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STRESS TESTING: PRACTICE AND IDEAS FOR RESEARCH

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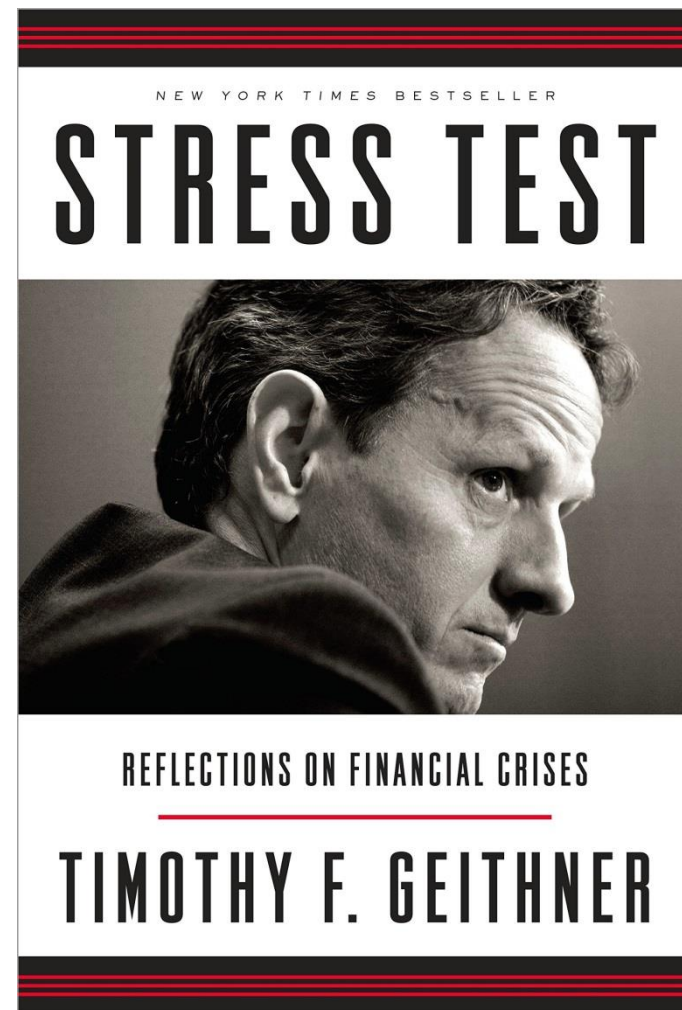
Agenda

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A flashback to 2009

- Feb 2009: Tim Geithner orders stress test of leading 19 US banks

- Bernanke says tests go beyond any form of oversight ever conducted among US banks, hoping they will bring "greater confidence" to markets

- Afterwards, stress tests emerged as solution to address backward-looking nature of capital ratios
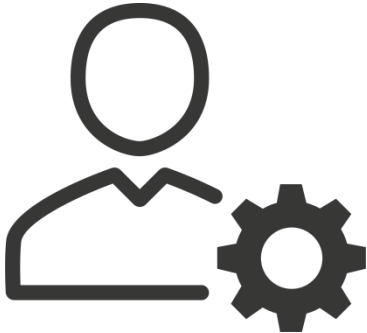
So what is a stress test?
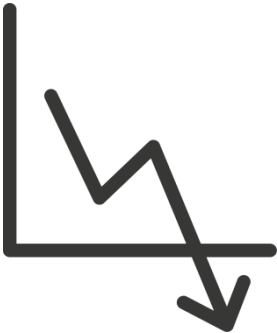
Scenario + Model(s) + Assumptions = Outcome

[macro time series] [ex: loan losses] [ex: div policy] [ex: capital ratio]

