

Does history repeat?



*Credit stress scenarios using sub-sampling
in a multi-factor portfolio model*

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Outline

- *Some applications for stress scenarios*
- *Summary of the portfolio model*
- *Candidate stress scenarios*
- *Sub-sampling techniques*
- *Using macro-economic forecasts*

Applications for stress scenarios

- *Challenge the assumptions of the risk measurement model (what if?)*
- *In particular, assumptions about probability distributions and their parameters*

Example:

Production in the automotive industry is forecasted to -15% during next year

Portfolio models for credit risk

- *Measure the risk of a portfolio of dependent credits*
- *Risk measures are related to a certain horizon (usually one year)*
- *Main output: portfolio loss distribution, usually via Monte Carlo simulation*

Risk factors and loss

- *Ability to pay (X) for each borrower is a function of one specific (e) and some systematic (r) risk factors:*

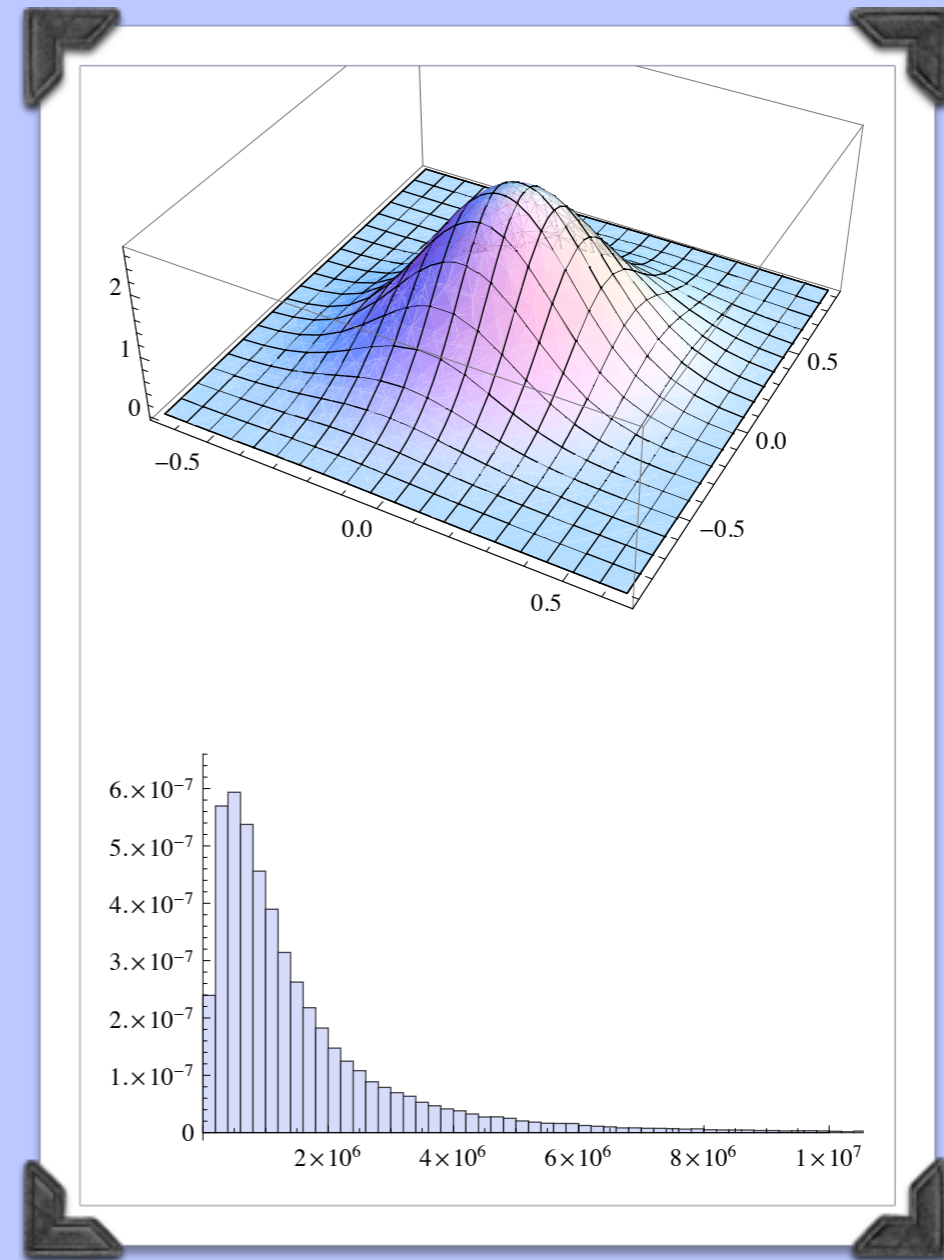
$$X_{BMW} = 0.7 r_{EU} + 0.3 r_{DEV} + 0.8 r_{CAR} + 0.2 r_{FIN} + e_{BMW}$$

