Zürcher Hochschule
für Angewandte Wissenschaften

School of
Management and Law

Credit risk in banking – an introduction

Building Competence. Crossing Borders.

Dr. Jan-Alexander Posth
Institute of Wealth & Asset Management

Contents

Topics

i. What is risk?

ii. What is credit risk?

iii. How is credit risk measured in banking?

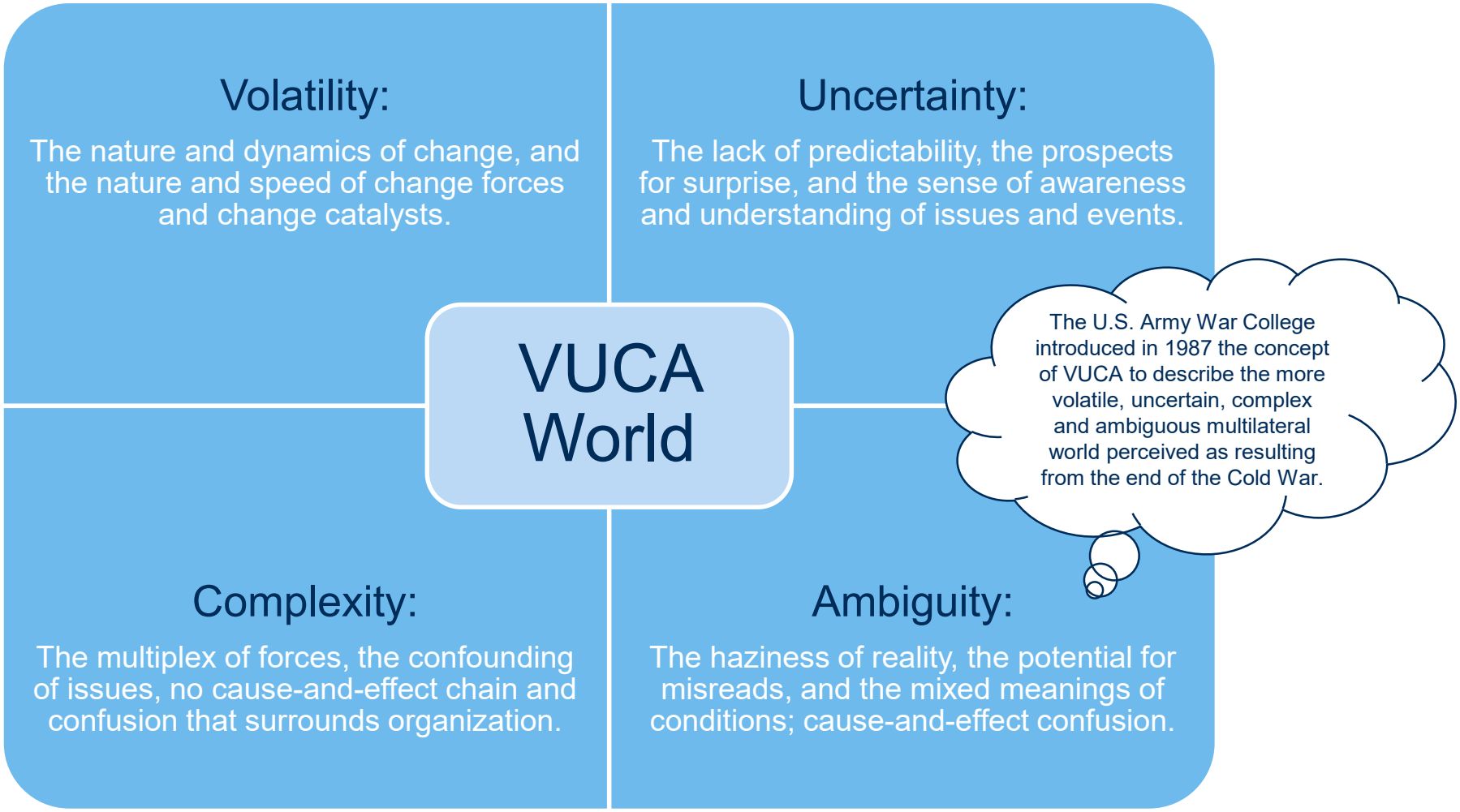
iv. How is credit risk managed?

v. Conclusio

vi. Further reading & links

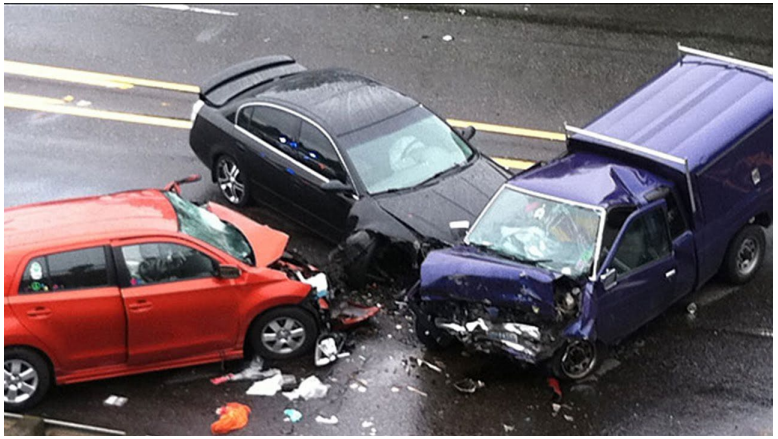
Part i: What is risk?

i. The world we live in is risky…



Source: https://en.wikipedia.org

i. … but is it all “risk”?



“Risk is measurable, quantifiable, insurable.

If not, it is called uncertainty”

Frank Knight; 1921

i. Let’s rephrased this more eloquently…

"… there are **known knowns**; there are things we know we know. We also know there are **known unknowns**; that is to say we know there are some things we do not know. But there are also **unknown unknowns** - the ones we don't know we don't know."

Donald Rumsfeld

i. Now, what does this mean?

Simply put, if you (or somebody else) can put a **price tag** on it, it's most probably a risk. If not, it's something else – e.g. uncertainty, bad luck or chaos.

If you (or somebody else) can put a price tag on it, then somebody might write an **insurance** against the risk.

If somebody writes an insurance against the risk, you can mitigate it. That's part (already) of **risk management**!

i. But financial risk is tricky…

… it depends on your **view** towards risk:

What might be a catastrophe for you, is just a risk for the insurer.