Design choices in a stress test

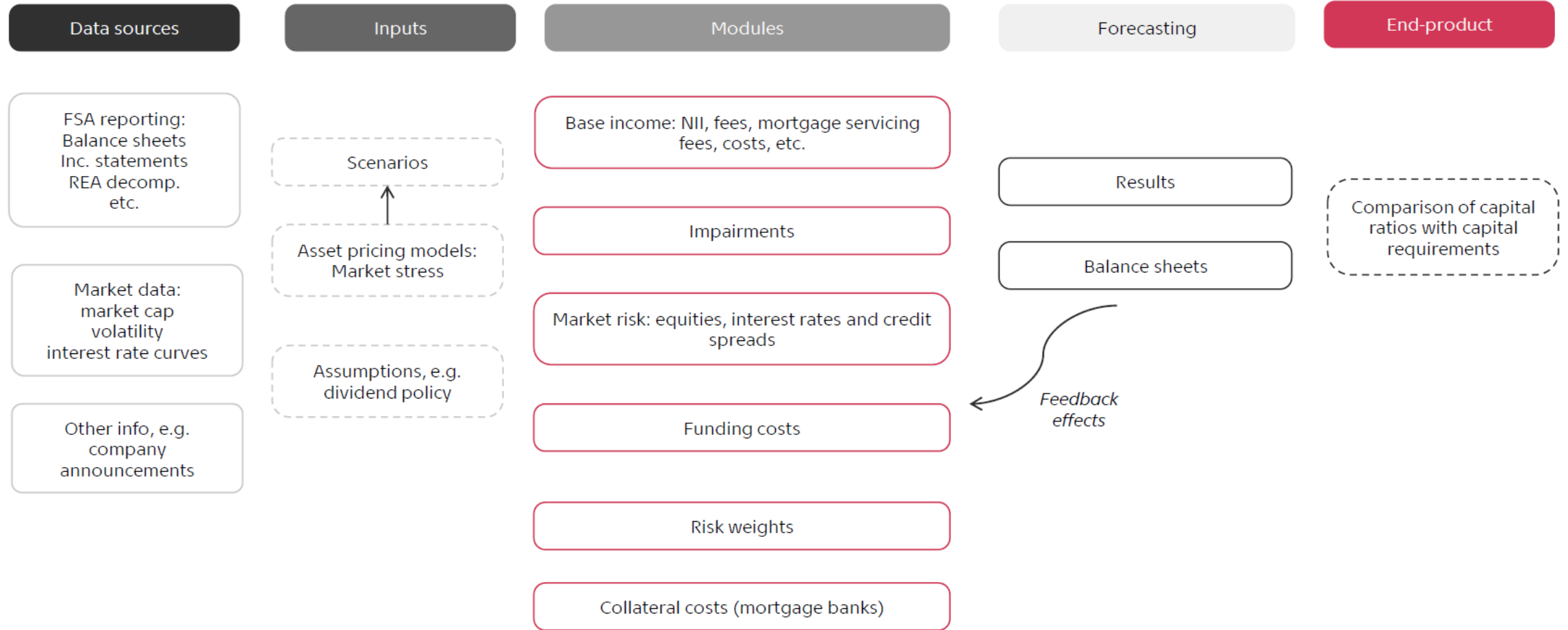| Design choices	Typically...	DK
Which institutions?	Banks whose assets exceed threshold	~ 15-20 largest banks
Who calculates?	US: Fed for largest banks EU: Banks themselves	Central bank: "Top-down" FSA / EBA: "Bottom-up"
Scenarios	2 - 5 year projections of macro variables	3 year macro scenarios
Risks	Credit risk, risk weights, market risk, etc....	
Assumptions	"Static balance sheet"	
Metric	Regulatory capital ratios (<u>solvency</u>, not liquidity)	
Outcome	Impact on "capital planning"	Focus on sector aggregates

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An example of how we generate scenarios

Real GDP, index year = 2010
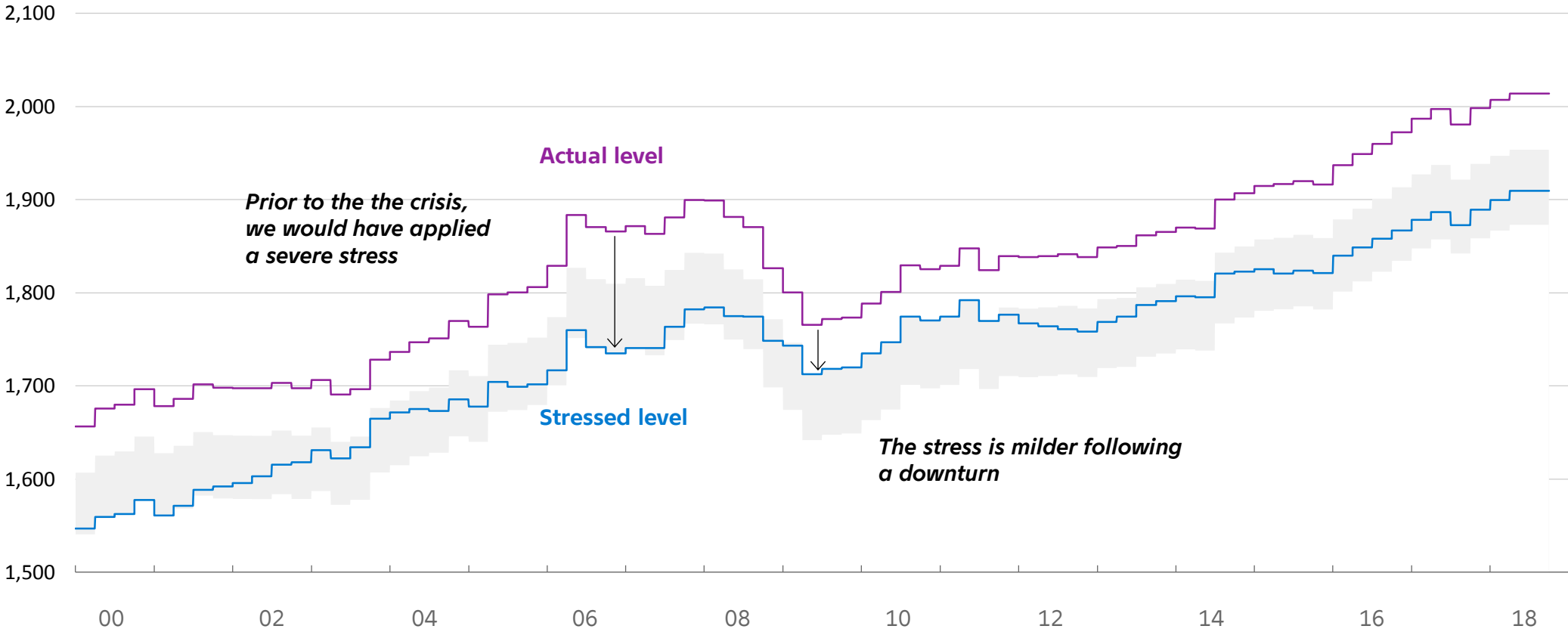
Danmarks Nationalbank's stress test