- *Loss (L) due to default or migration is a function of ability to pay:*

$$L_{BMW} = f(X_{BMW}) \text{ e.g.: } L_{BMW} = l_{BMW} \text{ if } X_{BMW} < d_{BMW}, 0 \text{ otherwise}$$

Statistical standards

- *Systematic risk factors as multivariate normal with zero mean*
- *(Monte Carlo) loss distribution derived from the risk factor distribution*
- *In what follows, other dependence models can be used*



A word about examples

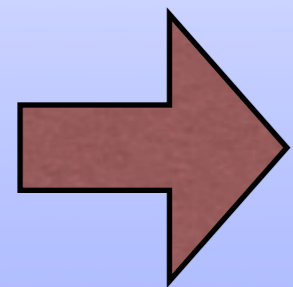
- *All examples use the same portfolio and factor model*
- *Dummy portfolio, but similar in size and composition to a global bank*
- *75 correlated systematic factors (country and industry branch related)*

Candidate stress scenarios

Shift the mean:

$$E(r_{EU}) = -24\%$$

$$E(r_{DEV}) = -10\%$$



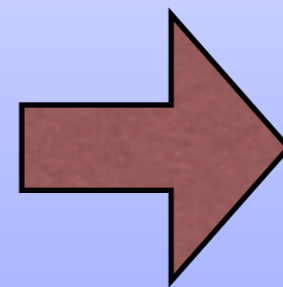
$$E(L_P) = ?$$

- *Correlation unchanged*

Fixed values:

$$r_{EU} = -24\%$$

$$r_{DEV} = -10\%$$



$$E(L_P) = ?$$

- *One systematic scenario*

Stress scenario candidate #1

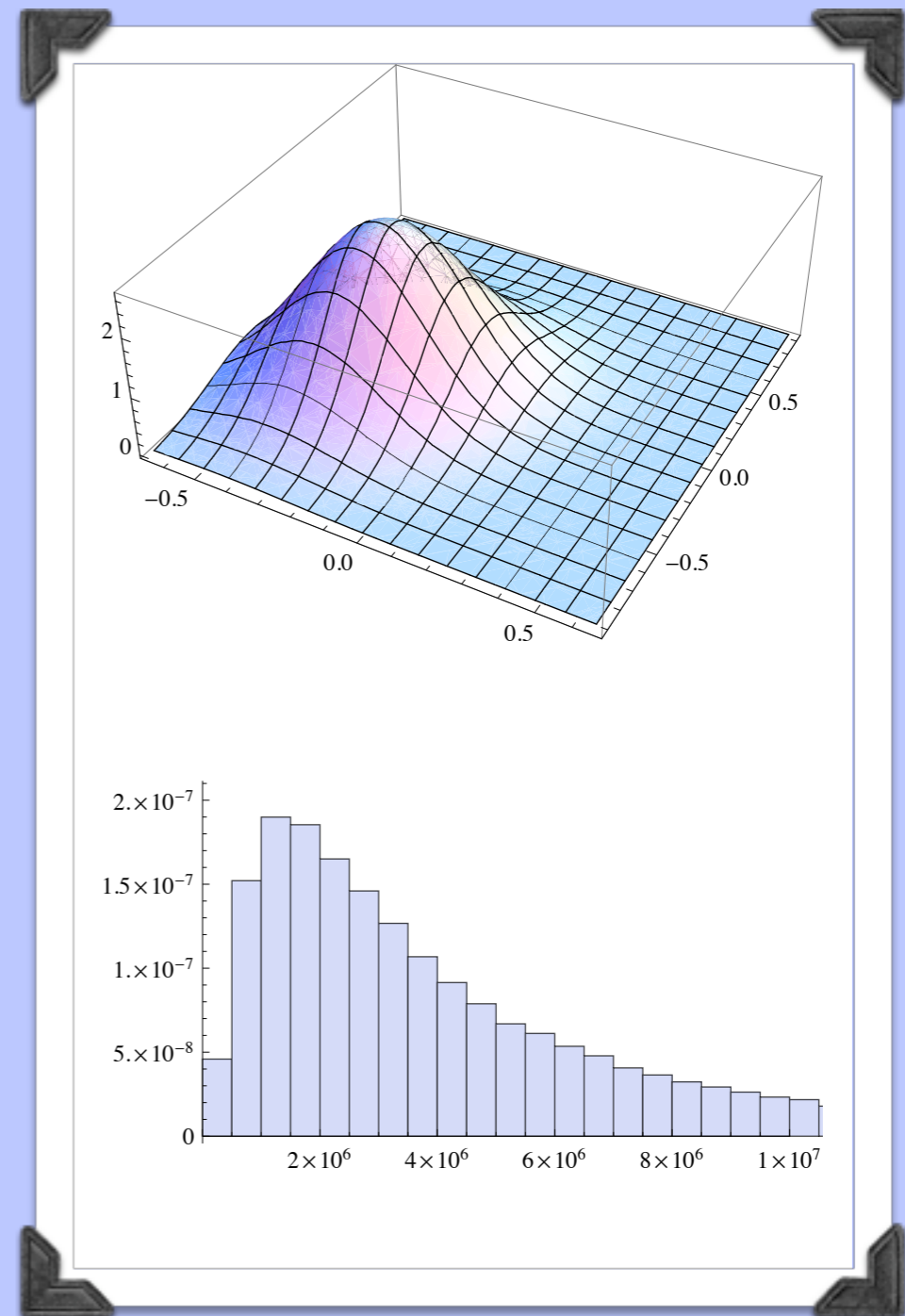
Shift the mean:

