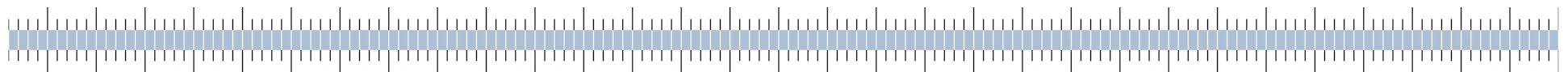


Stress-testing German Banks under the Scenario of a Downturn in the Automobile Industry

Klaus Düllmann, Martin Erdelmeier

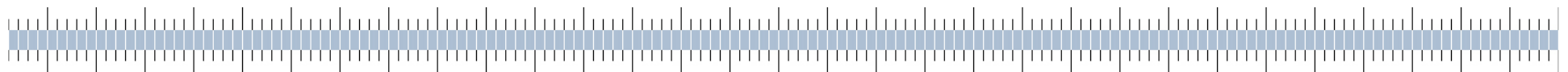
Deutsche Bundesbank

May 2009



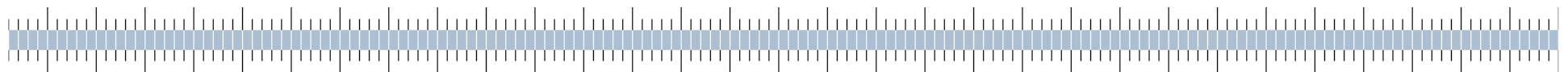
Agenda

- Motivation
- Data
- Portfolio Credit Risk Model
- Definition of Stress Event
- Results
- Outlook on Follow-up Project



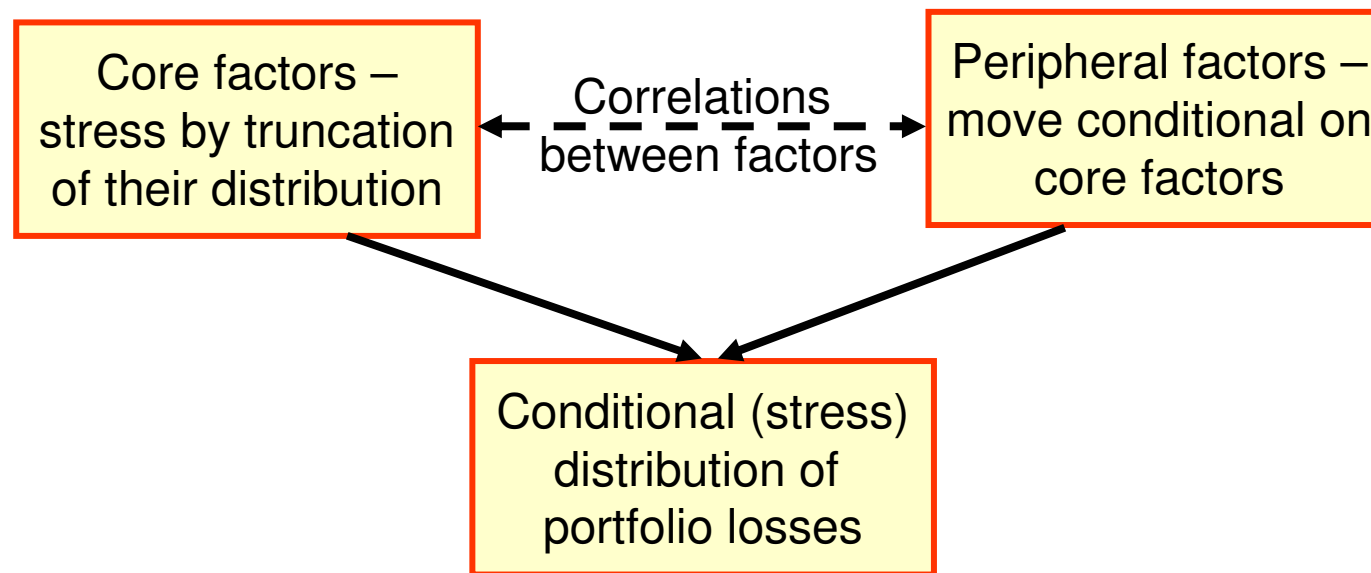
Motivation

- 1) Drop in automobile production (key sector of German industry)
 - Trend towards less petrol-consuming and less expensive models
 - Lower demand for cars due to downturn in US economy
- 2) Use of multi-factor model (CreditMetrics-type)
 - Spill-over to other sectors captured by inter-sector correlations
 - Sectoral and name concentrations automatically captured
- 3) More informative than a "point scenario" because a range of industry downturns in a specific sector is considered
- 4) Credit register of Bundesbank allows consistent application for a sample of large banks' credit portfolios



Key Idea: Stressing Core Factor(s)

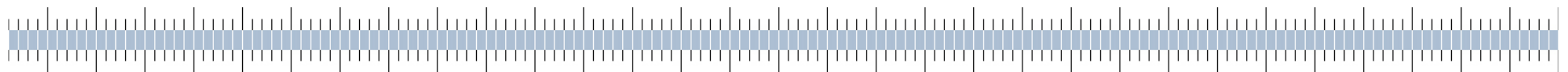
- See Bonti, Kalkbrener, Lotz and Stahl, Journal of Credit Risk, 2006



Data



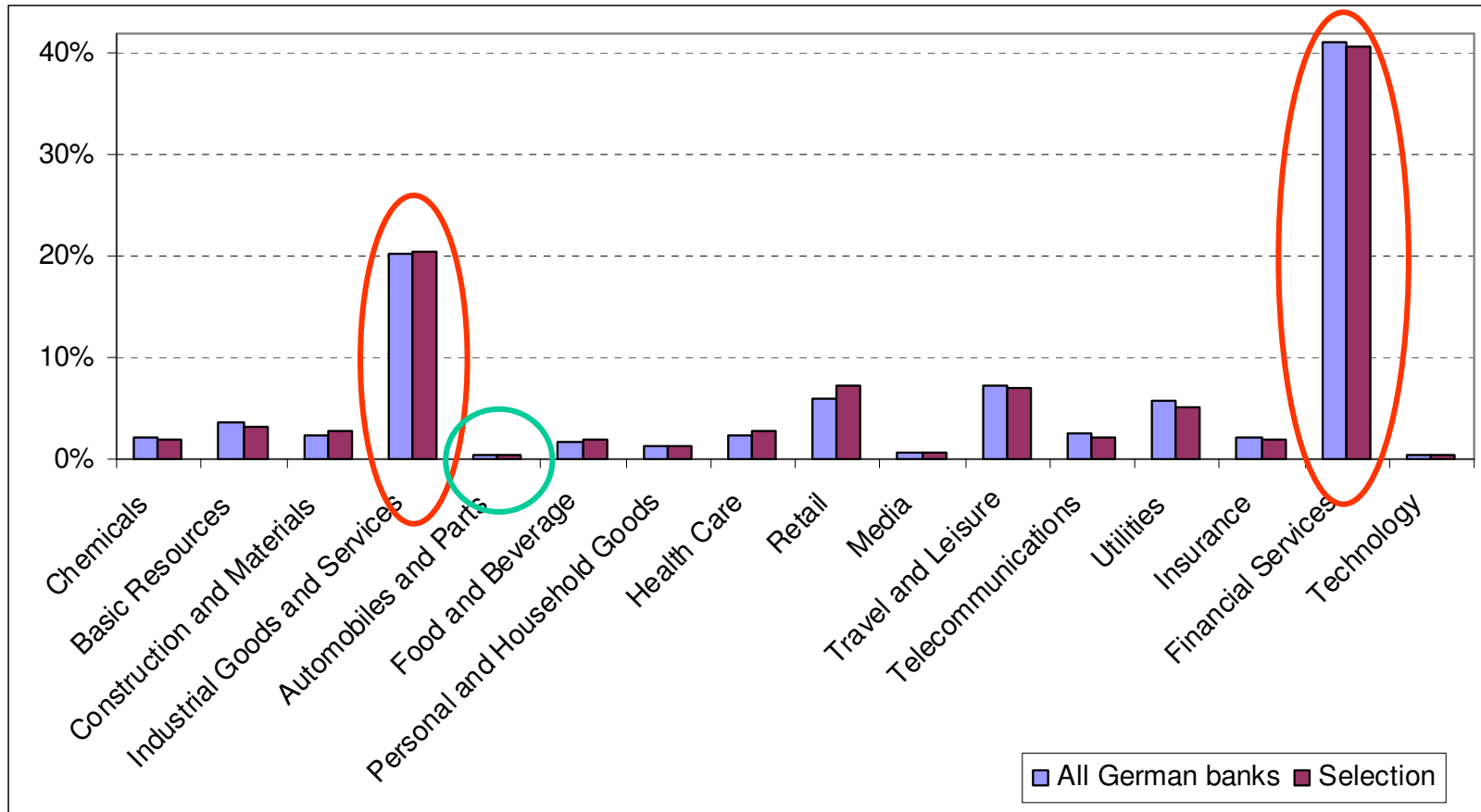
- Source: German credit register of "large exposures" (loans \geq 1.5m €)
- Only corporate loans
- Sample of 28 banks
 - 12 private banks (4 large banks)
 - 13 public sector banks (8 Landesbanken)
 - 3 cooperative sector banks
- Every bank has at least 1,200 borrowers included in credit register
- Sample covers more than 75% of total exposure in the credit register
- PDs estimated from historical insolvency rates per sector