⇨ **(Smooth) statistics** help to make risks manageable.

… it depends on your **attitude** towards risk:

Are you **risk-averse** or do you are you a **gambler**?

⇨ Only a linear utility function reflects neutrality towards risk.

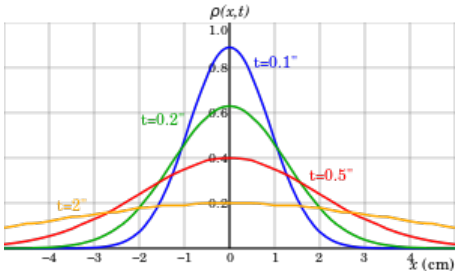
… the perception of risk is skewed by the **psychological effects**:

⇨ See e.g. Kahneman, “Thinking, fast and slow”

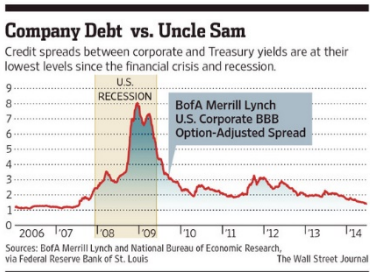
i. … it comes in different flavors…

Risk is e.g. …

⇨ **Volatility**, i.e. the standard deviation of returns



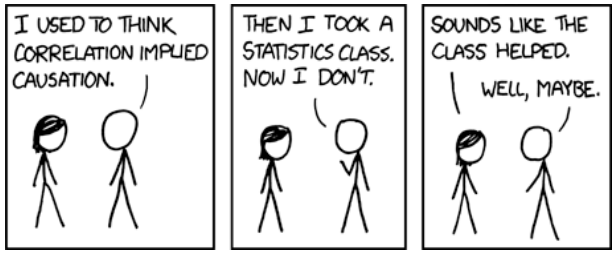
⇨ **Credit spreads**, i.e. a default risk premium to be payed



Systemic risk is e.g. …

⇨ **Liquidity** (drying up!), i.e. bid-offer spreads widening or markets locking up completely

⇨ **Correlation** (increasing), i.e. markets moving in sync (usually downwards)… but NOT causation!

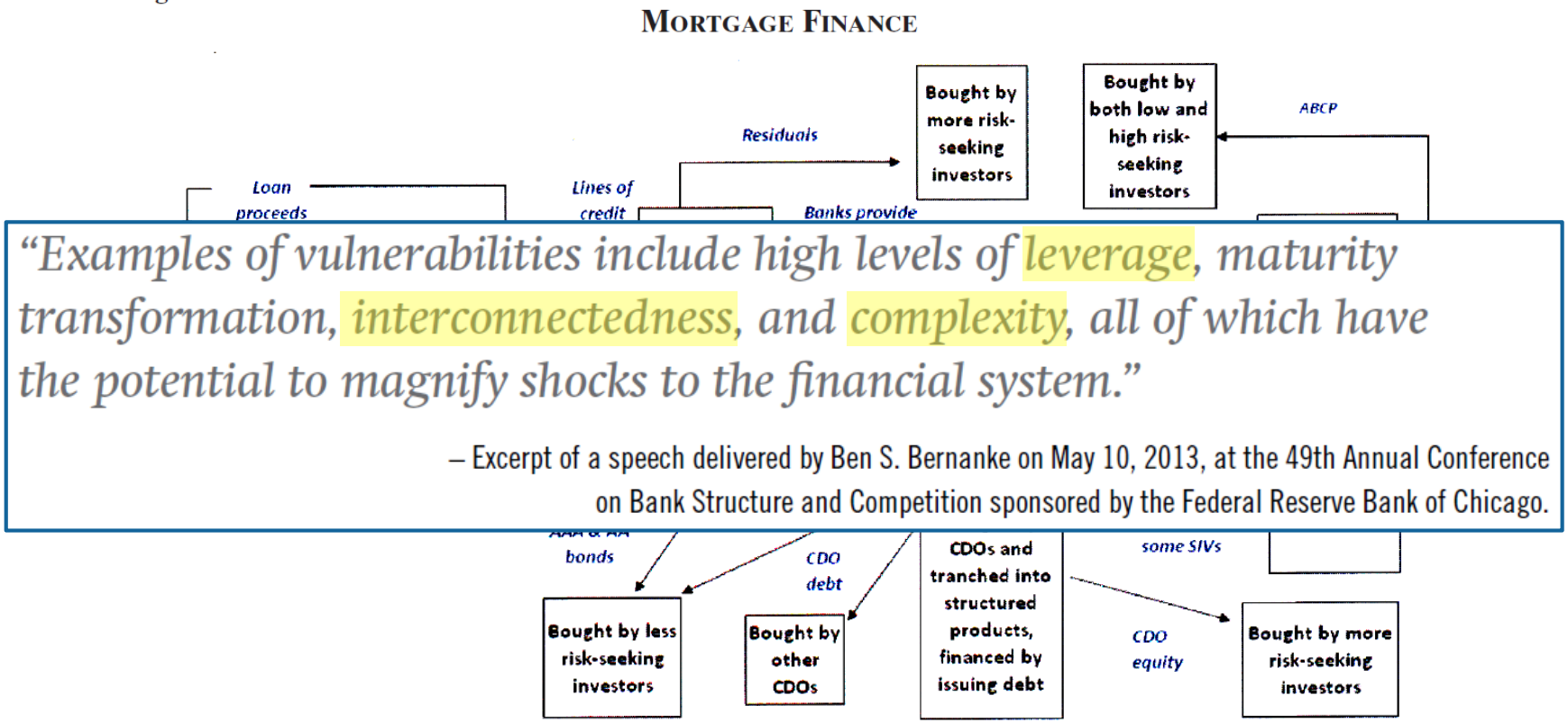


Sources: en.wikipedia.org, wsj.com, globalriskinsights.com, xkcd.com

i. … and is highly complex!

Complexity positively contributes to interconnectedness

Figure 2



"Examples of vulnerabilities include high levels of leverage, maturity transformation, interconnectedness, and complexity, all of which have the potential to magnify shocks to the financial system."

