

Joint Research Centre

Unit Finance and Economy

**Activities and
ways to cooperate**

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Outline

- **PART 1: GENERAL INTRODUCTION**
 - The JRC and Unit Finance and Economy
 - How we can collaborate

- **PART 2: SELECTED EXAMPLES**
 - SYMBOL
 - Robust clustering and robust PCA



PART 1: GENERAL INTRODUCTION

JRC is the EC's science and knowledge service

Our mission is to support EU policies with **independent evidence** throughout the whole policy cycle

Work is in strict contact
with policy DGs in
Brussels

Work is in strict
collaboration with
partners in the academia

The JRC Unit Finance and Economy

The Unit was created in 2011 as response to the financial crisis

Now it supports the EC in its efforts to strengthen economic governance and to build a stable financial system in the EU

Main research areas

- Modelling the EU banking system to assess policy options for banks
- Modelling the economies of the EU member States
- Capital markets integration and the SMEs financing
- Enhancing the role of “fairness” and “resilience” in the EU policy debate

The JRC provides scientific backing for



- Ex ante impact assessment of EC initiatives

- Proposals negotiation



- Monitoring the implementation of legislation

- Research to anticipate future policy needs





Selected policy impacts (banking)

- ❑ European Deposit Insurance Scheme, 2015 & 2016
- ❑ Capital Requirement Directive 4 & Revision, 2011 & 2016
- ❑ Structural reform of the European banking sector, 2014
- ❑ Bank Recovery and Resolution Directive, 2013
- ❑ Single Resolution Fund Contributions, 2015 & 2016
- ❑ Deposit Guarantee Schemes Directive, 2010, 2015, 2016

Macromodels are regularly used for e.g. the Spring and Autumn Forecasts of the EC and for MIPs

Collaboration forms

PhD students:

- Students enrolled in a PhD program, topic linked to Unit activities
- Work contract up to 36 months, working place is the JRC
- Special leaves of 5 days per year

Trainees:

- Official traineeship program of the EC for graduates
- Work contract up to 5 months, working place is the JRC

Senior scientists:

- Senior scientists holding a PhD + 10 years of research experience in a field relevant to the JRC's scientific activities
- Work contract up to 24 months, working place is the JRC

Organisational aspects

All contracts/grants need to

- be approved by hierarchy
- follow internal administrative rules, which require some months of time (4-6 months)
- be launched via calls, open to all public

Successful stories

In 10 years:

- 6 successful PhD (4 KU Leuven, 1 Bocconi, 1 Cass Business School London), 1 ongoing (TU Munich & KU Leuven)
- ~ 10 trainees
- Currently 3 senior scientists on site from various EU universities

JRC “Community of Practice in Financial Research”

Formalization of collaborations with academic partners

- Intent to collaborate in specific areas e.g. joint papers, exchange of staff, joint organization of events
- First meeting with potential partners, May 2016
- Potential launch event in spring 2017 (TBC)

Active collaborations with

OECD, ECB, ESRB, World Bank, EIF



PART 2: SELECTED EXAMPLES

The way we work

Policy driven research

- Data analysis
 - Data quality
 - Imputation of missing observations
- Statistical and mathematical modelling
 - SYMBOL model
 - Clustering and PCA

The way we work

Data analysis: data quality

Every year we produced a comprehensive dataset of the financial institutions in EU28

Different data sources are used:

- Commercial databases (Bankscope, SNL financial)
- Institutional country aggregate statistics (ECB, BIS, AMECO, World Bank)
- In-house surveys (eligible and covered customer deposits)