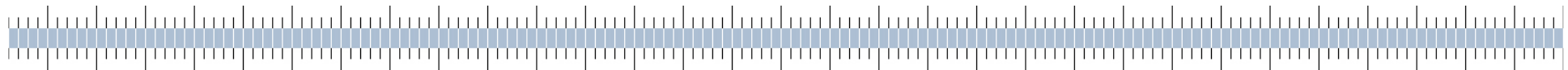
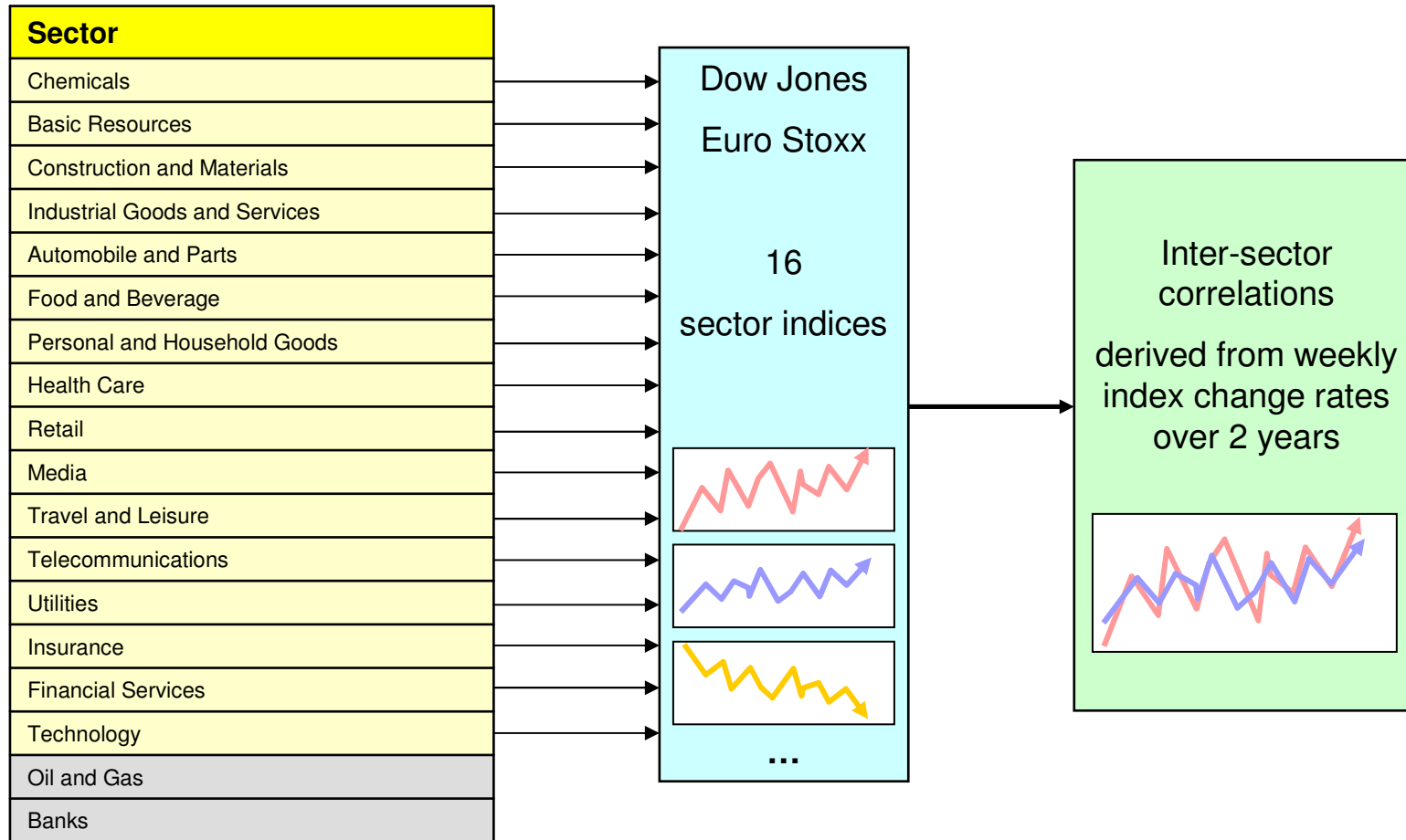
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Sectoral Breakdown...

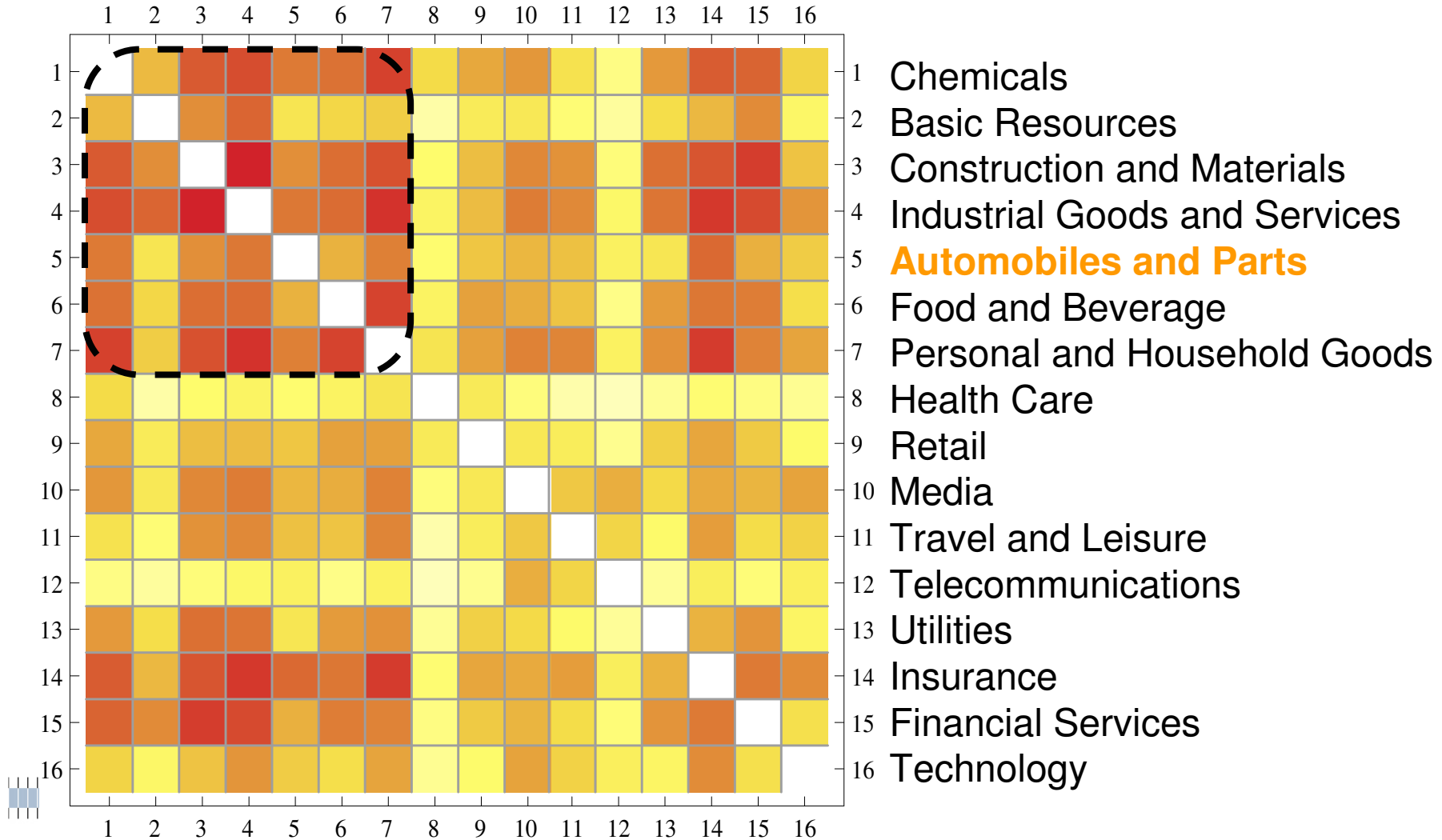
... of bank sample and total credit register; Industry Classification Benchmark (ICB)