$$E(r_{EU}) = -24\%$$

$$E(r_{DEV}) = -10\%$$

$$E(L_P) = +124\%$$

- *Increase in risk capital usually smaller*



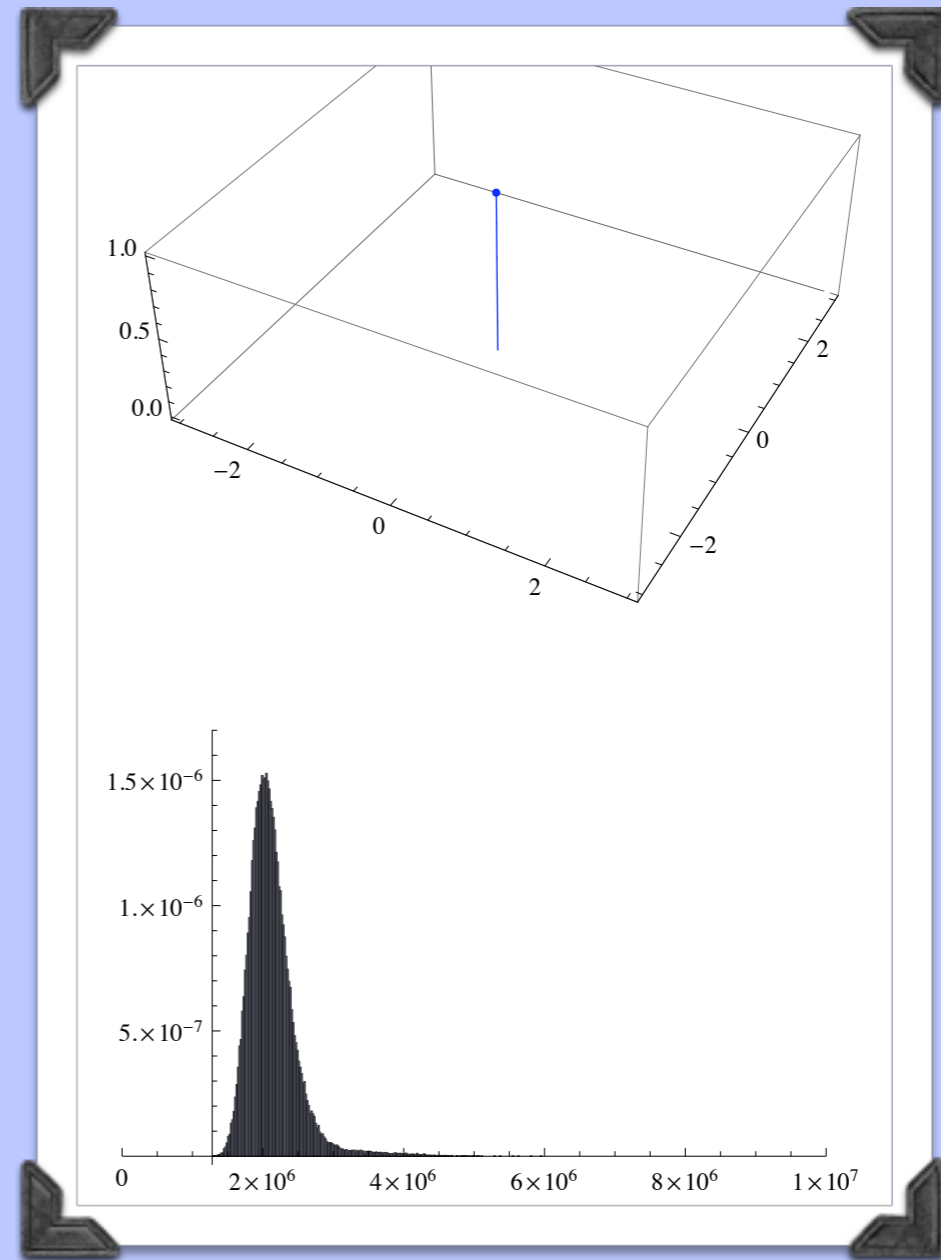
Stress scenario candidate #2

Fixed systematic factors:

$$r_{EU} = -24\%, r_{DEV} = -10\%$$

$$E(L_P) = +28\%$$

- *Change in systematic factors is a constant*
- *Random (independent) specific factors*