– Excerpt of a speech delivered by Ben S. Bernanke on May 10, 2013, at the 49th Annual Conference on Bank Structure and Competition sponsored by the Federal Reserve Bank of Chicago.

Source: IMF (2007).

Sources: IMF, Blanchard, O. (2009), Bernanke, B. (2013)

i. The risks banks look at…

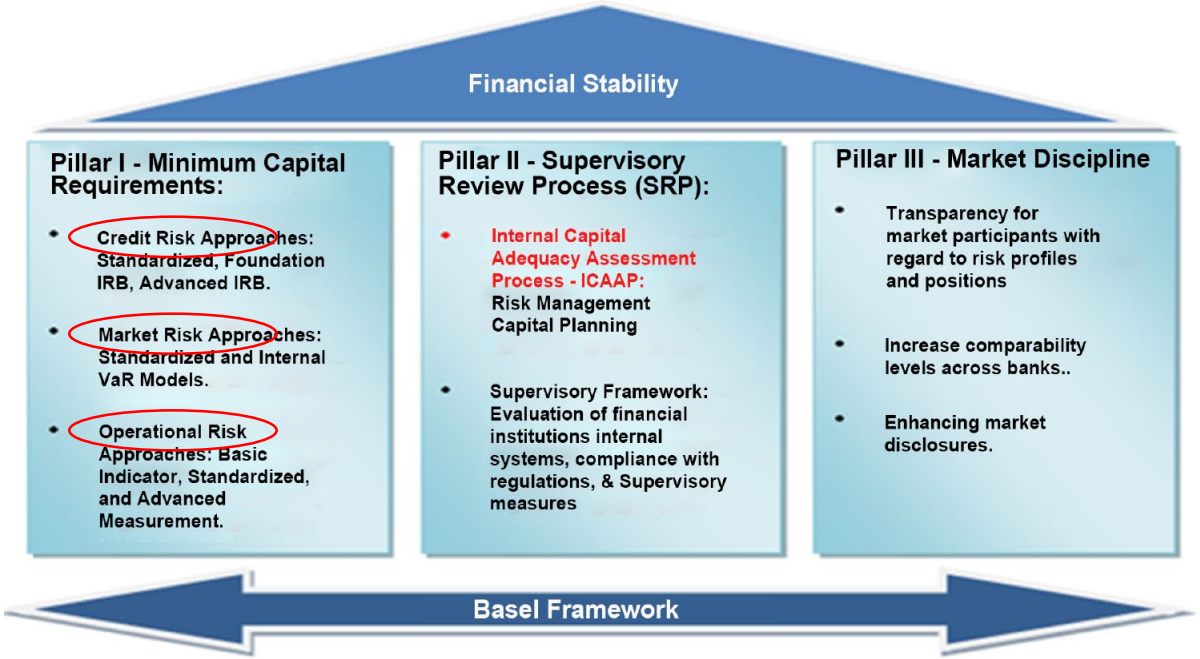
- ✓ Credit risk
- ✓ Market risk
- ✓ Operational risk, ERM
- ✓ Liquidity risk
- ✓ Funding risk
- ✓ Legal risk
- ✓ Business risk

The concept of risk and risk management dates back to 3500 BC (games of dice in Egypt, Codex of Hammurabi, …) and has a long-standing history

i. … and why they are important

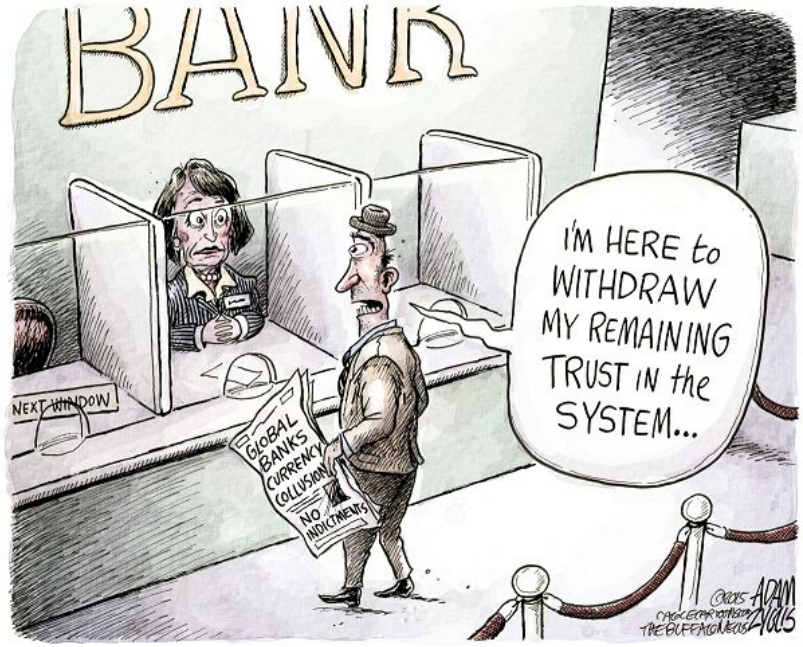
Risk – taking and managing – is the essence of banking

- ***"… bankers are in the business of managing risk, pure and simple, that is the business of banking."*** – Walter Wriston, former CEO of Citibank
- Basel Committee would agree: BASEL I-III…



Source: Karim F. F. Mohamed, Journal of Financial Risk Management, 2018, 7, 331-368

Part ii: What is credit risk?



ii. Credit risk is everywhere…

Credit risk is the greatest risk run by banking institutions…

- Credit risk is **inherent part of a bank's business**, e.g. lending and borrowing
- (Some) banks play a **systemic** role in the economic system, their balance sheet structures being driven by **credit risk**
- Credit risks gone bad, e.g. bankruptcies, are always **highly disruptive**, threatening and spectacular (hence associated with high media presence)


THE TI

Tuesday September 16 2008 timesonline.co.uk No 69430

Lehman collapse sends shockwave round world

hares and oil prices plunge, thousands lose jobs

ii. … and it's not just banks or corporates!