The way we work

Data analysis: data quality

All this leads to a strong need of suitable analyses on data coherence

Data on the banking sector present different level of reporting

- Consolidated
- Unconsolidated
- Aggregate

The way we work

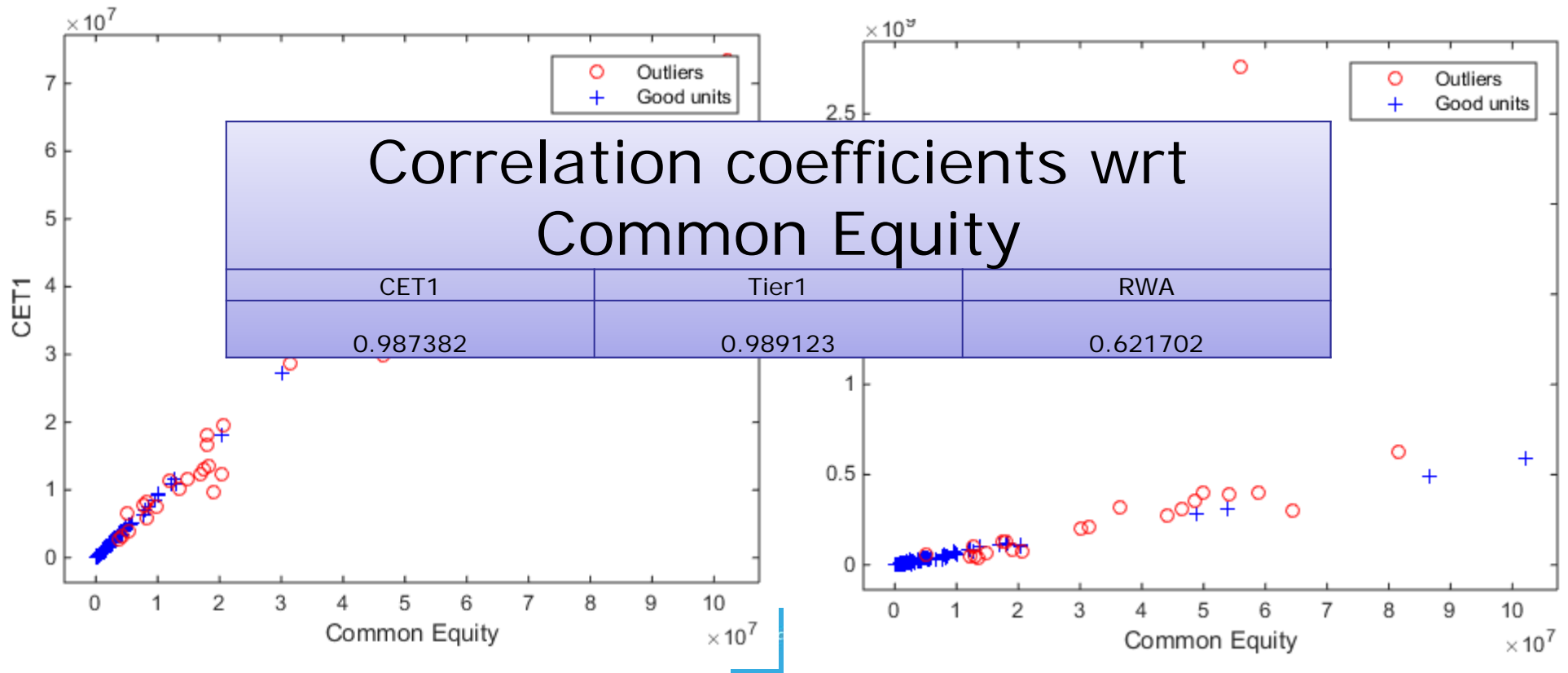
Imputation of missing observations

Datasets (even commercial ones) usually present quite few missing observations

Missing observations		
CET1	Tier1	RWA
49.58%	43.94%	43.10%

The way we work

Imputation of missing observations: fortunately we can use some proxies for imputations

