RISK CONTROL

Lectures on Securitisation

William Perraudin

February 2020

Agenda

1. Introduction to securitisation
2. Risk analysis and pricing of securitisations
3. Regulation of securitisations
4. Practical exercise 1: PURA RTS
5. Role of the ratings agencies
6. Liquidity of securitisations
7. Market drivers and motives for using securitizations
8. Practical exercise 2: Optimal Tranching

RISK CONTROL

A Research-Lead Software and Analytics Company

Analytics, software, proprietary algorithms, tools and quantitative models

Risk Control is a software and analytics company based in London. Founded in 2000, Risk Control is led by William Perraudin, Adjunct Professor and former Chair of Finance at Imperial College London, specialising in the field of risk

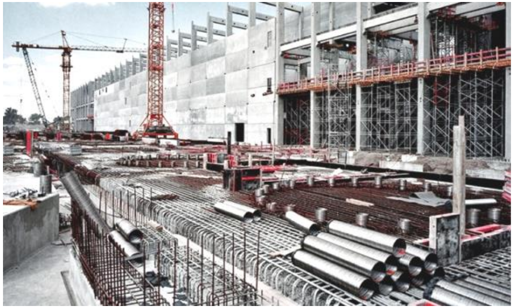
Risk Control staff include highly qualified financial and software engineers, specialised in implementing solutions for large financial firms

- We build bespoke high performance JEE solutions for our clients
- We are expert in valuation and risk modelling
- We have implemented financial planning software for multiple institutions
- We deliver robust, transparent, well-documented solutions

Risk Control works with regulators, central banks and commercial firms on data, risk and valuation issues

Objectives:

- Risk Control aims to increase transparency within our client's business environments and assist them in reducing the likelihood and cost of potential adverse events
- To achieve these objectives, Risk Control deploys multi-disciplinary teams of finance specialists, software engineers and statistical and mathematical modellers
- Our analyses of financial risk and liquidity have shaped the thinking of regulators and industry participants



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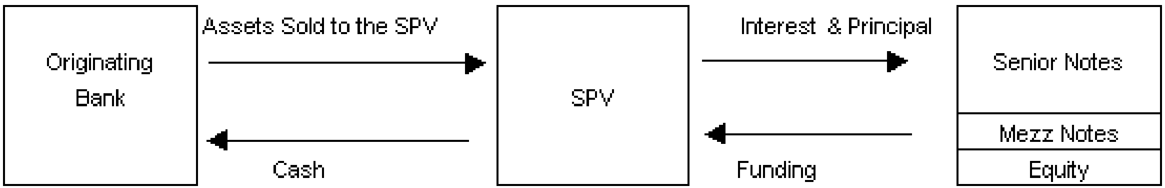
Introduction (1/4)

- A securitisation is created when
  1. A financial institution (e.g., a bank) sells a pool of risky assets into a bankruptcy-remote legal entity called a Special Purpose Vehicle. (Often, SPVs are established as trusts.)
  2. (Alternatively, a manager can create a securitisation by forming a fund for bonds via an SPV financed by issuing notes.)
  3. The SPV funds its acquisition of the assets by issuing liabilities, generally notes (or bonds), to the market.
- The terms of the note issues are such that if the income on the asset pool becomes too small to pay all the contractual coupons, the coupons will be reduced but without the SPV being considered insolvent.
- The liabilities of the SPV have a range of seniorities.
- In a typical transaction, the par value of the senior class of liabilities might make up 80% of the value of the underlying asset pool.
- Often, there are several so-called mezzanine classes of securities with successively lower seniorities.
- Each class of liabilities is collectively called a tranche.

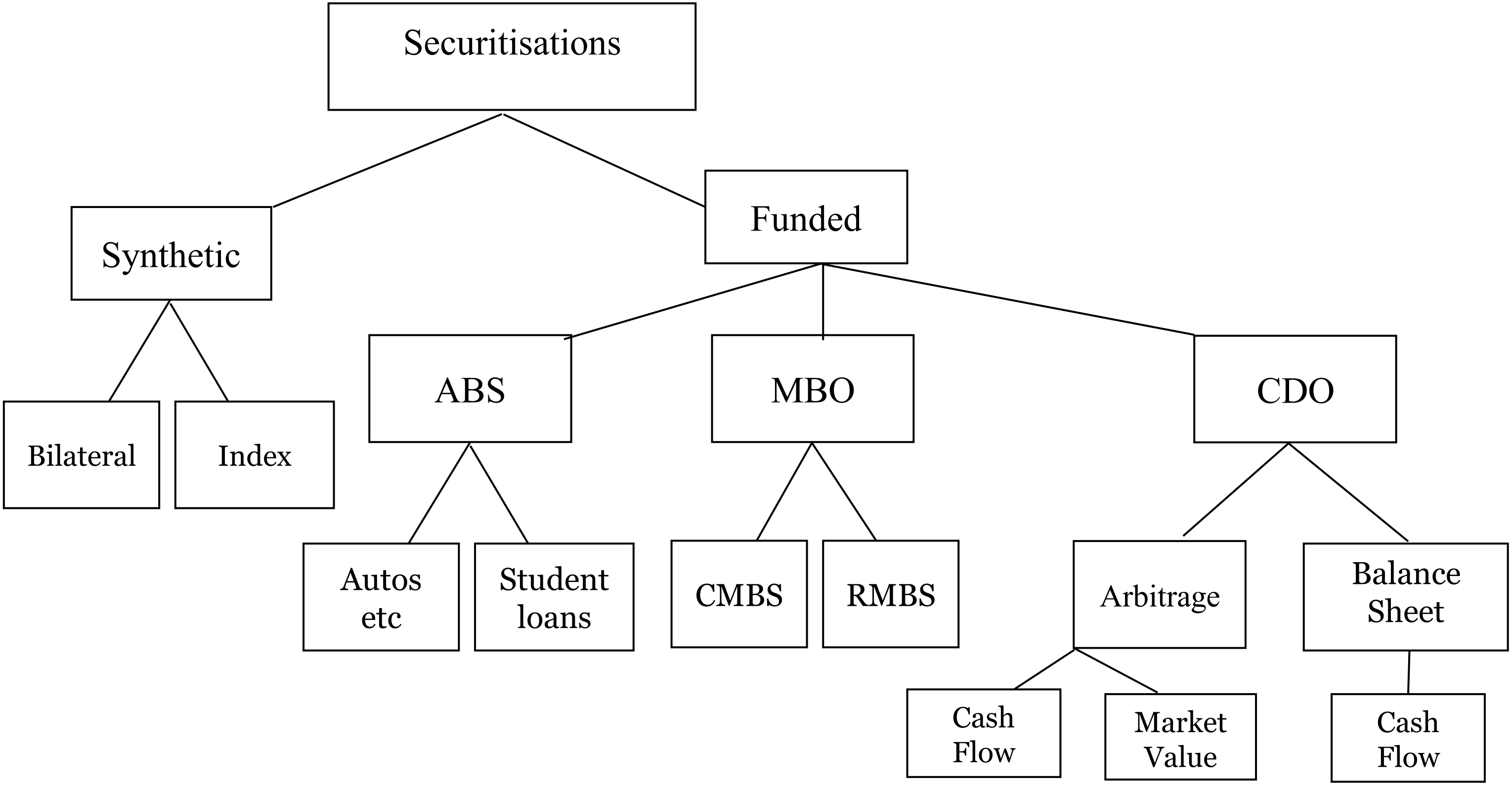


Introduction (2/4)

- In each period, income to the SPV is used to pay the coupons due to the different note holders starting with the most senior tranche.
- If at the maturity of the structure, the net reinvested income on the assets exceeds the amounts needed to repay the notes, the proceeds are paid to the holder of the so-called equity tranche.
- The detailed rules governing the way income to the SPV is split up and directed to holders of debt of different seniorities is called the “cash flow waterfall”.

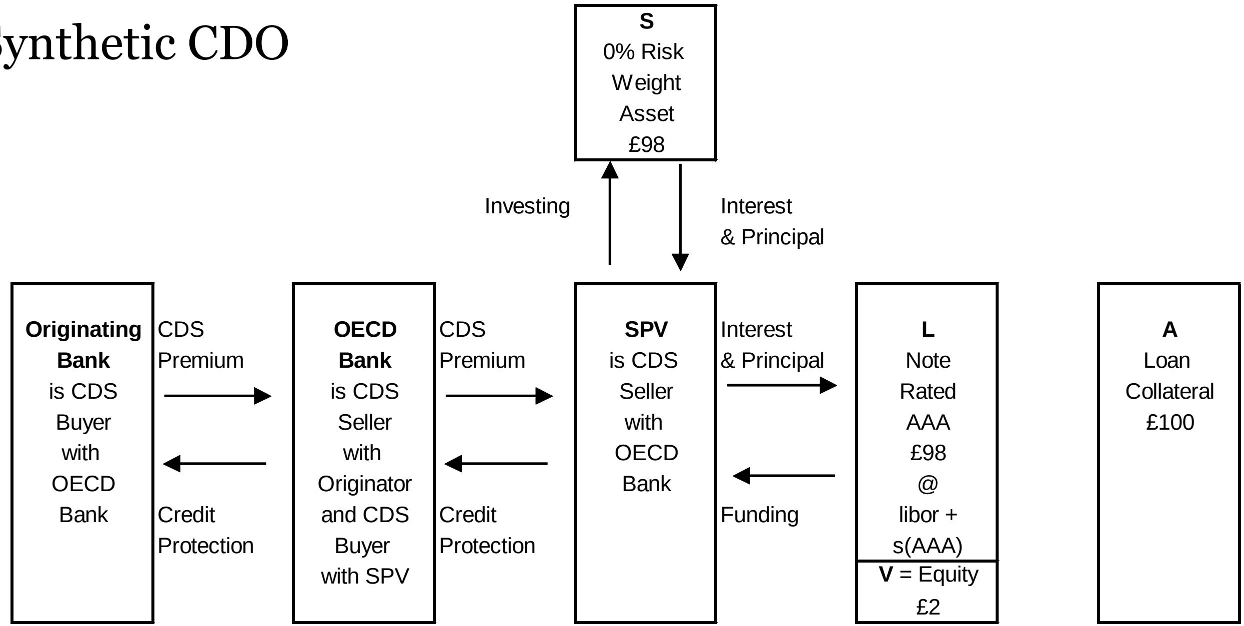
Classes	% of the Capital Structure
A Moody's/S&P Rating: Aaa/AAA Coupon: Libor+45bp	69%
B Moody's/S&P Rating: A2/A Coupon: Libor+145bp	15%
C Moody's/S&P Rating: Baa2/BBB- Coupon: Libor+245bp	8%
D Moody's/S&P Rating: Ba3/NR Coupon: Libor+645bp	4%
Equity Not Rated Expected Return: 25% - 30%	4%

Introduction (3/4)



Introduction (4/4)

Synthetic CDO



How Securitisations Contributed to the Crisis (1/3)

- The crisis started as a localised problem of higher than anticipated default rates in US sub-prime mortgages.
- These mortgages had been parcelled up and sold to banks round the world through RMBS and CDO. Confidence in valuations of these opaque transactions collapsed in the summer of 2007.
- The ratings agencies which had acted as experts in this market lost all credibility.
- Banks started to distrust their counter-parties because each bank knew that other banks could not value their books so anyone could be insolvent.
- Any bank with a business model requiring liquidity was in trouble.

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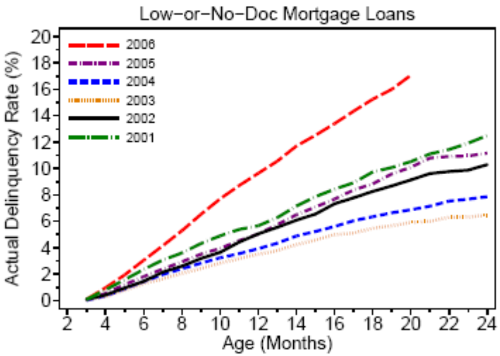
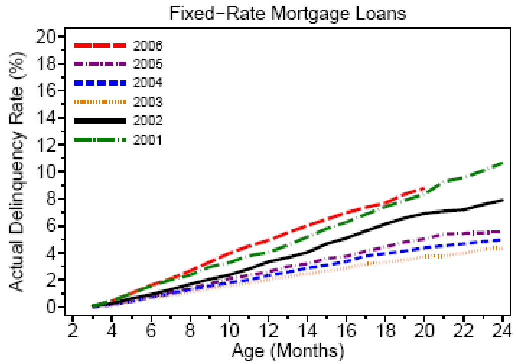
How Securitisations Contributed to the Crisis (2/3)

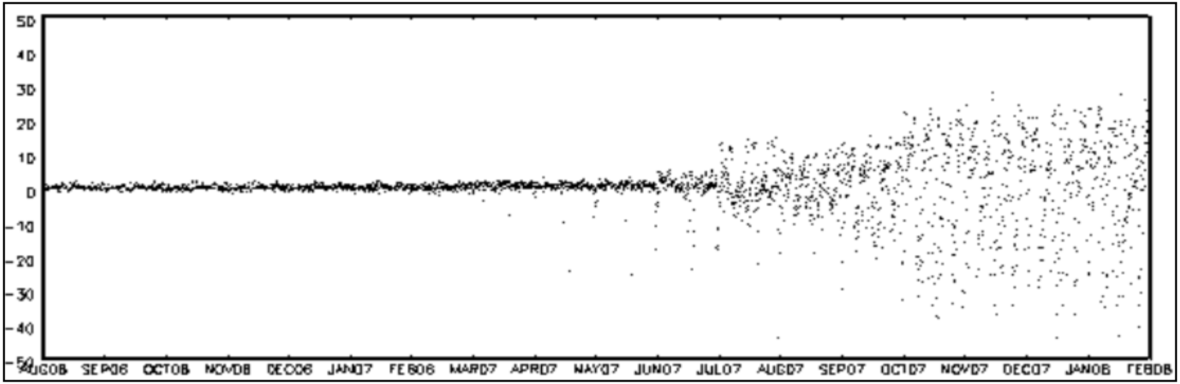




Source: Understanding the Subprime Mortgage Crisis Demyanyk and Van Hemert, February, 2008

- Delinquency rates by age of mortgage plotted for different origination years.
- Sub-prime mortgages (equal to about 20% of US mortgage market in 2007) showed major deterioration for mortgages originated in 2006.
- More broadly, fixed rate mortgages did not deteriorate so much. (Defaults rates looked like those seen in early 2000s.

How Securitisations Contributed to the Crisis (3/3)



- Plot shows prices of AA-rated US Fixed Rate Home Equity Loan Asset Backed Securities (ABS) with face value of 100.
- Prices are measured relative to “curve” the average AA-rated issue.
- Plot shows opening up of substantial price variation from August 2007 onwards.
- No one knew at that time how to value illiquid ABS. This created distrust and confusion in banks.

Basel II left two fatal loopholes

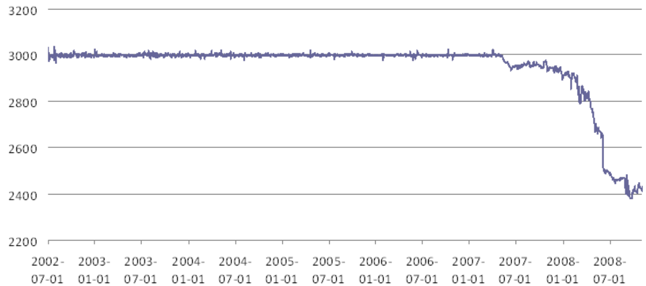
Loophole 1:

- Banks are allowed to calculate capital separately on trading book and banking book assets.
- The trading book capital rules in Basel II were hardly changed from those employed under Basel I. Banks calculated capital using short-term volatility models.
- This was reasonable if trading book exposures were very liquid and could be bought and sold easily if market prices started to move substantially.
- But post 2000, banks had built up major credit derivative and structured product positions in their trading book , incentivised by fact that trading book capital was relatively low for such exposures.

Loophole 2:

- Basel II was overwhelmingly about capital and paid insufficient attention to funding liquidity.
- The risk implications of business models that heavily relied on the availability of short term funding (secured or unsecured) were not understood or properly allowed for.
- In Basel II banks were required to monitor and manage their liquidity positions through such devices as maturity ladders, liquidity stress testing and contingency planning.
- But these systems were not enforced rigorously enough to constrain behaviour and typically banks aimed to be able to cope with disruptions to funding that lasted a couple of weeks not six months or a year.

Portfolio Value for 3 ABS



Implications of those Loopholes

- What one could expect from a banking system that had been radically transformed through the growth in credit derivative and risk transfer markets was little understood before the crisis.

Key points:

1. Thirty years ago, a crisis in US subprime might have affected a group of geographically specialised lenders with a particular emphasis in their customer base. When the crisis occurred, the market was concerned that almost any bank was exposed to the crisis.

2. The volume and complexity of risk transfers meant that the true extent of values or liabilities values was very hard to assess. Reliance on the ratings agencies had become excessive.

3. In a world where values are uncertain there is a much increased risk of general distrust between counterparties and hence a higher risk of a breakdown in the markets for liquidity.

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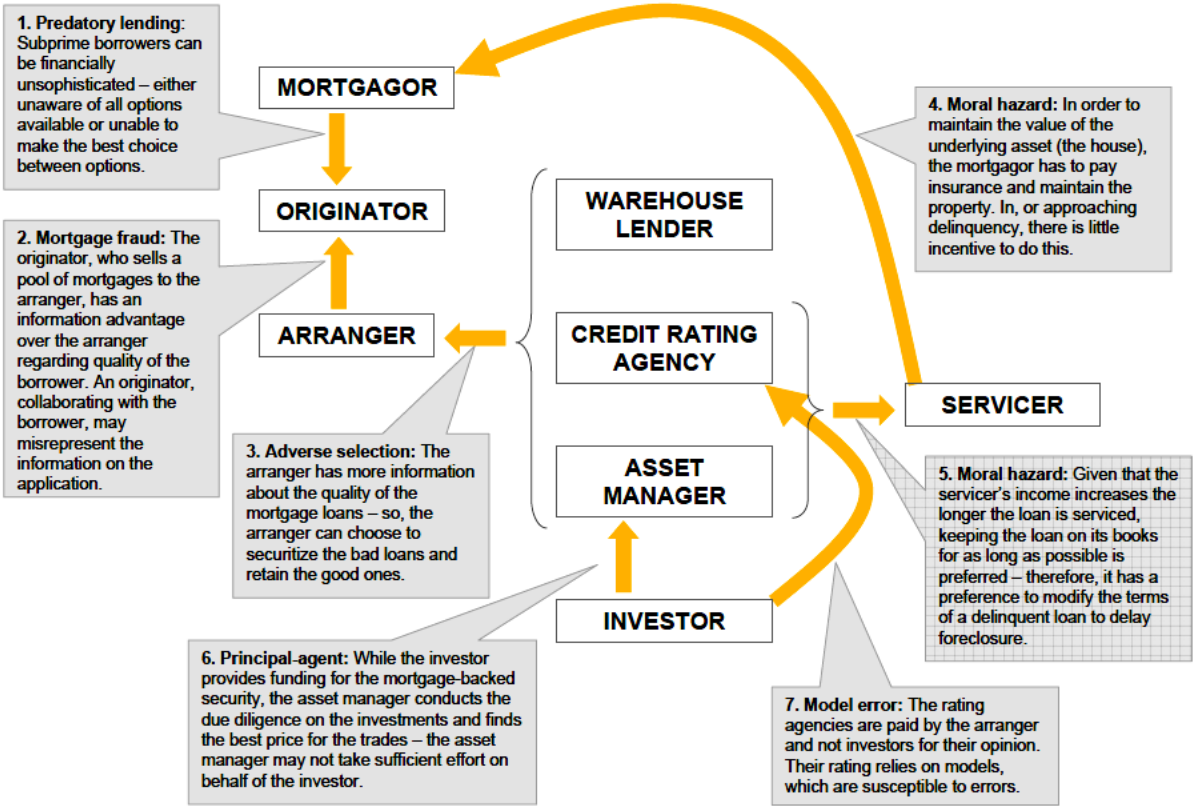
Seven Deadly Sins of Securitisation



Ashcraft and Schuermann (2008): "Understanding the Securitization of Subprime Mortgage Credit"

Contrasting US and European Markets

But all securitisation markets were not the same…

US Securitisation Markets

1. Vertically disintegrated industry
2. Non-bank balance sheet issuers common
3. Mortgage market without recourse
4. Regulation split between agencies
5. Most of market covered by government guarantees (via agencies)

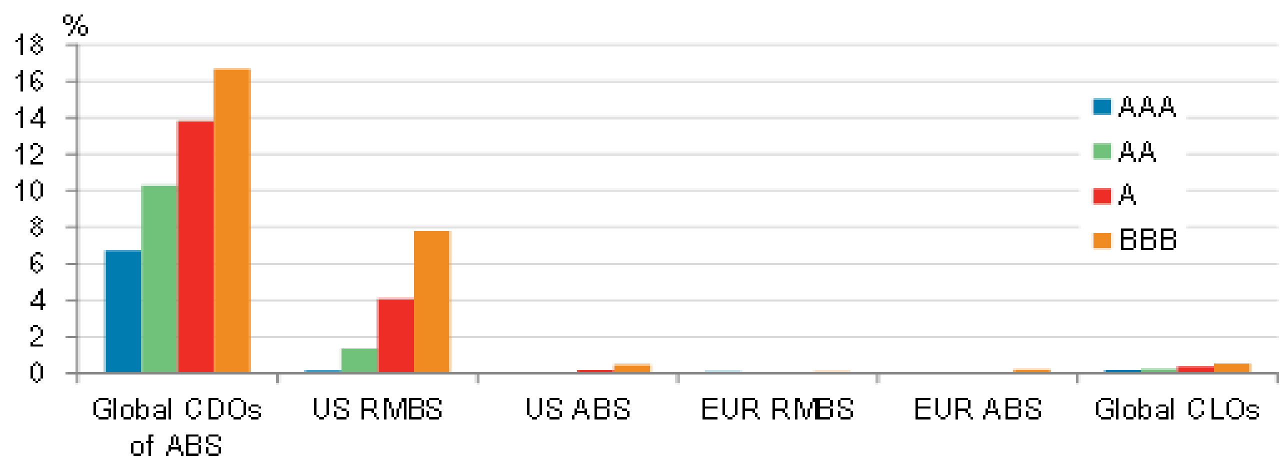
European Securisation Markets

1. Vertically integrated issuers common
2. Most balance sheet issuers banks
3. Mortgage market with recourse
4. Regulation more unified
5. Almost no public role in market

Performance of the ABS Market

- Post-crisis volatility in European securitisation ratings occurred despite good credit performance.
- Since 2007, UK, France, Spain and Italy showed peak to trough GDP declines of 7.2%, 4.4%, 5.0%, and 7.2% respectively
- Retail and SME loan backed securitisations have been strikingly robust to the crisis
- RMBS, Other Consumer ABS, Credit Card ABS and SME ABSs experienced cumulative default rates of 0.10%, 0.13%, 0.00% and 0.41% respectively between 2007 and 2013

Structured finance average 1-year default rates for 1983-2012



Source: Standard & Poor's

Questions 1a

1. Are securitisations more opaque as securities than
   a) Bank stocks
   b) Bank bonds
   c) Covered bonds

   and hence deserving of tighter regulatory treatment?

