The Credit Quality Channel

A novel approach to model contagion in the interbank market
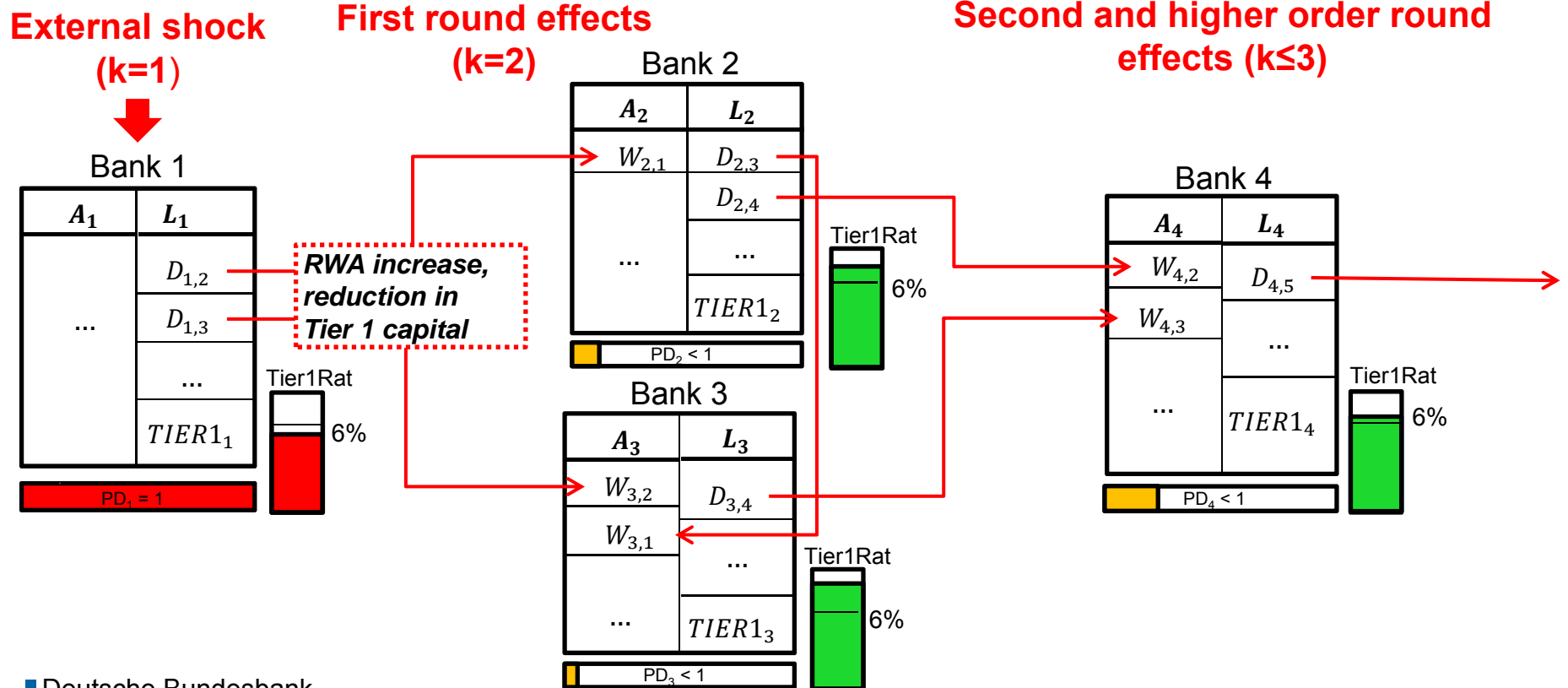
Ulrich Krüger, Deutsche Bundesbank

Motivation and general approach

- **Analysis of contagion effects due to a deterioration in credit quality in the banking network**

  - Credit event in the banking network

    - Transmission of the shock to other banks via asset devaluation and deterioration in credit quality

  - Adverse effect on Tier 1 capital derived from Basel accords

  - Reduction in aggregated Tier 1 capital in the banking system due to an exogenous shock

- **"Banking System Loss" (BSLoss) measures interconnectedness**

  - Extends existing default cascade models (sensitivity to small shocks)

Illustration of the contagion process

External shock (k=1)

First round effects (k=2)