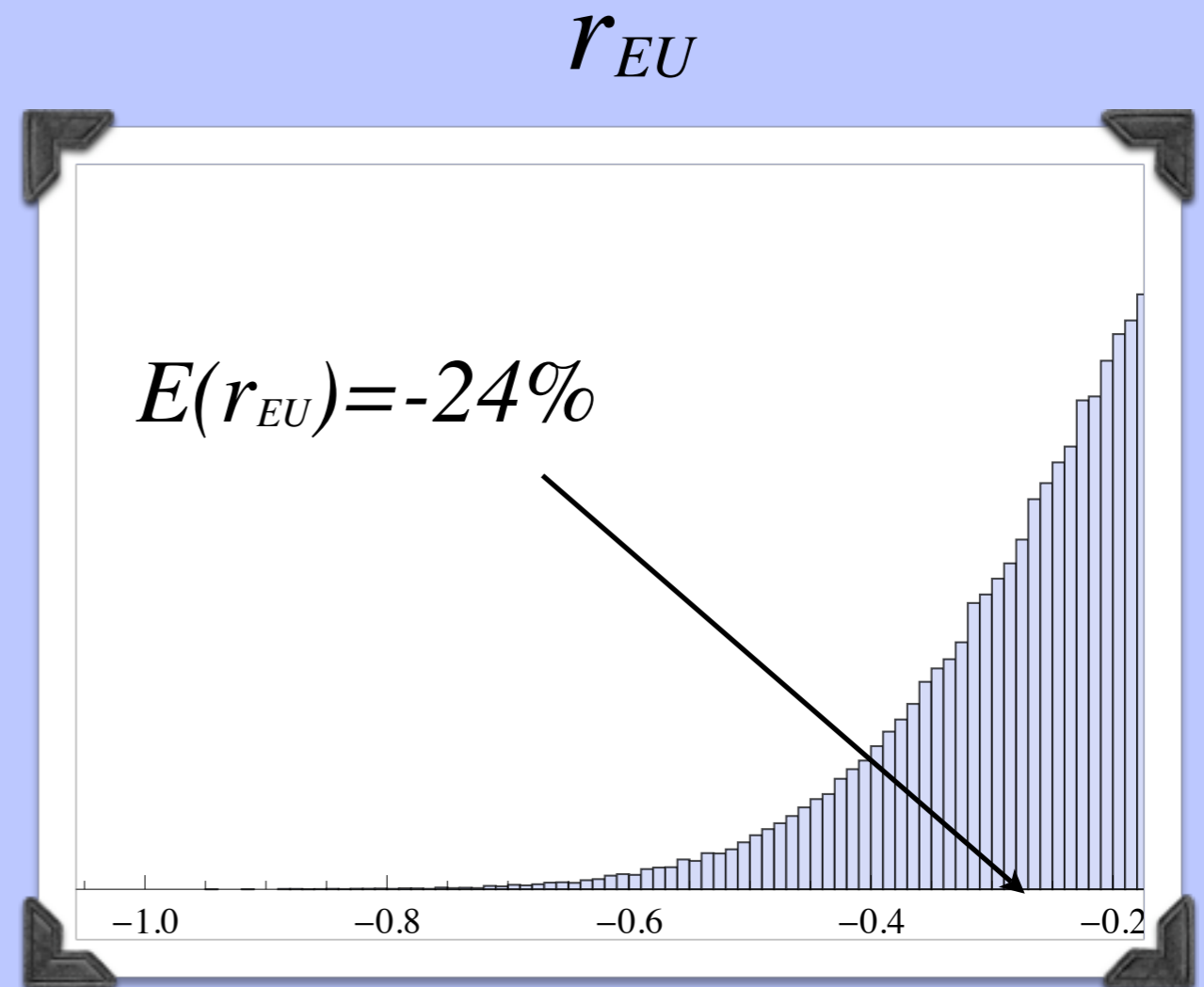


Candidate recap

- *Both approaches have disadvantages*
- *Correlations should be allowed to change*
- *Systematic factor should stay random*