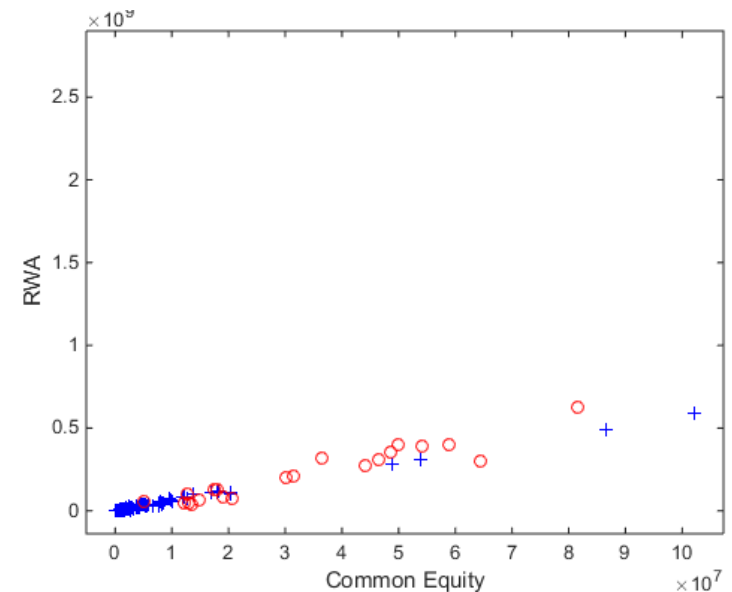


The way we work

Imputation of missing observations

Not considering the outlier correlation RWA CE increase to 0.9819

RWA	RWA no outliers
0.621702	0.9819



Robust imputation strategy

FSDA Toolbox

<https://ec.europa.eu/jrc/en/scientific-tool/fsda-matlab-code/downloads>

The way we work

Open problem (at least for us)

Through statistically robust procedures we aim to develop a general framework to input missing observations by regression estimates based on suitable proxies and data at different aggregation scales, taking into consideration the presence of outliers

The way we work

Statistical and mathematical modelling

- SYMBOL model
 - Used for assessing different impact on financial stability of different regulatory initiatives
- Clustering and PCA
 - Impact of separating risky and commercial banking activities

*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
of Financial Services Research*

The intuition of the SYMBOL model

- In 2005 the JRC was asked to support DG MARKT in the revision of the **Directive on Deposit Guarantee Schemes (DGS)**
- Key issue to be investigated: **target size of DGS funds**
- First goal: to provide an **estimate of the DGS loss distribution**

*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
of Financial Services Research*

The intuition of the SYMBOL model

KEY IDEA:

use BASEL II/III regulatory model and public data to simulate individual bank losses and aggregate at system-wide level

The **Basel Accord** imposes that each bank satisfies regulatory **capital requirements** to guard against the risks the bank may face

(“Advanced approach” → Vasicek single factor model of portfolio credit risk -- Loss distribution formula is available)

This capital provides a buffer against unexpected losses at a specific level of statistical confidence (fixed at 99.9%)

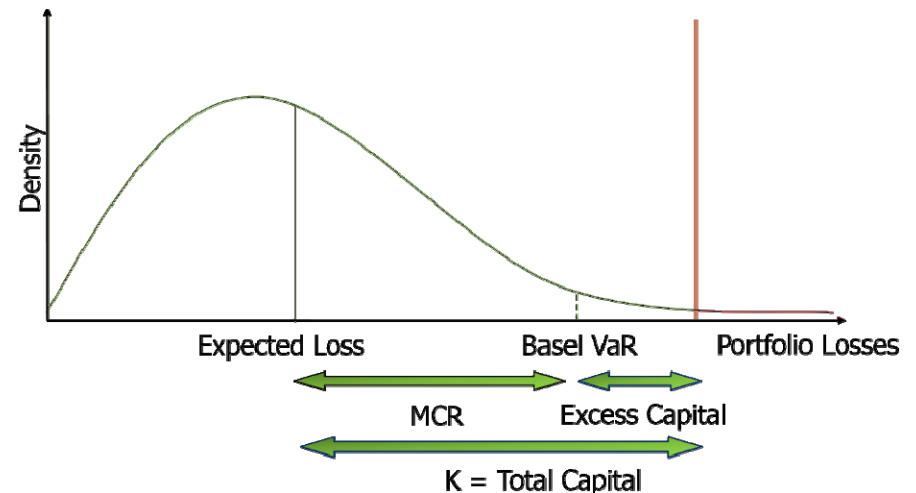
Regulatory capital (and effective capital) is publicly available.

If regulatory loss distribution parameters can be set for each bank, simulation can be performed

*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
of Financial Services Research*

The intuition of the SYMBOL model

1. Banks calculate their MCR using the 'Basel' IRB formula
2. Invert the Basel formula to obtain the average implied PD of each bank's asset portfolio
3. Using the obtained loss distributions, we run Monte Carlo simulations to get random realizations of loan losses for each bank
4. Check which banks fail (losses > K) and which need recap (losses > Excess cap)
5. When we have 100.000 runs with at least one bank failure, derive matrix of losses
6. Aggregate losses for each run at country level and rank them (low->high losses exceeding capital).
7. Select a percentile, (e.g. 99.95) check the losses attributed to (i) equity (ii) public finances and safety nets (iii) creditors