Second and higher order round effects (k≤3)

Bank 1

A_1	L_1
	$D_{1,2}$
...	$D_{1,3}$
	...
	$TIER1_1$

Tier1Rat 6%

$PD_1 = 1$

RWA increase, reduction in Tier 1 capital

Bank 2

A_2	L_2
$W_{2,1}$	$D_{2,3}$
	$D_{2,4}$
...	...
	$TIER1_2$

Tier1Rat 6%

$PD_2 < 1$

Bank 3

A_3	L_3
$W_{3,2}$	$D_{3,4}$
$W_{3,1}$	
	...
...	$TIER1_3$

Tier1Rat 6%

$PD_3 < 1$

Bank 4

A_4	L_4
$W_{4,2}$	$D_{4,5}$
$W_{4,3}$	
	...
...	$TIER1_4$

Tier1Rat 6%

$PD_4 < 1$

Conceptual description

- **Capital ratios of banks in the network (bank 2, bank, 3, bank 4 in the example) change through contagion**

    – Change to Tier 1 capital is translated into an increase of the Probability of Default (PD)
    – Expected losses of the neighboring banks are deducted from their Tier 1 capital (consistent with Basel accord)

- **"Banking System Loss" measures interconnectedness**

    – Reduction in aggregated Tier 1 capital in the banking system due to the exogenous shock

Application
Network of German banks
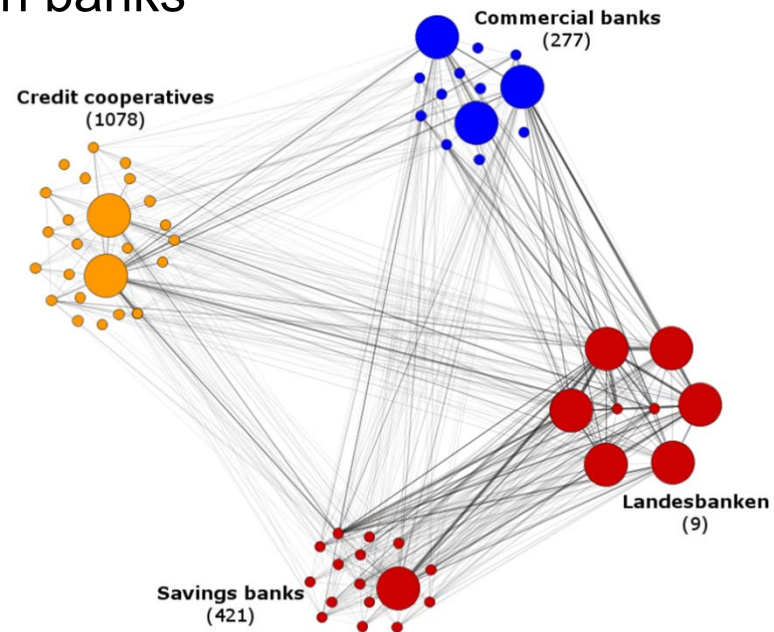
- Data as of end of December 2013 from Deutsche Bundesbank's credit register of large exposures (€1.5m or more)

Application I
Ranking of systemically important institutions

Rank of Inst.	Total Effect			Indirect Effect	
	BSLoss	Defaults	BSLoss / direct Exp.	BSLoss	Defaults
1	1	1	5.51	92%	96%
2	1	1	7.19	94%	96%
3	1	1	4.68	90%	95%
4	0.34	0.69	1.23	64%	21%
5	0.11	0.02	0.94	53%	54%
6	0.09	0.02	0.76	41%	27%
7	0.08	0.03	0.73	38%	17%
8	0.07	0.12	0.69	35%	2%

- "BSLoss" normalised by BSLoss of the highest ranked bank (bank 1)
- Number of defaults of banks in the contagion process shown in relation to the number of defaults following the default of bank 1

# Benchmarking with other measures of interconnectedness

	D-SIBs (Total score)	D-SIBs (Interconnec-tedness)	Bonacich centrality	In-Degree measure
ρ	39 %	66 %	96 %	70 %

- ρ shows Spearman's rank correlation coefficient between BSLoss and other measures
- Low correlation with D-SIBs' methodology for interconnectedness due to restrictions to direct exposures
- High correlation with Bonacich eigenvector-based centrality underlines that both measures take into account the entire network structure