Industrial Sectors and Correlations

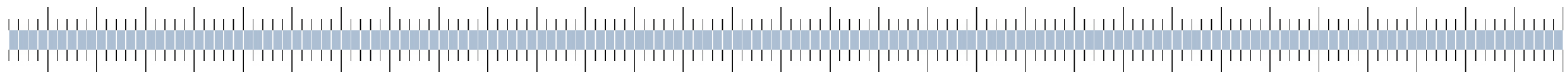
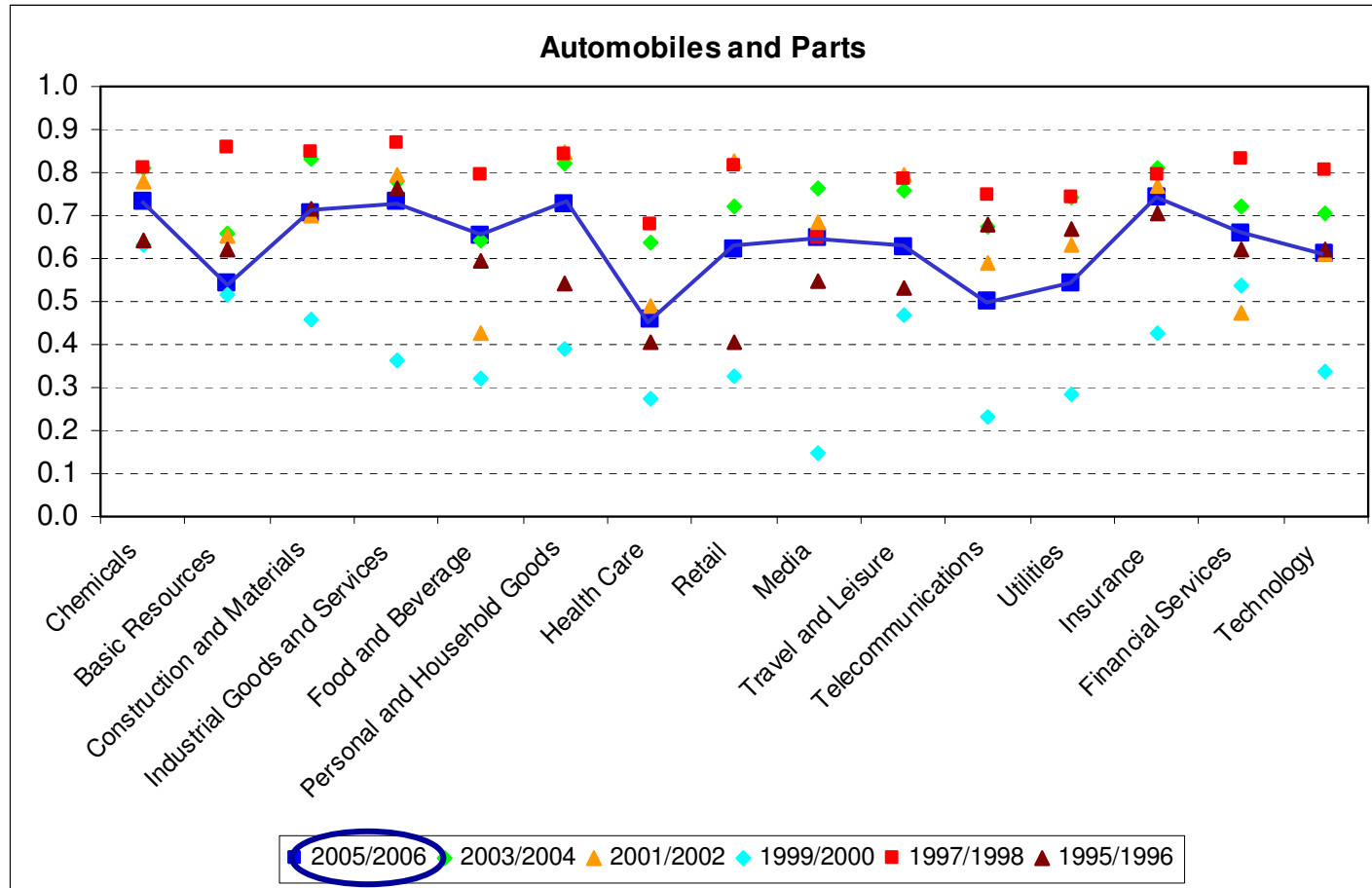


Correlation Matrix – Heat Plot



Minimum Correlation: 29 %, Maximum Correlation: 90%

Correlation with Automobile Sector



Portfolio Credit Risk Model

- Portfolio loss L_n :

$$L_n = \sum_{i=1}^n w_i \cdot LGD_i \cdot 1_{\{Y_i \leq c_i\}}$$

$$LGD = 45\%$$

- Default probability:

$$P(Y_i < c_i) = N(c_i)$$

where c_i is default barrier

- CreditMetrics-type default mode model

- Y_i : Unobservable default trigger variable

$$Y_i = r \cdot X_{s(i)} + \sqrt{1-r^2} \cdot \varepsilon_i$$

Systematic risk

Idiosyncratic risk

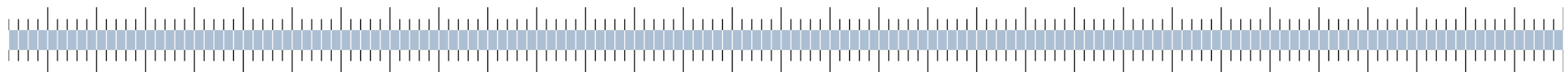
$$Y_i, \varepsilon_i \sim N(0,1)$$

$$X \sim N(0, \Omega)$$

$$\forall s, i: \text{cor}(X_s, \varepsilon_i) = 0$$

Ω : Covariance matrix of sectoral risk factors

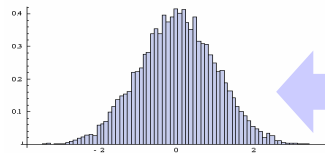
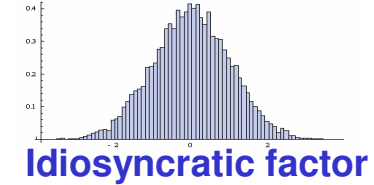
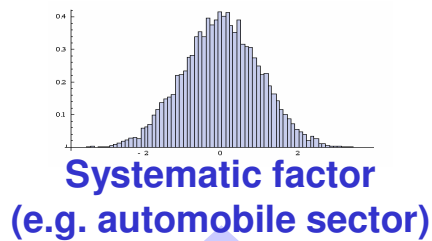
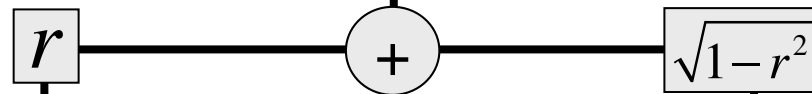
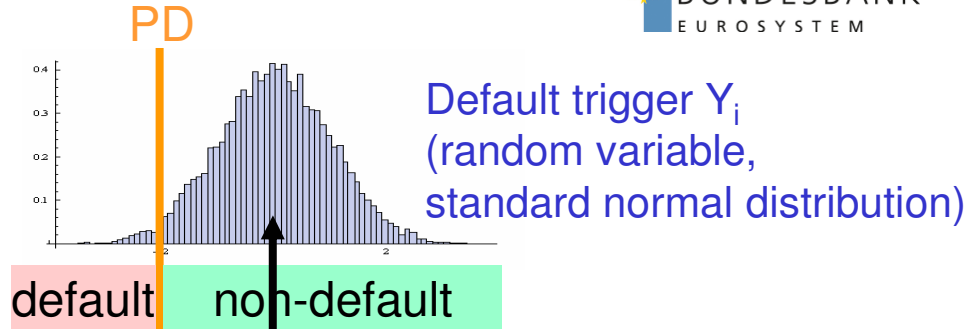
r : systematic factor weight