*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
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The intuition of the SYMBOL model

$$\frac{K_i}{\sum_l A_l} = \left\{ LGD \times N \left[\frac{\sqrt{R} N^{-1}(0.999) + N^{-1}(\overline{PD}_l)}{\sqrt{1-R}} \right] + \right. \\ \left. - LGD \times \overline{PD}_l \right\} \times \text{Maturity Correction}$$

K = Regulatory capital

A = Assets

LGD = Loss Given Default for assets

R = Correlation between assets' values

PD = average probability of default of banks' obligors

Known

**Default values
in regulation**

Unknown

Average probability of default of the loans portfolio of bank *i* can be derived by numerically inverting FIRB formula

*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
of Financial Services Research*

The intuition of the SYMBOL model

$$L_{hj}^{\alpha} = N \left[\frac{\sqrt{R_j} N^{-1}(\alpha_{hj}) + N^{-1}(\overline{PD}_j)}{\sqrt{1 - R_j}} \right]$$

Given the banks' average (implied) obligors' PD we can simulate for each bank j a sample of gross losses ($h = 1, 2, \dots, H$) by extracting a set of random numbers α_{ij} (representing how extreme is the shock to which the bank is subject)

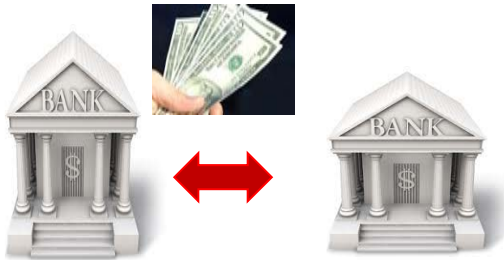
As banks are exposed to common shocks, random numbers are correlated normal random variables with covariance matrix

$$\Sigma = \begin{bmatrix} 1 & \rho & \dots & \rho \\ \rho & 1 & \rho & \dots \\ \dots & \rho & \dots & \rho \\ \rho & \dots & \rho & 1 \end{bmatrix}$$

*Modelling Deposit Insurance Scheme
Losses in a Basel 2 Framework, Journal
of Financial Services Research*

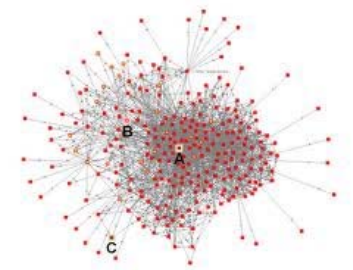
Contagion

SYMBOL can include **contagion effects** between banks linked
via the **interbank market**



Assumption

Whenever a bank defaults, 40%
of its interbank debits are
passed as **extra-losses** to
creditor banks



As true IB linkages are unknown, but total A/L are, losses
are distributed following ...

Application 1 : debt bias

The corporate debt bias and the cost of banking crises
<http://voxeu.org/article/corporate-debt-bias-and-cost-banking-crises>