Application II
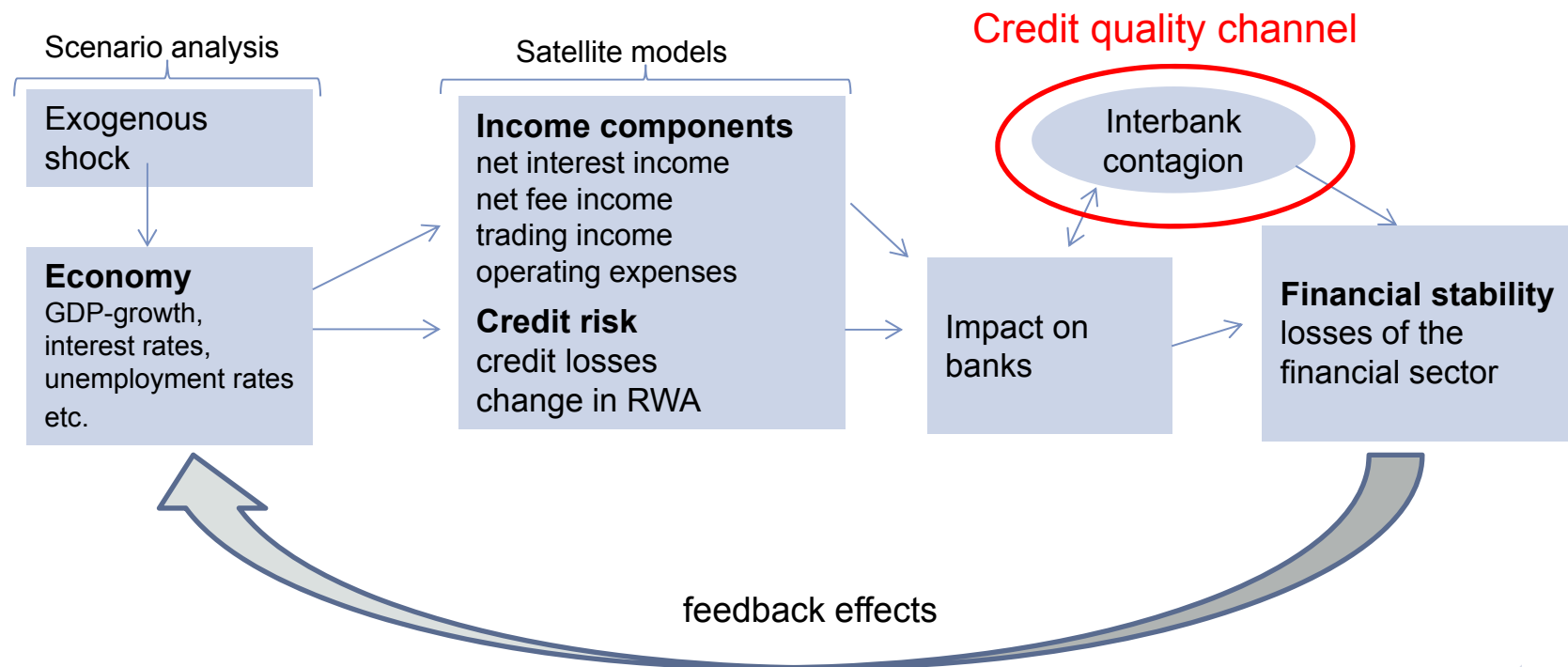Shock to the real estate sector
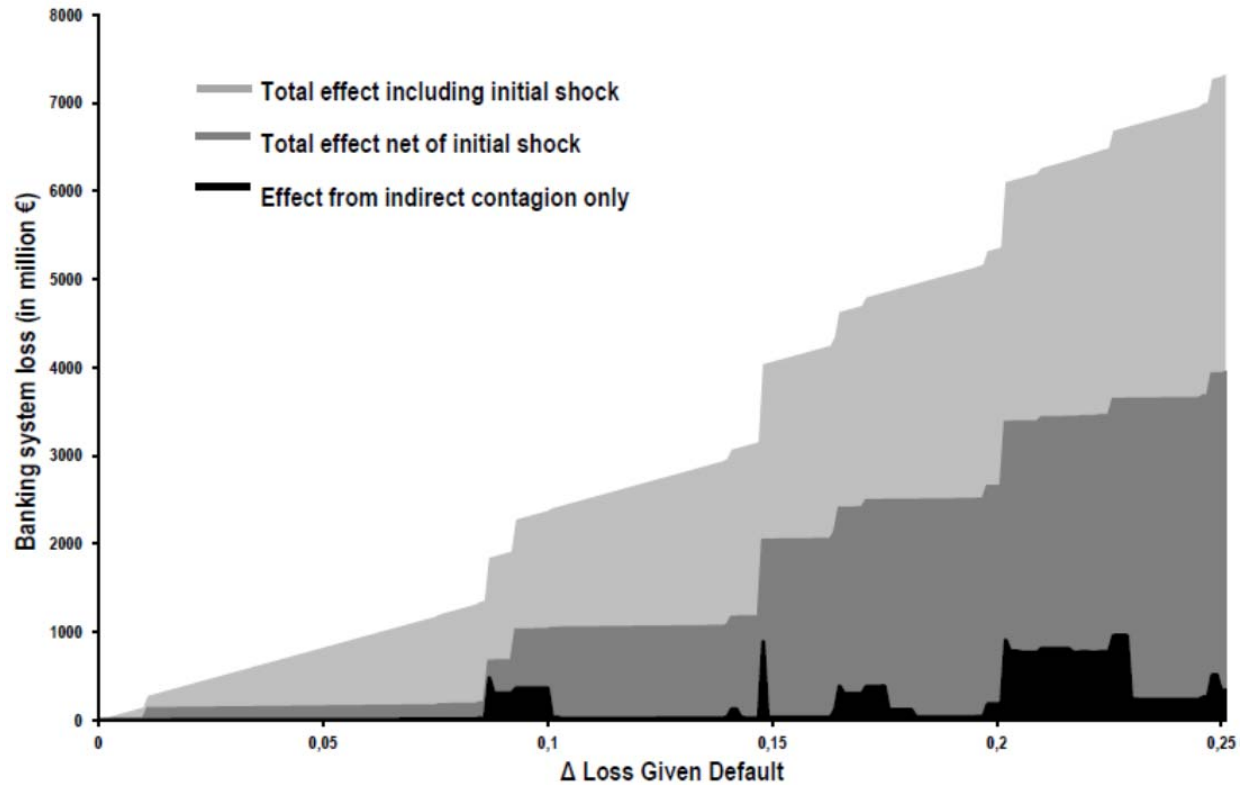
Conclusion