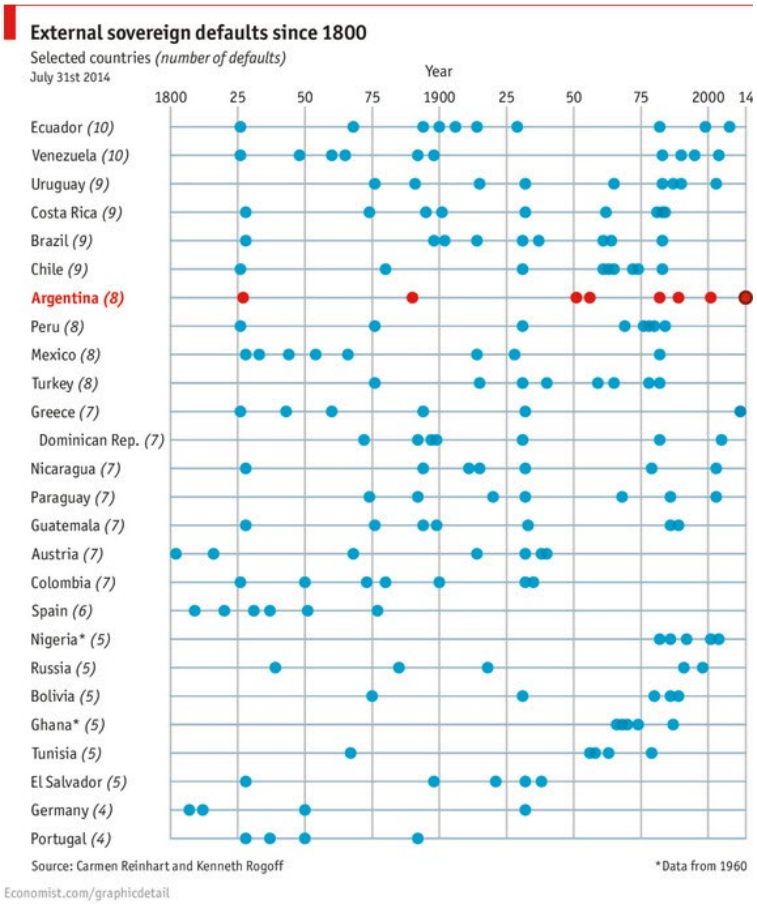
… and by corporates and governments alike

Table 5

Largest Global Rated Defaulters By Year

Largest corporate defaulters by outstanding debt amount

Year defaulted	Issuer	Amount (mil. $)
1994	Confederation Life Insurance	2,415
1995	Grand Union Co./Grand Union Capital	2,163
1996	Tiphook Finance	700
1997	Flagstar Corp.	1,021
1998	Service Merchandise Co.	1,326
1999	Integrated Health Services Inc.	3,394
2000	Owens Corning	3,299
2001	Enron Corp.	10,779
2002	WorldCom Inc.	30,000
2003	Parmalat Finanziaria SpA	7,177
2004	RCN Corp.	1,800
2005	Calpine Corp.	9,559
2006	Pliant Corp.	1,644
2007	Movie Gallery Inc.	1,225
2008	Lehman Brothers Holdings Inc.	144,426
2009	Ford Motor Co.	70,989
2010	Energy Future Holdings Corp.	47,648
2011	Texas Competitive Electric Holdings Co. LLC	32,460
2012	BTA Bank J.S.C.	10,184
2013	Texas Competitive Electric Holdings Co. LLC	31,628
2015	Arch Coal Inc.	6,025
2016	Petroleos de Venezuela S.A.	19,859
2017	Petroleos de Venezuela S.A.	17,617



Sources: www.standardandpoors.com/ratingsdirect, http://www.zerohedge.com

ii. Two dimensions of credit risk: Obligor & type of risk

Credit risk: Definition and typology

Definition:

The risk of loss arising from nonpayment of installments due by a debtor to a creditor under a contract.

Nature of obligor

- **Default risk**: "Any failure or delay in paying the principal and/or the interest." – Moody's
  - ⇨ Creditors are likely to suffer a loss with regard to the initial contractual obligation
- **Creditworthiness risk**: Deterioration of creditworthiness of borrower or counterparty
  - ⇨ Default is not certain, but: credit spreads increase, credit rating might be downgraded, probability of default rises

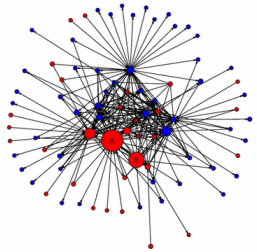
Type

- **Issuer/borrower risk**: Credit risk involves a funded financial instrument, e.g. bond or bank loan
- **Counterparty risk**: Credit risk involves an unfunded instrument, e.g. swap, option (derivatives)

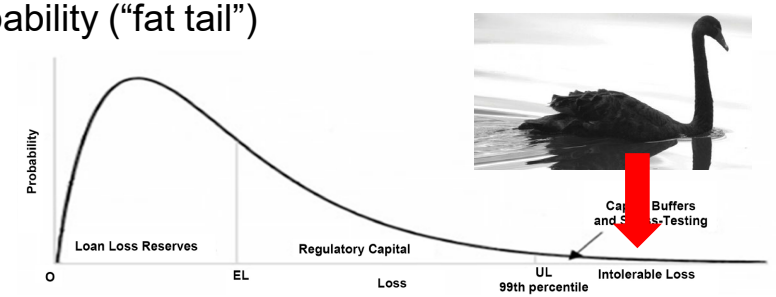
Credit risk = exposure x probability of default x (1- recovery rate)

ii. Again: What is credit risk?

Credit risk: Characteristics



- **Systemic risk**: Cyclical, influenced by the overall economic climate
  - ⇨ Increases during depressions, decreases during expansions
  - ⇨ Depends on region, sector &c.
  - ⇨ Negative feedback via bank lending funding (credit crunch)
- **Specific risk**: Idiosyncratic component, i.e. specific to the borrower
  - ⇨ Examples: Size, corporate strategy, corporate events, concentration of business, fraud, management quality &c.
- **Asymmetric risk**: Unlike other market risks, its profitability structure is asymmetric
  - ⇨ While market risk is (almost) symmetrical in its profitability structure, credit risk is skewed to large losses with low probability and small gains with high probability (“fat tail”)



ii. And again: It's everywhere!