CIT in most countries favors debt- over equity-financing

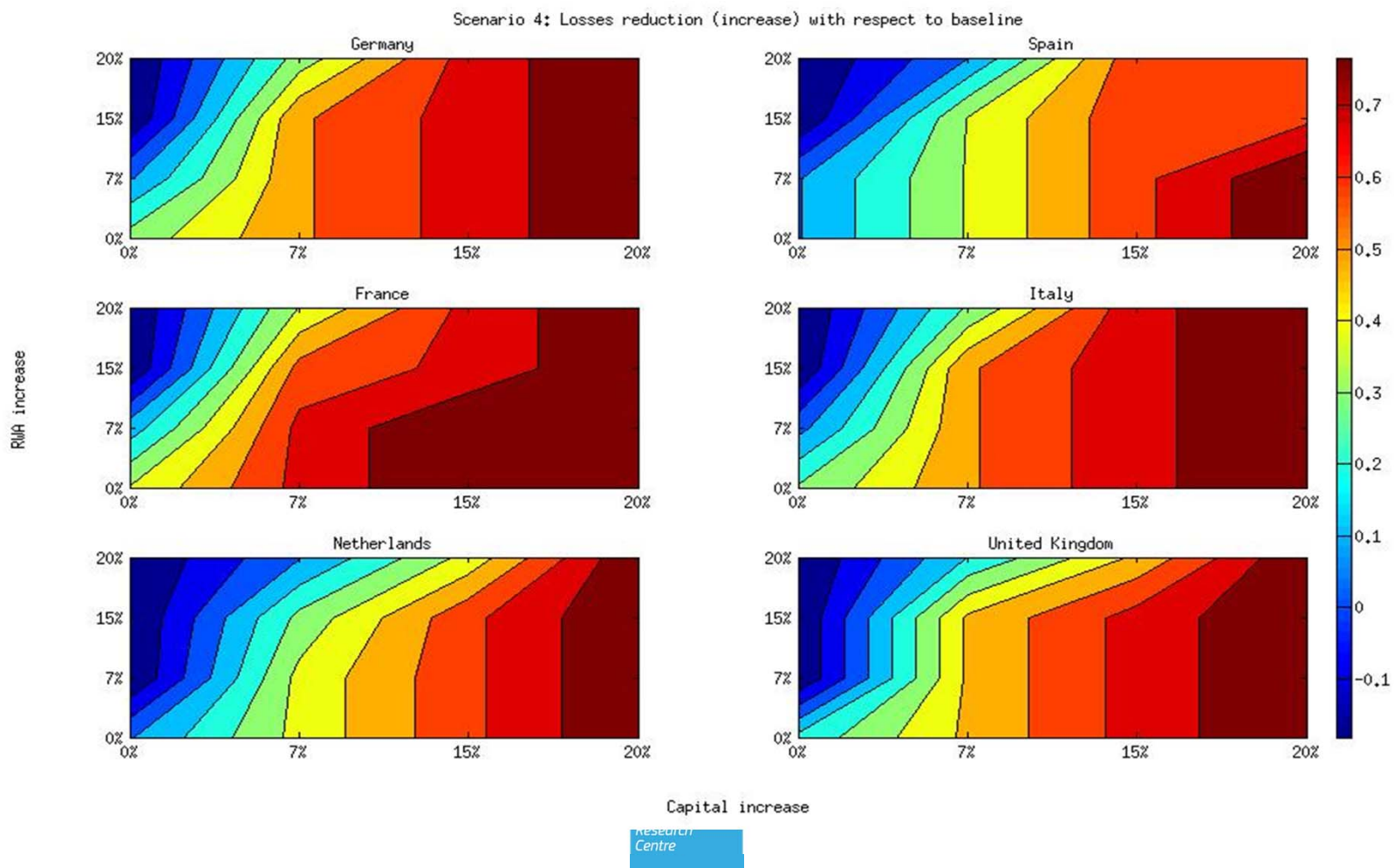
Eliminating this tax bias (for banks) could complement regulatory reforms reducing costs of financial crises

We estimate the potential effect of elimination of debt bias on public finance costs of financial crises

Endogenous reaction of asset risk to changes in the capital structure

Increase of capital → increase of risk

Application 1 : debt bias



Application 2: farewell to bail-out

The last economic and financial crisis has shown how quickly vulnerabilities on the financial side of the economy can turn into a deterioration of public finances.

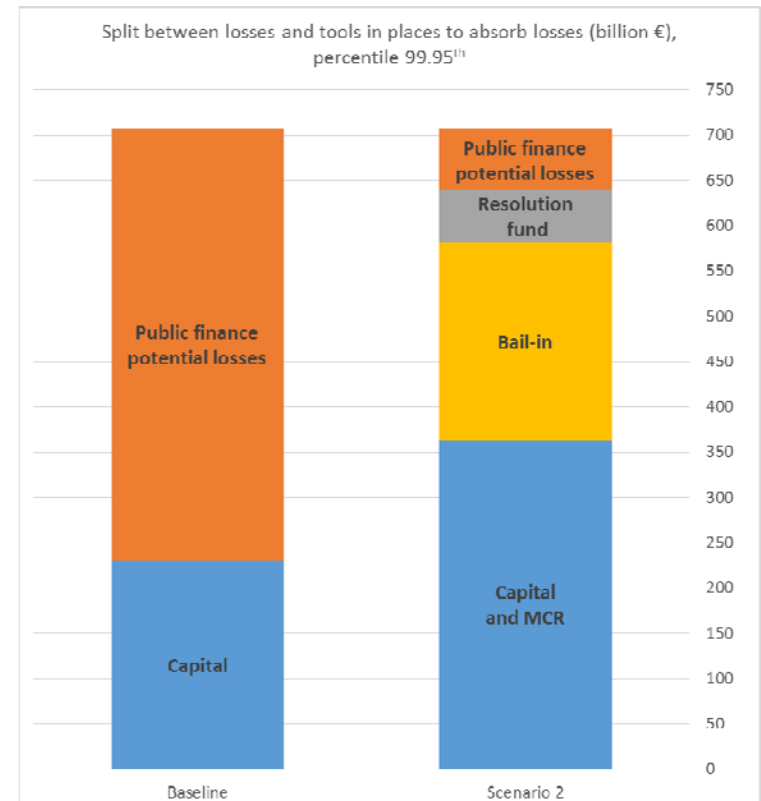
First response to the crisis: bail-out by governments and central banks (600 bn €, 4.6% EU GDP in 2008-2012).