2. If the crisis had not been triggered by securitisations, might the collapse of some other asset class have triggered it?

3. Is there any difference between a bank holding securitisations through the trading book versus the banking book? Should the capital treatments be different?

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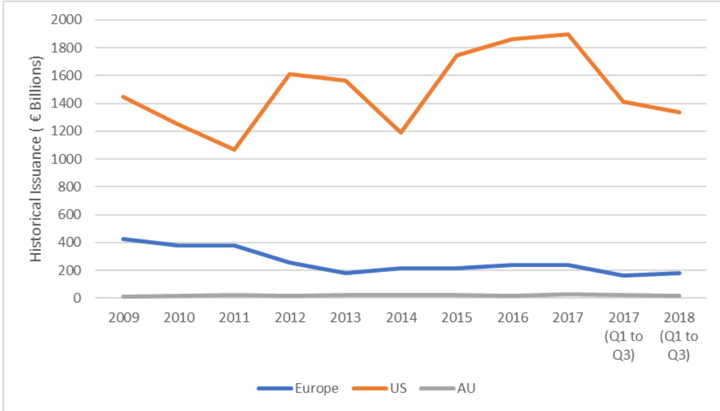
State of the Securitisation Market

1. Following the crisis, securitisation was blamed by many commentators for what had gone wrong.
2. Naturally, a major effort began among regulators to tighten up the capital rules for securitisations.
3. (We shall talk about this tightening of regulation subsequently.)
4. A parallel move began to tighten regulation of ratings agencies particularly as their activities related to securitisation
5. Volumes of new issues sank with the exception of issues aimed at creating securities that could be retained and employed as collateral for central bank borrowing.
6. Investor demand disappeared with pension funds and insurers being much more conservative.
7. In the next few slides, we look at statistics to see how the market has evolved recently and what are the states of new issuance and amounts outstanding.

Historical Issuance (€ Billions)

	Europe	US	AU
2009	423.9	1,447.2	9.7
2010	378	1,245.9	15.5
2011	376.8	1,068.9	20.4
2012	257.8	1,609.0	14.8
2013	180.8	1,565.1	22.4
2014	217.1	1,190.9	22.1
2015	216.6	1,744.5	19.9
2016	239.6	1,860.4	16.4
2017	236.5	1,899.3	29.2
2017 (Q1 to Q3)	162.3	1,414.3	21.6
2018 (Q1 to Q3)	180.1	1,338.6	14

Source: Bank of America Merrill-Lynch, Bloomberg, Citigroup, Dealogic, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA



- Recent US issuance has been stable with some fluctuations sustained by agency securitisations
- European issuance has trended downwards since the Lehmans Brothers collapse with a stabilisation in 2016.
- Much issuance has been associated with central bank collateral.
- European issuance has been 10-15% of US volumes

Recent Issuance (1/3)

European Issuance by Collateral (€ Billions)

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
ABS	39.3	30.2	52.9
CDO/CLO	42	31	44.7
CMBS	3.9	1.8	0.9
RMBS	87.4	90.5	123
SME	7.5	10.4	14.9
WBS/PFI	0	0	0
Total	180.1	162.3	236.5

US Issuance by Collateral (€ Billions)

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
ABS	170.2	163.1	219.1
CDO	121.8	192.2	262.4
Agency MBS	818.2	918.2	1,223.3
Non-Agency CMBS	56	58.1	84.4
Non-Agency RMBS	172.3	82.5	110.1
Total	1,338.6	1,414.3	1,899.3

European Issuance by Retention (€ Billions)

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Placed	100.2	79.8	111.3
Retained	80	82.7	125.2
Total	180.1	162.3	236.5

- 61% of US issues are agency MBS, of non-agency, ABS and CDOs comprise 33% and 24%, the rest being property related

- RMBS are the bulk of European issues followed by CDOs/CLOs and ABS (autos and cards)
- SME-loan-backed issues have been minor
- Only about half of European issuance is sold into the market
- 56% of European issues are placed and 44% retained

Source: Bank of America Merrill-Lynch, Bloomberg, Citigroup, Dealogic, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA

Recent Issuance (2/3)

Issuance by Country of Collateral (€ Billions)

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Belgium	0.2	12.3	12.3
Denmark	0	0	0
France	16.8	35.1	36.9
Germany	7.6	7.5	12.9
Greece	0.1	0	0
Ireland	8.5	1.6	4.4
Italy	29	12.1	29.5
Netherlands	25.5	15.8	15.9
Portugal	2.9	0.3	1.1
Spain	5.9	10.1	25.6
UK	36.7	33.6	47.2
Other EU	0.6	0.8	1.5
Other Europe	1.2	1	2.3
PanEurope	45.1	31.6	45.4
Multinational	0	0	0
European Total	180.1	161.9	235
US Total	1,338.6	1,414.3	1,899.3

Issuance by Collateral Type and Country of Collateral:Q3 2018 (€ Billions)

	ABS	CDO/CLO	CMBS	RMBS	SME	WBS/PFI	TOTAL
Belgium							-
Denmark							-
France	0.6			5.0			5.6
Germany	2.0						2.0
Greece	0.1						0.1
Ireland	0.4			3.3			3.8
Italy	1.7			9.5	1.7		12.9
Netherlands				1.5			1.5
Portugal							-
Spain	0.6				0.2		0.8
UK	2.2		0.8	9.2			12.3
Other EU			0.1				0.1
Other Europe				0.1			0.1
PanEurope		14.2	0.2				14.4
Multinational							-
European Total	7.8	14.2	1.1	28.6	1.9	-	53.6

	ABS	CDO	AGENCY MBS	NON-AGENCY CMBS	NON-AGENCY RMBS	TOTAL
US Total	43	24.2	293.8	18.2	105	484.2

- UK RMBS contribute most to recent issuance volume followed by Netherlands and Italian RMBS
- These three contribute 53% of the entire market
- CDO/CLOs are Pan-European in underlyings

Source: Bloomberg, Citigroup, Dealogic, Bank of America-Merrill Lynch, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA

Recent Issuance (3/3)

European Issuance by Rating (€ Billions)

	2018	2017
AAA	101.7	113
AA	28.1	52.2
A	12.7	27.2
BBB & Below	11.7	12.3
Not Rated	25.9	31.8
European Total*	180.1	236.5

Source: Bank of America-Merrill Lynch, Bloomberg, Citigroup, Dealogic, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA

US Issuance by Rating (€ Billions)

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
AAA	200.8	259.7	343.5
AA	24.7	38.8	51.2
A	25	31.6	42.9
BBB & Below	39.6	42.6	57.2
Not Rated	230.3	123.4	181.3
Agency MBS	818.2	918.20	1,223.30
US Total	1,338.60	1,414.30	1,899.30

- In Europe, 56% of issues in 2018 were rated AAA, while 14% were unrated
- In contrast in the US, 25% of non-agency issues were AAA and 28% were unrated
- This suggests that the US market is less in thrall to the ratings agencies than the European
- Non-AAA fell from 52% to 44% of total European issuance from 2017 to 2018. On the other hand in the US, non-AAA went from 49% to 61% from 2017 to 2018.

Outstandings by Collateral

European Outstandings by Collateral (€ Billions)

	2018:Q3
ABS	217.6
CDO/CLO	124.7
CMBS	50.3
RMBS	670.5
SME	69.9
WBS/PFI	63.2
Total	1,196.3

Source: Bloomberg (US & Europe), Fannie Mae (US), Federal Reserve (US), Freddie Mac (US), Ginnie Mae (US), Loan Performance (US), Dealogic (US), Macquarie (Australia), Refinitiv (US), AFME &SIFMA Estimates (US & Europe)

US Outstandings by Collateral (€ Billions)

	2018:Q3
ABS	1,345.80
Agency MBS	6,173.70
Non-Agency CMBS	702.4
Non-Agency RMBS	459.3
Total	8,681.2

- In Europe, 56% of the outstanding market volume is RMBS with ABS, CD)/CLO, SME and CMBS contributing 18%, 10%, 6% and 4%.
- In the US, ABS, non-agency CMBS and non-agency RMBS represent 54%, 28% and 18% of non-agency issues.
- ABS and property related issues (agency and non-agency) represent 16% and 84% of total outstandings.

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European Outstandings Breakdown

European Outstandings by Vintage (€ Billions)

	2018:Q3
2018	168.7
2017	202.0
2016	166.2
2015	95.9
2014	82.7
2013	49.9
2012	29.8
2011	29.0
2010	83.0
2009	42.5
Prior	246.7
Total	1196.3

Source: Bloomberg, Macquarie, AFME, SIFMA

European Outstandings by Collateral and Country:Q3 2018 (€ Billions)

	ABS	CDO/CLO	CMBS	RMBS	SME	WBS/PFI	TOTAL
Austria	0.3			1.2			1.5
Belgium	0.4		0.1	39.1	17.1		56.7
Finland	0.7					0.5	1.2
France	21.5	0.07	0.2	83	0		104.8
Germany	36.2	0.2	1.2	2.9	6.2	0	46.9
Greece	8.5	1.8	0.2	1.1	7.1		18.6
Ireland	0.8		0.2	27.4	0.19		28.5
Italy	65.5	0.5	2.7	59.9	13.9	0.3	142.9
Netherlands	2.3	0	0.4	172.4	0		175.2
Portugal	3.7		0.53	18.1	4.3		26.8
Russia				1.5	-		1.5
Spain	23.9	0.3	0.3	115.7	14.7		154.9
Turkey	1.4						1.4
UK	46.5	7.3	40.9	147.1	5.8	61.8	309.4
Other	4.5	0.2	0.08	0.9	0.31		6
PanEurope	1.1	101.7	3.6	0.1	0.3	0.1	106.9
Multinational	0.1	12.7				0.4	13.2
European Total	217.6	124.7	50.3	670.5	69.9	63.2	1196.3

- The major European markets by amounts outstanding are, in order, UK, Netherlands, Spain and France.
- RMBS followed by ABS are the dominant contributors.
- Spain, Italy and Belgium have some SME-backed issues.

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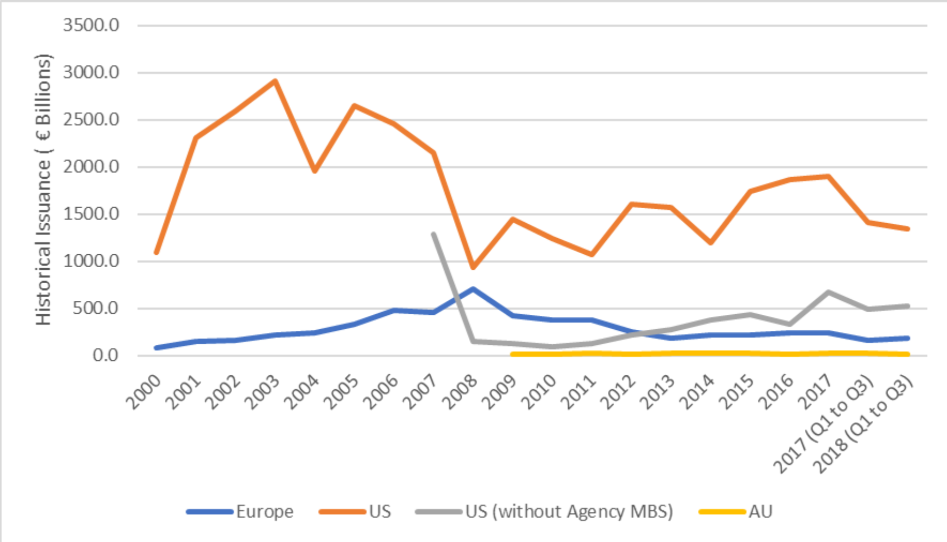
Historical Issuance (€ Billions)

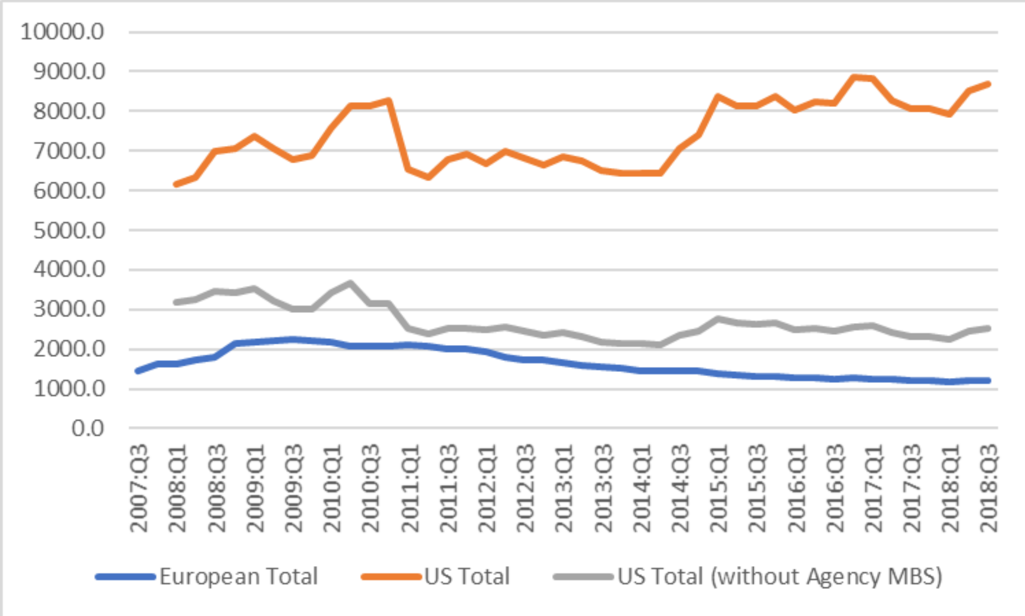
	Europe	US	US (without Agency MBS)	AU
2000	78.2	1088.0		
2001	152.6	2308.4		
2002	157.7	2592.7		
2003	217.3	2914.5		
2004	243.5	1956.6		
2005	327.0	2650.6		
2006	481.0	2455.8		
2007	453.7	2147.1	1,289.19	
2008	711.1	933.6	154.63	
2009	423.9	1,447.2	127.92	9.7
2010	378	1,245.9	95.42	15.5
2011	376.8	1,068.9	123.25	20.4
2012	257.8	1,609.0	220.34	14.8
2013	180.8	1,565.1	271.54	22.4
2014	217.1	1,190.9	373.49	22.1
2015	216.6	1,744.5	431.20	19.9
2016	239.6	1,860.4	332.99	16.4
2017	236.5	1,899.3	676.0	29.2
2017 (Q1 to Q3)	162.3	1,414.3	496.1	21.6
2018 (Q1 to Q3)	180.1	1,338.6	520.4	14

Source: Bank of America Merrill-Lynch, Bloomberg, Citigroup, Dealogic, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA



Historical Outstandings (€ Billions)

	European Total	US Total	US Total (without Agency MBS)
2007:Q3	1467.5		
2007:Q4	1617.5		
2008:Q1	1607.7	6167.9	3165.3
2008:Q2	1736.7	6341.0	3235.5
2008:Q3	1795.8	6984.4	3449.5
2008:Q4	2134.9	7056.3	3424.5
2009:Q1	2179.9	7365.0	3521.2
2009:Q2	2199.6	7056.5	3228.1
2009:Q3	2237.0	6780.0	3017.0
2009:Q4	2220.9	6892.0	3000.7
2010:Q1	2167.0	7568.9	3435.8
2010:Q2	2070.1	8135.7	3667.1
2010:Q3	2083.5	8139.5	3163.4
2010:Q4	2089.8	8264.2	3154.1
2011:Q1	2115.3	6541.5	2527.0
2011:Q2	2079.0	6330.9	2391.3
2011:Q3	1992.1	6783.8	2513.3
2011:Q4	1993.7	6922.9	2529.5
2012:Q1	1922.6	6682.8	2493.7
2012:Q2	1810.3	6978.1	2552.3
2012:Q3	1733.4	6827.2	2450.4
2012:Q4	1712.7	6646.7	2358.9
2013:Q1	1653.9	6852.5	2408.2
2013:Q2	1600.4	6751.9	2328.3
2013:Q3	1551.1	6496.9	2192.1
2013:Q4	1503.5	6449.1	2151.6
2014:Q1	1446.9	6448.1	2152.6
2014:Q2	1444.6	6438.9	2110.3
2014:Q3	1446.8	7056.2	2335.6
2014:Q4	1441.0	7407.5	2442.1
2015:Q1	1373.2	8375.1	2765.8
2015:Q2	1355.6	8126.3	2676.7
2015:Q3	1329.7	8125.0	2625.5
2015:Q4	1301.9	8382.3	2656.4
2016:Q1	1273.0	8034.3	2500.2
2016:Q2	1278.2	8252.7	2529.1
2016:Q3	1249.2	8204.1	2451.1
2016:Q4	1262.5	8851.5	2567.8
2017:Q1	1229.7	8810.3	2587.3
2017:Q2	1231.6	8274.8	2404.3
2017:Q3	1198.2	8076.3	2313.4
2017:Q4	1217.2	8077.2	2309.2
2018:Q1	1190.4	7927.4	2252.5
2018:Q2	1200.9	8499.5	2450.1
2018:Q3	1196.3	8681.2	2507.5



Source: Bank of America Merrill-Lynch, Bloomberg, Citigroup, Dealogic, Deutsche Bank, JP Morgan, Macquarie, Refinitiv, Unicredit, AFME, SIFMA

Questions 1b

1. List the three differences between the US and European securitisation markets that strike you as most important?

2. What are the challenges that these differences create for international regulation such as the Basel framework?

3. What are the legitimate uses of securitisation that regulators may view favourably – if any?

4. What would you forecast will happen to the securitisation market in the US and Europe over the next few years?

Agenda

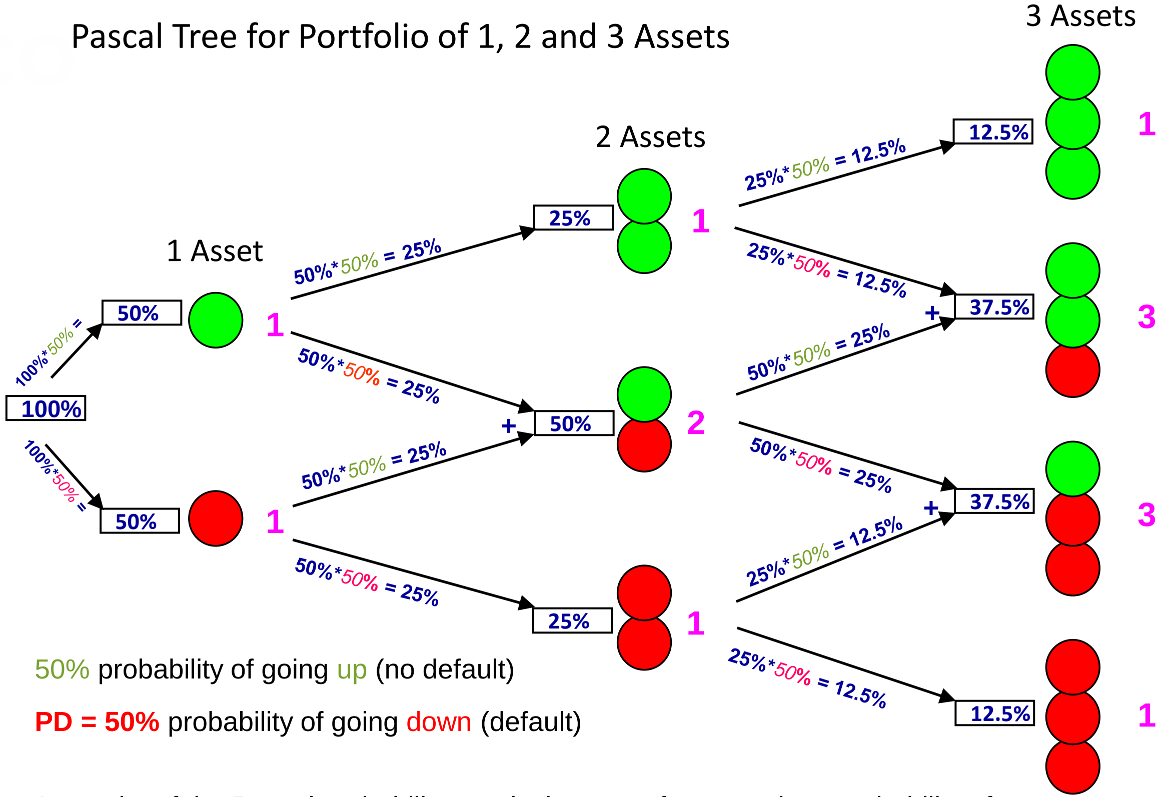
1. Introduction to securitisation
2. Risk analysis and pricing of securitisations
3. Regulation of securitisations
4. Practical exercise 1: PURA RTS
5. Role of the ratings agencies
6. Liquidity of securitisations
7. Market drivers and motives for using securitizations
8. Practical exercise 2: Optimal Tranching

RISK CONTROL

Introduction to Risk Analysis of Securitisations

- How can one model expected losses and calculate capital requirements for holdings of different tranches of a securitisation?
- Focus on a simple, essentially static model, in which exposures default or not by some terminal date T.
- Suppose an SPV has issued a set of tranches of notes of different seniorities and that these tranches are repaid or not again at the terminal date T.
- Structured product agreements are complex and contain detailed rules on how senior tranches are amortised early (e.g., if financial triggers based on ratios of asset value to liabilities are contravened).
- We ignore possibilities of cash flow prior to T and rule out the complexities of real life deals such as collateral or interest rate triggers and early amortization.
- While very stylised, this approach reveals much about the basic properties of structured exposures.
- The starting point for analysis is the distribution of losses on the pool.
- After examining some simple binomial examples, we shall study the Vasicek distribution (which is the basis for the Basel II capital formulae for loans) both in its conditional and unconditional form.