- Merits
    - "BSLoss" easy to interpret (expressed in monetary units)
    - Sensitive to small shocks
    - Allows for different credit stress scenarios
        - shock to one bank or a group of banks
        - shock to the mortgage sector or to other sectors
    - Supports evaluation of macroprudential instruments (eg SIFI-buffer)

- Limitations
    - Ignores impact from other relevant contagion channels (liquidity channel, reputation channel etc.)

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Appendix: The credit quality channel in the context of stress testing

Scenario analysis

Satellite models

Credit quality channel

Exogenous shock

Economy
GDP-growth, interest rates, unemployment rates etc.

Income components
net interest income
net fee income
trading income
operating expenses

Credit risk
credit losses
change in RWA

Interbank contagion

Impact on banks

Financial stability
losses of the financial sector

feedback effects

Appendix: Relationship between Tier capital ratio and Probability of Default

- Impact of banks' Tier1 capital ratio on its PDs derived from a univariate logit-regression

$$PD_{i,t} = F\big(\alpha + \beta \cdot ln\big(CapRat_{i,t-1}\big)\big)$$

$PD_{i,t}$: Probability that bank i will fail in time $(t-1; t]$

$CapRat_{i,t}$: Tier 1 Capital Ratio $(Tier1_{i,t}/RWA_{i,t})$

$F(z)$: Cumulative logistic distribution $(e^z/(1+e^z))$

Appendix: Assessing shock transmission for different types of banks

Comparison of system loss for various situations
in % of the aggregated Tier 1 capital

	Typical large institution	Group of regional institutions	Individual small institution
■ Second-order effects	3%	13%	0,0%
■ First-order effects	12%	4%	0,1%