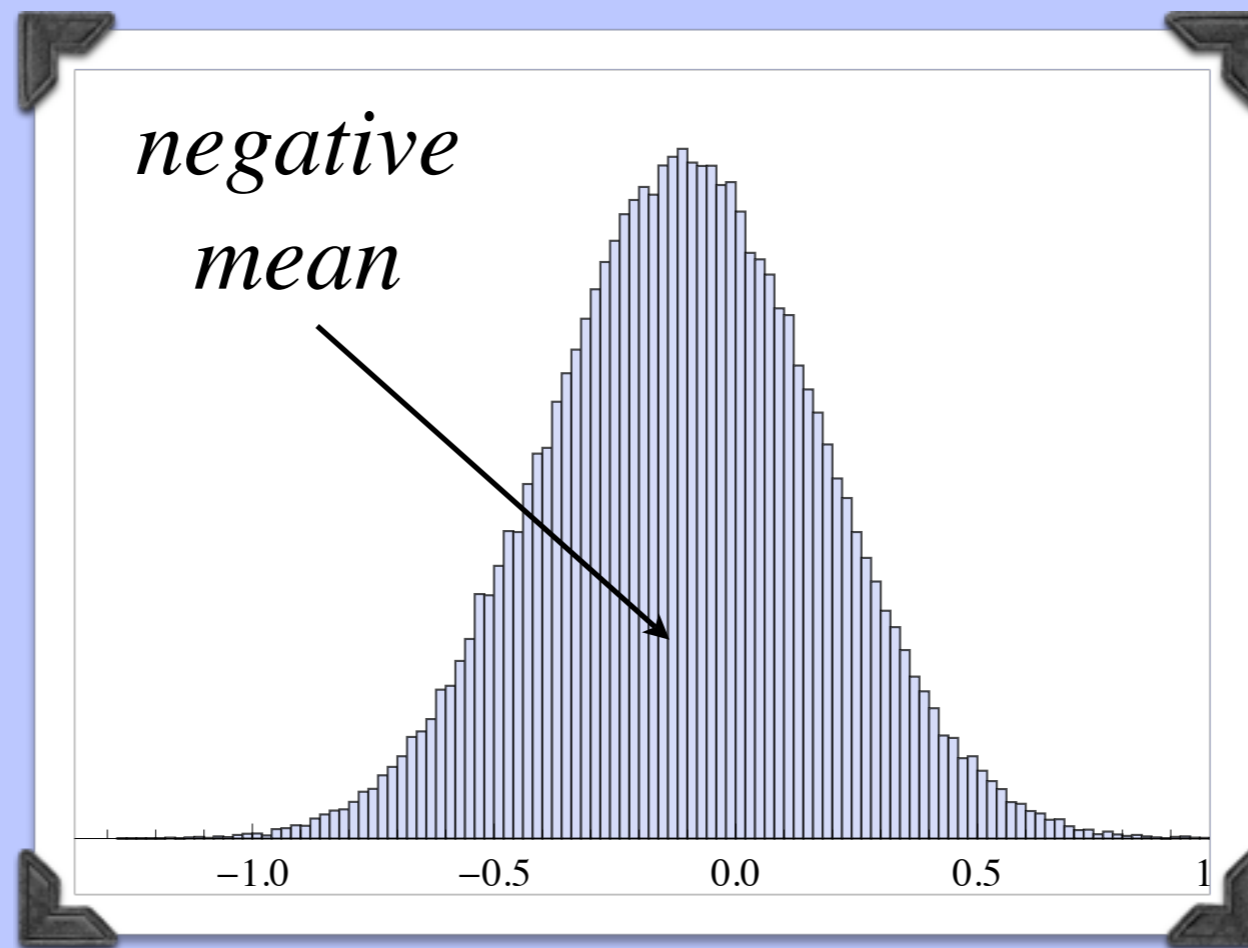
Sub-sampling

- *Idea: keep only “bad” scenarios*
- *Fix a mean (e.g. your forecast)*
- *Choose a bound, so that selected scenarios match the mean*