EC: **new regulatory framework** to strengthen the financial system, improving market transparency and protect consumers.

- Capital Requirement Directive IV
- Bank Recovery and Resolution Directive
- Single Resolution Mechanism Regulation
- Deposit Guarantee Schemes Directive

Safety-net tools

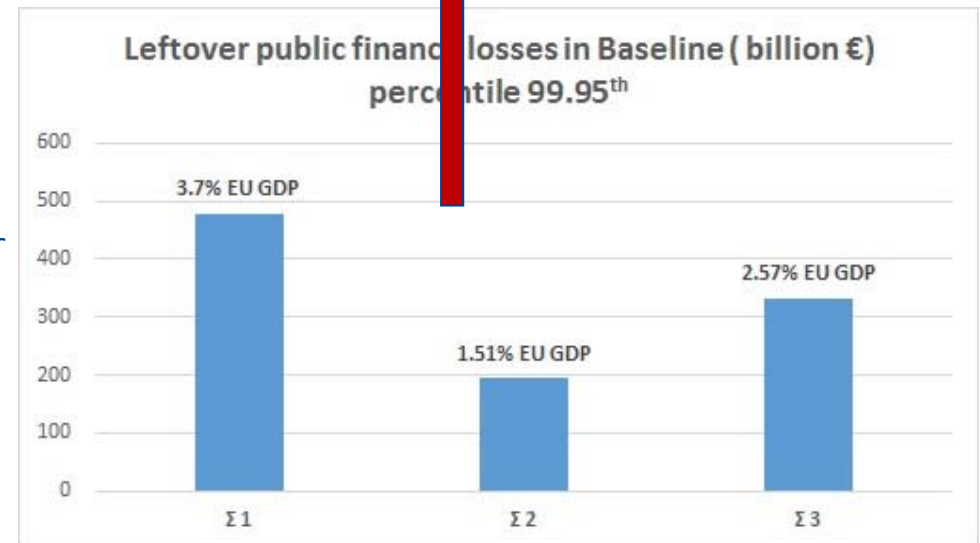
Evaluating the effectiveness of the new EU bank regulatory framework: A farewell to bail-out?
Journal of Financial Stability



Application 2 : farewell to bail-out

$$[\Sigma^1]_{i,j} = \begin{cases} 1 & i = j \\ 0.5 & i \neq j \end{cases} \quad [\Sigma^2]_{i,j} = \begin{cases} 1 & i = j \\ 0.5 & i \neq j \wedge C_i = C_j \\ 0 & i \neq j \wedge C_i \neq C_j \end{cases} \quad [\Sigma^3]_{i,j} = \begin{cases} 1 & i = j \\ 0.6 & i \neq j \wedge C_i = C_j \\ 0.3 & i \neq j \wedge C_i \neq C_j \end{cases}$$

- Σ^1 : all banks have 0.5 correlation factor
- Σ^2 : banks within the same country have correlation factor equal to 0.5, banks in different countries have 0 correlation factor
- Σ^3 : banks within the same country have correlation factor equal to 0.6, banks in different countries have 0.3 correlation factor.



Statistical modelling: identifying banks' business models

Banks under X-rays: business model choices and trading
Journal of Financial Economic Policy

Policy context: strengthen financial stability by separating/ring fencing **risky trading activities** from more customer-oriented activities (2011)

- Volcker rule (US)
- Vickers' (UK)
- Germany and France
- High Level Expert Group (HLEG) chaired by Liikanen