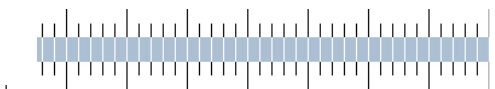
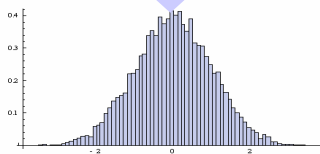
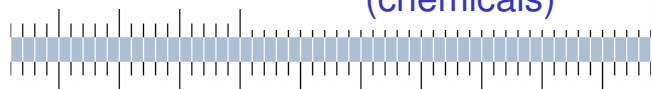
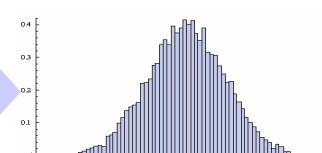
Portfolio Credit Risk Model

Y_i : Unobservable default trigger variable

$$Y_i = r \cdot X_{s(i)} + \sqrt{1-r^2} \cdot \varepsilon_i$$



interdependencies
due to correlations



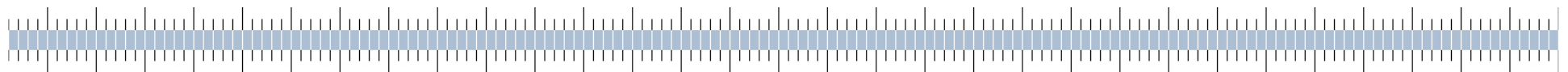
Factor Weight

- Calculation of factor weight r

$$r = \sqrt{\bar{\rho}_{i,j} / \bar{\omega}_{i,j}} \approx 0.37$$

$\bar{\rho}_{i,j}$: Empirical asset correlation of German SMEs (mean 9%)

$\bar{\omega}_{i,j}$: Mean value of elements of correlation matrix (65%)



Autoabsatz in Westeuropa bricht ein

Schlechte Ergebnisse im wichtigen Verkaufsmonat März / ZEW-Indikator deutlich gesunken

Von Harald Schwarz

Frankfurt - Die Finanzkrise hat einen der wichtigsten europäischen Industriezweige erfasst. Der Autoabsatz ist im März in Westeuropa um mehr als zehn Prozent gesunken. Das ist ein deutliches Signal für die europäische Wirtschaft.

Nach Angaben des Autogewerksverbandes VDA sank der Pkw-Verkauf in den ersten drei Monaten dieses Jahres in den meisten westeuropäischen Staaten um mehr als zehn Prozent. Der Verband der Automobilhersteller warnt allerdings nicht zu früh. Er erwartet, dass sich die Situation in den kommenden Monaten noch verschärfen wird.

Er gab an, dass die Automobilhersteller in Westeuropa im März um 10,4 Prozent weniger Autos als im März 2007 verkauften. Das ist ein deutliches Signal für die europäische Wirtschaft.

gegen mit mehr Skepsis: Die Aktie von Daimler verlor seit Anfang des Jahres mehr als 26 Prozent, die Papiere von BMW gut 20 Prozent - deutlich mehr als der Deutsche Aktienindex (Dax).

Eine schlechte Nachricht für alle Autobauer enthält auch eine Studie der Beratungsgesellschaft Booz Allen Hamilton. Demnach kommen in diesem Jahr auf die Autobranche Mehrkosten von über 500 Millionen Euro zu. Hintergrund seien die

wohl nur ein Zwischenhoch gewesen, sagte der Wirtschaftsweiser und ZEW-Präsident Wolfgang Franz. Ein Wachstum des Bruttoinlandsprodukts von 1,7 Prozent, wie es die Bundesregierung für dieses Jahr erwarte, sei aber immer noch realis-

Süddeutsche Zeitung, 16.4.2008

[...] In March 2008, the sales figures of Western European car manufacturers decreased by 10.4 per cent compared with the year before. [...]

April gleichschon - auf das Ende dieses Jahres mit „außerordentlich hohen“ Zinsen im Euro und die Gefahr, dass ein weiterer Unternehmenszusammenbruch wirtschaftliche

nach Meinung Finanzminister bis weit ins nächste Jahr 2008 hinein. Die Finanzminister des Jahres 2009 beabsichtigen, die Zinsen zu senken. Zum Ende des Jahres gebe es keine Anzeichen auf die Gefahr, dass die Zinsen bei dem derzeitigen Niveau verbleiben werden. Die europäischen Zentralbanken zuzufügen.

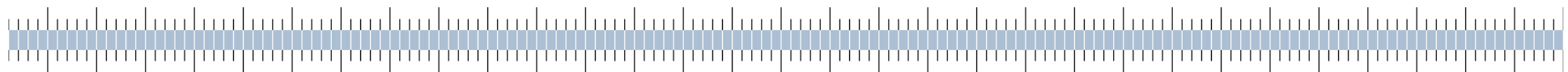
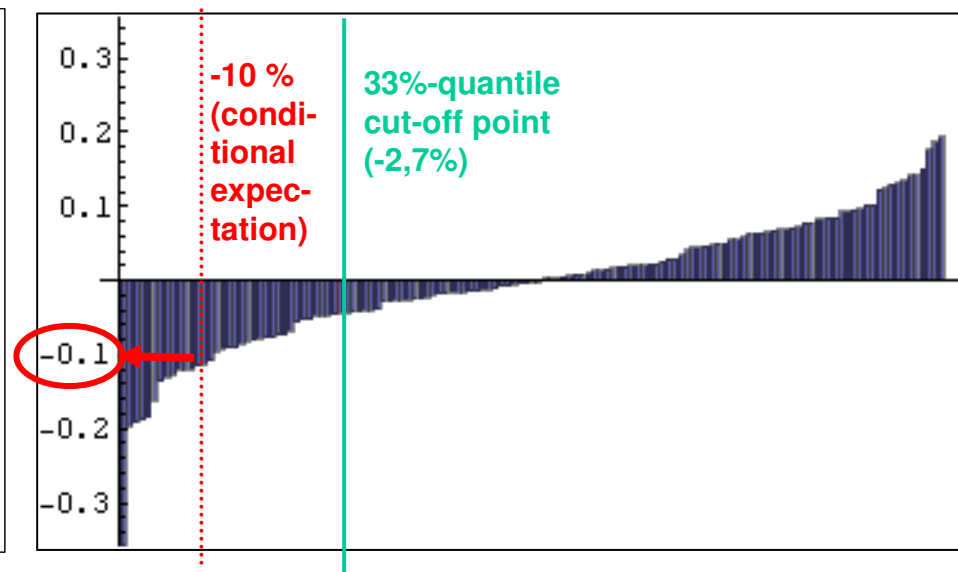
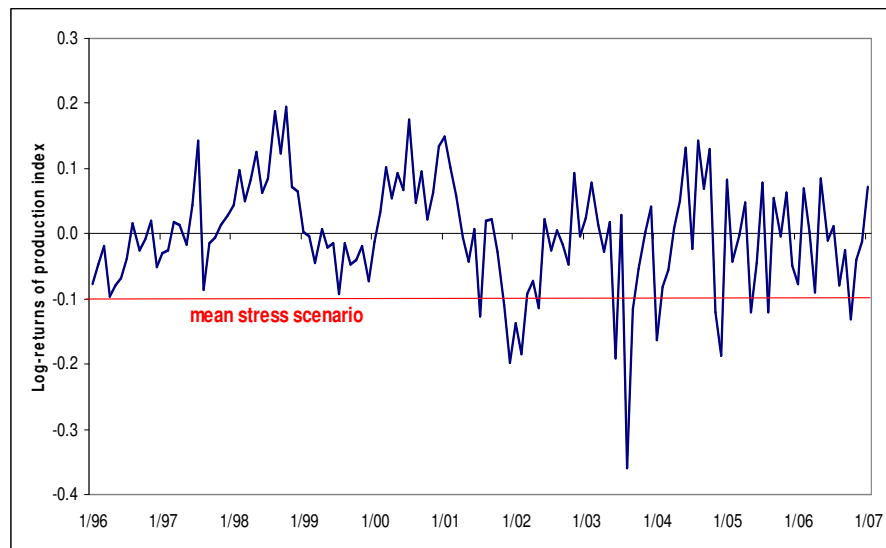
Süddeutschen Zeitung, 16.4.2008. Der Rückgang der US-Nachfrage trifft die Exporte, und wenn der Euro bei 1,80 Dollar liegt, kann sich selbst eine Export-Supermacht wie Deutschland den Folgen nicht mehr entziehen.“ (Seite 30)

die jedoch als normaler Teil des Börsenlebens nicht direkt der Immobilienkrise anzukreiden seien. Auch die Bankbranche hatte der IWF-Schätzung widersprochen. Reuters