Pascal Tree for Portfolio of 1, 2 and 3 Assets

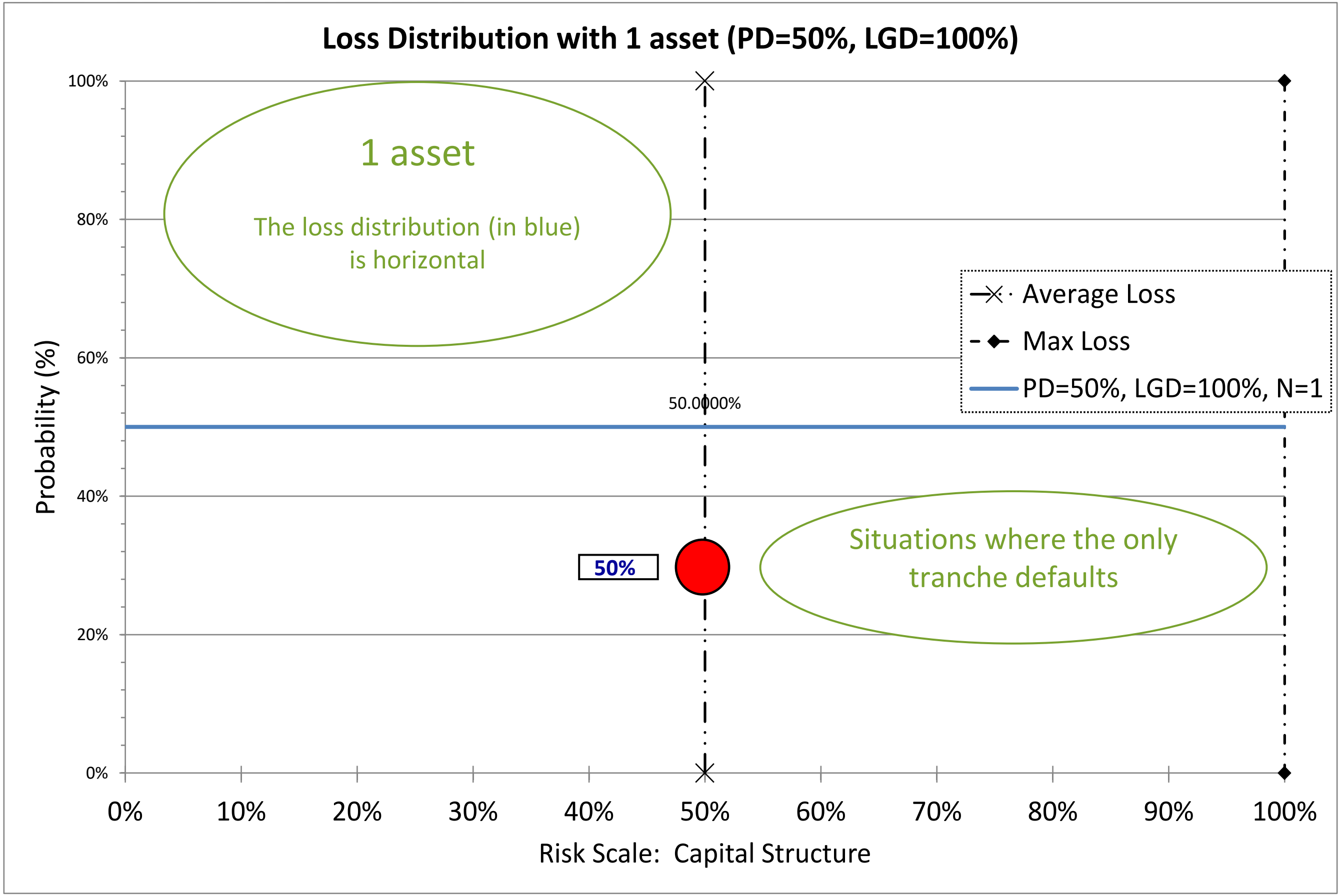


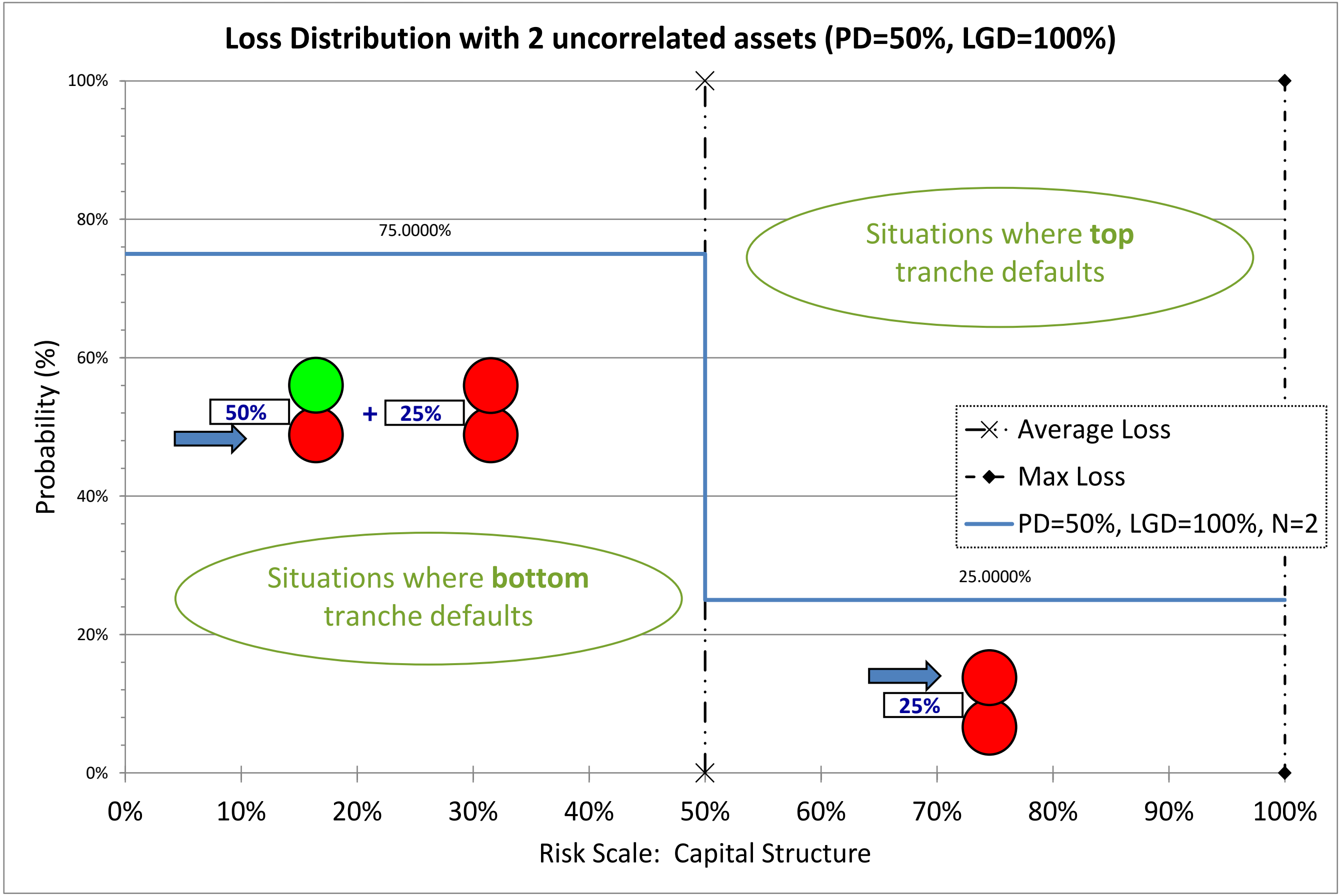
50% probability of going up (no default)

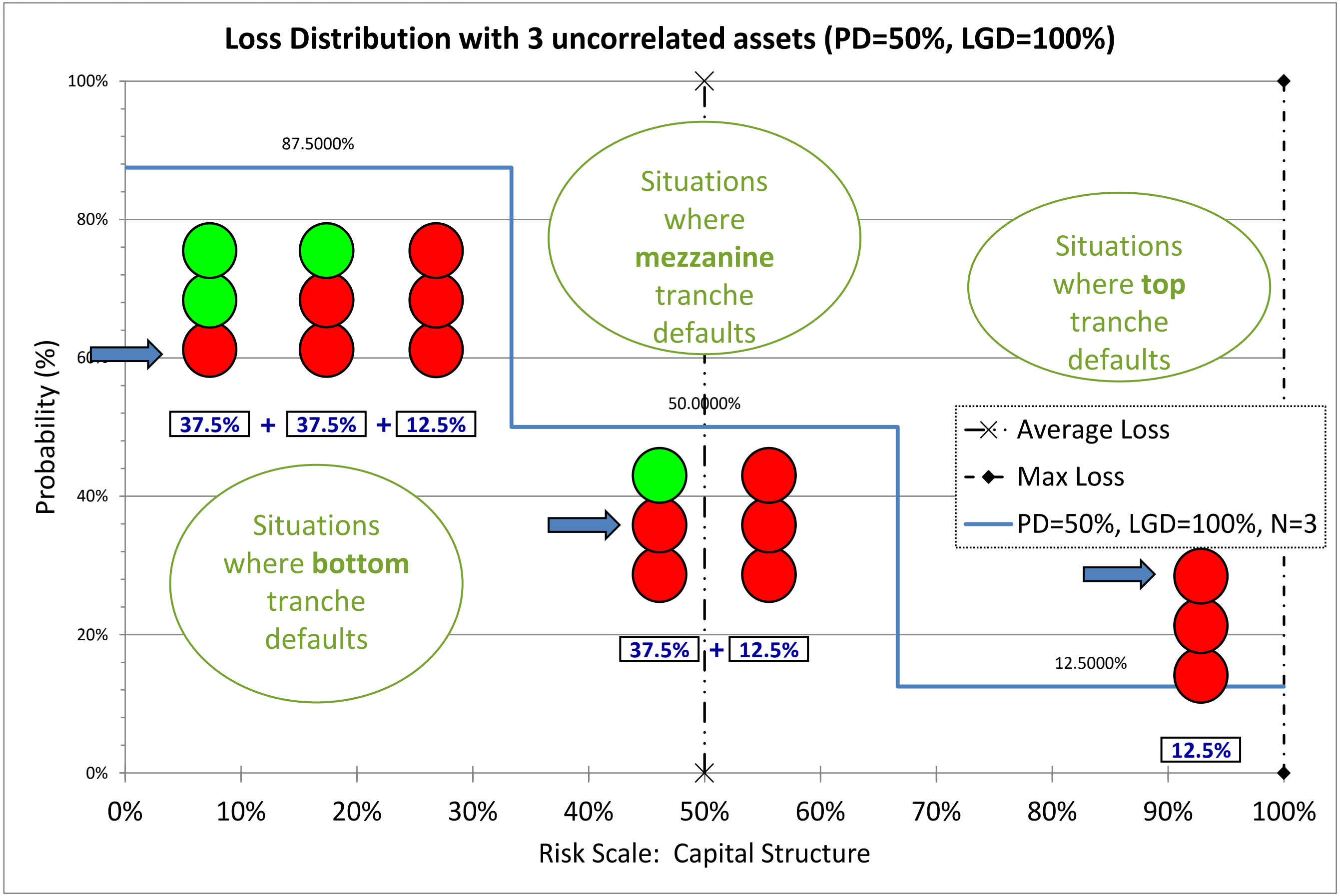
PD = 50% probability of going down (default)

Any point of the Pascal probability tree is the sum of two previous probability of occurrence weighted respectively by the probabilities of going up (no default event) and down (default event with **LGD=100%**)

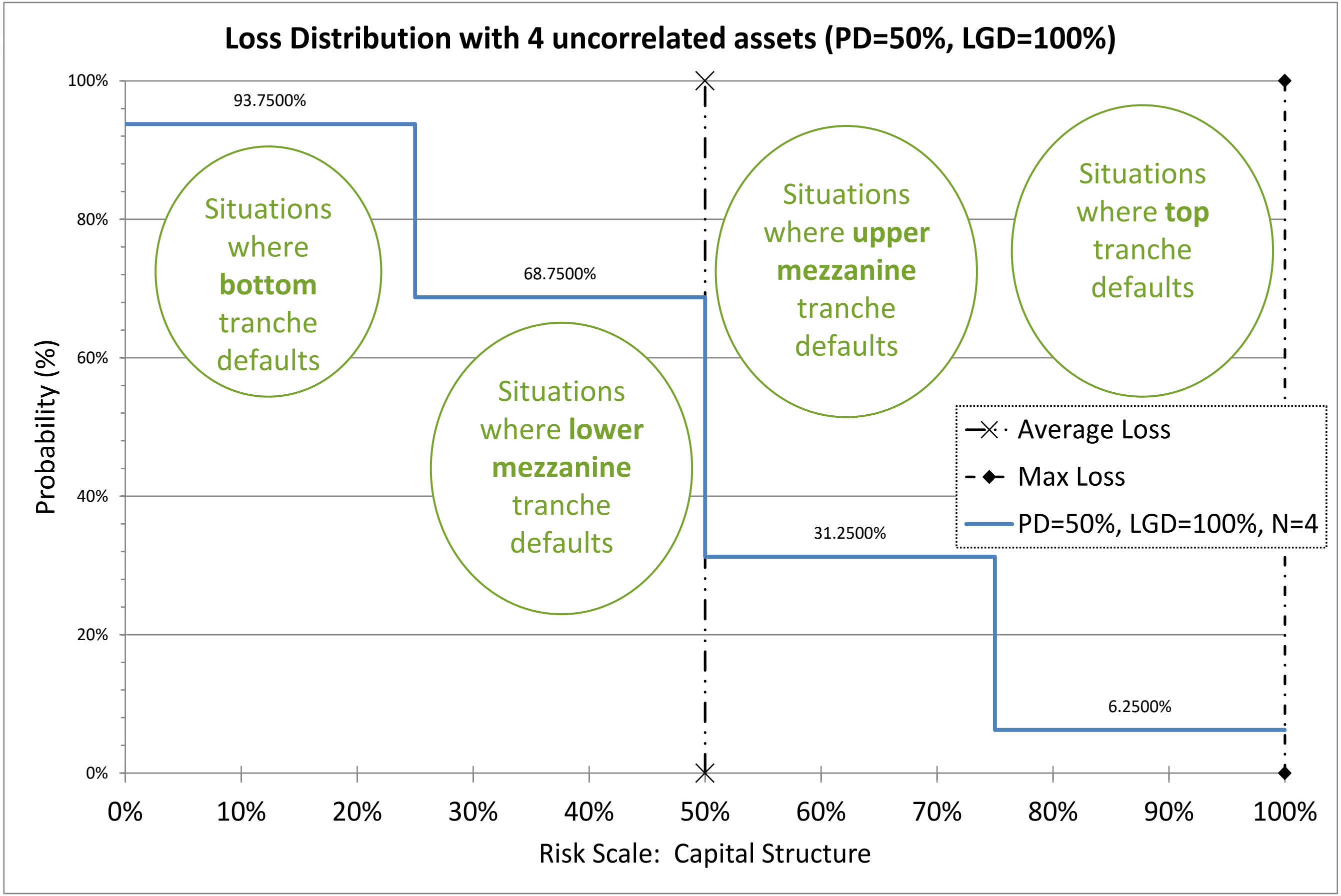
The integers on the right (in pink), are the number of possible outcomes


Loss Distribution with 1 asset (PD=50%, LGD=100%)
1 asset
The loss distribution (in blue) is horizontal
Average Loss
Max Loss
PD=50%, LGD=100%, N=1
50.0000%
50%
Situations where the only tranche defaults
Probability (%)
100%
80%
60%
40%
20%
0%
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure

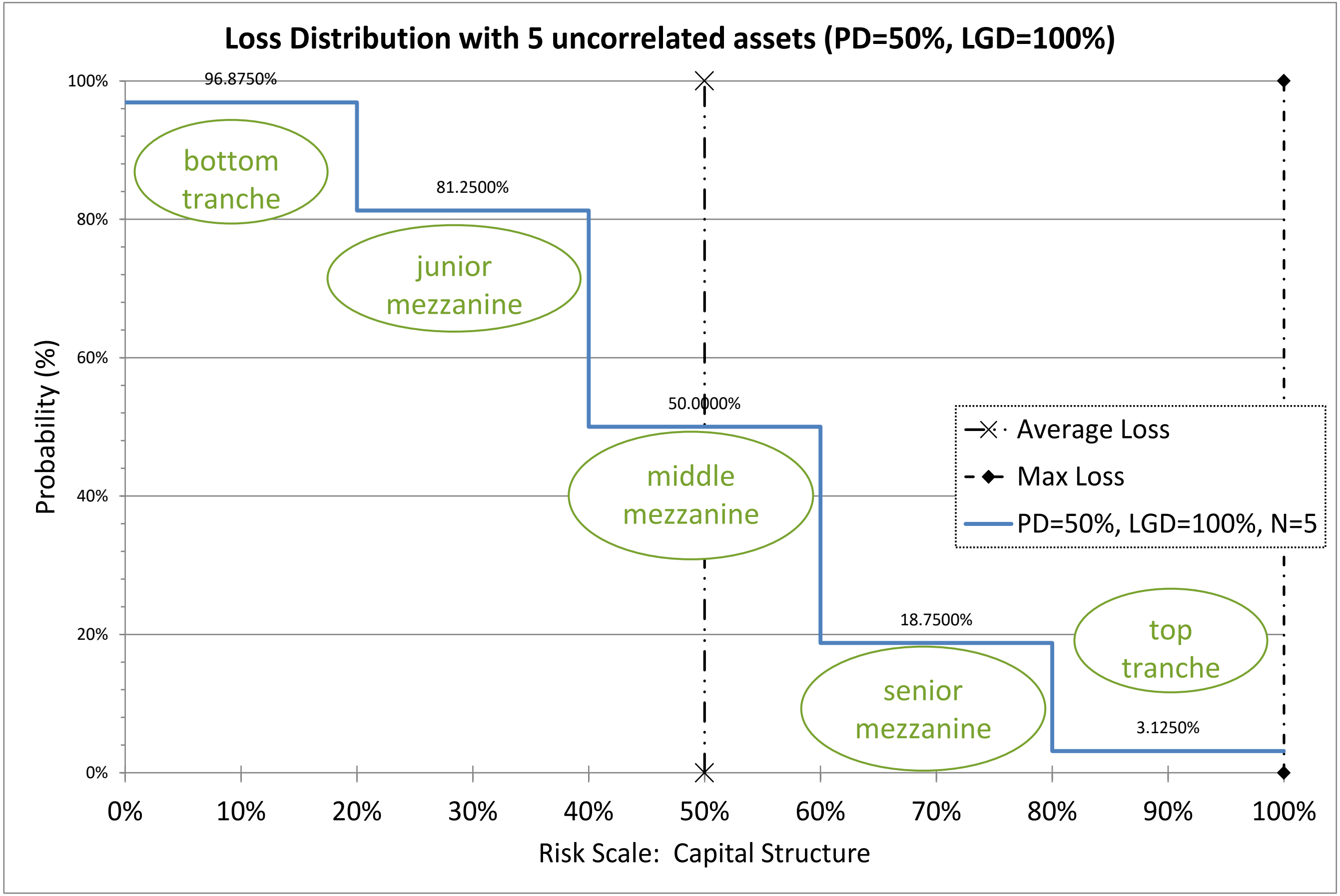

Loss Distribution with 2 uncorrelated assets (PD=50%, LGD=100%)
100%
80%
60%
40%
20%
0%
Probability (%)
75.0000%
25.0000%
Situations where **top** tranche defaults
Situations where **bottom** tranche defaults
50%
+
25%
25%
Average Loss
Max Loss
PD=50%, LGD=100%, N=2
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure

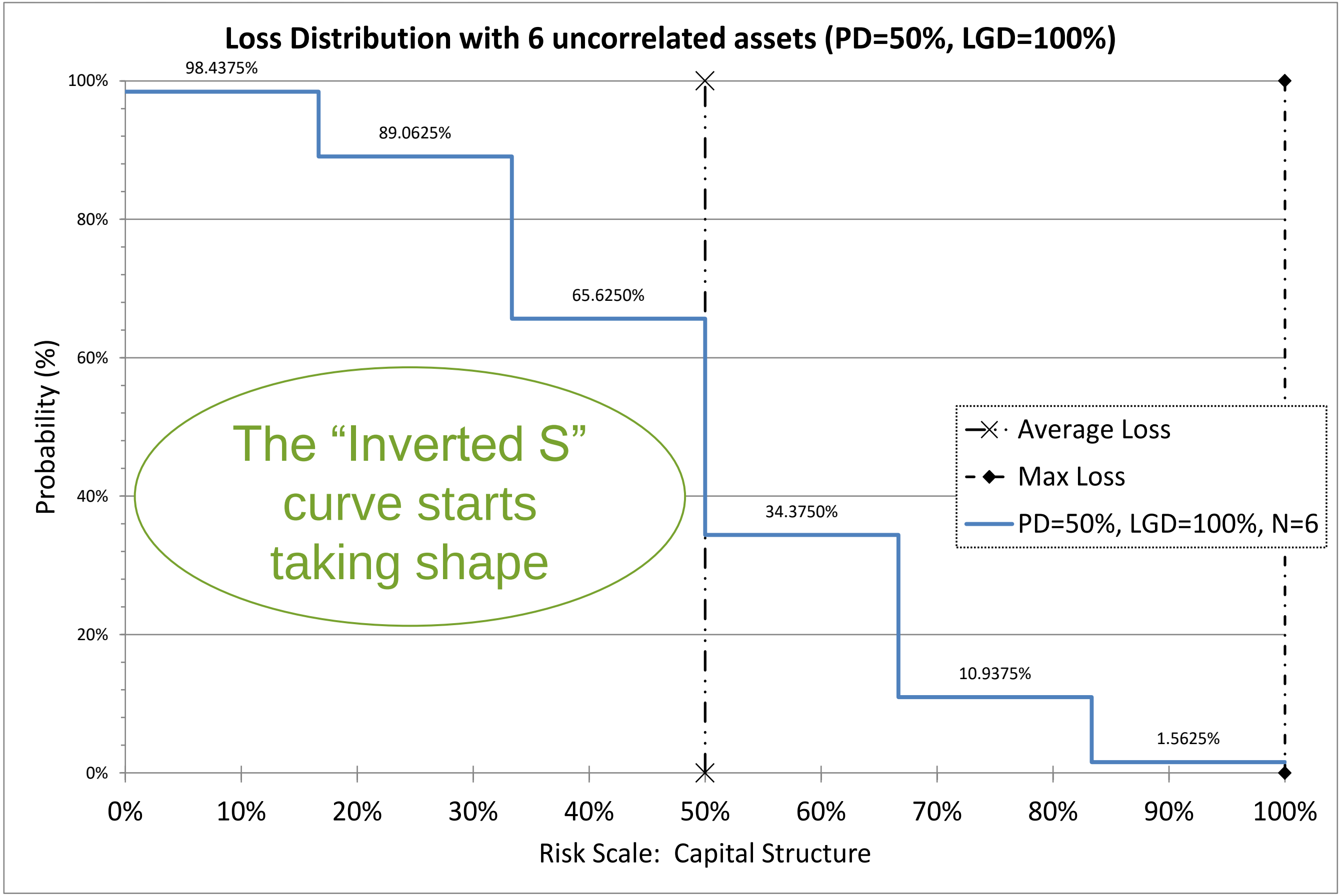


Loss Distribution with 3 uncorrelated assets (PD=50%, LGD=100%)
100%
80%
60%
40%
20%
0%
Probability (%)
87.5000%
50.0000%
12.5000%
Situations where mezzanine tranche defaults
Situations where top tranche defaults
Situations where bottom tranche defaults
37.5% + 37.5% + 12.5%
37.5% + 12.5%
12.5%
Average Loss
Max Loss
PD=50%, LGD=100%, N=3
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Risk Scale: Capital Structure