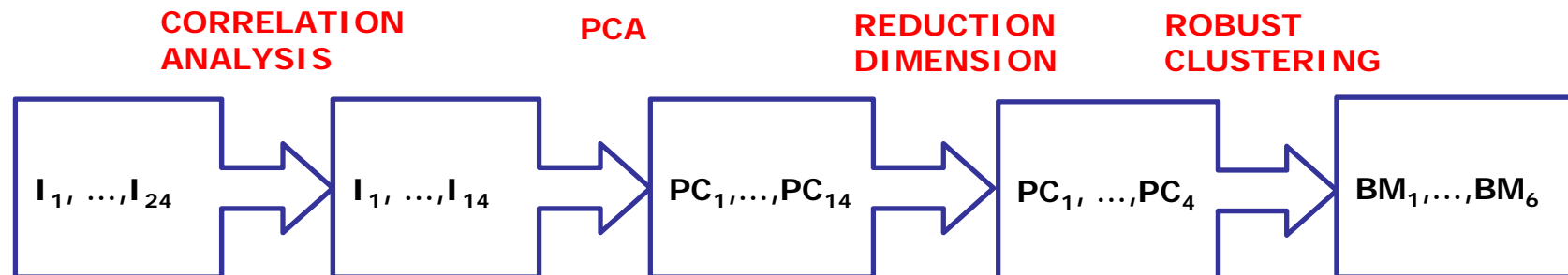
Research objective: couple information on trading and banks' business model

Statistical modelling: identifying banks' business models

Bank business model are assessed based on balance sheet indicators

Statistical tools:

- **TCLUSTERING:** Robust clustering (FSDA Matlab toolbox developed by JRC and academia)
- **PCA** Principal component analysis coupled with robust statistics



Statistical modelling: identifying banks' business models

Inv: Very large and leveraged investment banks, having large shares of derivatives assets & liab. and also high %trading income

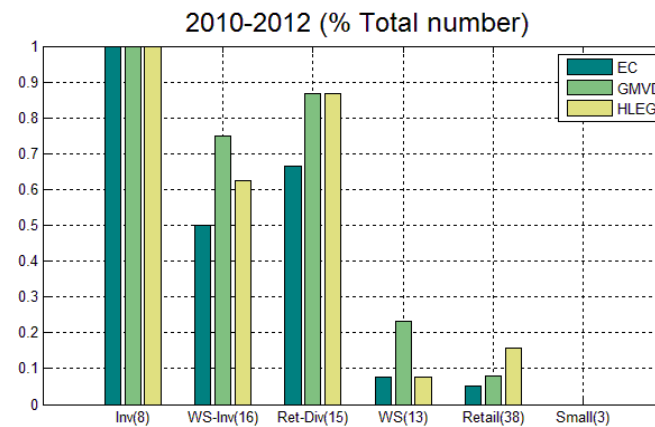
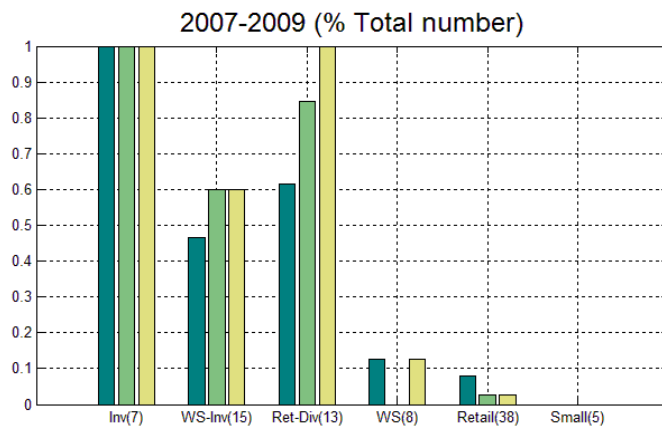
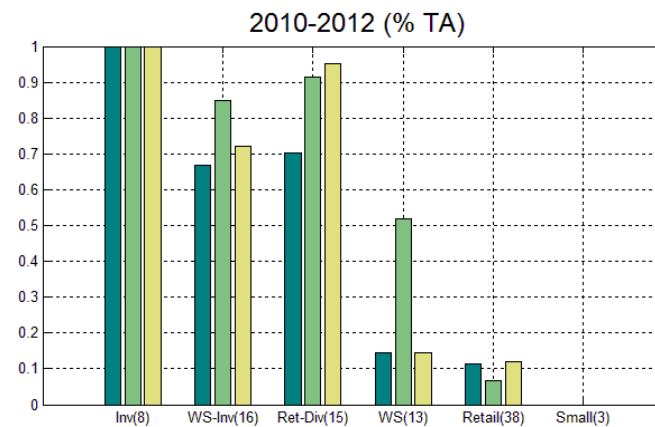
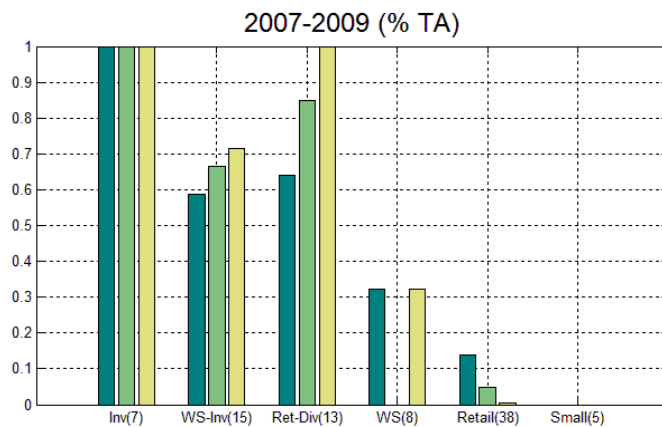
WS-Inv: Medium-large wholesale investment banks, with a stronger orientation toward interbank financing. It contains the least capitalized banks