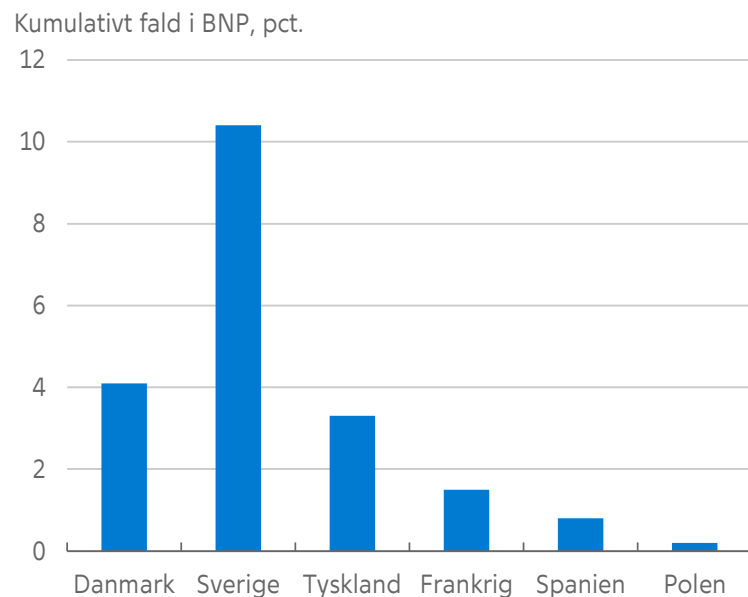DANMARKS NATIONALBANK

The EBA stress test - scenarios

GDP decline

Kumulativt fald i BNP, pct.

Unemployment increase

Stigning i arbejdsløshed, pct.point
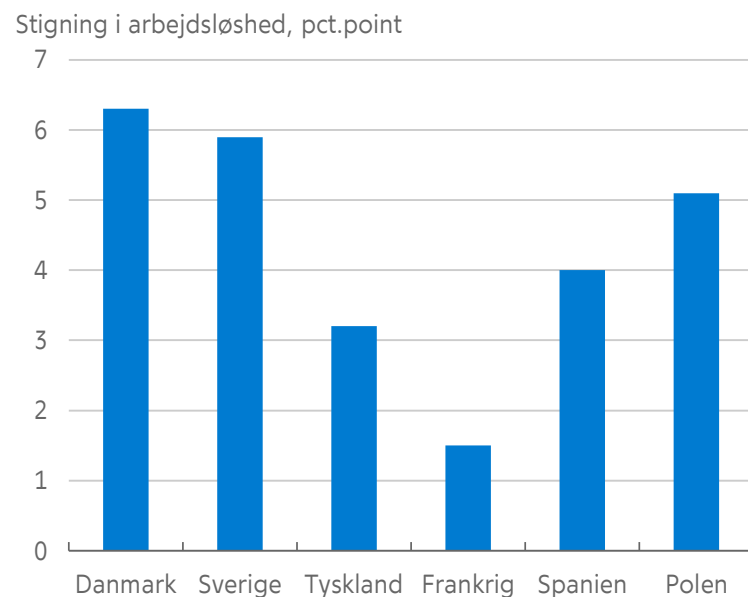
House price decline

Fald i boligpriser, pct.
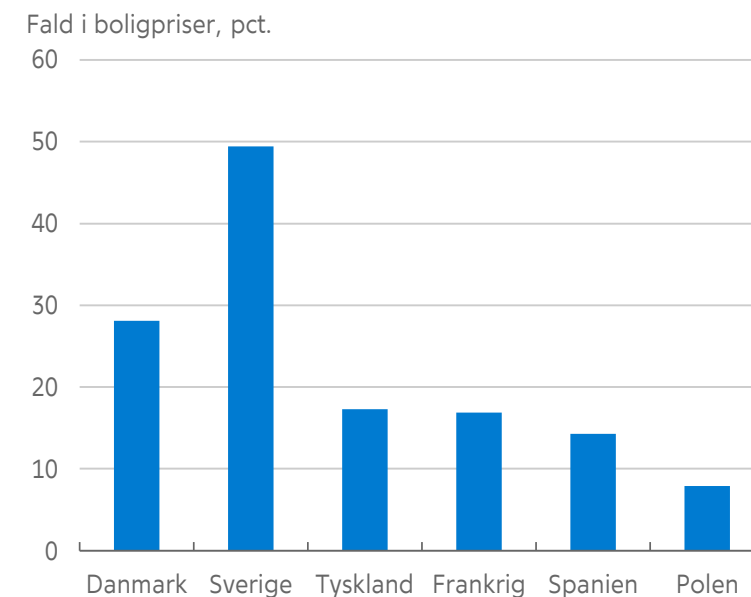
The EBA stress test – some results
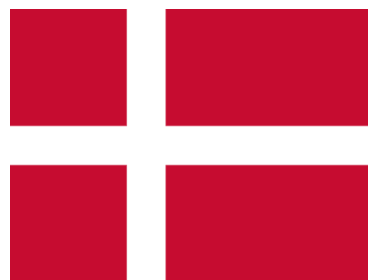
(figures in percentage points)	Danske Bank	Nykredit	Jyske Bank	Sydbank
Reduction in capital ratio	2.5	1.4	2.9	2.3
Effect due to loan losses	4.5	4.4	4.4	3.7
Effect due to market + conduct risk	1.5	0.1	0.3	0.2
Effect due to risk weights	3.3	4.3	1.9	2.5

	Nordea	Swedbank	SEB	Handels-banken
Leverage ratio, initial	5.03	5.18	5.16	4.49
Leverage ratio, final	5.05	5.41	5.18	4.81

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RESEARCH QUESTIONS

Research questions

- What are interesting questions from the perspective of someone doing stress testing? Caveats:

  - … maybe not the route to Top 3 publications!