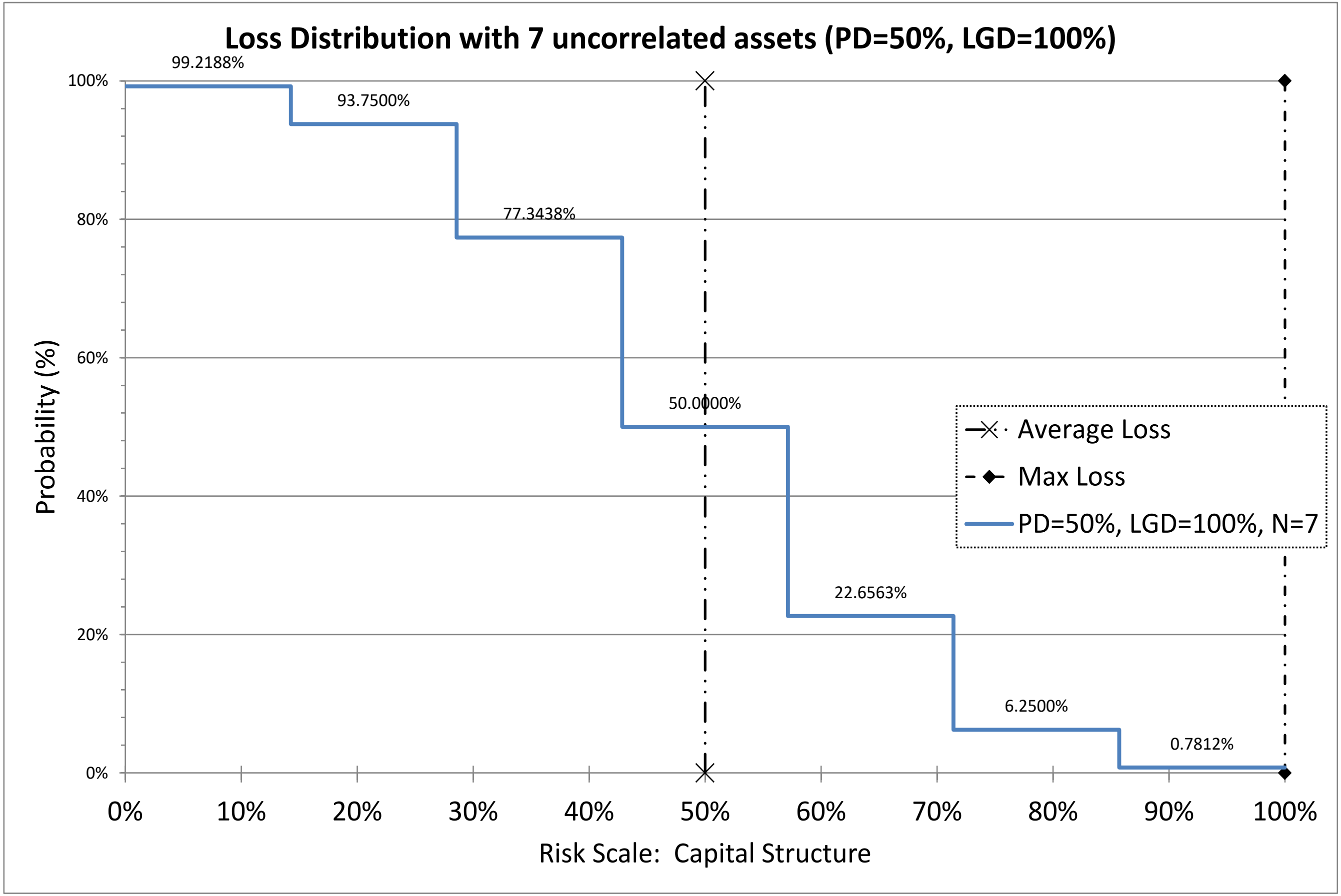


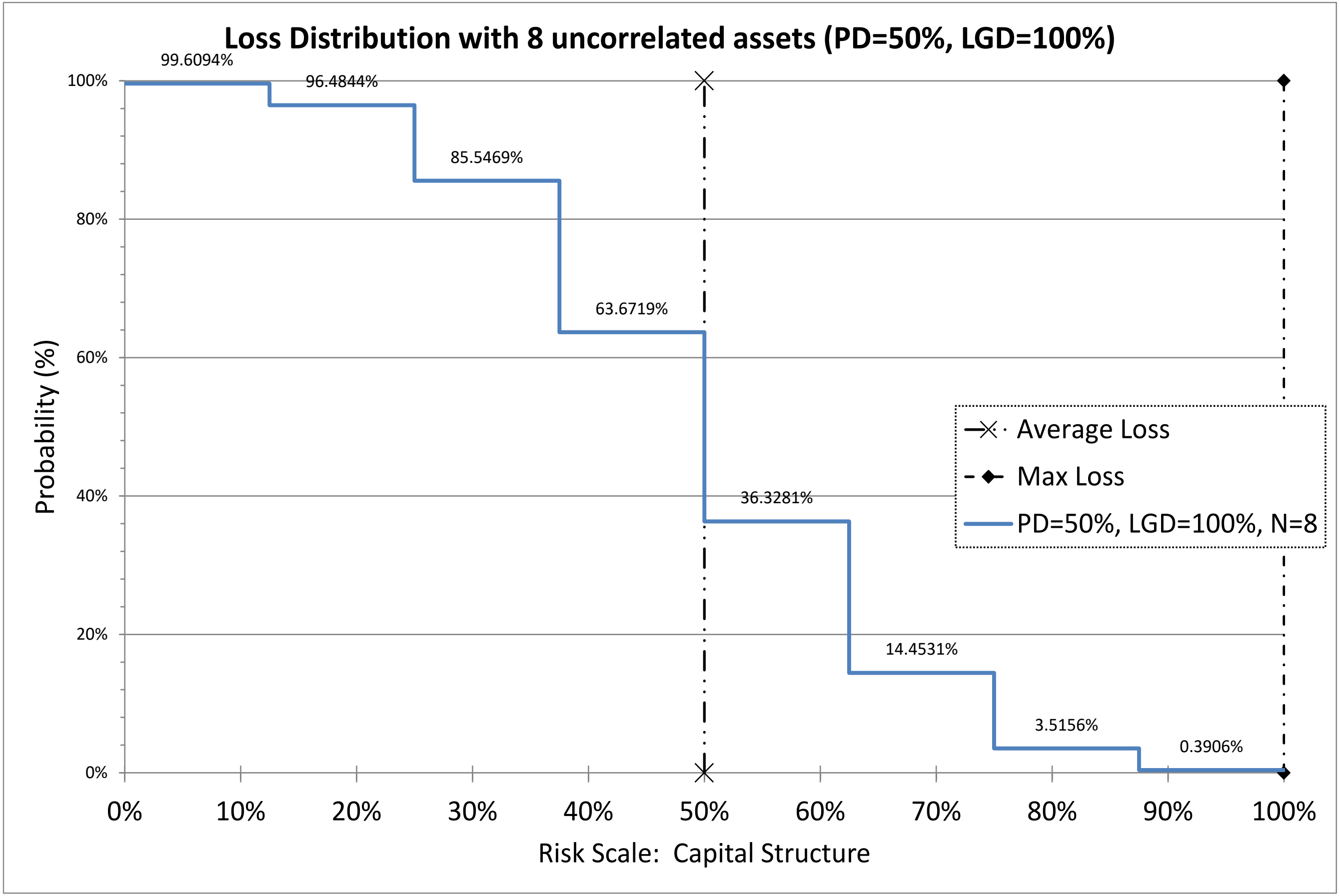
Loss Distribution with 4 uncorrelated assets (PD=50%, LGD=100%)
100%
80%
60%
40%
20%
0%
Probability (%)
93.7500%
68.7500%
31.2500%
6.2500%
Situations where bottom tranche defaults
Situations where lower mezzanine tranche defaults
Situations where upper mezzanine tranche defaults
Situations where top tranche defaults
Average Loss
Max Loss
PD=50%, LGD=100%, N=4
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure


Loss Distribution with 5 uncorrelated assets (PD=50%, LGD=100%)
100%
80%
60%
40%
20%
0%
Probability (%)
96.8750%
81.2500%
50.0000%
18.7500%
3.1250%
bottom tranche
junior mezzanine
middle mezzanine
senior mezzanine
top tranche
Average Loss
Max Loss
PD=50%, LGD=100%, N=5
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure

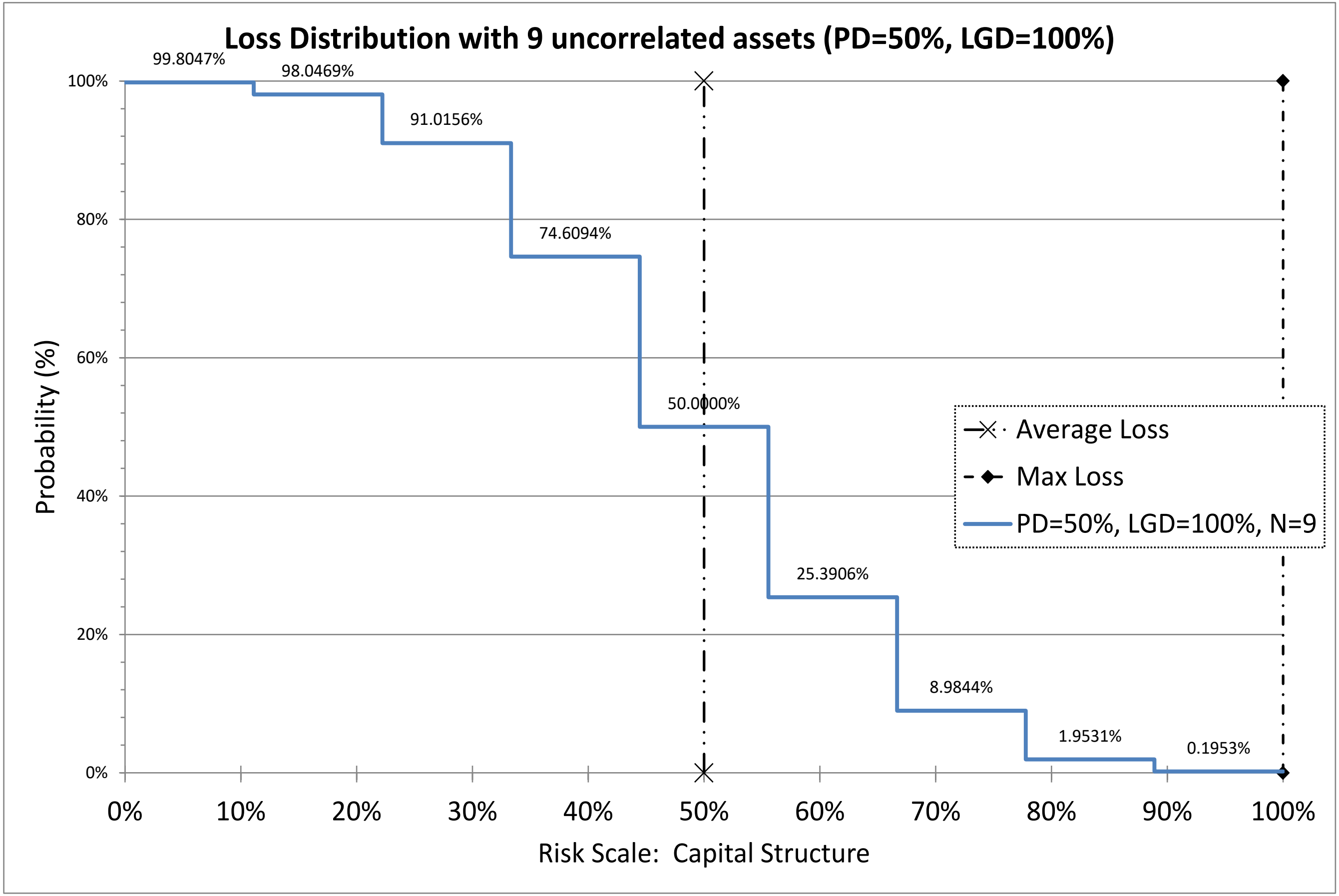


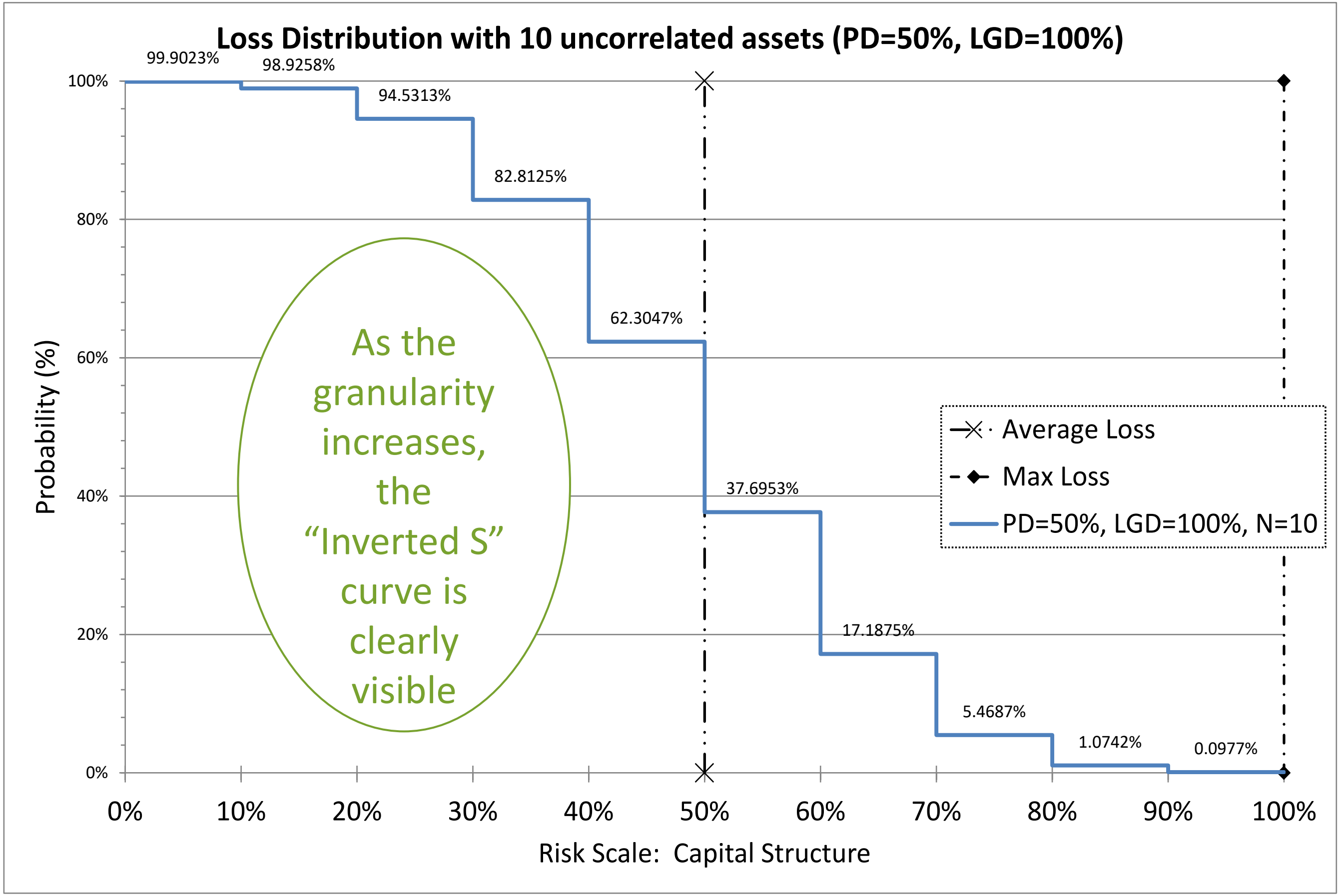
Loss Distribution with 6 uncorrelated assets (PD=50%, LGD=100%)
98.4375%
89.0625%
65.6250%
34.3750%
10.9375%
1.5625%
100%
80%
60%
40%
20%
0%
Probability (%)
The "Inverted S" curve starts taking shape
Average Loss
Max Loss
PD=50%, LGD=100%, N=6
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure


Loss Distribution with 7 uncorrelated assets (PD=50%, LGD=100%)
99.2188%
93.7500%
77.3438%
50.0000%
22.6563%
6.2500%
0.7812%
100%
80%
60%
40%
20%
0%
Probability (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure
Average Loss
Max Loss
PD=50%, LGD=100%, N=7

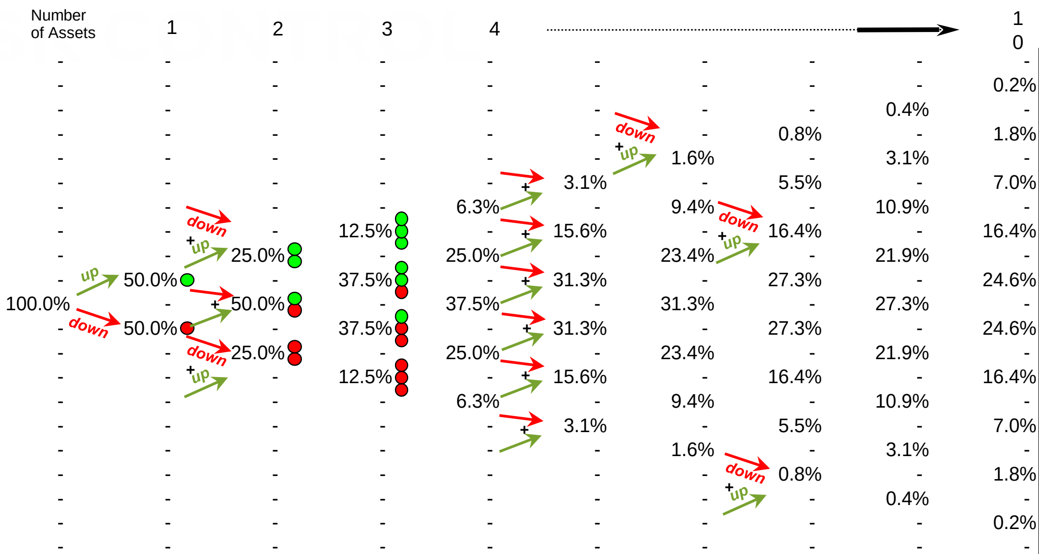


Loss Distribution with 8 uncorrelated assets (PD=50%, LGD=100%)
99.6094%
96.4844%
85.5469%
63.6719%
36.3281%
14.4531%
3.5156%
0.3906%
100%
80%
60%
40%
20%
0%
Probability (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure
Average Loss
Max Loss
PD=50%, LGD=100%, N=8


Loss Distribution with 9 uncorrelated assets (PD=50%, LGD=100%)
99.8047%
98.0469%
91.0156%
74.6094%
50.0000%
25.3906%
8.9844%
1.9531%
0.1953%
100%
80%
60%
40%
20%
0%
Probability (%)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure
Average Loss
Max Loss
PD=50%, LGD=100%, N=9


Loss Distribution with 10 uncorrelated assets (PD=50%, LGD=100%)
99.9023%
98.9258%
94.5313%
82.8125%
62.3047%
37.6953%
17.1875%
5.4687%
1.0742%
0.0977%
100%
80%
60%
40%
20%
0%
Probability (%)
As the granularity increases, the “Inverted S” curve is clearly visible
Average Loss
Max Loss
PD=50%, LGD=100%, N=10
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Risk Scale: Capital Structure

Pascal Tree for up to 10 Assets: Probabilities



Probability of occurrence	Number of defaults	Cumulated Binomial (10 assets)
0.1%	0	0.0977%
1.0%	1	1.0742%
4.4%	2	5.4688%
11.7%	3	17.1875%
20.5%	4	37.6953%
24.6%	5	62.3047%
20.5%	6	82.8125%
11.7%	7	94.5313%
4.4%	8	98.9258%
1.0%	9	99.9023%
0.1%	10	100.0000%