Rückgang der US-Nachfrage trifft die Exporte, und wenn der Euro bei 1,80 Dollar liegt, kann sich selbst eine Export-Supermacht wie Deutschland den Folgen nicht mehr entziehen.“ (Seite 30)

Definition of Stress Event

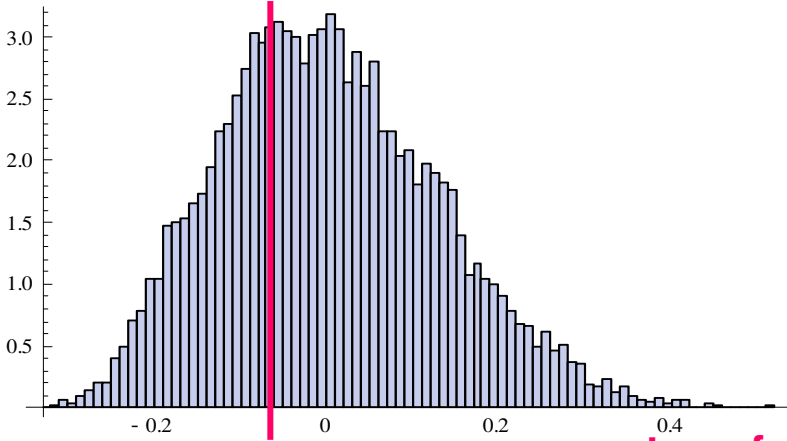
- Input: de-trended change rates of automobile production index
- Stress forecast: change in production index of -10%



Transfer of Stress Event into Model

- Cut-off quantile is used to transfer the stress event to the systematic factor of the automobile industry

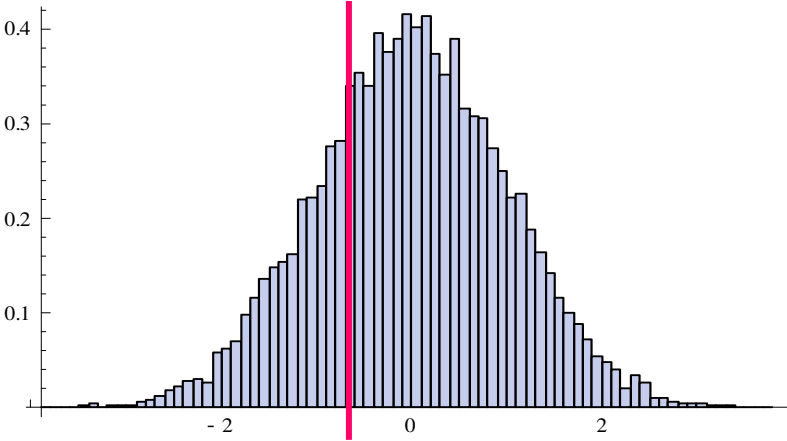
production index
(change rates)



33% quantile

transfer

systematic factor
(automobile industry)



33% quantile

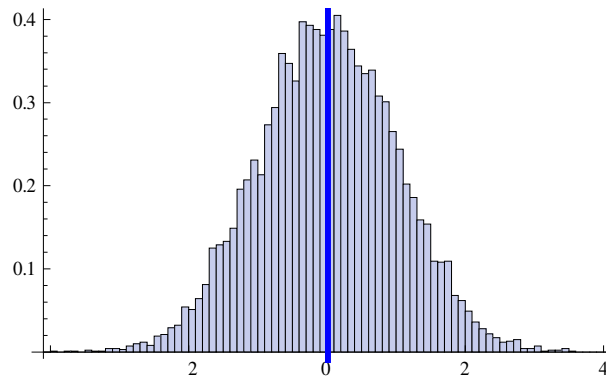
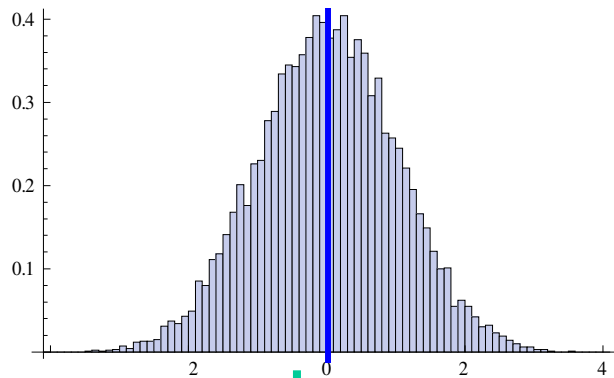
high ← probability of loan default → low

Stress Impact on Risk Factors

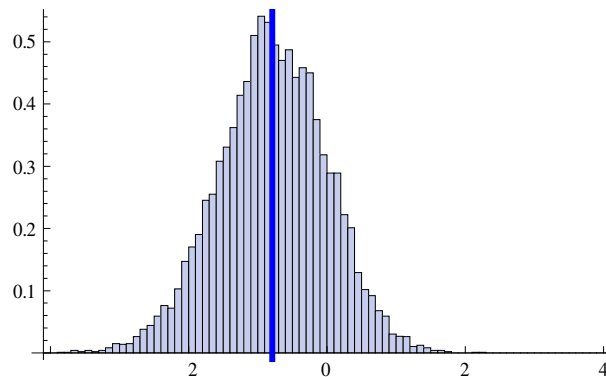
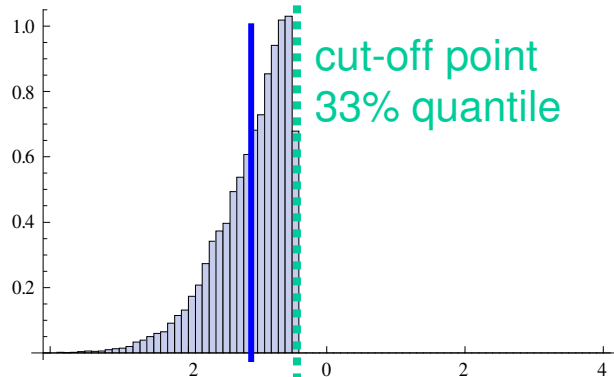
Automobile sector
(core factor)

Industrial Goods and Services
(peripheral factor)

Before
Stress

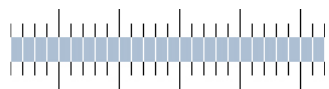


After
Stress

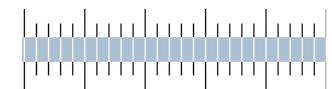


high ← probability of → low
loan default

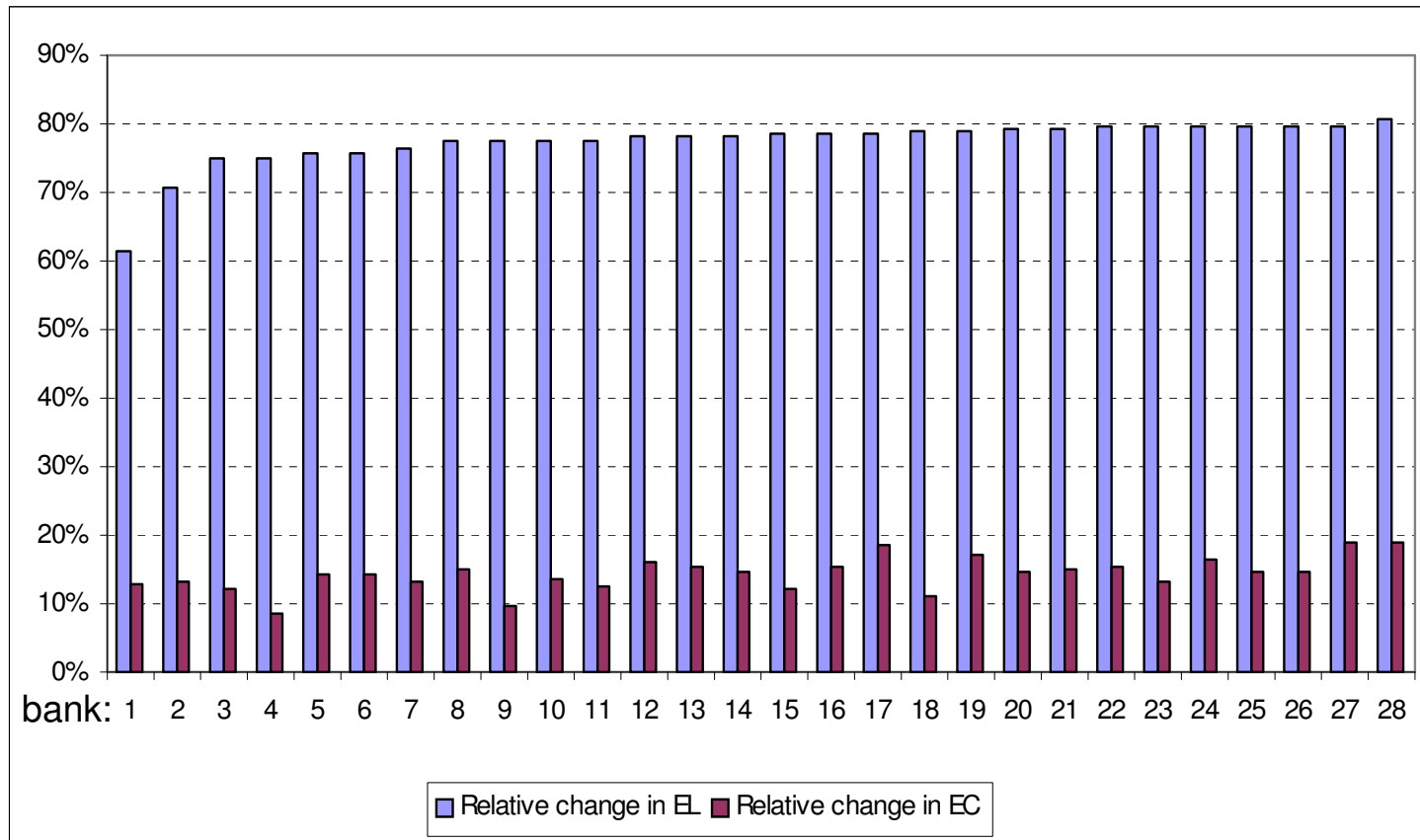
high ← probability of → low
loan default