  - … some problems very "applied" in nature

 - … "simple" models most useful in my experience [accessible replication code really helpful!]

Examples of links btw research and stress testing practice

- Asset pricing:
  - scenarios, market risk

- Credit risk modelling:
  - loan losses, risk weights

- Corporate finance:
  - bank funding costs

- …

Topic I: Impairments / loan losses – the practical issue

Rare and extreme events

Loan losses (%), Sweden

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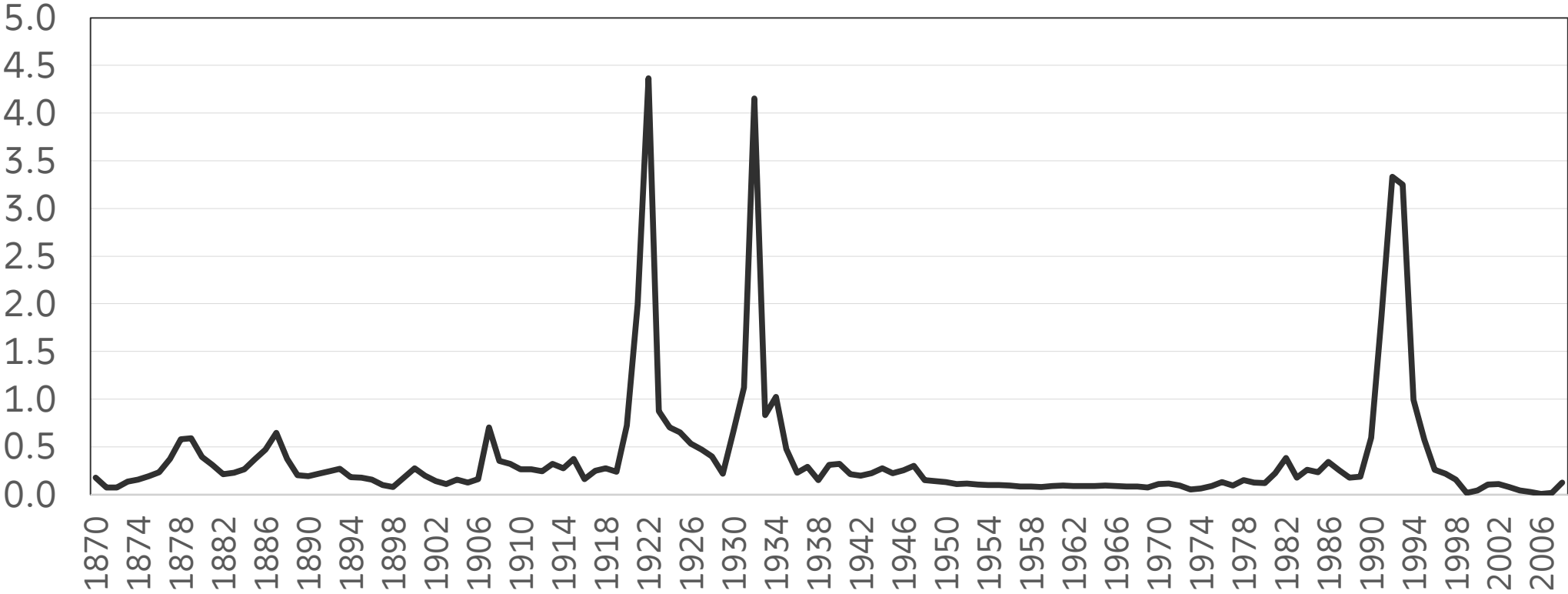
Topic I: Impairments / loan losses – the conceptual issue

Someone should write a "sharpening the arithmetic / thinking on PDs" paper
[PD: Probability of Default]

Basel model. Loan losses should reflect expected losses:

$$EL = PD \times EAD \times LGD$$

PDs hugely important – reality really messy…

Use of PDs	Rule set	PD – horizon	PD – type
Impairments	EU: IFRS9 US: FASB	EU: "Stage model" (1yr -> lifetime) US: Lifetime	Point-in-time
Risk weights / capital requirements	Basel rules, as implemented in jurisdictions	1 yr	Through the cycle (/hybrid)

Topic I: Impairments / loan losses – the welfare issue

- Impairments increasingly reflect *expected* losses

- Similar to mark-to-market issue, though here it is really mark-to-model

- What are the effects? E.g. procyclicality, incentives, …

- How should impairment rules be designed?