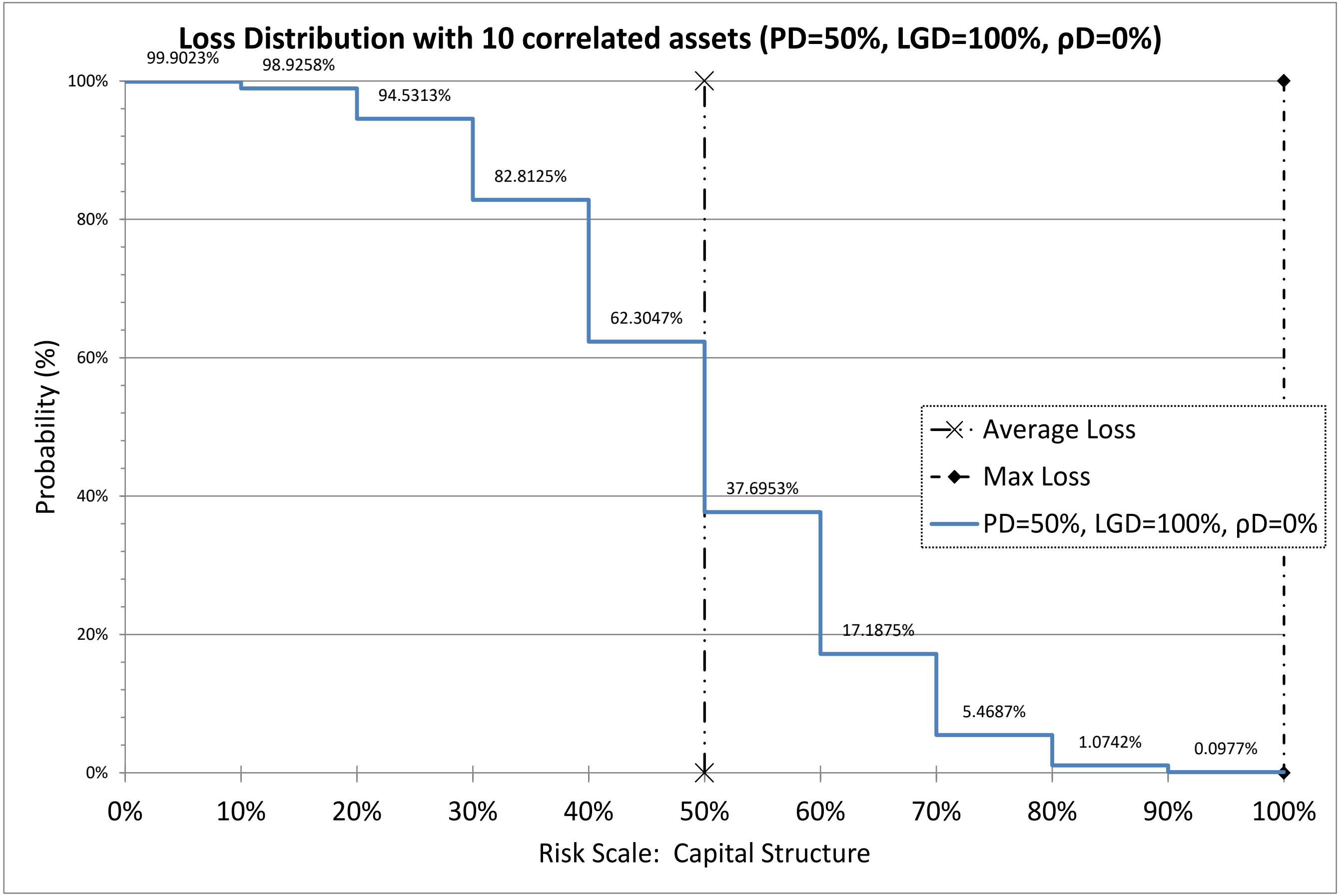
50% probability of going up (no default)

PD = 50% probability of going down (default)

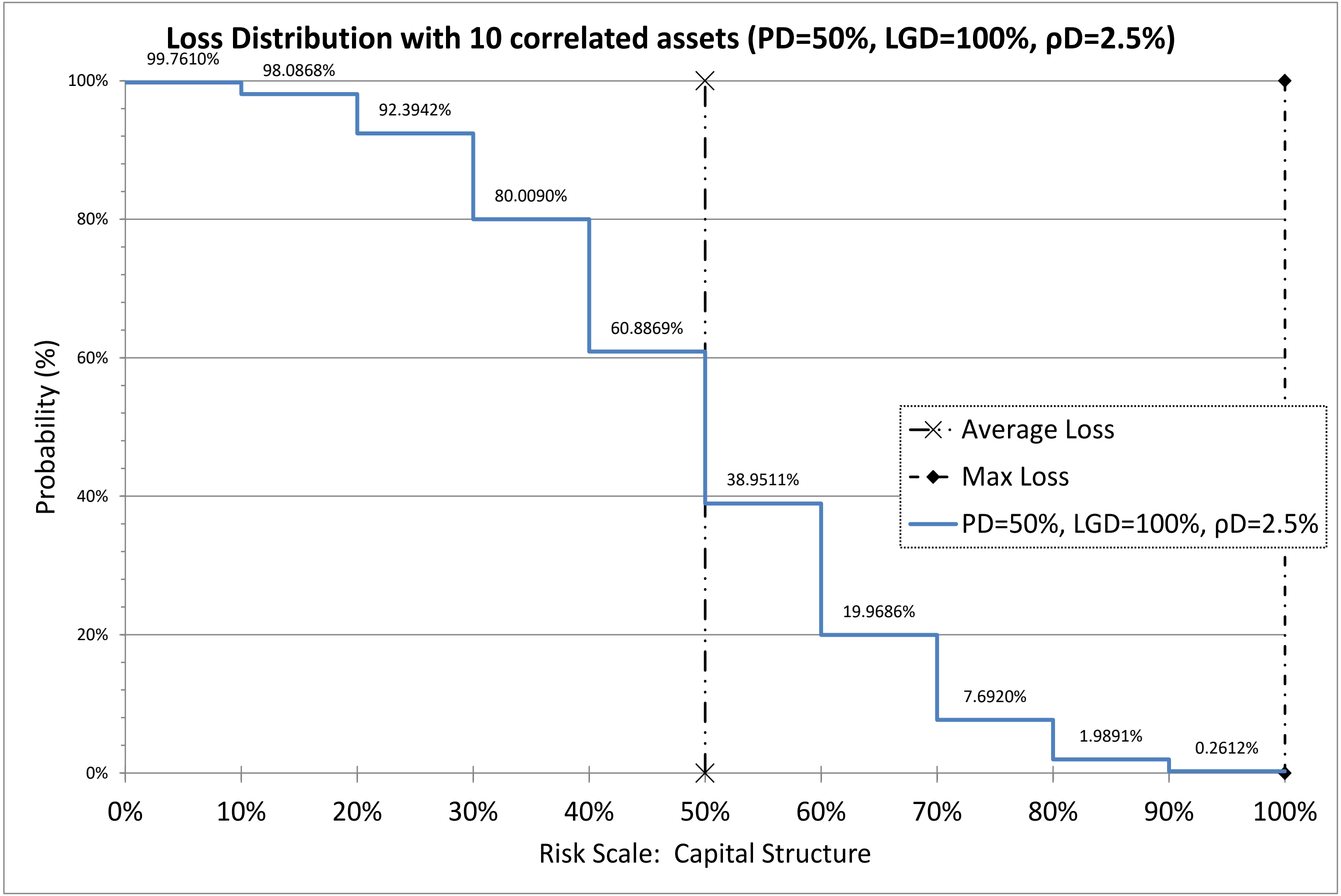
The probability of occurrence for each outcome obtained via a Pascal Tree is also called the **"binomial distribution"**. It depends on the number of assets and on the probability of the event (such as "exactly 7 default" (11.7%)).

The "**cumulated binomial distribution**" gives the probability of having at least a given event (such as "3 defaults or more" is 94.53%)

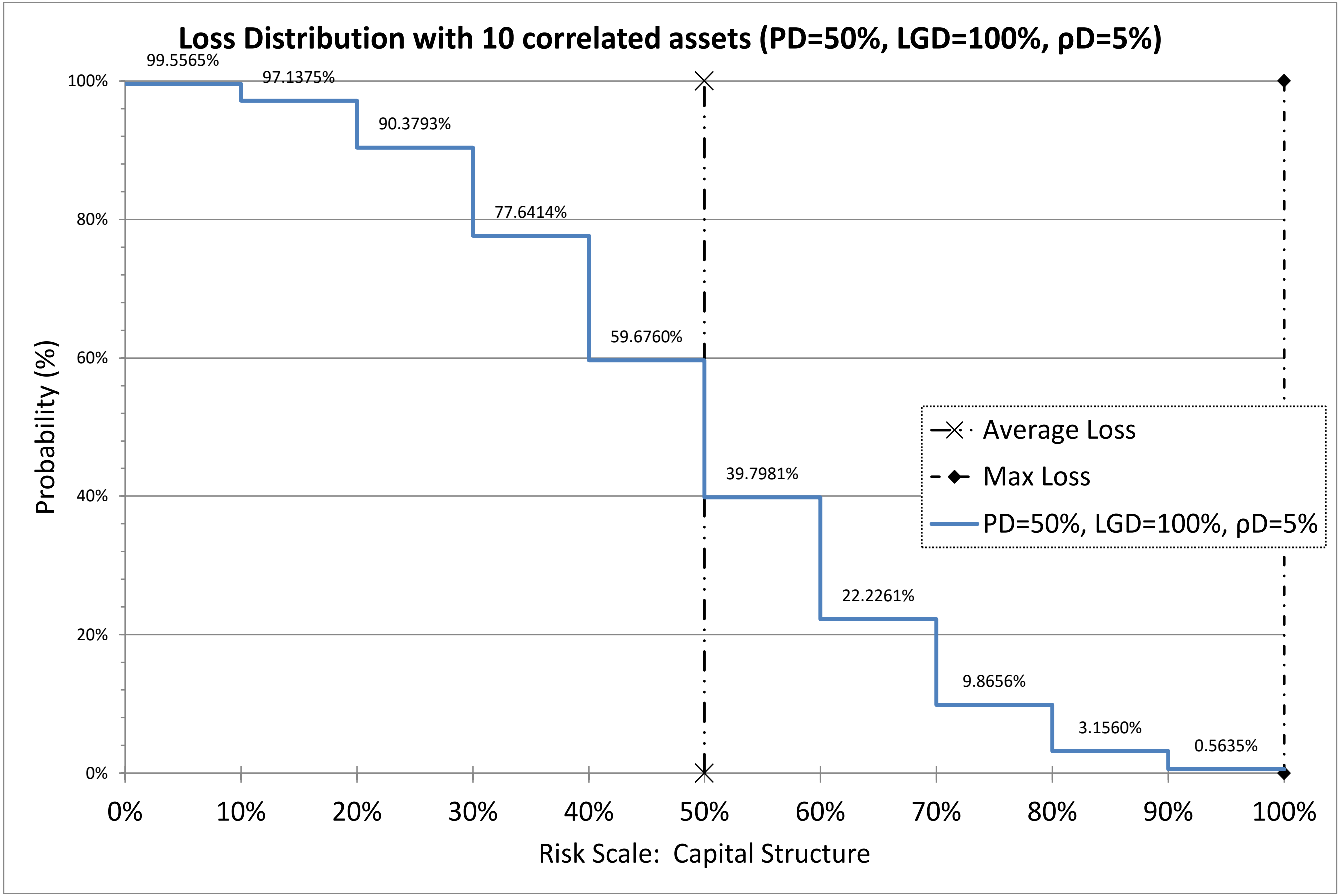
Default Correlation 0%



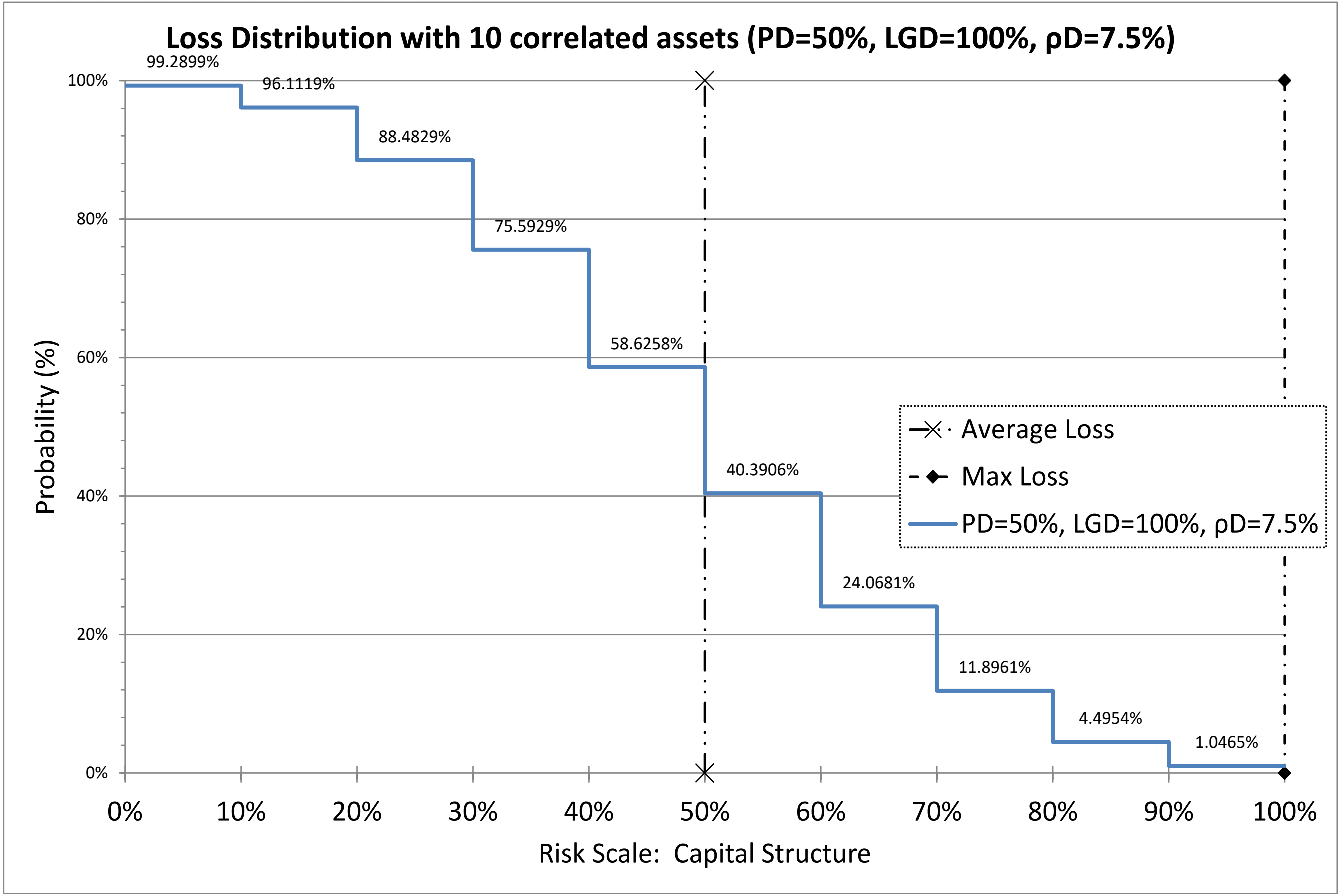
Default Correlation: 2.5%



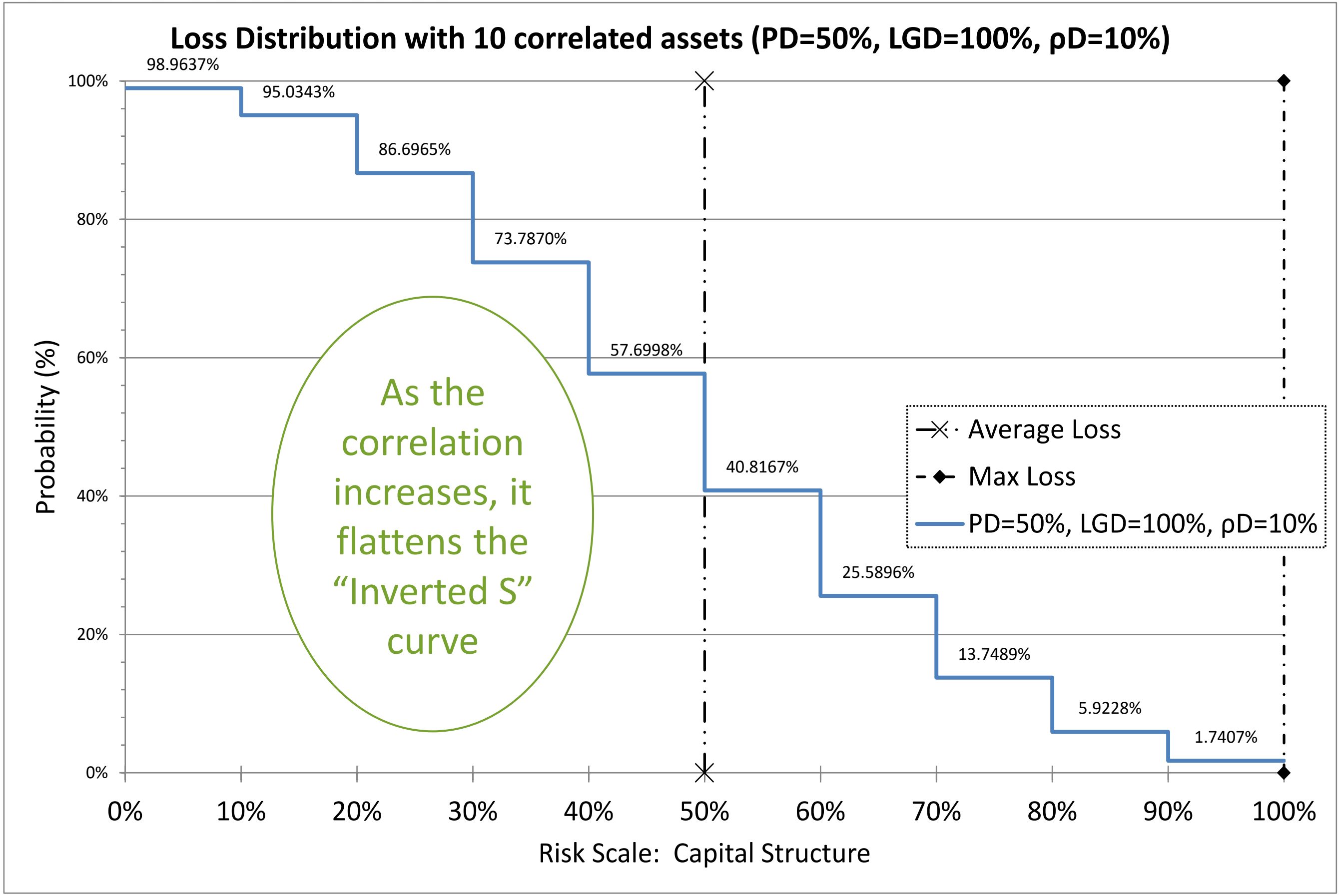
Default Correlation: 5%



Default Correlation: 7.5%



Default Correlation: 10%



Questions 2a

1. Can you explain intuitively why, for a given number of loans, the curve flattens as correlation goes up?

2. In the binomial model, what do you think happens to the loss curve as the number of loans goes to infinity if the loan defaults are independent?

3. In the binomial model, what happens to the curve if the number of loans goes to infinity and the defaults are perfectly correlated?

4. Can you guess how things turn out if loans are imperfectly correlated and the number goes to infinity?

RISK CONTROL

Modelling Risk in Securitisations

- Given a loss distribution for the underlying pool (typically of loans), we shall consider how one can calculate the Expected Losses (EL on a tranched exposure to that pool.
- A short set of arguments will take us to the marginal Value at Risk (MVaR) associated with holdings of tranches of a tranched exposure.
- Finally, we shall talk about pricing and show that again, from the EL, we may infer the price of the tranched exposure.
- The framework we use has been called the Arbitrage Free Approach (AFA).
- It build on a classic paper by Pykhtin and Dev on capital for securitisations, first, in a static version recalibrating and aligning to Basel II capital analysis, and second, generalising that approach to multiple periods.
- The AFA model employs as its starting point the same assumption as the original Asymptotic Single Risk Factor (ASRF) model employed in Basel II.
- Both start with the Vasicek distribution of losses on a loan pool.

Arbitrage Free Approach (AFA)

- The ASRF model presumes that the exposures in give classes in the bank's portfolio have Basel-prescribed asset correlations, e.g., any pair of high credit corporates had asset correlations of 24%.

- The AFA model assumes that a securitisation pool exposure has the same Basel-prescribed correlation with an exposure in the bank portfolio as it would have if the two exposures were both in the bank portfolio (again, in our example, 24%); but that it is more correlated with other comparable exposures in the securitisation pool.

- A single parameter, ρ^* , describes this additional within-pool-correlation.

- Varying ρ^* alters the allocation of capital across tranches of different seniority but does not affect the total capital of all the tranches together since this is determined by the correlations of the pool exposures with bank portfolio exposures which are set at Basel II levels

Latent Variable for the ith Pool Loan (1/2)

- The AFA model is based on a simple extension of the assumption of the original Asymptotic Single Risk Factor model employed in Basel II.
- The latent variable for the ith loan in the bank portfolio:

$$Z_i = \sqrt{\rho}\; Y_B + \sqrt{1-\rho}\;\sqrt{\rho^*}\; X + \sqrt{1-\rho}\,\sqrt{1-\rho^*}\;\epsilon_i$$

- The probability of default is:

$$PD = N(-c)$$

- Here, Y_B is the Basel Asymptotic Single Risk Factor, X is an uncorrelated additional common factor and the e_i's are idiosyncratic shocks.
- Choosing the correlation parameters, ρ^*, to take the Basel II values, ensures that the MVaRs of a pool of such assets will equal the Basel II levels and so capital for all the tranches of a securitization equals the Basel II levels for on balance sheet assets.
- The additional common factor risk from X spreads risk and capital across tranches in the structure in a smooth and economically well-motivated way.

Latent Variable for the ith Pool Loan (1/2)

- Rearranging, we get the latent variable for the ith pool exposure:

$$Z_i = \sqrt{\rho_{Pool}}\ Y_S + \sqrt{1 - \rho_{Pool}}\ \epsilon_i$$

$$Y_S = \frac{1}{\sqrt{\rho_{Pool}}}\left(\sqrt{\rho}\ Y_B + \sqrt{1-\rho}\ \sqrt{\rho^*}\ X\right)$$

$$\rho_{Pool} = \rho + (1 - \rho)\ \rho^*$$

- Here, ρ_{Pool} is the pairwise correlation of individual obligors' asset values.

- Note that ρ_{Pool} is higher than the Basel parameter, ρ, reflecting the fact that there is additional correlation or concentration in the securitization pool assets by assumption.

How Expected Loss is Calculated in Such a Model?

- Vasicek (2002) explains how to calculate the distribution of portfolio losses in such a model.
- A given thin tranche defaults when losses exceed the tranche attachment point.
- If the tranche is thin, the detachment point is just slightly higher so if default occurs, the loss given default on the tranche is 100%.
- So the expected loss on the tranche equals the probability of default.
- One may think of a thick tranche with attachment point discretely below its detachment point as a portfolio of thin tranches.
- Expected losses are additive in exposures so the expected loss on the thick tranche is the sum of those on the thin ranches that make it up.