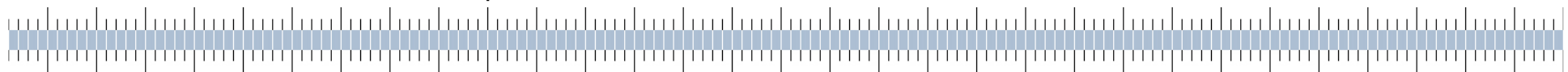
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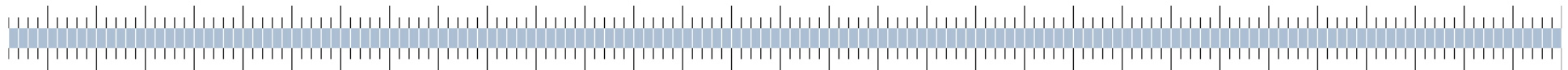
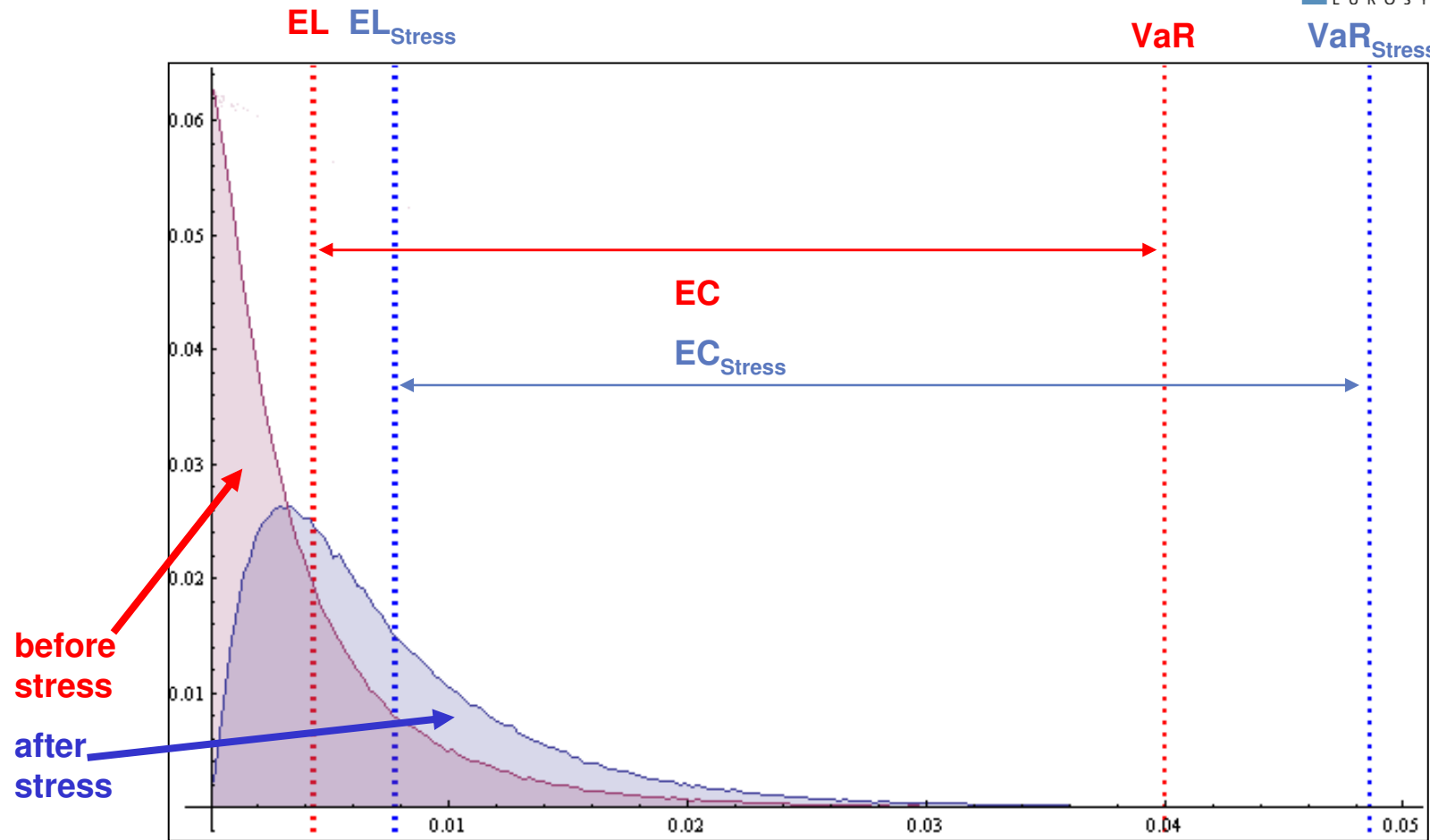
Relative Impact of Sectoral Stress on Expected Loss (EL) and Economic Capital (EC)