Abstract

The Global Financial Crisis has pushed accounting standards to shift from an incurred loss approach to an expected credit loss approach (ECL) to loan loss provisions. The ECL approach adopted by IFRS 9 and the incoming update of US GAAP implies a more timely recognition of credit losses but also a greater responsiveness to changes in aggregate conditions, which raises procyclicality concerns. This paper develops a recursive model for the assessment of the implications of different provisioning approaches for banks' profits and regulatory capital. Its application to a portfolio of European corporate loans suggests that the new standards will sizably increase the deterioration of profits and regulatory capital at the beginning of downturns, potentially contributing to a contraction in credit supply at that point in time.
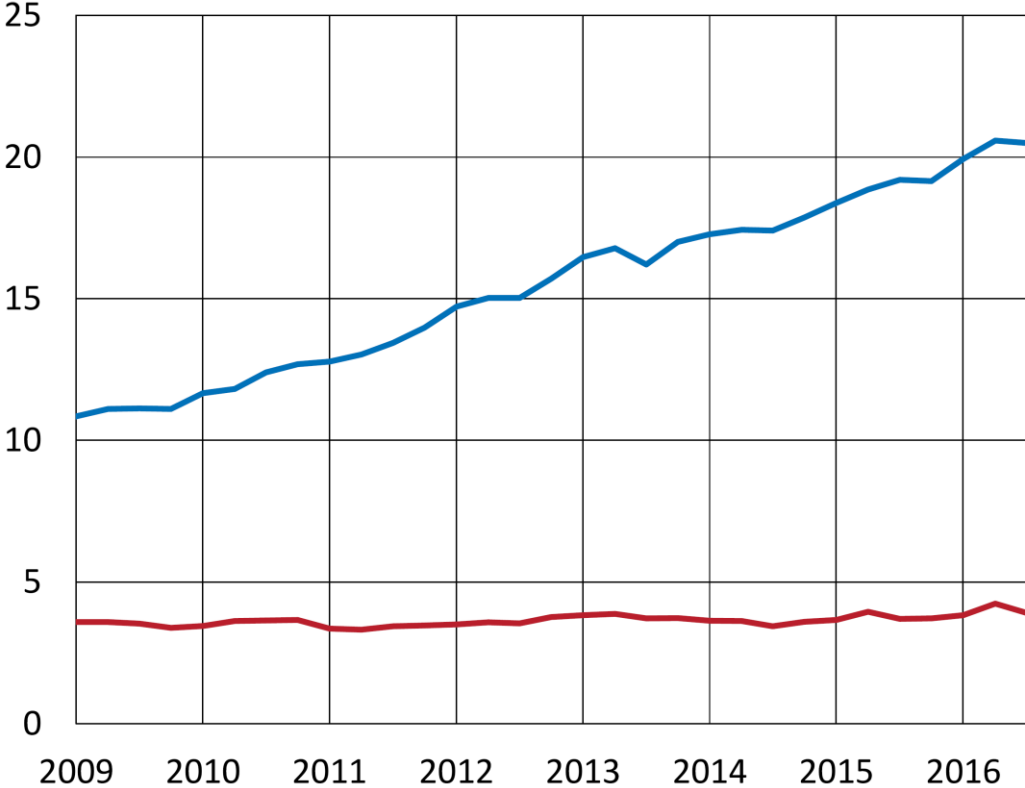
Keywords: credit loss allowances, expected credit losses, incurred losses, rating migrations, procyclicality.

Topic II: Risk weights – empirical motivation

Swedish data (sorry to pick on you again, Sweden!)
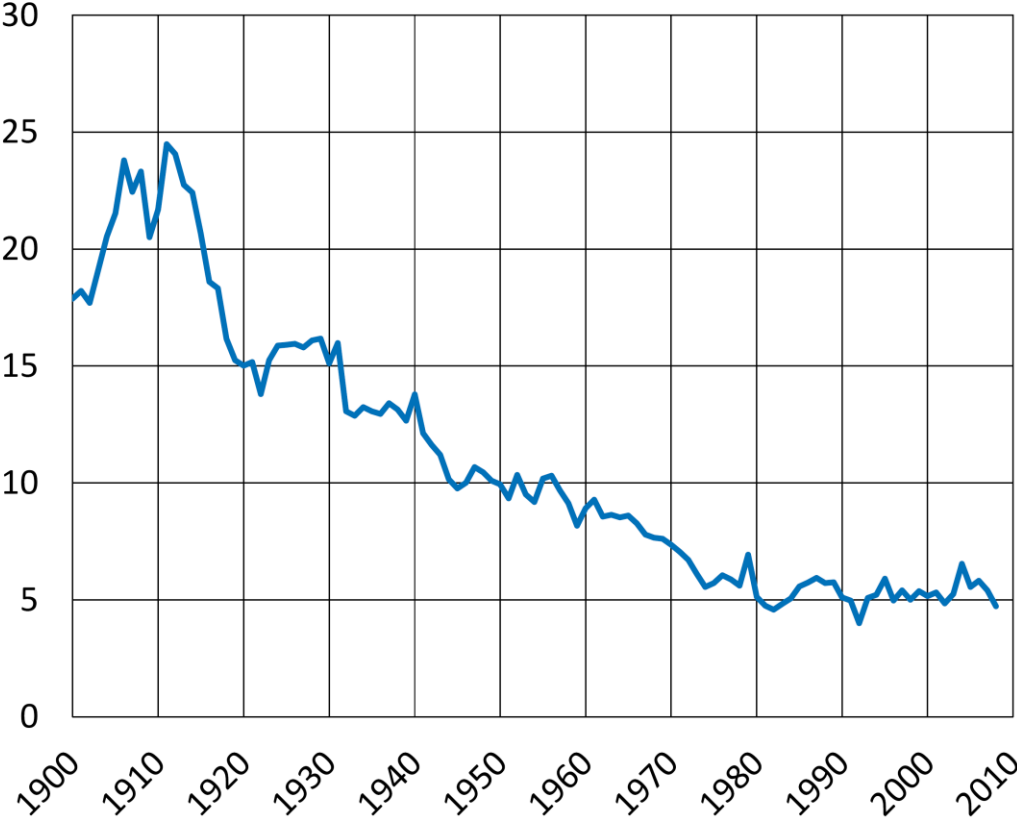
leverage ratio

CET1 capital/Risk-weighted assets (REA)
CET1 capital/Total assets

From the legal text ("CRR)":

Calculation of risk weighted exposure amounts for credit risk

Article 153

Risk weighted exposure amounts for exposures to corporates, institutions and central governments and central banks