Credit risk & the financial markets

- **Largest risk in the world**: All commercial transactions which are not paid 100% in cash immediately bear a credit risk!
- **Derivatives markets**: counterparty risk (not on notional of transaction but on mark-to-market, i.e. cost of replacing the contract at market conditions
- For banks, credit risks stems from their traditional loan activities as well as form their role as financial intermediaries

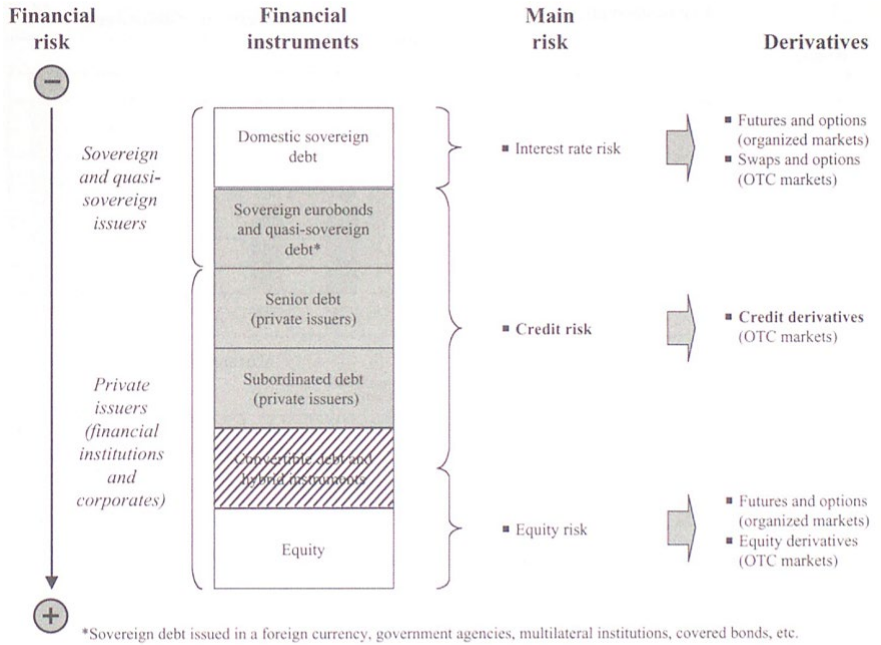


Figure 1.7 The spectrum of financial risk and derivatives

Sources: Bruyère, R. Credit Derivatives and Structured Credit

Part iii: How is credit risk measured in banking?

iii. BASEL first to deal with credit risk…

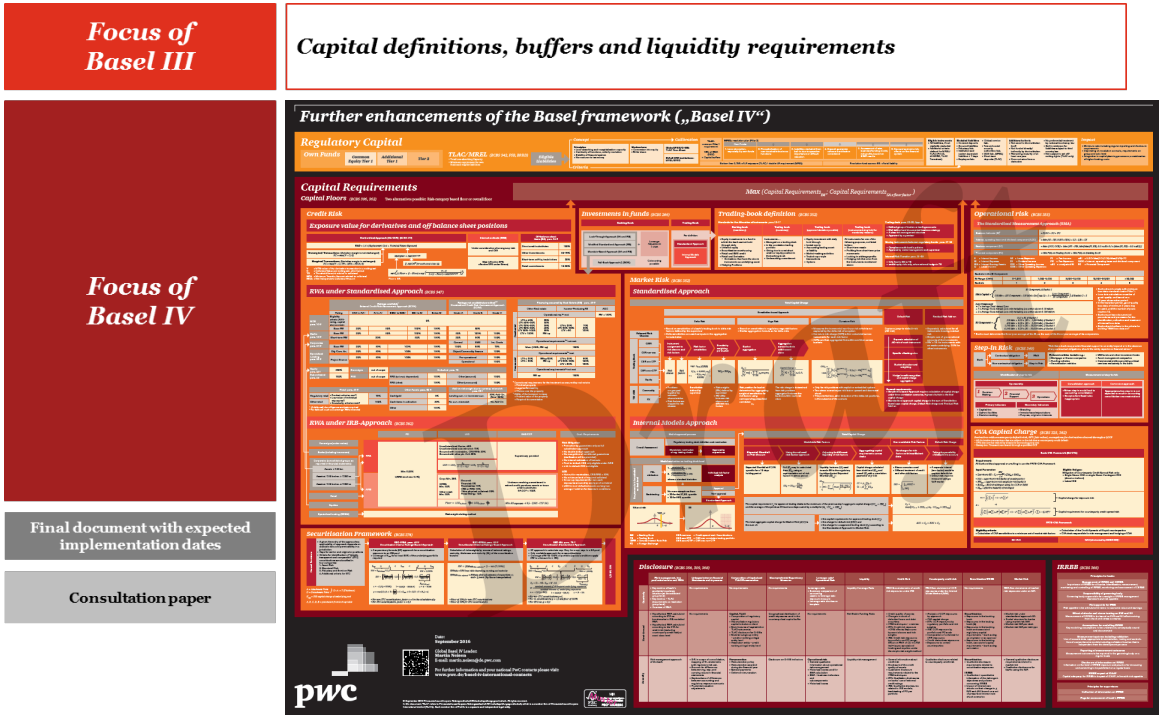
1) Regulatory framework: How it started

- Materialising credit risk of banks and banking institutions may **endanger the financial system.**
  - ⇨ Banks are **closely linked** between each other and thus a single default may trigger a chain reaction
  - ⇨ Public authorities (sometime) guarantee bank deposits; if **trust** is lost and deposits are withdrawn too fast banks will default (“bank run”)
- **Supervisory authorities** have drawn up strict rules to limit and manage credit risk
- First set of regulations: Basel Committee in 1988 (**BASEL I**)
- The Basel Committee consists of the representatives of 28 jurisdictions and 45 institutions
- Basic idea: **Adequacy of a bank’s capital** wit regard to the risk the run
- BASEL I only dealt **with credit risk**, risk-weighted assets (RWAs)
- **Goals**: ⇨ Force banks to raise capital amount and thus stabilising the international banking system
  ⇨ Establish a uniform regulatory framework for all banking institutions

iii. … but struggling with complexity, too!

1) Regulatory framework: More BASELs…

- BASEL II: the New Capital Framework, 2004-2006
- BASEL III: 2009-today & beyond
- BASEL IV: … more to come



Sources: pwc

iii. A rating is just an opinion!