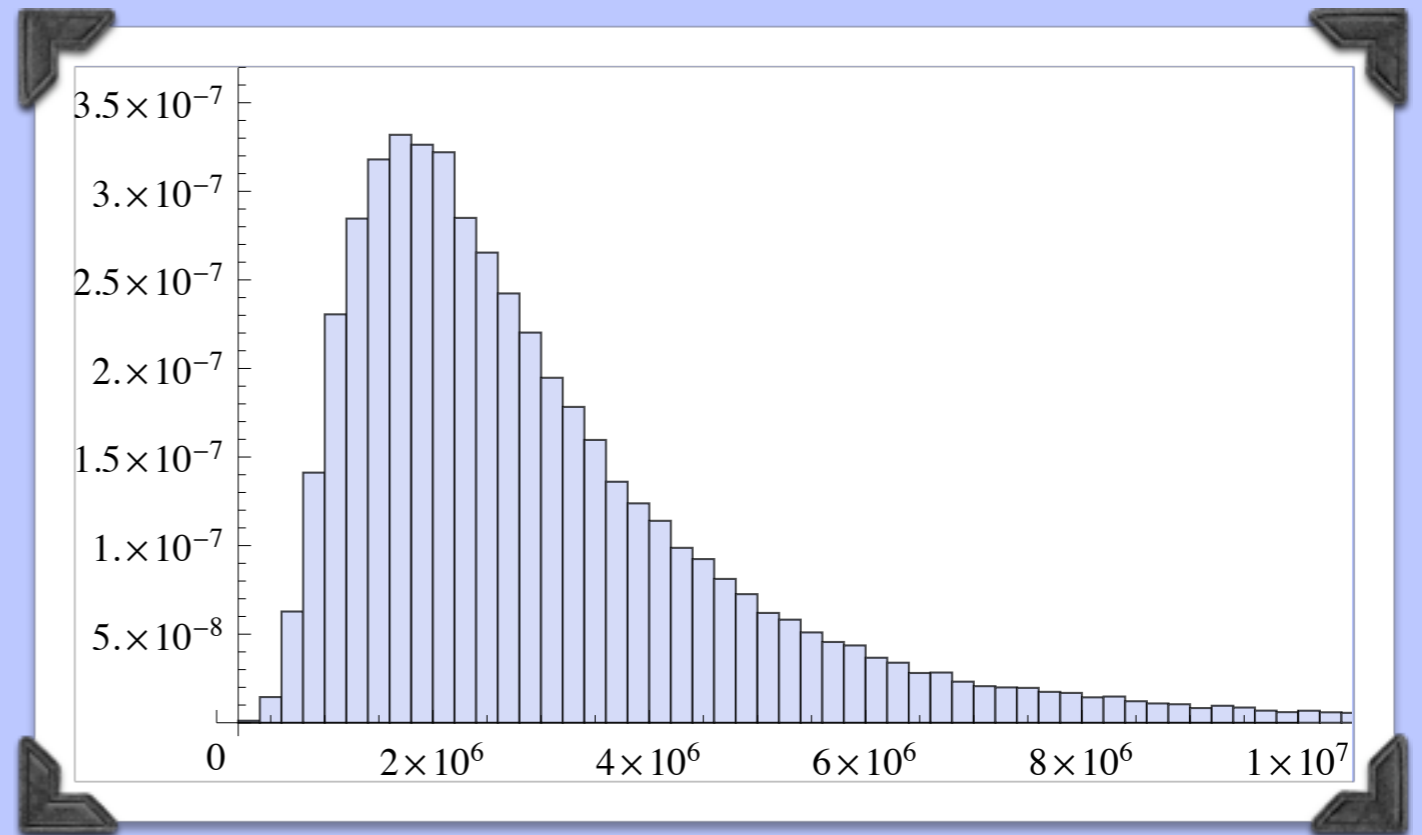
Correlations drive other factors

r_{DEV}

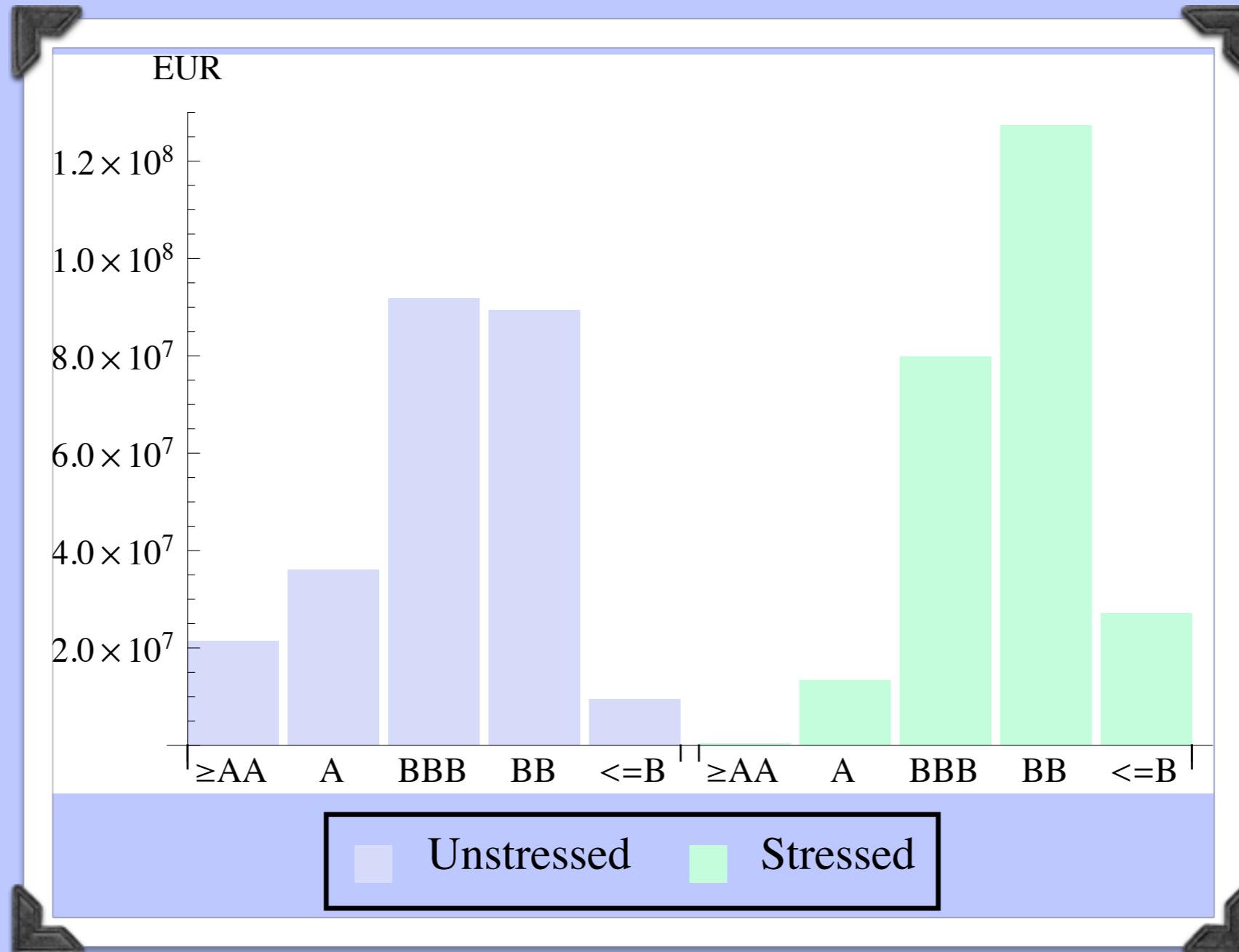


Loss distribution

- *No further changes needed in order to estimate the loss distribution!*

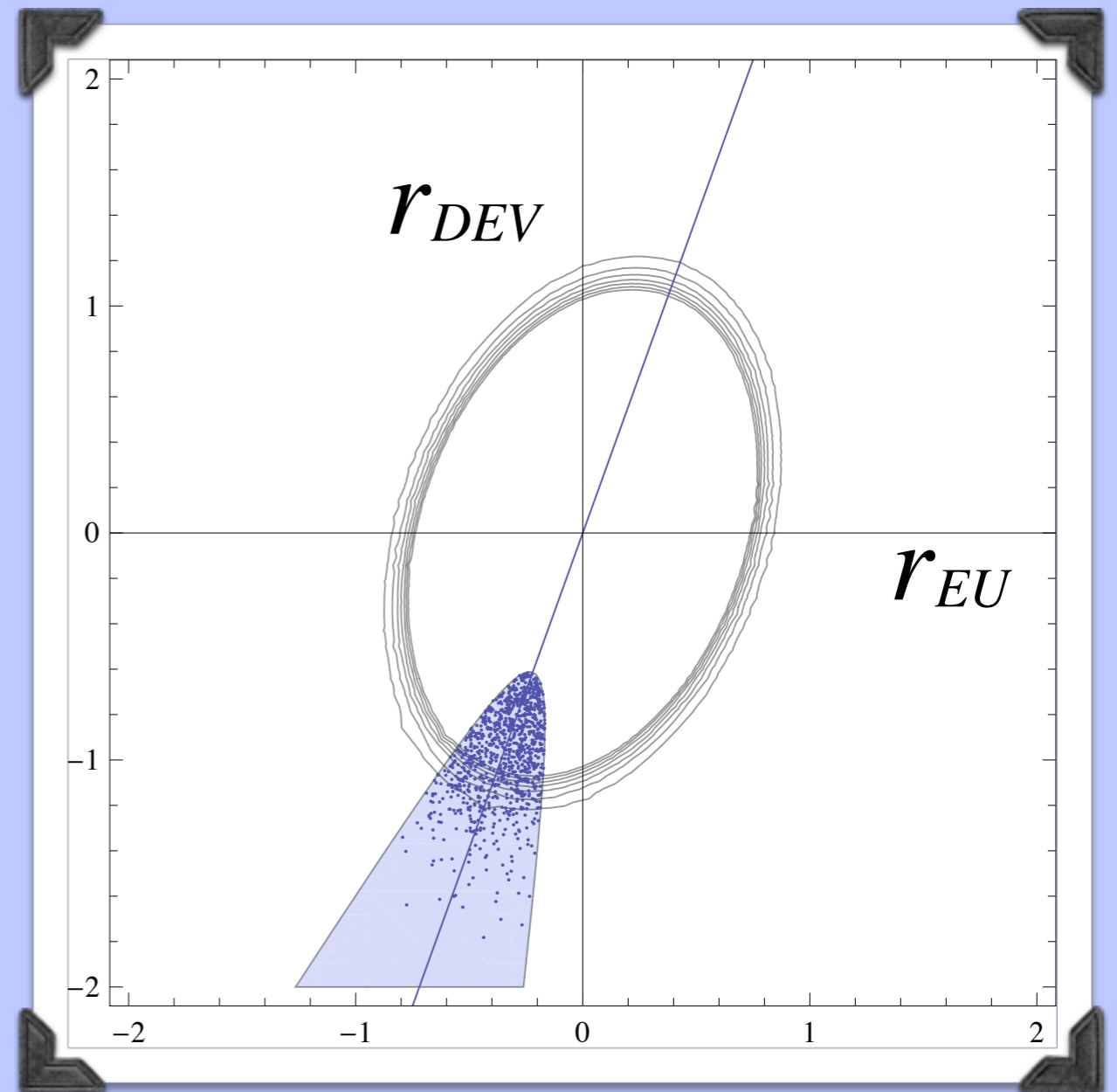


Rating changes



Two factor sub-sampling

- Scenario can be chosen to match a given constrain (probability, mean, etc.)
- Change in correlation can be chosen in a simple way
- Use IS for efficiency



Using macro-economic forecasts

- *If time series for the macro-economic variable is available, then it could be integrated into the factor model*
- *Most often this is not possible*
- *Alternative: match probability*
- *If forecast is a 1 in 10 years case, choose mean of similar factor to match 10% percentile*

Thank you!



- *Questions ?*
- *Remarks ?*