RISK CONTROL

Thin and Thick Tranche Expected Losses

- Thin tranche expected loss with attachment point A

$$EL_{Thin}(A) = N\left(\frac{N^{-1}(PD) - \sqrt{1-\rho_{Pool}} \cdot N^{-1}\left(\frac{A}{LGD}\right)}{\sqrt{\rho_{Pool}}}\right)$$

- Thick tranche expected loss with attachment point A and detachment point D

$$EL_{Thick}(A,D) = \frac{(1-A)\times EL_{Senior}(A) - (1-D)\times EL_{Senior}(D)}{D-A}$$

$$EL_{Senior}(X) = \frac{LGD\times \overline{N}_2 - X \times PD_{Tranche}(X)}{1-X}$$

$$\overline{N}_2 \equiv N_2\left(N^{-1}(PD), N^{-1}(PD_{Tranche}(X)), \sqrt{\rho_{Pool}}\right)$$

$$PD_{Tranche}(X) = N\left(\frac{N^{-1}(PD) - \sqrt{1-\rho_{Pool}} \cdot N^{-1}\left(\frac{X}{LGD}\right)}{\sqrt{\rho_{Pool}}}\right)$$

How Capital is Calculated in Such a Model?

- Gourieroux, Laurent and Scaillet (2001) show in general that:

Unexpected Losses (with a confidence level of α)	=	Expected Losses conditional on bank portfolio losses equalling their α-quantile	-	Expected Losses

- In other words, to work out the capital on a tranche, we can (i) calculate the expected loss conditional on total bank losses equalling their α-quantile and (ii) subtract the expected loss.
- Thin tranche expected loss equals its default probability and this in turn equals the probability that losses exceed the attachment point.
- Calculating this with and without a stress and then integrating over successive 'thin tranche' attachment points up to the thick tranche detachment point then gives us the capital number.

Thin and Thick Tranche Marginal VaRs

- Stressed default probability of pool exposures

$$PD_{\alpha} = N\left(\frac{N^{-1}(PD) - \sqrt{\rho}\ N^{-1}(\alpha)}{\sqrt{1-\rho}} \right)$$

- Stressed correlation between pool assets

$$\rho_{Pool,\alpha} = \rho^{*}$$

- Unexpected-loss based capital K(A,D)

$$K(A,D) = EL_{ThickTranche}(A,D \mid \rho^{*}, PD_{\alpha}) - EL_{ThickTranche}(A,D \mid \rho_{Pool}, PD)$$

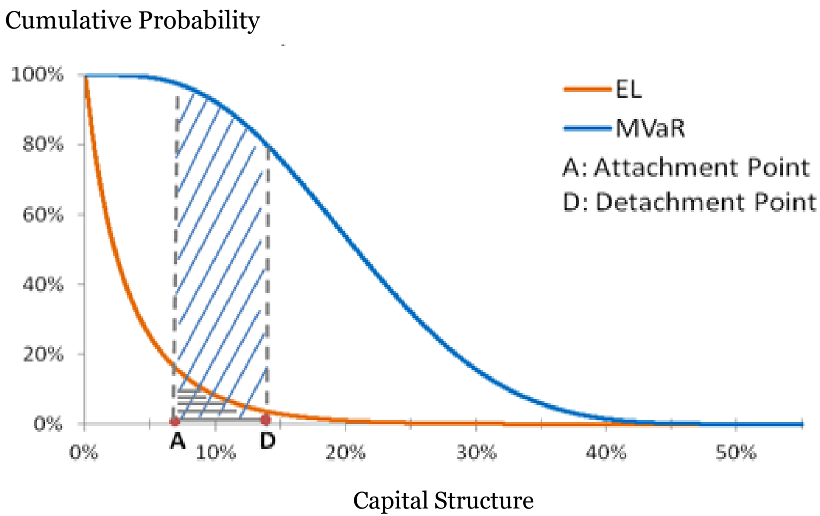
Note that, the stressed PD (denoted PD_a) is obtained by calculating the PD when Y_B has a big negative shock.

The stressed correlation (ρ*) is obtained by calculating how much pairwise asset correlation will be left once we have assumed a particular shock for Y_B .

RISK CONTROL

Arbitrage Free Approach (AFA)

Expected Loss and Thin Tranche Capital as a function of attachment/detachment points:



- For a discretely thick tranche with attachment and detachment points A and D has EL equal to the area between A and D under the real line, Marginal Value-at-Risk equal to the area under the blue curve between A and D and Unexpected losses equal to the difference between the two.
- The shape of the EL curve is determined by ρ_{Pool} whereas the shape of the Marginal Value-at-Risk curve is determined by ρ^*.

Tranche Capital as a Function of Pool Capital

- Unexpected-loss based capital K(A,D) can be expressed in terms of pool unexpected loss, *K*, and pool *EL* in that:

$$PD_{\alpha} = \frac{K + EL}{LGD} = \frac{K_{IRB}}{LGD}$$

$$PD = EL/LGD$$

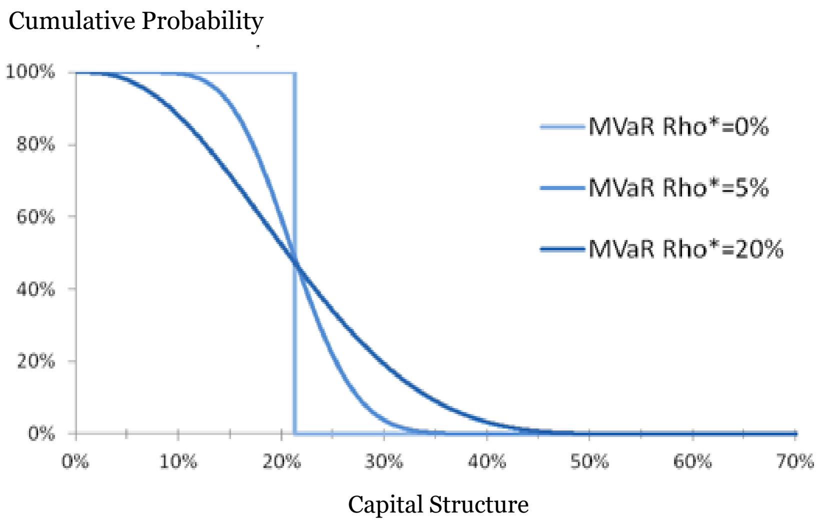
- It follows that

$$K(A,D) = EL_{Thicktranche}\left(A,D \,\middle|\, \rho^{*}, \frac{K_{IRB}}{LGD}\right) - EL_{Thicktranche}\left(A,D \,\middle|\, \rho_{Pool}, \frac{EL}{LGD}\right)$$

- **This is a key result:** tranche capital depends on (i) attachment and detachment points, (ii) pool capital and (iii) pool EL.
- Here, $K(A,D)$ is the tranche Unexpected Loss (UL), the first term on the RHS is the tranche Marginal VaR and the second term on the RHS is the tranche Expected Loss (EL).
- $K(A,D)$ is exactly symmetric with the standard Basel II capital formula for loans which is based on a UL notion of capital.

Arbitrage Free Approach (AFA)

Thin Tranche MVaR for Different ρ^* Values:



- When ρ^* is zero, the capital curve is a step function.
- For higher values, the curve flattens out, implying higher capital for senior tranches.

RISK CONTROL

Calibration of ρ^* (1/2)

- The key parameter in the above capital model is ρ^*.
- This determines how the pool capital is spread out over different tranches.
- It can be calibrated using rating change correlations in a two-step process described below.

Step 1: Estimate Intra-Sector Correlations

• The ρ^* parameter may be inferred from estimates of the correlation between bank and SPV pool factors

• If there were no additional risk factors in the SPV pool, then all ratings would move together in perfect lock-step.

• So one may identify the ρ^* from the degree to which changes in individual tranche ratings are correlated.

Maximum Likelihood based				
Sample	All regions 2000-2012	All regions 2005-2012	North America 2000-2012	North America 2005-2012
1. RMBS	83.9%	75.1%	84.2%	75.2%
2. ABS	50.5%	50.4%	48.3%	50.8%
3. Other	79.3%	81.0%	82.7%	83.5%
4. PF	48.7%	42.7%	48.7%	42.7%
5. CDO	68.8%	77.2%	76.4%	85.1%
6. CMBS	72.4%	73.0%	71.3%	74.1%
7. Structured Products	65.9%	64.7%	84.2%	75.2%

• Step 1: estimate (asset) correlation of individual tranche ratings.

• Step 2: infer ρ^* given that correlations between pool and bank portfolio exposures must equal Basel II assumptions.

RISK CONTROL

Calibration of ρ^* (2/2)

Step 2: Infer ρ^*

Maximum Likelihood based estimates

	ρ	ρ*	ρ*	ρ*	ρ*
Sector	Assumed Basel value	All regions 2000-2012	All regions 2005-2012	North America 2000-2012	North America 2005-2012
1. RMBS	15%	3%	6%	3%	6%
2. ABS	10%	11%	11%	12%	11%
3. Other	10%	3%	3%	2%	2%
4. PF	20%	26%	34%	26%	34%
5. CDO	20%	11%	7%	8%	4%
6. CMBS	9%	4%	4%	4%	3%
7. Structured Products	16%	10%	10%	4%	6%

- Alternative calibration approaches for ρ^* include direct estimation of correlation for pools and bank portfolios
- This is data intensive

- This approach yields ρ^* estimates for different periods and data sets
- We find plausible patterns with higher ρ^* for CDO and ABS (with structured and other underlyings) and lower values for retail
- Note the fact that one can calibrate ρ^* from data does not mean we do not see it as a regulator control variable – but it is surely an advantage

RISK CONTROL

Generalisation to Multiple Periods

- The model described above is a single period model.
- We now turn to deriving a multi-period model consistent with it.
- We replace Gaussian random factors with Brownian motions evolving for t>0.
- We assume the same correlation structure over discrete time periods.

- The credit quality of the ith loan is driven by:

$$Z_{i,t} = \sqrt{\rho} Y_{B,t} + \sqrt{1-\rho}\sqrt{\rho^*} X_t + \sqrt{1-\rho}\sqrt{1-\rho^*}\varepsilon_{i,t}$$

- The pairwise correlation of the discrete time increments

$$\rho_{Pool} = \rho + (1-\rho)\rho^*$$

- Conditional on $Y_1 - Y_0$, the correlation is equal to

$$\rho_M^* \equiv \frac{\text{Covariance}(Z_{i,t}-Z_{i,0}, Z_{j,t}-Z_{j,0}|Y_1)}{\text{StDev}(Z_{i,t}-Z_{i,0}|Y_1)\text{StDev}(Z_{j,t}-Z_{j,0}|Y_1)} = \frac{(1-\rho)\rho^*+(M-1)\rho_{Pool}}{(1-\rho)+(M-1)}$$

The Risk Adjusted Process in the Multi-Period Model

We need

1. To include a risk premium in the asset value processes for t>1.
2. To include a stress on the bank risk factor

- The risk adjusted process followed by the latent variable for the ith loan is

$$\tilde{Z}_{i,t} = \begin{cases} Z_{i,t} & if\ \ 0 < t < 1 \\ Z_{i,t} + \gamma t & if\ t > 1 \end{cases}$$

- The default probability inclusive of appropriate risk premiums is:

$$PD_M = N\left(N^{-1}(pd_M) + \frac{(M-1)\,\gamma}{\sqrt{M}} \right)$$

where pd_M is the M-period default probability and is equal to $N\left(-\frac{c_M}{\sqrt{M}}\right)$

- The stressed default probability

$$PD_{\alpha,M} = N\left(\frac{N^{-1}(PD_M) - \sqrt{\frac{\rho}{M}}\, N^{-1}(\alpha)}{\sqrt{1-\frac{\rho}{M}}} \right)$$

which may be set in the following way to ensure the neutrality between on- and off-balance sheet capital:

$$PD_{\alpha,M} = \frac{K_{IRB}}{LGD} + PD_M$$

K_{IRB} is the IRBA pool capital charge inclusive of IRBA maturity adjustments

Maturity Effects in Securitisation Capital

- We calculate capital for portfolios of loans held within a wider bank portfolio of loans.
- We also calculate capital for tranched exposures to this loan portfolio.
- A ratings-based model is employed but this time with a Longstaff-Schwarz approach to pricing the (long-lived, M-year-maturity) tranches at the 1-year VaR horizon.
- We assume securitization pools of 200 loans comprising 7% of the par of a wider bank portfolio of 500 BBB-rated loans.
- We look at cases with BB-rated and BBB-rated pool loans and with maturities of 1,2,3,4 and 5 years.

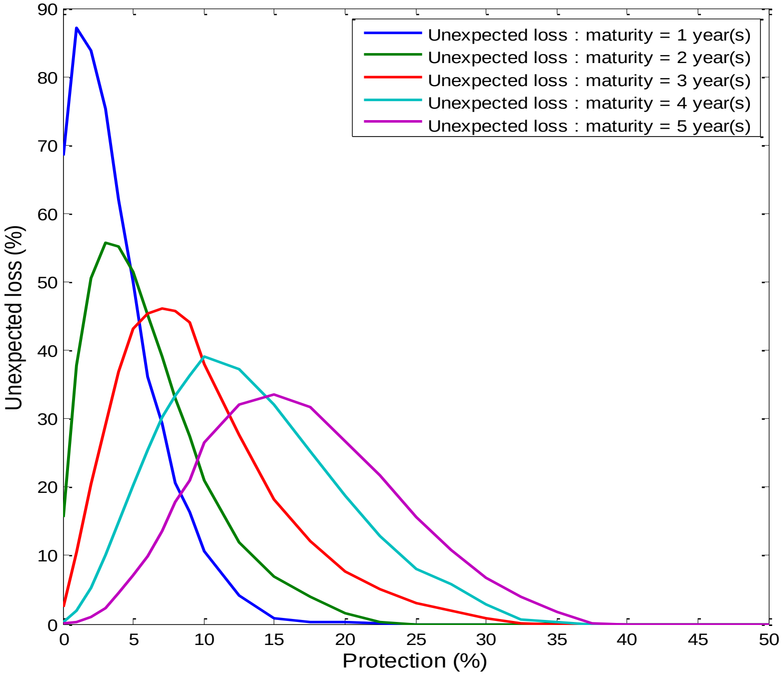
Tranche Par Assumptions

Category	Percentage of total par	Number of tranches
Junior tranches	10%	10
Mezzanine tranches	40%	16
Senior tranches	50%	1
Total	100%	27

- We adopt the factor structure of the AFA with a ρ^*=10% and the standard Basel II r values.
- We construct the tranched positions assuming 27 tranches as shown in the table.

RISK CONTROL

Unexpected Losses for different tranches (with BB-rated pool exposures)



- When maturity is increased, the distribution of Unexpected Losses across tranches shifts to the right and widens out.
- Note here UL=MVaR-EL, i.e, UL is stressed EL – actual EL.

Heterogeneity and Granularity (1/5)

- Given the concentration correlation $\rho^*$and the pool correlation $\rho_{Pool} = \rho + (1-\rho) \cdot \rho^*$, the correlation should be adjusted with a pool-level granularity adjustment (the same as in the current SFA) by using the square of the weights consolidated by obligors

$$\delta = \sum_{c \subset Pool} w_c^2$$

to obtain the granularity-adjusted pool correlation (to calculate EL):

$$\rho'_{Pool} = \rho_{Pool} + \delta \cdot (1 - \rho_{Pool})$$

and to obtain the granularity-adjusted stressed correlation (to calculate Stressed EL):

$$s\rho' = \rho^* + \delta \cdot (1 - \rho^*)$$

- Numerical illustrations:
    - For 1000 identical assets, $\delta = 0.1\%$ and $\rho^* = 10\%$,
      we have $s\rho' = 10\% + 0.1\% \cdot (1 - 10\%) = 10.09\%$ (insignificant change)
    - For 100 identical assets, $\delta = 1\%$ and $\rho^* = 10\%$,
      we have $s\rho' = 10\% + 1\% \cdot (1 - 10\%) = 10.9\%$ (about 10% change)
- For 10 identical assets, $\delta = 10\%$ and $\rho^* = 10\%$,
  we have $s\rho' = 10\% + 10\% \cdot (1 - 10\%) = 19\%$ (significant change)

Experiments suggests a granularity adjustment should be used with portfolio with less than [100] effective exposures

Heterogeneity and Granularity (2/5)

Adjusting for granularity in the AFA Option 2 needs the following steps:

- given the notional weight w_i of an asset i, ($w_i = \frac{EAD_i}{EAD_{Pool}}$)
- given the consolidated weight w_c for the obligor of asset i, ($w_c = \sum_{i,i \subset c} w_i$)
- given the concentration correlation ρ_i^* for asset i,
- given the pool correlation $\rho_{i_{Pool_i}}$ in the theoretical pool: ($\rho_{i_{Pool_i}} = \rho_i + (1 - \rho_i) \cdot \rho_i^*$)

We define an asset-level granularity adjustment δ_i for the theoretical pool $Pool_i$ such that:

$$\delta_i = w_c$$

- the granularity-adjusted pool correlation (to calculate EL):

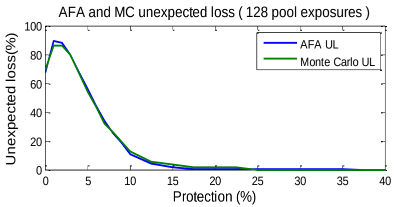
$$\rho'_{i_{Pool_i}} = \rho_{i_{Pool_i}} + \delta_i \cdot \left(1 - \rho_{i_{Pool_i}}\right)$$

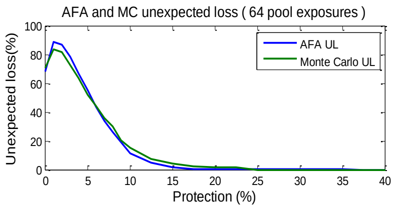
- the granularity-adjusted stressed correlation (to calculate Stressed EL):

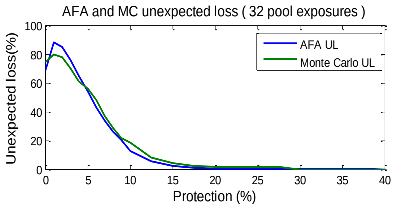
$$s\rho'_{i_{Pool_i}} = \rho_i^* + \delta_i \cdot (1 - \rho_i^*)$$

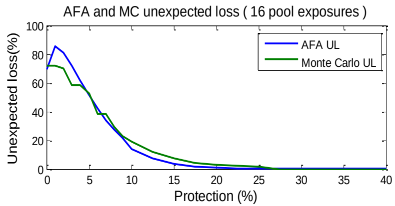
Heterogeneity and Granularity (3/5)

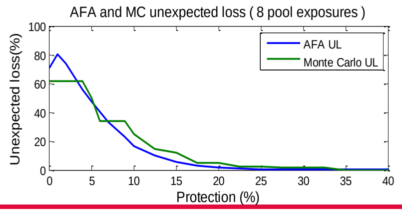
We have conducted convergence analysis of the **granularity adjustments** in Duponcheele, Perraudin, Pickett and Totouom-Tangho (2013d)

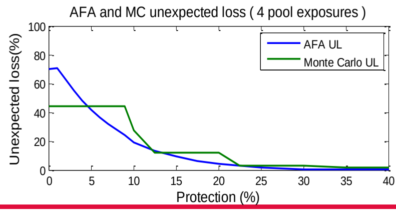


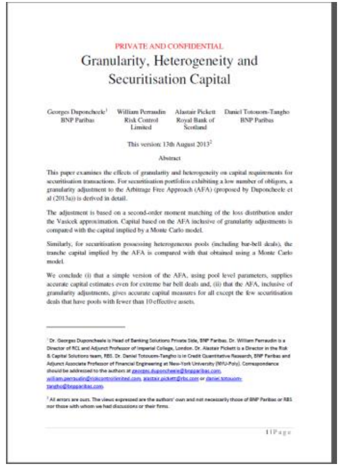












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Granularity, Heterogeneity and Securitisation Capital

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Abstract

This paper examines the effects of granularity and heterogeneity on capital requirements for securitisation transactions. For securitisation portfolios exhibiting a low number of obligors, a granularity adjustment to the Arbitrage Free Approach (AFA) (proposed by Duponcheele et al (2013a)) is derived in detail.

The adjustment is based on a second-order moment matching of the loss distribution under the Vasicek approximation. Capital based on the AFA inclusive of granularity adjustments is compared with the capital implied by a Monte Carlo model.

Similarly, for securitisation possessing heterogeneous pools (including bar-bell deals), the tranche capital implied by the AFA is compared with that obtained using a Monte Carlo model.

We conclude (i) that a simple version of the AFA, using pool level parameters, supplies accurate capital estimates even for extreme bar bell deals and, (ii) that the AFA, inclusive of granularity adjustments, gives accurate capital measures for all except the few securitisation deals that have pools with fewer than 10 effective assets.

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[2] All errors are ours. The views expressed are the authors' own and not necessarily those of BNP Paribas or RBS nor those with whom we had discussions or their firms.