1. Subject to the application of the specific treatments laid down in paragraphs 2, 3 and 4, the risk weighted exposure

— where in be RW

where the to as 'EL$_{\text{B}}$ expected lc with Article

(iii) if 0 < PD < 1

$$RW = \left[LGD \cdot N \left(\frac{1}{\sqrt{1-R}} \cdot G(PD) + \sqrt{\frac{R}{1-R}} \cdot G(0.999) \right) - LGD \cdot PD \right]$$

where:

N(x) = the cumulative distribution function for a standard norma ability that a normal random variable with mean zero and v to x);

This comes from model by Vasicek:

Default if normal variable below threshold ('t')

$$\underbrace{\sqrt{R} \; F}_{systemic} + \underbrace{\sqrt{1-R} \; Z_i}_{idiosyncratic} < t$$

$$PD_i = Prob\left(RF + \sqrt{1-R}Z_i < t \right) = N(t)$$

$$t = N^{-1}(PD_i)$$

$$\Leftrightarrow Z_i < \frac{N^{-1}(PD_i) - \sqrt{R}F}{\sqrt{1-\rho^2}}$$

$$Prob(Default|F) = N\left(\frac{N^{-1}(PD_i) - \sqrt{R}F}{\sqrt{1-R}} \right)$$

F is normal. "Worst case" < 0.1% probability:

$$F = N^{-1}(0.001) = -N^{-1}(0.999)$$

$$Prob\left(Default|F = -N^{-1}(0.999) \right) = N\left(\frac{N^{-1}(PD_i) + \sqrt{R}N^{-1}(0.999)}{\sqrt{1-R}} \right)$$
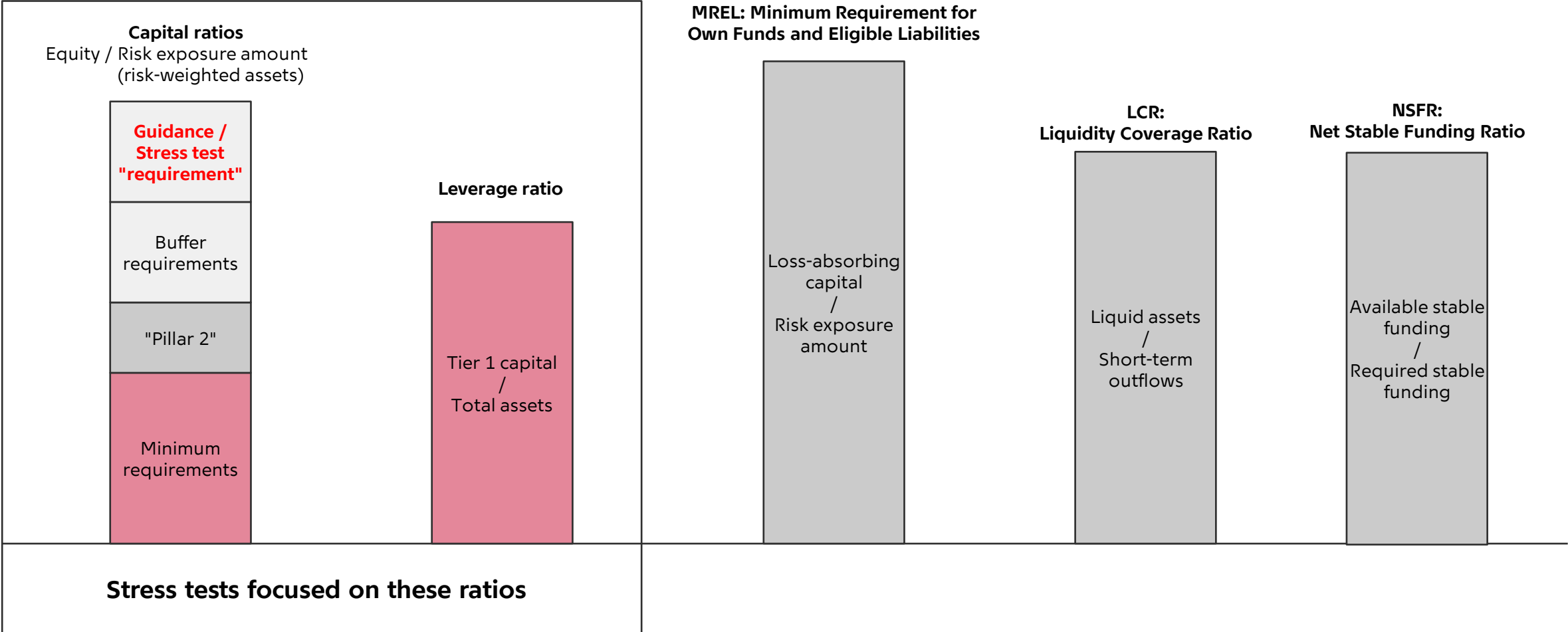
Topic II: Risk weights

- Risk weights key part of capital ratio – and thereby of whether banks look solvent or not

- Glasserman and Wang (2014): *"The theoretical underpinnings of risk weights have not received a great deal of attention"*

    (see references therein for existing literature)

- I agree!