2) Ratings & rating agencies

- First rating agency: Moody's Investors Service 1909
  - ⇨ **Business case**: Provide independent assessment of creditworthiness of bond issue to investors, reduce information asymmetry between issuer and investor, thus reducing cost for the investor
- Moody's Investor Service, Standard & Poor's and Fitch Ratings share most of the rating market coverage between themselves
- Ratings are (just) **opinions** of the rating agencies – e.g. Fitch Ratings:

*"Fitch Ratings publishes **opinions** on a variety of scales. The most common of these are credit ratings, but the agency also publishes ratings, scores and other relative opinions relating to financial or operational strength. (…) Fitch's credit ratings relating to issuers are an **opinion** on the **relative ability of an entity to meet financial commitments**, such as **interest, preferred dividends, repayment of principal, insurance claims or counterparty obligations**. Credit ratings relating to securities and obligations of an issuer can include a **recovery expectation.** (…) Credit ratings are **used by investors as indications of the likelihood of receiving the money** owed to them in accordance with the terms on which they invested."*

- Fundamental analysis, qualitative and quantitative methodologies are used to arrive at a rating

iii. Different degrees of credit quality

2) Ratings & rating agencies: Rating scales

- Ratings are represented by **scales of letters**
- The letters are associated with a **not-quantified** risk of default
- Two main categories: ***investment-grade*** and ***non-investment-grade***
- But: Ratings are associated with historical **(measured) default rates**

Moody's		S&P		Fitch		Description	
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term		
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime	Investment-grade
Aa1		AA+		AA+		High grade	
Aa2		AA		AA			
Aa3		AA−		AA−			
A1		A+	A-1	A+	F1	Upper medium grade	
A2		A		A			
A3	P-2	A−	A-2	A−	F2	Lower medium grade	
Baa1		BBB+		BBB+			
Baa2	P-3	BBB	A-3	BBB	F3		
Baa3		BBB−		BBB−			
Ba1	Not prime	BB+	B	BB+	B	Speculative	Non-investment grade
Ba2		BB		BB			
Ba3		BB−		BB−			
B1		B+		B+		Highly speculative	
B2		B		B			
B3		B−		B−			
Caa1		CCC+	C	CCC	C	Substantial risks	
Caa2		CCC				Extremely speculative	
Caa3		CCC−				Default imminent with little	
Ca		CC				prospect for recovery	
		C					
C		D	/	DDD	/	In default	
/				DD			
				D			

Global Corporate Average Cumulative Default Rates (1981-2015) (%) (cont.)

	--Time horizon (years)--														
Rating	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
A	0.06	0.15	0.26	0.40	0.55	0.72	0.92	1.10	1.28	1.48	1.65	1.81	1.97	2.11	2.28
BBB	0.19	0.53	0.91	1.37	1.84	2.30	2.71	3.11	3.50	3.89	4.31	4.66	4.99	5.33	5.68
BB	0.73	2.25	4.07	5.86	7.51	9.03	10.34	11.49	12.53	13.45	14.20	14.85	15.39	15.87	16.39
B	3.77	8.56	12.66	15.82	18.27	20.26	21.89	23.19	24.32	25.37	26.26	26.97	27.61	28.21	28.80
CCC/C	26.36	35.54	40.83	44.05	46.43	47.28	48.24	49.05	49.95	50.60	51.09	51.73	52.57	53.25	53.25
Investment grade	0.10	0.28	0.48	0.73	0.98	1.24	1.49	1.72	1.94	2.17	2.40	2.59	2.77	2.95	3.14
Speculative grade	3.80	7.44	10.60	13.15	15.24	16.94	18.38	19.58	20.65	21.61	22.41	23.08	23.69	24.23	24.75
All rated	1.49	2.94	4.21	5.27	6.17	6.92	7.57	8.12	8.62	9.09	9.49	9.83	10.13	10.41	10.70

Sources: Standard & Poor's Global Fixed Income Research and Standard & Poor's CreditPro®.

Sources: www.standardandpoors.com/ratingsdirect

iii. Lots of problems with rating agencies

2) Ratings & rating agencies: Problems…

- Data coverage incomplete, insufficient, not global (especially historical)
- Categorising of credit risk neglects idiosyncratic risk of borrower
- Providing an outlook regarding the credit quality by **extrapolation of historical data** poses a problem in general
- Due to the fundamental approach, ratings only adapt slowly and hence do not reflect a rapid deterioration of the credit quality
- **Structurally unable to predict "sudden death"** of borrower, e.g. because of fraud (Enron)
- **Conflict of interest**, strong incentive to sell "good" ratings ("rating-shopping", "rating arbitrage")
- Market monopoly of the big three agencies makes it even more difficult to get an "independent" credit quality assessment
- All of the big three agencies are U.S. companies, **political independence challenged**

iii. Credit spread measures credit risk as priced by the market

3) Credit spread

- Market data is more adaptive than ratings and hence better suited to measured fast changes in the credit quality
  - Share prices: Moody's KMV, Merton's Model of Default Risk
  - **Credit spreads:** Compensating the investor for the credit risk of any debt instrument not issued by a sovereign borrower in its own currency ("risk-free")
- But: Exogenous factors may dilute the pure measurement credit risk
- Two parameters important: **probability of default q** and **recovery rate R**
- Let's look at a 1y zero-coupon bond with principal P. Its value at maturity is given by

$$V_m = q[P - P(1-R)] + (1-q)P = q(PR) + (1-q)P$$

- The fair spread S needs to compensate the probability-weighted loss $L = qP(1-R) = SP$. Solving for S yields

$$S = q(1-R)$$

- S increases with q and decreases R

iii. Credit spread can be traded & hedged

3) Credit spread: Properties

- Usually quoted in **basis points** (bps), i.e. 1 basis point = 1 per myriad or **one-hundredth** of one percent
- Ideally, the credit spread should be an assessment of **pure credit risk**, reflecting only the probability of default and the loss severity, BUT:
  - Investors are not risk-neutral and need to be compensated for non-diversifiable risk, driving spreads up (especially for very risky corporate securities)
  - Supply-demand imbalances may sway the credit spread either way
  - Liquidity, size plays an important role
  - Regulations, legal framework as per jurisdiction influence the spread…
  - … as do the specific characteristics of the contract, e.g. coupon rate, optionality, step-up coupons, up-front payments, &c.
- In short, everything which will reduce or increase the risk of the underlying transaction will be reflected in the spread, too

⇨ The need to **trade/manage pure credit risk** is addressed by **credit derivatives**, e.g. CDS…

iii. What is a C.redit D.efault S.wap anyway?