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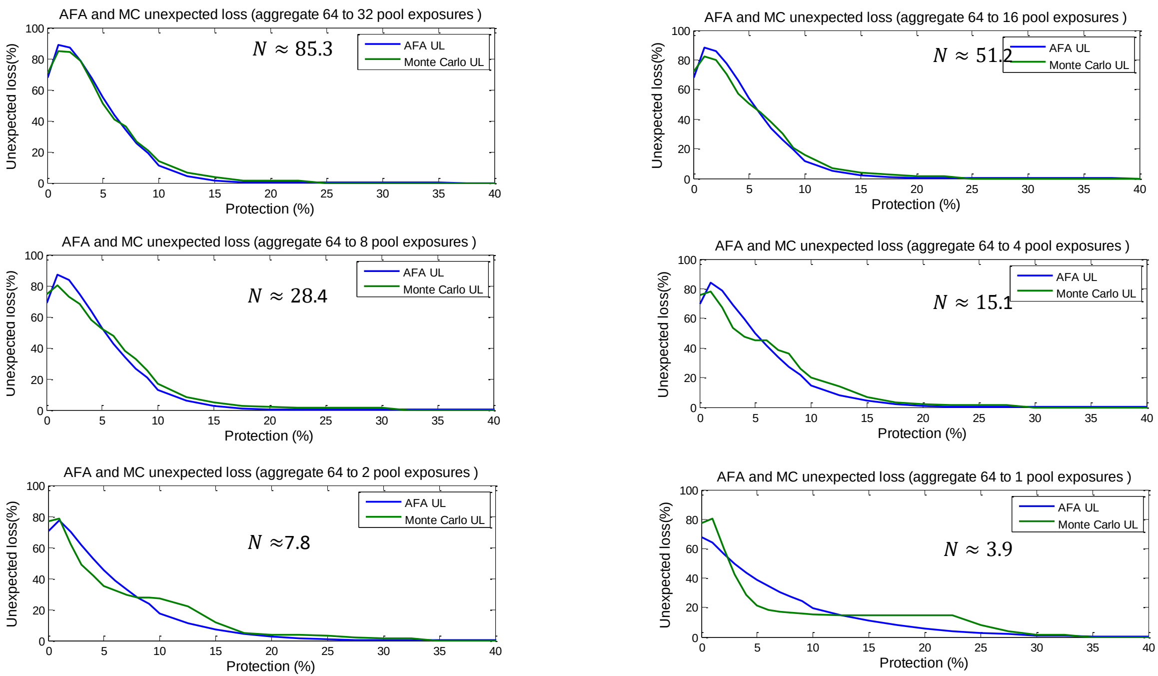
Examples suggest the granularity adjustment δ to be down to [10] effective exposures.

Heterogeneity and Granularity (4/5)

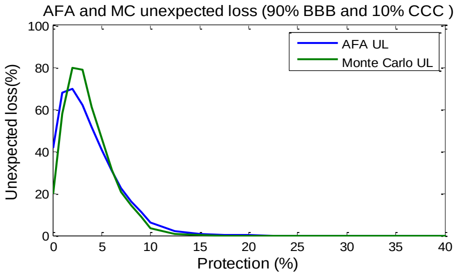
Sensitivity to **heterogeneity in granularity**:
half of the portfolio is granular and the other half is increasingly less granular.

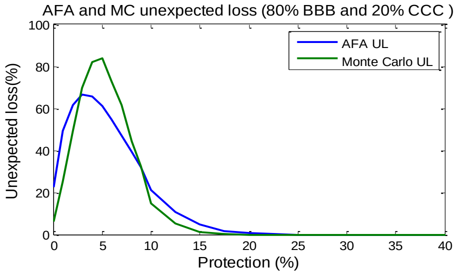


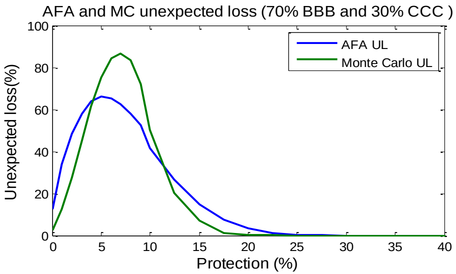
Examples suggest the granularity adjustment δ to be down to [10] effective exposures.

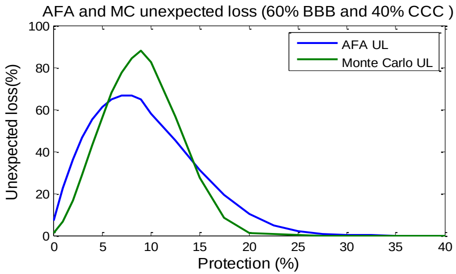
Heterogeneity and Granularity in the AFA (5/5)

Sensitivity to **heterogeneity in credit quality**: a good credit quality portfolio is mixed with an increasing portion of low credit quality portfolio.









The AFA is more conservative than the Monte Carlo model for highly heterogeneous credit quality portfolio.

RISK CONTROL

Pricing Using Risk Adjusted Expected Losses (1/2)

- Above we explained how a single expression can be used to calculate Expected Losses for a tranche as a function of pool EL and LGD:

$$EL_{Thicktranche}\left(A, D \middle| \rho_{Pool}, \frac{EL}{LGD}\right)$$

- and also can be used to calculate tranche UL + EL:

$$EL_{Thicktranche}\left(A, D \middle| \rho^{*}, \frac{K_{IRB}}{LGD}\right)$$

- The same expression can be used in pricing since the value of a guarantee against the credit losses in the pool may be expressed as the risk adjusted Expected Loss:

$$EL_{Thicktranche}\left(A, D \middle| \rho_{Pool}, \frac{EL_{RA}}{LGD}\right)$$

- Here, EL_{RA} is the pool risk-adjusted Expected Loss.

Pricing Using Risk Adjusted Expected Losses (2/2)

- Suppose that the loans consist of 1-year pure discount bonds paying $1 at the end of the year in case they do not default and yielding a value of $(1 - LGD)$ in the event that they do default.
- If we observe the spread on such a loan, S, we can infer the risk-adjusted pool EL, denoted EL_{RA} , using the following logic:

$$EL_{RA} = 1 - exp(-S)$$

- This gives a powerful method that can be generalised in multiple ways for pricing tranches of securitisations.
- If we want to infer a spread for a 1-year note associated with the tranche in question, we can reverse the logic to get:

$$S_{Thicktranche} = -log\left(1 - EL_{Thicktranche}\left(A, D \middle| \rho_{Pool}, \frac{EL_{RA}}{LGD}\right)\right)$$

Questions 2b

1. The AFA as calibrated here requires that intra-pool correlation is greater than the correlation between average pairs of assets on the bank balance sheet. Is this reasonable?
2. In slide 60, the area under the blue curve equals the total capital for all the tranches. What do guess this equals? (Hint: you might guess from the name.)
3. We have emphasised one approach to valuing securitisations that requires specification of correlations, pool PDS, LGDs etc. What alternative “simple” approach do you think is also used?

RISK CONTROL

Agenda

1. Introduction to securitisation
2. Risk analysis and pricing of securitisations
3. Regulation of securitisations
4. Practical exercise 1: PURA RTS
5. Role of the ratings agencies
6. Liquidity of securitisations
7. Market drivers and motives for using securitizations
8. Practical exercise 2: Optimal Tranching

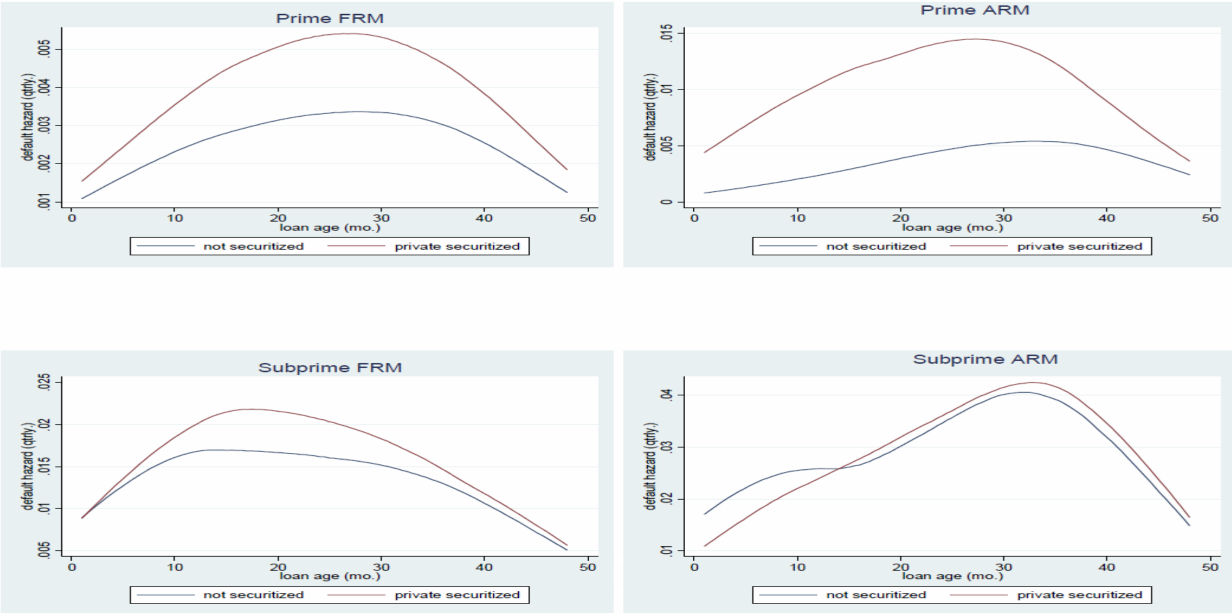
A Primer on Securitisation Capital

- Here, we present perspectives on how much capital banks should hold against securitisation investments and explain how regulatory views on securitisation capital have varied over time and across jurisdictions.
- Securitisations are tranched exposures to pools of assets, typically credit exposures such as bonds or loans.
- A securitisation tranche experiences losses when pool losses exceed the tranche's attachment point, and are limited to the tranche thickness, determined by the tranche's detachment point.
- Since a securitisation just splits pool cash flows between tranche holders, the risk of holding all the tranches of a securitisation is identically equal to that of holding all the loans or bonds in the pool.
- However, if a tranche is sold to outside investors, the incentives of those involved in the origination or servicing of the underlying loans may be affected.
- For example, if the pool servicer no longer holds all the risk, their incentive to manage the pool effectively may be reduced.
- Equally, an originating bank that intends to sell the risk via a securitisation, may have weaker incentives to choose prudently from among prospective borrowers.
- These problems are referred to as "agency risk". They provide arguments for some capital non-neutrality in the sense that one may require that the capital for all the tranches in a securitisation should somewhat exceed that required for holding pool assets.

Agency Costs and Securitisation (1/2)

- Academic research has uncovered evidence of agency risk in the US sub-prime market. Elul (2011), in particular, shows that the default rates of securitised sub-prime loans in the crisis period exceeded those of comparable but non-securitised loans.

Nonparametric Default Hazard Functions from Elul (2011)



The horizontal axis represents the age of the mortgage (in months) and the vertical axis shows the probability of default in the next quarter, conditional on not having defaulted before.

Agency Costs and Securitisation (1/2)

- Perraudin (2013) calculates, based on Basel II loan capital formulae, the boost in capital implied by these higher default rates and deduces an implied capital premium of 10-20%.
- The current European securitisation market is certainly much less subject to agency risk than the US sub-prime market at the height of the pre-crisis US housing market boom.
- The European market consists of relatively simple securitisations of well-established asset classes implemented in a vertically integrated way by regulated banks operating in a credit regulated environment.
- In this, it is very different from the pre-crisis US market in which sub-prime loans with little track record were originated and securitised by non-bank specialist lenders that were following an originate-to-distribute business model.
- Since the crisis, regulators have put in place a variety of measures to reinforce the stability and performance of the securitisation market.
- These include, among other measures, retention requirements, improvements in transparency and availability of pool exposure data and increased due diligence requirements for investors.

Capital increases implied by "agency cost" PD adjustments – Mortgage Loans

Corporate Ratings	PD	Scaling Factor	Capital Increase including EL	Capital Increase excluding EL
AA	0.04%	1.2544	19.87%	19.63%
A	0.08%	1.2544	19.38%	19.08%
BBB	0.29%	1.2544	18.33%	17.84%
BB	1.05%	1.2544	16.85%	15.98%
B	5.14%	1.2544	14.12%	11.94%

The PDs are from S&P 2011 annual global corporate default study and rating transitions. The LGD calibration in this calculation is irrelevant. The asset value correlation coefficient is calibrated as 0.15.

Performance of the European Market

- Even before these changes were implemented, one should note that, despite the severity of the recent crisis, the European market performed relatively well.
- The GDP shock experienced in many European countries exceeded that in the US and yet default rates in the bulk of the European securitisation market were negligible.
- The primary exceptions were (i) securitisations that, while European, contained indirect exposures to US mortgage assets and (ii) Commercial Mortgage Backed Securities (CMBS).
- The latter are subject to refinancing risk in the sense that the underlying mortgages often require refinancing when the securitisation matures which proved difficult in the recent crisis.
- When the Basel II securitisation capital framework was designed, regulators were clear that the main risk in a securitisation depends on the risk of the underlying pool of assets.
- Therefore, the approach taken should start from capital neutrality but then include reasonable capital premiums.

Perraudin (2014b) calculates the peak to trough GDP declines for UK, France, Spain and Italy after 2007 as being 7.2%, 4.4%, 5.0%, and 7.2% respectively, compared to 4.3% for the US.

Excluding CDOs of ABS, CMBS and other CDOs, the default rate of European securitisations was 0.12%.

Data in Standard & Poor's (2013) implies cumulative default rates in Europe between 2007 and 2013 for RMBS, Other Consumer ABS, Credit Card ABS and SME CLOs of 0.10%, 0.13%, 0.00% and 0.41%, respectively.

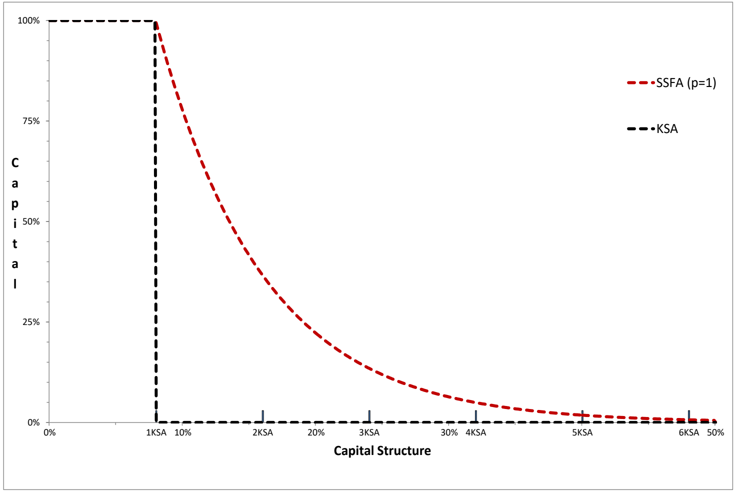
RISK CONTROL

The Post-Crisis Review

- Following the crisis, regulators have been concerned to review and where appropriate modify prudential rules for securitisation, sometimes before modifying the prudential rules for the underlying assets where the main risk resides.
- In the trading book, substantial changes were implemented quite soon after the crisis in 2009.
- The banking book treatment of securitisation capital was subjected to a multi-year review by the Basel Committee's RSW.
- The RSW's initial consultative paper (see BCBS 236) published in December 2012 proposed for IRB banks a highly complicated capital formula based on an analytic approximation to an underlying model.
- The underlying model employed assumptions that were inconsistent with the assumptions behind the Basel II capital for on-balance-sheet loans.
- This meant that substantial deviations from capital neutrality arose for some exposures and much smaller deviations for others just because of inconsistency of assumptions rather than because of clear policy decisions.
- For SA banks, the RSW introduced a simple ad hoc formula, the so-called Simplified Supervisory Formula Approach (SSFA).
- This formula had the advantage that one could transparently calculate from the model's parameters the deviation from capital neutrality that the framework implied (leaving aside the effect of capital floors).
- Specifically, a parameter p within the SSFA equals the fraction by which the sum of capital for all tranches post-securitisation exceeds pre-securitisation pool capital.

The SSFA

- As a formula, the SSFA has a long history in that it was proposed in an early Basel II paper on securitisation capital but rejected in favour of the complex SFA (which remained the Basel II formula-based approach).
- Since the crisis, the SSFA has been used for bank trading book capital for securitisations by the US authorities.
- In July 2013, after a consultation period, the SSFA was implemented by the US as a Standardised Approach formula for banking book investments in securitisations, for which the US has set the p parameter to 0.5.
- The US implemented the SFA and SSFA respectively as IRB and SA methods for securitisation.
- It followed this approach in order to meet the requirements of the Dodd-Frank Act of 2010 which required the removal of references to agency ratings from regulatory rules.



For tranches with an attachment point A greater than K_T, capital is calculated using an exponential function:

$$K_{SSFA}(l,u) = \frac{\left(e^{a\,u} - e^{a\,l}\right)}{a\,(u-l)}$$

A Rethink

- In 2013, a set of industry quants specialised in securitisation risk analysis published a series of papers advocating securitisation capital calculation based on analytically solvable models.
- In these models (which in different versions were generalised to cover granularity, multi-period securitisations and multiple asset classes), either capital neutrality or controlled and reasonable deviations from it were allowed for.
- In December 2013, the RSW published in BCBS 269 a substantially revised framework which extended the US-designed SSFA framework to an IRBA securitisation approach from a SA securitisation approach.
- Later, to avoid confusion with the names of the methods used for the underlying pool of assets, IRBA and SA were renamed SEC-IRBA and SEC-SA.
- The parameter p was set to a constant value of 1.0 in the SEC-SA while, in the SEC-IRBA, p, is a function of deal and pool characteristics with a floor of 0.3. For re-securitisations, p takes a constant value of 1.5.

Constraints on the RSW

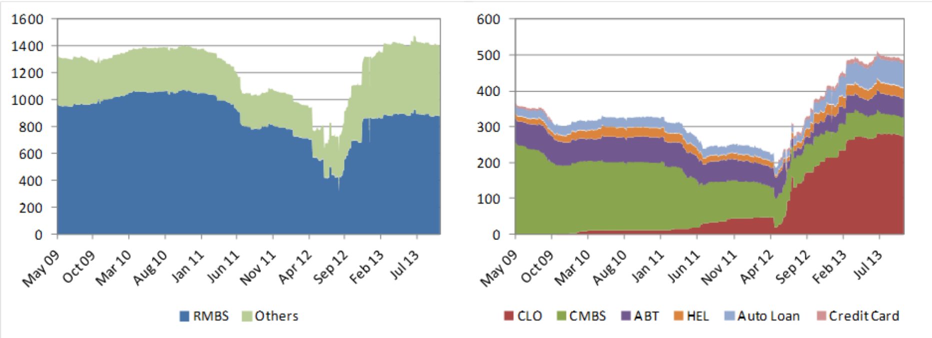
- An important constraint on the RSW was to produce a Basel III set of rules that could be adopted by the US, and that meant using formulae-based instead of external ratings-based approaches.
- The External Ratings Based Approach (ERBA) (later renamed SEC-ERBA) proposed by the RSW is not used by the US.
- The role of ratings in regulation has been controversial not just in the US.
- The summit declaration of the Toronto G20 meeting announced the intention by other jurisdictions to reduce mechanistic reliance of regulation on agency ratings.
- In Europe, despite repeated subsequent statements by the authorities, little progress was been made.
- The hierarchy of capital approaches in BCBS 269 implied that, if possible, a bank should calculate capital for a securitisation position using in order
    1. The SEC-IRBA (a version of the SSFA in which the pool capital input is based on a calculation of pool capital K_{IRB} under Basel IRB standards)
    2. The External Ratings Based Approach in which capital is deduced from a look up table based on agency ratings
    3. The SEC-SA (a version of the SSFA in which the pool capital input is based on a calculation of pool capital K_{SA} under the Basel Standardised Approach)

RISK CONTROL

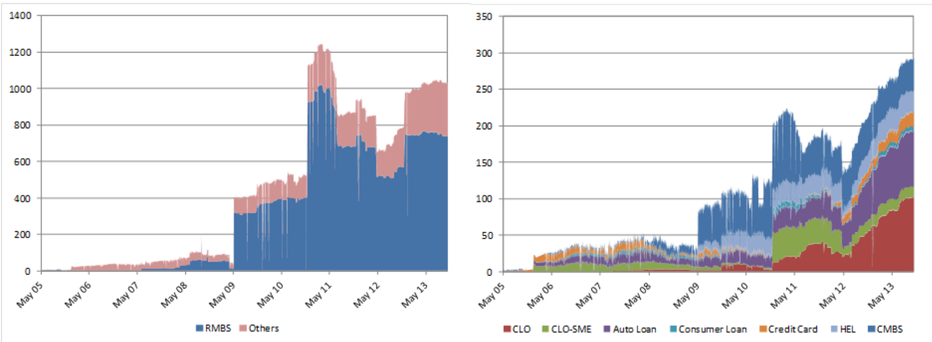
A Second Rethink (in Europe)

- After the December 2013 publication of BCBS 269, it became progressively more apparent to economic policy-makers who had followed the development of the Basel rules from a distance that the degree of conservatism would make it very difficult for the securitisation market to revive in jurisdictions where bank investors were a significant part of the buy side.
- This was particularly regrettable for the European market in which, in many countries, bank lending remained very subdued and where, after all, the securitisation market had been largely free of significant delinquencies throughout the crisis.
- In this context, the Bank of England and the ECB published in March and May 2014 two papers arguing that one should distinguish between High Quality Securitisations (HQS) (which are simple in structure and transparent in risk implications) and more complex deals.
- Perraudin (2014b) provided statistical evidence in favour of the notion that HQS are less risky and more liquid than non-HQS.
- While the joint Bank of England-ECB papers did not directly propose concessions in the regulatory treatment of HQS, many took this to be their implication.
- The EBA was mandated by the Commission to draft rules for such securitisation.

Empirical evidence on HQS (1/6)



Dataset 1: data from S&P starts in 2009 and includes bid-ask spreads.



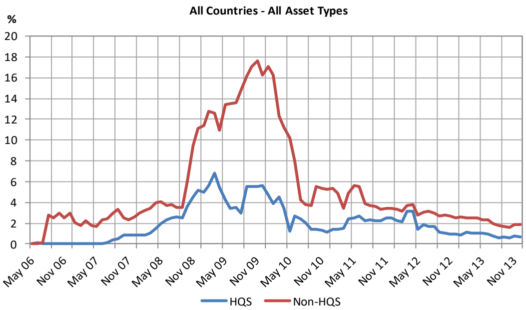
Dataset 2: drawn from Bloomberg and Reuters, starts in 2005.

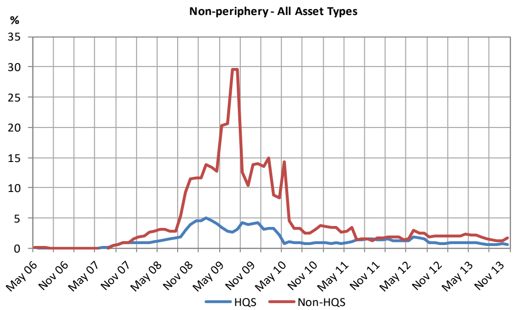
- HQS should exhibit superior risk and liquidity behaviour.
- The material in this section is extracted from Perraudin (2014), an investigation of the risk and liquidity performance of European securitisation tranches since 2005, commissioned by the industry institution Prime Collateralised Securities (PCS).
- We focus on AAA-rated tranches for volatility and AAA and AA-rated tranches for liquidity in order to show that the HQS definition has incremental value in differentiating performance after allowing for the rating.