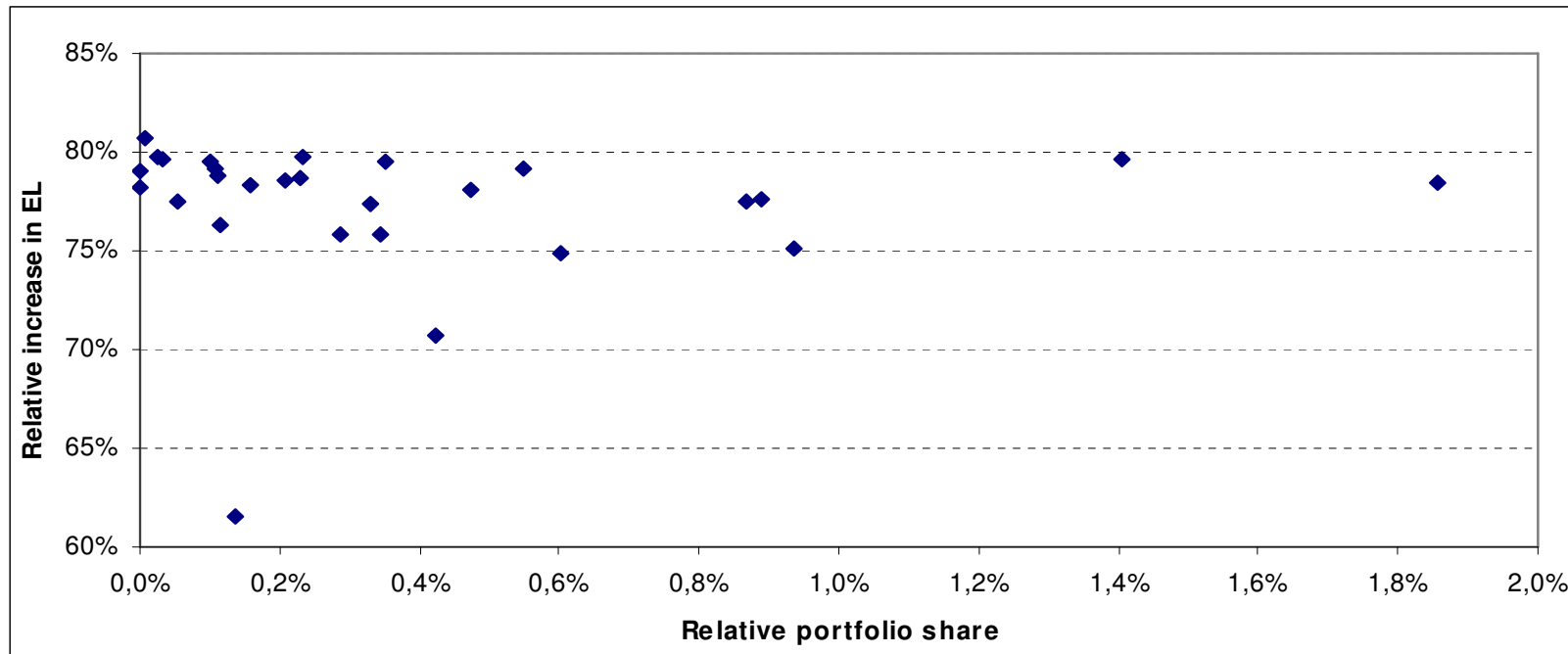
UL based on 99.9%-quantile



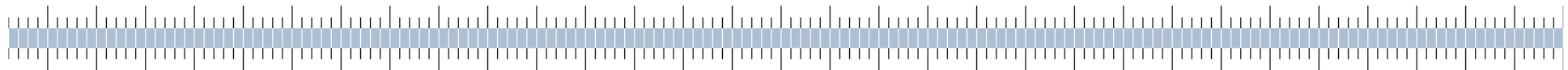
Loss Distribution before/after Stress



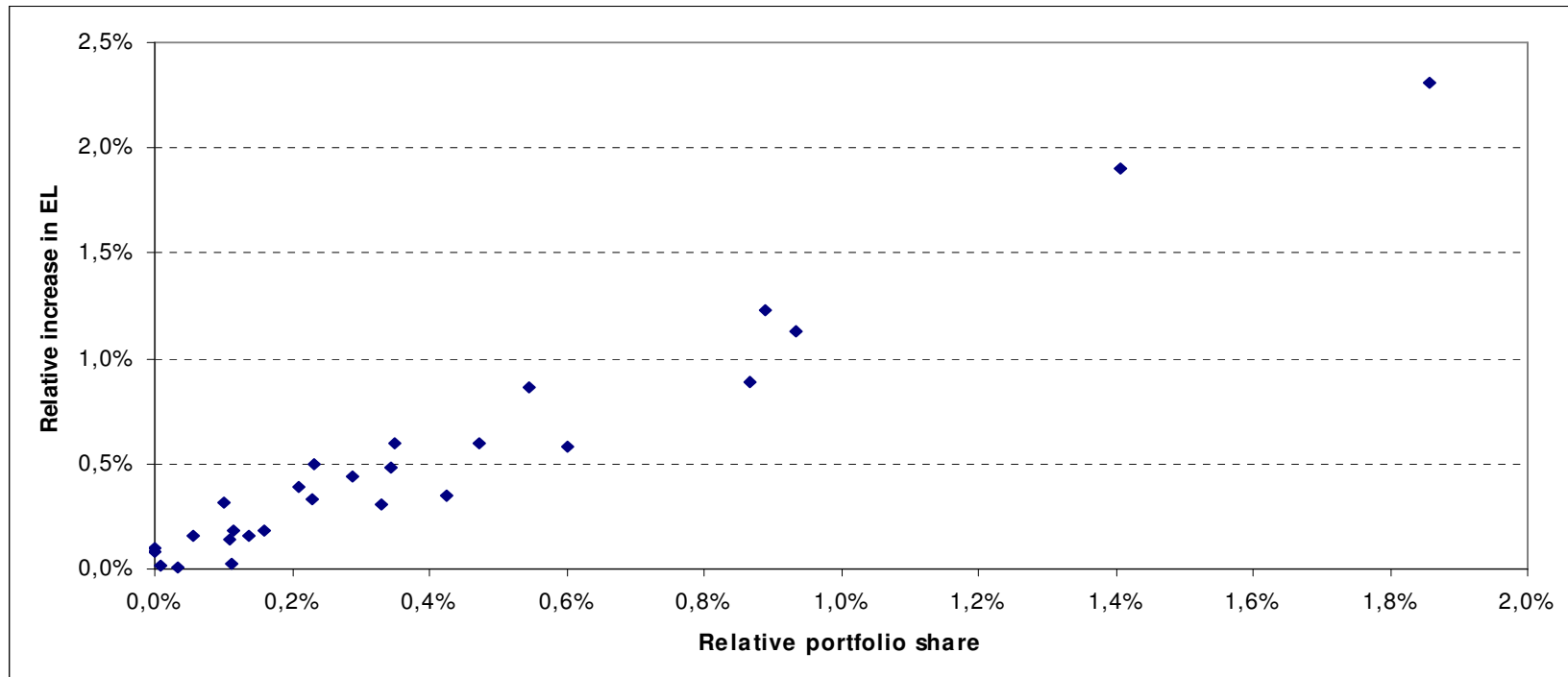
Overall Impact of Automobile Sector on EL



- No perceptible relationship between relative portfolio share of automobile sector and overall relative increase in EL
- (Isolated) automobile sector probably not main driver of overall increase in EL



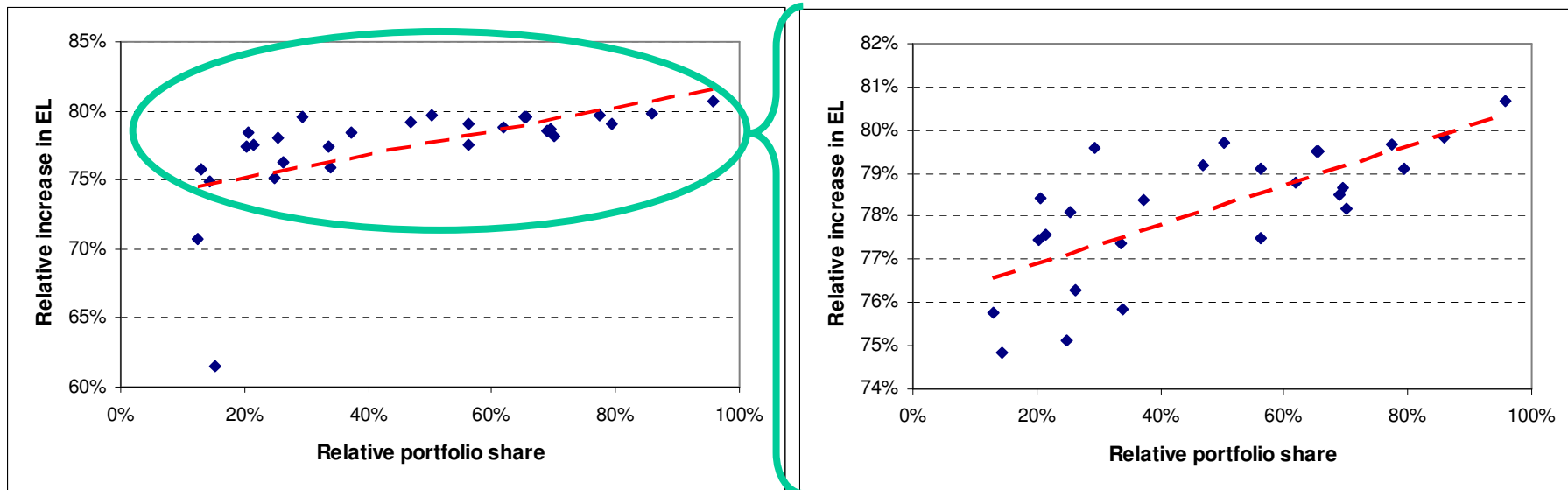
Isolated Impact of Automobile Sector on EL



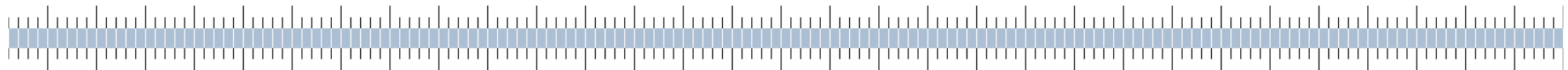
- Inter-sector correlations omitted, i.e. stress events impacts automobile sector only
→ Contribution to overall EL increase does not exceed 2.3% (overall EL increase: 60%-80% !)