Protection buyer

Seller of credit risk,
short credit risk

Reference Entity, e.g. bond

CDS premium / spread (bps)

Risk transfer

Credit event contingent payment:
1 - recovery

Default

Protection seller

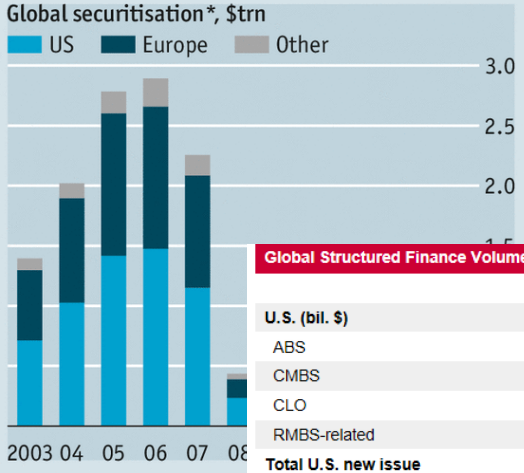
Buyer of credit risk,
long credit risk

iii. Credit-risk-transfer-wise, is that all, folks?

Old alphabet soup, new taste

ABS *(asset-backed security)*	Most generic form of securitisation, includes credit-card debt, car loans, or any packaged income stream. Making steady comeback
MBS *(mortgage-backed security)*	Backed either by commercial (CMBS) or residential (RMBS) mortgages. The most problematic in the downturn, fuelled subprime crisis
CDO *(collateralised debt obligation)*	Pre-crisis these were often invested in "tranches" of ABSs and MBSs or in other CDOs. Not popular with regulators
CLO *(collateralised loan obligation)*	Frequently filled with sliced and diced loans extended to poor-credit firms, such as those taken over by private-equity. Making a comeback

Sources: Dealogic; *The Economist*



Global Structured Finance Volumes

	2015	2016	2017	2018	2019 forecast
U.S. (bil. $)					
ABS	183	191(i)	229(i)	239(i)	245(i)
CMBS	101	76	93	77	80
CLO	98	72	118	129	110(ii)
RMBS-related	54	34	70	86	100
Total U.S. new issue	**436**	**373**	**510**	**531**	**535**
U.S. CLO reset/refi	10	39	167	155	110
Canada (bil. C$)	**15**	**18**	**20**	**24**	**21**
Europe (bil. €)	**77**	**81**	**82**	**106**	**95**
Asia-Pacific (bil. $)					
China	97	116	220	292	310
Japan	38	53	48	55	58
Australia	24	17	36	23	26
Total Asia-Pacific new issue	**159**	**186**	**304**	**370**	**394**
Latin America (bil. $)	**11**	**12**	**17**	**9**	**18**
APPROXIMATE GLOBAL NEW ISSUE TOTAL (bil. $)	**700**	**670**	**930**	**1,040**	**1,050**

(i)U.S. auto loan ABS volume includes the U.S. dollar-denominated cross-border Canadian transactions. (ii)U.S. CLO resets/refis excluded. ABS--Asset-backed securities. CMBS--Commercial mortgage-backed securities. CLO--Collateralized loan obligation. RMBS--Residential mortgage-backed securities. NPL--Nonperforming loan.

Plus, many, many more like e.g. CLN, CBO, CDO of ABS, Synthetic CDO, CDO^2, …

Sources: www.spglobal.com

Part iv: How is credit risk managed?

iv. “A priori” vs. “a posteriori” management of credit risk

Historical context & traditional approach

- During the 1980s and 1990s, the focus was on **measuring and managing market risk** which led to the development of the **Value-at-Risk** methodology
- Prior to the mid-1990s, credit risk was not consistently and in its entirety addressed scientifically
- ***A priori* management** of credit risk, i.e. issuer risk
  - ⇨ Assess the credit quality using classical financial analysis
  - ⇨ Apply appropriate counterparty limits
- ***A posteriori* management** of the credit risk: In case of deterioration of creditworthiness of borrower, either fall back on provisions or settle the position at a loss in the secondary market
  - ⇨ Sub-participation: Transfer only the risky cash flows but retain the main commercial relationship
  - ⇨ Insure / mitigate the credit risk using letters of credit, guarantees, credit insurance policies, governmental guarantees, &c.

iv. “Micro” vs. “macro” management of credit risk

A priori management of credit risks

- **Micro management:** Structuring each single transaction
  - ⇨ Appropriate pricing, with the risk premium compensating the potential loss
  - ⇨ Syndication, i.e. spreading the risk over the syndicate of lenders
  - ⇨ Ensure top seniority to be first to receive proceeds of a liquidation in case of default
  - ⇨ Ensure collateral to have first claim of certain assets
  - ⇨ Introduce credit/rating triggers to account for deterioration of creditworthiness of borrower (like step-up coupons, collateral clauses, repayment, margin calls)
- **Macro management:** Portfolio level limits
  - ⇨ Avoid concentration effects by limiting credit risk as per region, country, industry, sector, rating (i.e. risk) category: Diversification of idiosyncratic credit risks
  - ⇨ Account for correlations between credit risks
  - ⇨ Adjust global credit limits to account for changes in overall systemic credit risk

iv. “Organised” vs. “OTC” markets

Counterparty risk management

- **Organised derivative markets:** Institutional arrangements reduce CP risk
  - ⇨ All transactions are centralised by a clearinghouse which functions as counterparty for market participants
  - ⇨ Daily mark-to-market valuation allows timely adjustment of margin requirements via margin calls
  - ⇨ Initial **margin** (depending on the volatility of the underlying) covers day-to-day losses in case of default
  - ⇨ Position limits on market participants prevent concentration of credit risks
- **OTC (Over-The-Counter) markets:**
  - ⇨ Bilateral netting and collateral agreements (Master Agreement, International Swap and Derivatives Association ISDA)
  - ⇨ Counterparty position limits, CVA (Credit Valuation Adjustment), DVA, Wrong-way risk
  - ⇨ Initial **margin**, like in organised markets
  - ⇨ Interim netting of market value (re-couponing), credit triggers, specialised subsidiaries
  - ⇨ Credit derivatives