Topic III: Regulatory constraints – in practice (simplified)

Capital ratios
Equity / Risk exposure amount
(risk-weighted assets)

Guidance /
Stress test
"requirement"

Buffer
requirements

"Pillar 2"

Minimum
requirements

Leverage ratio

Tier 1 capital
/
Total assets

Stress tests focused on these ratios

**MREL: Minimum Requirement for
Own Funds and Eligible Liabilities**

Loss-absorbing
capital
/
Risk exposure
amount

**LCR:
Liquidity Coverage Ratio**

Liquid assets
/
Short-term
outflows

**NSFR:
Net Stable Funding Ratio**

Available stable
funding
/
Required stable
funding

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Topic III: Regulatory constraints

- All of these probably aren't necessary(?) (Cecchetti and Kashyap, 2016)

- Unintended consequences? (e.g. Repullo and Suarez papers)

  - Example I: Countercyclical Capital Buffer

  - Example II: Does the leverage ratio render buffers inefficient?

- "Contract theory" + structural corp. finance-like models:

  - How should regulation be designed?

  - Banks' response function?

- Institutional knowledge: Internal capital markets in banks – see e.g. BoE Quarterly Bulletin 2018 Q2

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An interesting chart...

Chart B.7 Price to book ratios are broadly in line with expected return on equity

Price to book ratios for major global banks compared with expected returns on equity
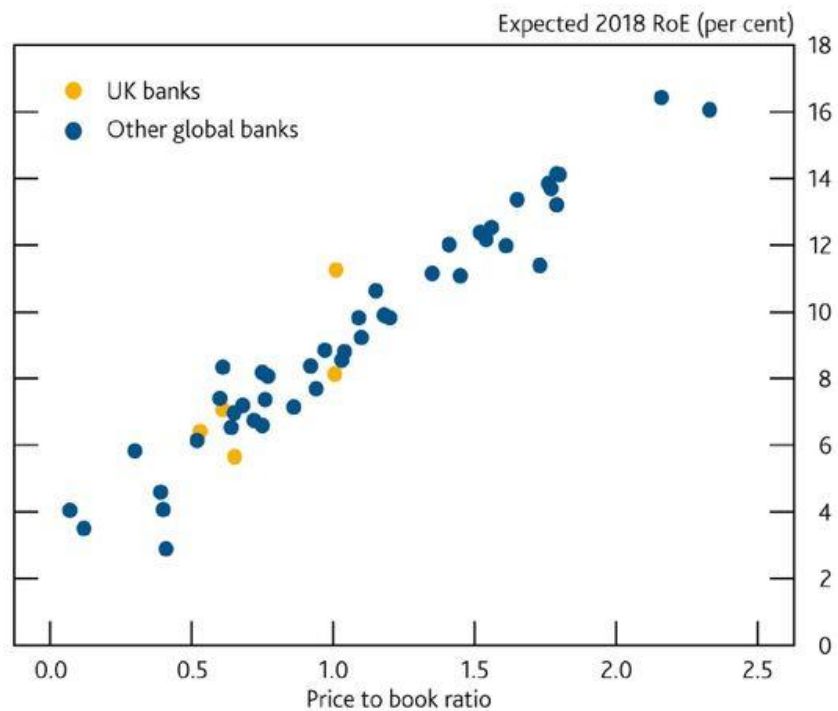
Sources: Bloomberg, Thomson Reuters Datastream and Bank calculations.

Topic IV: What is "right" capital ratio?

<u>Open question</u>: When are we satisfied that banks have enough capital?

Banks' arguments against (higher) capital requirements:

- The societal argument

  - [sub-argument: SMEs will suffer]

- Regulators become de facto risk managers

- Shadow banking

- Risk-insensitive rules lead to riskier lending

THE CREDIT REGISTER

Basics of the credit register

- Denmark (Finanstilsynet / Danmarks Nationalbank) will have a credit register from (expected) end-2019

- The credit register is a database covering – essentially – all loans granted by Danish banks and foreign banks operating in Denmark

- It contains information about individual loans such as loan terms, underlying collateral, bank estimates of PD (IRB-banks), etc.

  - Can be coupled with other data sources

- The credit register is useful for e.g.

  - Monitoring financial stability and stress tests

  - Research!

Examples of credit register uses

Practical

- Observe lending standards instead of relying on survey evidence

- "Dashboards" for financial stability monitoring

- Own credit risk models

- Stress testing

  - impairment calculations

  - risk weights

- …

Research

- Monetary policy transmission

- Effects of macroprudential policies

- Banking theory

  - Industrial organization

  - Relationship lending

  - Credit crunches

- …

Use in stress testing

Impairments (loan losses) single most important factor in stress test

Current model has four steps:

1. Model of aggregate impairments

2. Sectoral impairments

3. Bank-level adjustments

4. Final calibration

Step 3 is most problematic – we don't know quality of individual banks' credit portfolios!