Impact of Inter-Sector Correlations on EL – Financial Services Sector (Example)

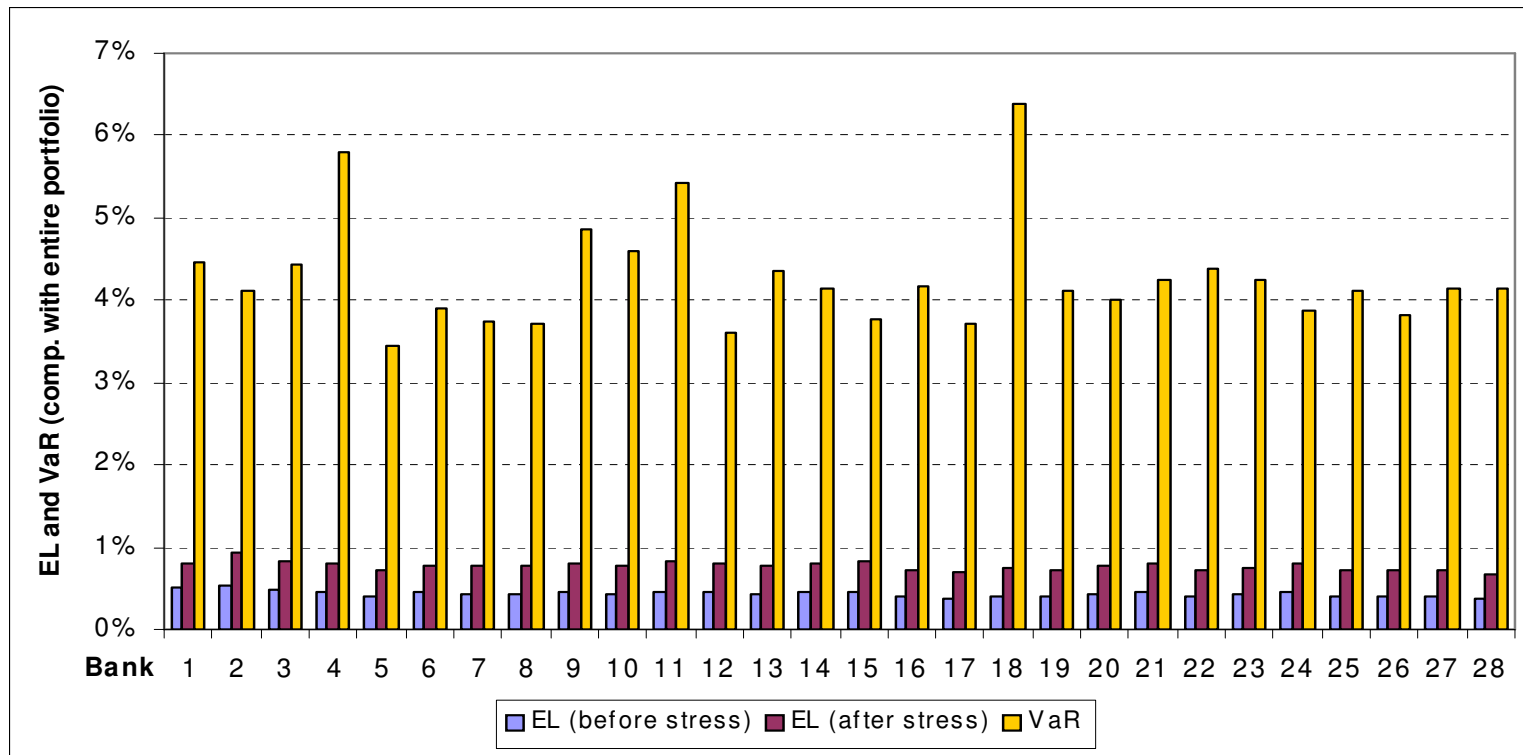
- Average portfolio share of financial services sector: 40 %
- Relatively high correlated with automobile sector: 66 %



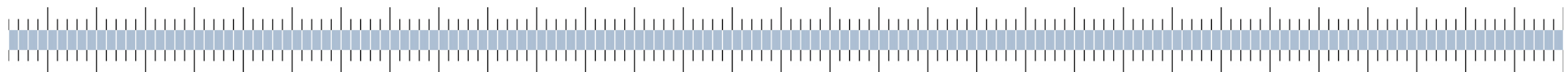
→ Increase in EL mainly driven by inter-sector correlations



Utilization of additional Capital Buffer



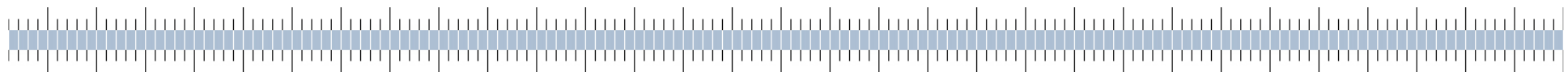
- Assumption: Banks hold additional capital up to VaR (based on 99.9%-quantile)
- Additional capital buffer sufficient to absorb impact of stress scenario



Impact on Capital Ratio

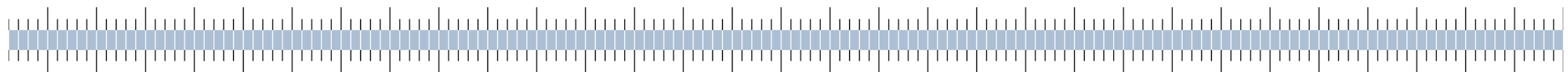
$$CR^{stress} = \frac{\text{capital} - \Delta EL^{stress}}{\text{risk weighted assets incl. market risk}}$$

- Capital ratios CR reduced on average from **12%** to **11.6%** under stress conditions
- Robustness check
 - Usage of highest correlations observed between 1995 and 2006
 - Moderately lower capital ratios under stress: on average **11.5%**



Results

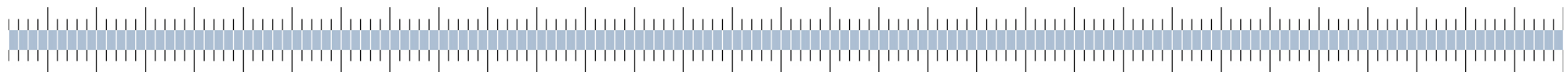
- EL increases by 70 – 80%
 - But increase below 2.3% if only impact on stressed sector considered
- Correlation effects play a key role ("hidden concentrations")
 - Stress impact on core sector (automobile industry) can almost be neglected
 - Certain peripheral sectors are main driver due to inter-sector correlations
- Capital ratios under stress conditions remain on average well above the regulatory minimum of 8%



Outlook on Follow-up Project: Multi-Sector Stress Test

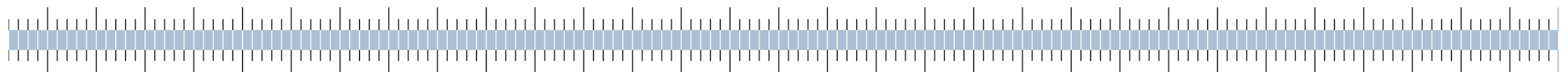


- Follow-up project launched in spring 2008
- Motivation
 - Severe downturn in US
 - More than one sector affected by the economic downturn
- Multi-sector stress test
 - **Primary stress impact:** Three sectors most critical for German exports to US
 - Chemicals, industrial goods and services, automobile
 - **Secondary stress impact:** Remaining industry sectors via inter-sector correlations

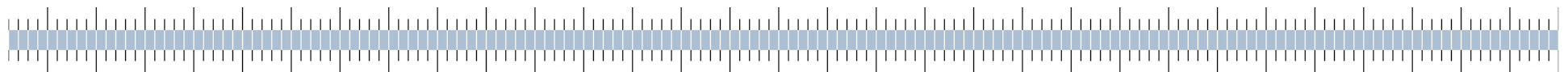


Outlook on follow-up Project: Further Model Extensions

- Integration of macro-economic stress forecast model
 - Allows simultaneous and consistent stressing of *multiple* industry sectors
- Impact of heterogeneity in default probabilities
 - So far: average PD for all companies within a certain sector
 - Borrower-specific PDs available from mid 2008



- Paper available
 - Stress testing German banks in a downturn in the automobile industry (Klaus Duellmann, Martin Erdelmeier)
 - www.bundesbank.de/vfz/vfz_diskussionspapiere_2009.php



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