iv. Use of PDF to determine Economic capital

Economic credit risk management

- Three “kinds” of capital
  - ⇨ Accounting capital: The bank’s physical, e.g. equity, long-term subordinated debt, …
  - ⇨ Regulatory capital: Minimum capital required by regulator
  - ⇨ **Economic capital:** Target capital required to back all transactions and to maintain solvency
- The management of the credit portfolio of a bank has the goal to **maximise shareholder value**, i.e. to maximise the risk-adjusted return, the **efficient use of economic capital**
- Economic capital is determined using **probability density functions (PDF)** of credit losses
  - ⇨ Measures the probability of the losses on the risk portfolio exceeding the solvency threshold
  - ⇨ Loss may be modelled binary, i.e. default/non-default, or continuously as evolution of creditworthiness
  - ⇨ Very much like **VaR,** but: Timescale is different, ~some days for market risk vs. ~1y for credit risk
  - ⇨ Determine **solvency threshold**: depends on risk aversion, financial soundness of bank, the tolerated confidence interval of the PDF

iv. RAROC provides forward looking risk assessment

Economic credit risk management: RAROC

- **Economic** rate of return *ex ante:* $RAROC = \frac{NBI-EL}{EC}$
  - ⇨ Assess risk (expected & unexpected loss) *a priori*
  - ⇨ Cover expected losses via credit spread & *ex ante* provisions
  - ⇨ Reserve economic capital to hedge unexpected losses occurring within a confidence interval
- Diversifiable risk no longer incur risk costs
- **Paradigm shift** from *ex post* to *ex ante* provisioning of credit risks

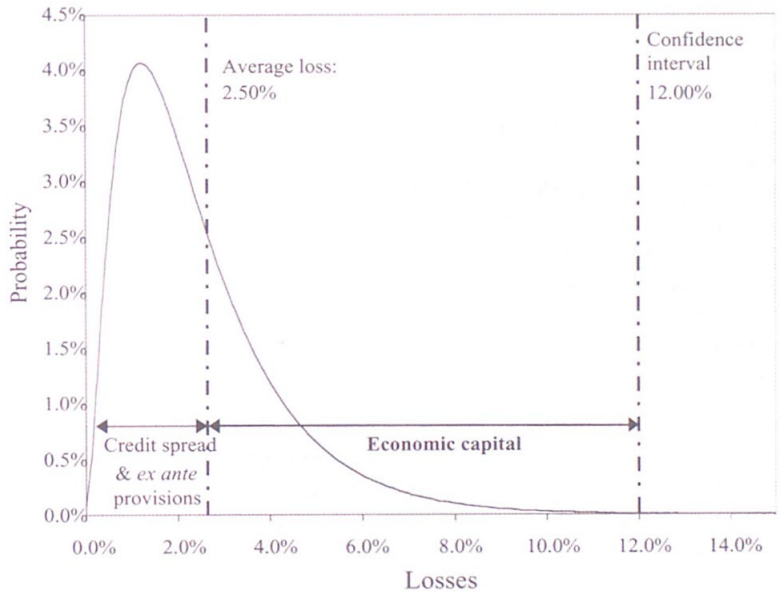


Figure 7.3 Economic capital definition

Sources: Bruyère, R. Credit Derivatives and Structured Credit

v. Conclusio

Let's sum it all up on one slide…

- Risk (and even financial risk) has been an **integral part** of human life for many millennia and so has risk management
- There are many different forms of risk in banking, **credit risk** being the closest to the business of banking and, thus, the largest
- Consequently, banks have a **long-standing tradition** and **tried-and tested, well-established** procedures of risk management
- Credit risks materialises as pure **default risk** and **deterioration of creditworthiness**, referring to an issuer or a counterparty
- Credit risk has a **systemic** and an **idiosyncratic component**, defaults happen rarely but with huge impact (asymmetric risk, **fat tail**)
- Credit risk is measured by the **regulatory authorities** (BASEL I-IV), by **rating agencies** (Moody's, S&P, Fitch) and by the **markets** (via credit spreads, cost of risk)
- "**Traditional**" credit risk management works *ex post* by reacting only **after** credit losses have occurred
- **Economic** credit risk management anticipates losses *ex ante* and accounts for risk diversification on portfolio level
- Measuring portfolio credit risk is done by **calculating a probability density function of losses** (e.g. via Monte Carlo simulation) and is used to quantify the unexpected loss which needs to be backed by economic capital

vi. Further reading & links

- Bruyère, R. Credit Derivatives and Structured Credit. John Wiley & Sons, Ltd. ISBN 0-470-01879-8.
- D'Errico, M. et al. (2017): *ECB Working Paper 2041: How does risk flow in the credit default swap market?*
- Blanchard, O. (2009): *The Crisis: Basic Mechanisms and Appropriate Policies*, CESifo Forum 1/2009
- Westphal, A. (2015): *Systemic Risk in the European Union: A Network Approach to Banks' Sovereign Debt Exposures*, Int. J. Financial Stud. 2015, 3, 244-279, DOI:10.3390/ijfs3030244
- DTCC (2015): *Understanding Interconnectedness Risks*
- BIS (2018): *Statistical release: OTC derivatives statistics at end-June 2018,* https://www.bis.org/publ/otc_hy1810.htm
- World Trade Organization (2018): *World Trade Statistical Review 2018*, https://www.wto.org
- Bernanke, B. (2013): *Monitoring the Financial System*, Lecture presented at the 49th Annual Conference on Bank Structure and Competition, Chicago
- Mohamed, K. (2018): *Evaluating the Relationship between the Banking System Stability and the Internal Capital Adequacy Assessment Process: Evidence from the Egyptian Banking Sector*, Journal of Financial Risk Management, 2018, 7, 331-368

- https://www.diplomaticourier.com/posts/davos-was-all-about-globalization-4-0-so-what-does-it-mean
- https://simpolproject.eu/2017/07/10/mapping-the-global-credit-default-swap-network/
- https://www.risk.net/margin-in-derivatives-trading/6162151/systemic-risks-in-central-counterparty-clearing-house-networks
- https://www.fimarkets.com/pagesen/credit_value_adjustment.php
- https://www.spglobal.com

Thank you very much

www.linkedin.com/in/dr-jan-alexander-posth-5324b152

posh@zhaw.ch