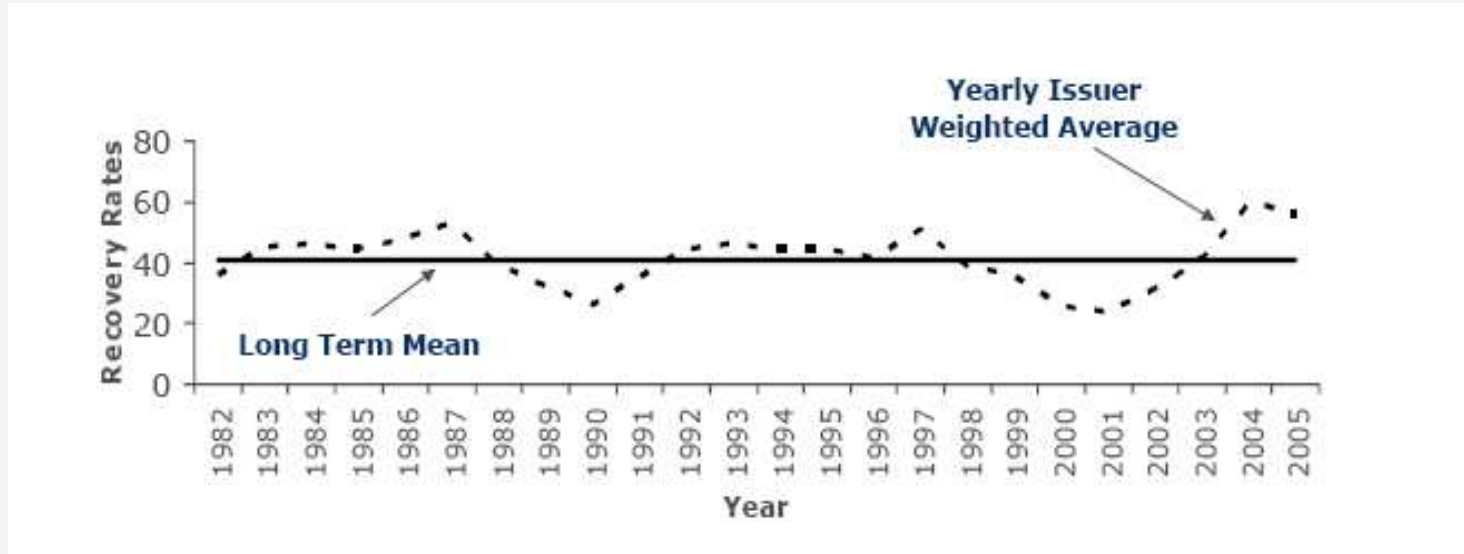
Beginning of Year Rating	End of Year Rating								WR
	Aaa	Aa	A	Baa	Ba	B	Caa-C	Default	
Aaa	88.365	6.994	0.760	0.165	0.021	0.001	0.000	0.000	3,694
Aa	1.242	85.498	6.521	0.709	0.179	0.037	0.006	0.060	5,748
A	0.076	2.851	85.279	5.359	0.717	0.117	0.028	0.073	5,500
Baa	0.045	0.306	4.666	80.898	5.290	0.795	0.170	0.287	7,542
Ba	0.007	0.084	0.522	5.975	73.632	6.982	0.641	1.316	10,840
B	0.004	0.060	0.181	0.709	6.439	71.200	5.498	4.225	11,683
Caa-C	0.000	0.027	0.054	0.200	0.944	6.806	66.583	13.885	11,502

* Percentage of Issuers calculated using monthly cohort spacing

Source Moody's

On Recovery and Default Rates

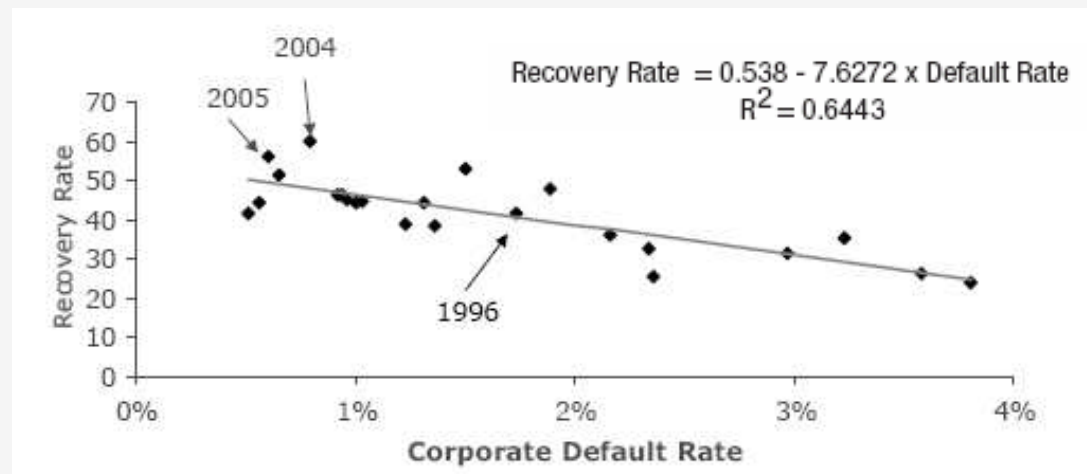
Senior Unsecured Recovery Rates



Source Moody's

Recovery Rates are **mean reverting!** ...

...And it depends on **Business cycle.**



Source Moody's

References

- [1] FSA Discussion Paper 05/2 « *Stress Testing* », May 2005
- [2] FSA Feedback Statement 05/02 « *Stress Testing: Feedback on the DP05/2* »
- [3] Artzner P., F. Delbaen, J. Eber, and D. Heath, *Coherent Measures of Risk*, Mathematical Finance, 9: 2003-228, 1999
- [4] J. Garcia, T. Alderweireld and L. Leonard, *Comparing Different Approaches for Economic Capital Allocation*, Brussels Conference