Impairments of Danish banks: 1975-2017
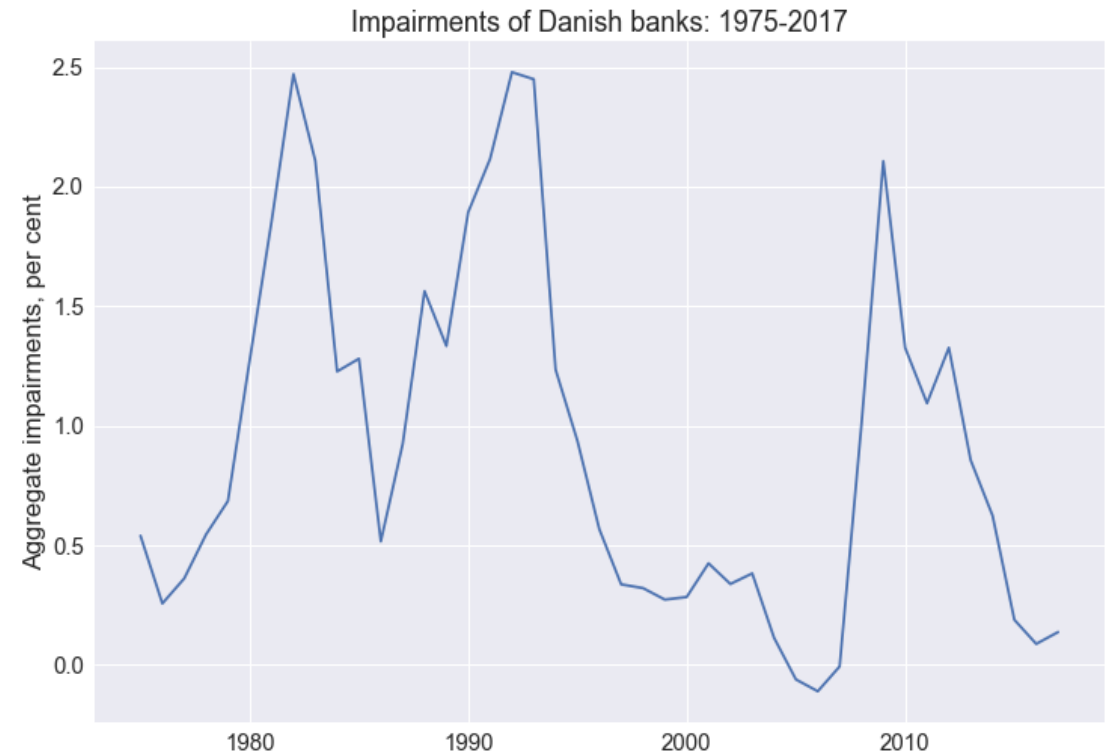
Upcoming, practical issues

- How to measure credit quality and distribute impairments

  - Which "Basel parameters"?

  - How to deal with missing time series?

  - How to get PD term structure?

  - How to operationalize stage definitions in IFRS9

  - How to handle different types of PD used in impairment and risk weight calculations?

  - Etc.

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Use in financial stability monitoring

Don't ask, just look

(in the data)…

Use in research - examples

Jiménez, Ongena, Peydro and Saurina

- AER 2012: Bank balance-sheet channel paper

- Econometrica 2014: Effects of monetary policy on risk taking

- JPE 2017: Macroprudential policy

Behn, Haselmann and Vig (R&R, JF): "The Limits of Model-Based Regulation"

Relationship banking: A number of studies based on Italian credit register data, e.g. Detragiache, Garella and Guiso (JF, 2002)
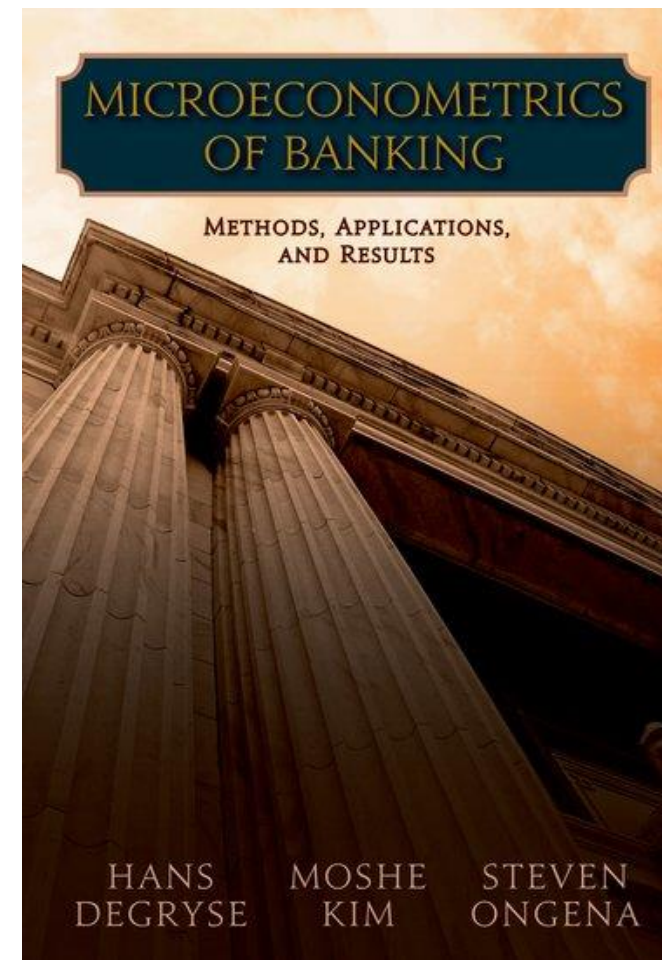
Use in research – example of own idea

Question: Is there a sort of "winner's curse" in lending?

Credit register – we know:
- Loan risk: Impairments (or PD)
- Loan characteristics
- (some) Borrower characteristics

+

Borrower characteristics from other sources, e.g.
- VIRK, Experian, …
- Statistics Denmark

Statistical / machine learning models:
Mimic each bank's "model"

Does bank evaluate its own loans better than other banks would?

Track loans to check alternative hypotheses, e.g. comparative advantage

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Some final comments on stress testing

- Stress testing

  - Useful tool for understanding banks and regulation

  - Increasingly used as a regulatory tool

  - Lots of topics I haven't discussed: 2nd round effects, network effects, …

- Humility required when interpreting results of stress test

  - Passing a stress test ≠ "adequately capitalized" (in my opinion)

  - Banks fail for other reasons than systemic stress

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THANK YOU!