Ret-Div: Large and very large retail diversified banks, having introduced derivative trading in a pure retailed focused model

WS: Medium sized wholesale banks, funding via wholesale and diversifying assets between retail and trading activities

Retail , Small: Small and medium sized retail focused banks, focused on customer deposits and loans

Statistical modelling: identifying banks' business models



Selected publications

- Heynderickx W., Cariboni J., Schoutens W., Smits B. (2016), European banks' implied recovery rates, **Journal of Banking & Finance**, submitted
- Benczur P., Cannas G., Cariboni J. et al (2016), Evaluating the effectiveness of the new EU bank regulatory framework: A farewell to bail-out?, **Journal of Financial Stability**
- Nardo M., Petracco Giudici M., Naltsidis M. (2016), Walking down Wall Street with a tablet: A survey of stock market predictions using the web, **Journal Of Economic Surveys**
- Garcimartín C., Kvedaras V., Rivas L. (2016), Business cycles in a balance-of-payments constrained growth framework, **Economic Modelling**
- Benos N., Karagiannis S. (2016), Do Education Quality and Spillovers Matter Evidence on Human Capital and Productivity in Greece, **Economic Modelling**
- Kollmann R., Pataracchia B., et al (2016), The Post-Crisis Slump in the Euro Area and the US: Evidence from an Estimated Three-region DSGE Model, **European Economic Review**
- Hohberger S., Kraus L. (2016), Is fiscal devaluation welfare enhancing , **Economic Modelling**
- Di Girolamo F., Campolongo F., et al (2016), Contingent Conversion Convertible Bond: New avenue to raise bank capital, **International Journal of financial engineering**



- Heynderickx W., Cariboni J., Schoutens W., Smits B. (2015), The Relationship between Risk-Neutral and Actual Default Probabilities: the Credit Risk Premium, **Applied Economics**
- Campolongo F., Cariboni J., Ndacyayisenga N., Pagano A. (2015) Banks under X-rays: business model choices and trading, **Journal of Financial Economic Policy**
- Lahiri K., Monokrousos G., Zhao Y. (2015), Forecasting Consumption: The Role Of Consumer Confidence In Real Time With Many Predictors, **Journal of Applied Econometrics**
- Dierx A., Ilkovitz F., Pataracchia B., Ratto M., et al (2015), Does EU competition policy support inclusive growth, **Review of Industrial Organization**
- Int Veld J., Pagano A., et al. (2015), Imbalances and rebalancing in an estimated structural model for Spain, **International Journal of Central Banking**
- Corcuera J.M., De Spiegeleer J., Fajardo J., Jönsson H., Schoutens W. (2014), Close form pricing formulas for Coupon Cancellable CoCos, **Journal of Banking & Finance**
- Fiorentini G., Planas C., and Rossi A. and (2014), Efficient MCMC sampling in dynamic mixture models, **Statistics and Computing**, 24, 77-89.
- Maccaferi S, Cariboni J, Schoutens W. Lévy, (2013), Processes and the Financial Crisis: Can We Design a More Effective Deposit Protection, **International Journal of Financial Research**



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