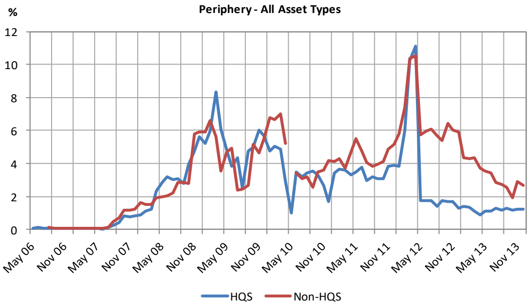
Empirical evidence on HQS (2/6)

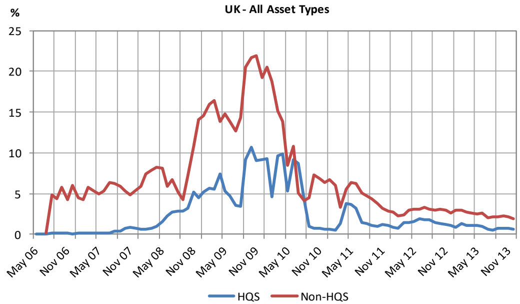
- We define HQS consistent with PCS's key principles, namely:
  1. Excluding securitisations that are issued under an originate-to-distribute business model.
  2. Excluding securitisations that involve "leverage" in the sense that they create highly rated securitisation tranches out of pools containing lower rated, already credit-tranched securitisations.
  3. Ruling out maturity transformation.
  4. Requiring transparency.
- In practice, to represent the above principles, we define HQS as follows:
  1. We rule out CMBS and large corporate securitisations (consistent with 3.)
  2. We rule out resecuritisations (consistent with 2.)
  3. We rule out any originate-to-distribute deals using a flag provided to us by PCS.
  4. We require that the tranche be the most senior in the structure.
  5. We require that the face value exceed 100mn monetary units (Euros, GBP or USD)
- Note: in fact, there were not any resecuritisations in our sample. This affects the comparisons we report below between HQS and non-HQS risk and liquidity measures. (If we did have resecuritisation data, one might expect to observe even bigger differences.)

Empirical evidence on HQS (3/6)









Note: results are intuitive in all cases except for periphery volatilities in crisis period. This reflects bank-level selectivity effects in the Spanish data, with almost all the HQS being issued by distressed cajas. The results for periphery countries other than Spain are consistent with intuition.

- The figure shows volatilities of HQS and Non-HQS over time for all asset types in four different country-groupings: all countries, non-periphery countries, periphery countries and the UK.
- Average volatilities are calculated as annualised percentages.
- For instance, in February 2010, the estimated volatility for all HQS asset types in all countries was approximately 5%, compared to a volatility of approximately 15% for non-HQS assets.

RISK CONTROL

Empirical evidence on HQS (4/6)

		HQS				Non-HQS			
		Mean Price	Avg Price SD	Avg Volatility	Avg Sample Size	Mean Price	Avg Price SD	Avg Volatility	Avg Sample Size
All Asset Types	All	97.65	3.60	1.97	143.43	96.76	7.82	5.29	378.98
	Non-periphery	98.33	2.16	1.45	69.10	95.63	6.60	4.67	100.16
	Periphery	96.54	4.05	2.63	40.18	94.44	5.67	3.59	47.09
	UK	98.68	3.33	2.42	34.15	98.19	7.82	6.93	231.73
RMBS	All	97.09	3.92	3.02	93.39	97.94	6.58	5.99	272.22
	Non-periphery	97.36	2.58	2.42	46.59	95.59	6.11	4.22	66.38
	Periphery	95.17	3.97	4.95	23.64	92.86	5.30	3.96	20.93
	UK	99.04	3.46	2.93	23.16	98.35	6.40	7.08	184.90
CLO	All	100.27	1.04	0.69	1.00	99.27	4.11	2.97	15.46
	Non-periphery	100.01	0.00	0.62	0.14	101.33	2.71	2.50	9.29
	Periphery	97.51	0.00	1.61	0.15	94.86	3.31	3.80	3.54
	UK	100.75	0.69	0.58	0.71	95.30	4.70	2.54	2.62
CLO-SME	All	91.18	3.99	1.64	5.57	80.19	2.95	2.37	8.48
	Non-periphery	86.81	1.45	0.35	1.96	57.09	0.23	0.21	1.04
	Periphery	85.00	1.95	2.78	2.77	65.14	3.35	3.56	6.64
	UK	31.35	0.21	0.60	0.84	23.42	0.60	0.43	0.79
Auto Loan	All	99.07	1.12	1.05	20.52	99.58	0.54	1.11	4.45
	Non-periphery	99.33	0.69	0.87	15.67	99.68	0.52	0.76	2.82
	Periphery	98.36	1.40	1.42	3.67	98.02	0.00	2.51	0.15
	UK	100.09	0.09	0.36	1.17	100.15	0.22	0.84	1.48
Consumer Loan	All	97.45	1.47	1.64	2.99	84.55	6.71	8.60	0.28
	Non-periphery	99.17	0.33	0.77	1.16	84.55	6.71	8.60	0.28
	Periphery	96.00	1.44	2.13	1.71	-	-	-	0.00
	UK	101.70	0.00	0.94	0.12	-	-	-	0.00
Credit Card	All	98.20	1.11	1.97	5.03	99.33	0.26	1.02	1.17
	Non-periphery	-	-	-	0.00	-	-	-	0.00
	Periphery	-	-	-	0.00	-	-	-	0.00
	UK	98.20	1.11	1.97	5.03	99.33	0.26	1.02	1.17
HEL	All	99.37	1.74	1.02	3.98	98.51	3.47	2.76	9.17
	Non-periphery	96.83	1.62	0.85	1.08	97.83	1.45	1.90	2.78
	Periphery	-	-	-	0.00	84.69	0.00	4.55	0.29
	UK	100.22	0.46	1.22	2.90	99.33	2.13	2.66	6.10

- The table displays key summary statistics for time series of individual security specific quantities.
- Time series for each asset sub-class are further divided by whether they belong to the Non-periphery, Periphery, the UK, or all countries.
- For each aggregation the mean price, average price standard deviation, average volatility (with a window of 125 days) and average sample size are displayed.

Note: In other cases, where sign of effect is not as expected, it reflects time period or bank/country sample selectivity as explained in note on (3/6) slide.

RISK CONTROL

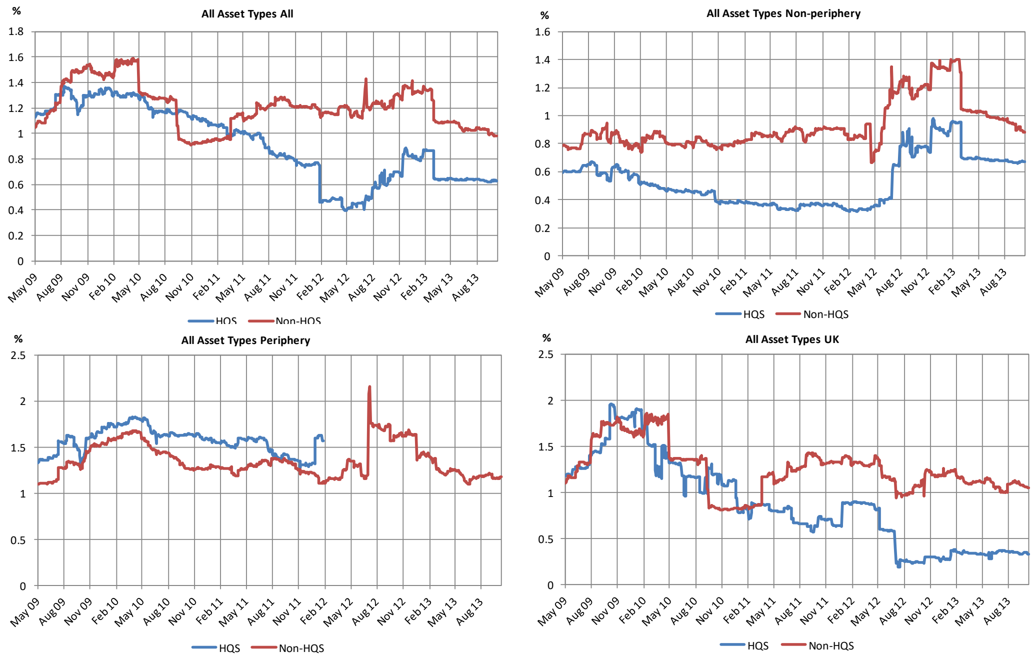
Empirical evidence on HQS (5/6)

		Full criteria		Relax not OTD		Relax most senior tranche		Relax not CMBS		Relax principle amount > 100m		Relax all criteria
		HQS	Non-HQS	HQS	Non-HQS	HQS	Non-HQS	HQS	Non-HQS	HQS	Non-HQS	
All Asset Types	All	2.32	6.64	2.58	6.54	2.80	9.72	2.76	6.50	2.37	6.66	4.97
	Non-periphery	1.54	6.17	1.89	5.61	1.81	12.86	1.62	6.13	1.54	6.18	3.29
	Periphery	3.14	4.10	3.20	4.19	3.14	4.44	3.15	4.10	3.15	4.22	3.73
	UK	3.25	8.54	4.27	8.43	3.77	11.31	4.85	8.44	3.38	8.56	7.09
RMBS	All	3.59	7.42	4.06	7.23	4.40	11.43	3.59	7.42	3.68	7.45	6.58
	Non-periphery	2.57	4.99	3.17	3.92	2.76	6.69	2.57	4.96	2.56	4.97	3.77
	Periphery	5.97	4.60	5.85	4.56	5.73	4.22	5.97	4.60	5.66	4.78	5.50
	UK	4.36	8.92	6.79	8.71	5.08	15.37	4.36	8.92	4.39	8.96	8.58

- The figure total, average time series volatilities of HQS and Non-HQS for all asset types and for RMBS for the four different country-groupings.
- Reading across the columns, we show the result of relaxing successively individual criteria from our HQS definition.
- For example, the effect of relaxing the most senior tranche requirement is to boost the volatility of All Asset Types in All regions by 0.48 = 2.80 - 2.32 percent.

Note: on periphery RMBS, see note to slide (3/6) on bank level selectivity effects in Spain.

Empirical evidence on HQS (6/6)



Note: on periphery country bid-ask spreads, see note to (3/6) slide on bank level selectivity effects to do with distressed cajas in Spain.

- The plots show the evolution of average bid-ask spreads of HQS and Non-HQS for all asset types in four different country-groupings: all countries, non-periphery countries, periphery countries and the UK.
- Bid-ask spreads have been estimated by Standard & Poor's.
- For instance, in May 2009 the bid-ask spread of all non-periphery HQS assets was approximately 0.6% of the bond's par value, compared to bid-ask spreads of approximately 0.8% for non-HQS assets.

RISK CONTROL

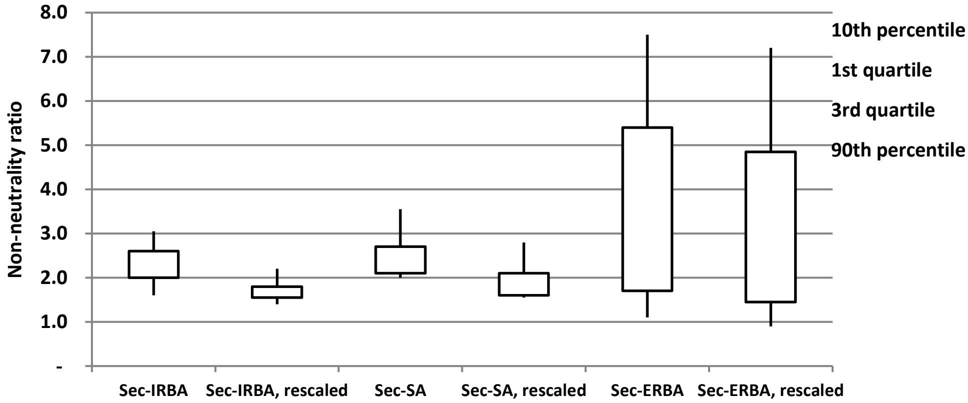
The EBA (2014) Working Paper

- A major contribution of EBA (2014) was the analysis of the impact of different capital rules on realistic example securitisations.
- This yields results that are more relevant to the market than the calibration exercises behind the BCBS SEC-ERBA, as the RSW calibration was performed, as far as is publicly known, using stylised securitisation deals rather than actual transactions.
- Focussing on the existing Basel II approaches (formula-based SFA, IRB Ratings Based Approach (RBA) and Ratings Based Standardised Approach (RB(SA)) so as not to impinge on the work of the RSW, the EBA showed that the formula- and ratings-based approaches had become completely misaligned.
- A variety of factors contributed.
    1. Rating agencies had increased the conservatism of their rating methodologies following the crisis.
    2. The major agencies imposed sovereign ceiling caps on securitisation ratings.
    3. As mentioned above, the rating agencies are very conservative in their evaluation of European SME backed deals.
- The net effect, documented by the EBA, is that the post-securitisation capital can easily be 5 times or more the pool capital for significant parts of the European market.

Impact Effects of Capital Rules: EBA

- The figure displays statistics of the distribution of non-neutrality ratios for over 2,000 securitisation deals contained in the European Data Warehouse (EDW) as published by the EBA (2015b).
- The non-neutrality ratio for a given securitisation under a particular capital treatment equals the ratio of
  - ➢ the capital requirement a bank must meet if it holds all the tranches in a securitisation
  - ➢ to the capital it must maintain if it owns the assets in the securitisation pool.

Non-neutrality ratios for EDW securitisations before and after rescaling



- The plots show the 25% and 75% quantiles (the bottom and top level of the bars) and the 10% and 90% quantiles (the extreme points on the lines).
- The quantiles are shown for before and after the EBA 're-scaling' (for STS) of capital charges is performed and for the three approaches contained in BCBS 303, the SEC-IRBA, SEC-ERBA and the SEC-SA.

Reducing the Role of Ratings

- The dislocation and inconsistency of the current Basel II and intended Basel III (BCBS 269 and later, finalised as 303 in December 2014) capital frameworks has been extensively explored and documented by industry studies.
- Perraudin (2014c) presents an analysis of the regulatory capital implications of different rules for the securitisation holdings of 8 major international banks.
- Using primarily US bank data on exposures to US deals, it shows that the BCBS 269 ERBA is more conservative than the SEC-IRBA and SEC-SA formulae and that, looking across tranches, the risk weights implied by the former have low correlations with the formulae-based capital.
- More pertinent to the European market, Duponcheele, Linden and Perraudin (2014) analyse 1,771 European securitisations for which public data is available, calculating risk weights under the three BCBS 269 approaches.
- Their conclusions were striking in that they showed very substantial relative conservatism of the SEC-ERBA when applied to European prime mortgage and SME deals in particular.

STS Securitisation

- In February 2015, the Commission launched its “Consultation Document on an EU framework for simple, transparent and standardised securitisation”.
- In June 2015, EBA (2015a) published proposals for a category of “Simple, Transparent and Standardised” (STS) securitisations and a suggested recalibration of the RSW’s BCBS 303 risk weight rules for this category.
- The recalibration for STS securitisations consists of halving (vis-à-vis the BCBS 303 values) the p parameter employed in both the SEC-IRBA and SEC-SA (while maintaining the floor of 0.3 in the case of the SEC-IRBA).
- The resulting SEC-SA p value of 0.5, one may note, equals the value used in the current domestic US SA approach adopted in July 2013.
- EBA (2015a) also presents a recalibration of the SEC-ERBA for STS securitisations. The effectiveness of this recalibration is open to doubt, however.
- EBA (2015a) presents calculations based on European Data Warehouse (EDW) data suggesting that SEC-ERBA risk weights are reduced by only 7% .
- Perraudin (2015b) analyses the impact of the EBA (2015a) recalibration using the same 1,771 securitisations employed by Duponcheele, Linden and Perraudin (2014) and shows that the SEC-ERBA remains prohibitively conservative for European prime mortgage and SME loan backed securitisation, especially for senior tranches.

The Final Basel Rules

- The final package of Basel III rules for securitisation capital was published in BCBS D374 in July 2016.
- This revised the December 2014 BCBS 303 to include less conservative capital rules for "simple, transparent and comparable" securitisations.

Simplicity	Simplicity refers to the homogeneity of underlying assets with simple characteristics, and a transaction structure that is not overly complex.
Transparency	Criteria for transparency provide investors with sufficient information on the underlying assets, the structure of the transaction and the parties to the transaction, promoting a more comprehensive and thorough understanding of the risks involved. The manner in which the information is available should not hinder transparency, but instead support investors in their assessment.
Comparability	Criteria promoting comparability could assist investors in their understanding of such investments and enable more straightforward comparison across securitisation products within an asset class. Importantly, they should appropriately take into account differences across jurisdictions.

STS Securitisation in the European Rules (1/2)

- The European version of STC is called Simple, Transparent and Standardised
    1. Originators and Sponsors may notify ESMA that a transaction is "STS" if both of them and the SPV are established in the Union and the securitisation meets the STS-securitisation criteria. The notification is published on the ESMA website.
    2. For non-ABCP securitisations, to be STS, it must involve:
    3. Unconditional and unencumbered transfer of ownership of a homogenous pool of assets to the SPV.
    4. No "originate to distribute-model" in that loans cannot be entered into in the first place only for sale and repackaging.
    5. No transferred assets may be in default and all must have at least one payment.
    6. Interest rate and currency risks arising from the securitisation must be swapped and multiple legal aspects must be fully disclosed with responsibilities specified.
    7. Statistical data and liability cash flow models must be available.

STS Securitisation in the European Rules (2/2)

Background and rationale for the criteria related to simplicity

- True sale, assignment or transfer with the same legal effect, representations and warranties (Article 20(1)-(6))
- Eligibility criteria for the underlying exposures, active portfolio management (Article 20(7))
- Homogeneity, obligations of the underlying exposures, periodic payment streams, no transferable securities (Article 20(8))
- No resecuritisation (Article 20(9))
- Underwriting standards (Article 20(10))
- No exposures in default and to credit-impaired debtors/guarantors (Article 20(11))
- At least one payment made (Article 20(12))
- No predominant dependence on the sale of assets (Article 20(13))

Background and rationale for the criteria related to standardisation

- Risk retention (Article 21(1))
- Appropriate mitigation of interest-rate and currency risks (Article 21(2))
- Referenced interest payments (Article 21(3))
- Requirements in case of enforcement or delivery of an acceleration notice (Article 21(4))
- Non-sequential priority of payments (Article 21(5))
- Early amortisation provisions/triggers for termination of the revolving period (Article 21(6))
- Transaction documentation (Article 21(7))
- Expertise of the servicer (Article 21(8))
- Remedies and actions related to delinquency and default of a debtor (Article 21(9))
- Resolution of conflicts between different classes of investors (Article 21(10))

Background and rationale for the criteria related to transparency

- Data on historical default and loss performance (Article 22(1))
- Verification of a sample of the underlying exposures (Article 22(2))
- Liability cash flow model (Article 22(3))
- Environmental performance of assets (Article 22(4))
- Compliance with transparency requirements (Article 22(5))

Internal Ratings-Based Approach (SEC-IRBA) (1/2)

- K_{IRB} is the capital charge of the underlying pool . It is is the ratio of (a) the IRB capital requirement (including the expected loss portion and, where applicable, dilution risk) for the underlying exposures in the pool to (b) the exposure amount of the pool (eg the sum of drawn amounts related to securitised exposures plus the exposure-at-default associated with undrawn commitments related to securitised exposures).
- LGD is the exposure-weighted average loss-given-default of the underlying pool
- M_T is the maturity of the tranche calculated
- $K_{SSFA(K_{IRB})}$ is the capital requirement per unit of securitisaion exposure under the SEC-IRBA
- p is the supervisory parameter
- N is the effective number of loans in the underlying pool
- 0.3 denote the p-parameter floor
- 15% denote the risk weight floor
- The parameters A,B,C,D and E are determined according to the following look-up table.

SEC-IRBA look-up table

		A	B	C	D	E
Wholesale	**Senior**, granular (N>=25)	0	3.56	-1.85	0.55	0.07
	Senior, non-granular (N<25)	0.11	2.61	-2.91	0.68	0.07
	Non-Senior, granular (N>=25)	0.16	2.87	-1.03	0.21	0.07
	Non-Senior, non-granular (N<25)	0.22	2.35	-2.46	0.48	0.07
Retail	**Senior**	0	0	-7.48	0.71	0.24
	Non-Senior	0	0	-5.78	0.55	0.27

Source: BCBS (2014)

Internal Ratings-Based Approach (SEC-IRBA) (2/2)

- For normal securitisations

$$p = max\left(0.3, A + B \times \frac{1}{N} + C \times K_{IRB} + D \times LGD + E \times M_T\right)$$

- For STC securitisations

$$p = max\left(0.3, \left(A + B \times \frac{1}{N} + C \times K_{IRB} + D \times LGD + E \times M_T\right) \times 0.5\right)$$

$$K_{SSFA(K_{IRB})} = \frac{e^{a \times u} - e^{a \times l}}{a \times (l - u)}, \; a = -\frac{1}{p \times K_{IRB}}, \; u = D - K_{IRB}, \; l = \max(A - K_{IRB}, 0)$$

$$\text{RW}= \begin{cases} 12.5 & if\ D \leq K_{IRB}, \\ \max(15\%,\ K_{SSFA(K_{IRB})} \times 12.5) & if\ A \geq K_{IRB}, \\ \max\left(15\%, \frac{K_{IRB}-A}{D-A} \times 12.5 + \frac{D-K_{IRB}}{D-A} \times 12.5 \times K_{SSFA(K_{IRB})}\right) & Otherwise \end{cases}$$

- Under the normal method, let EAD_i represent theexposure–at–default associated with the ith instrument in the pool, LGD_i represent the average LGD associated with all exposures to the ith obligor

$$N = \frac{\left(\sum_i EAD_i\right)^2}{\sum_i EAD_i^2}, \text{LGD}= \frac{\sum_i EAD_i \times LGD_i}{\sum_i EAD_i}$$

- Let c_m denote the share of the pool corresponding to the sum of the largest m shares. The level of m is set by each bank. If the portfolio share associated with the largest exposure, c_1, is no more than 0.03

$$N = \left(c_1 \times c_m + \frac{c_m - c_1}{m - 1} \times \max(1 - m \times c_1, 0)\right)^{-1}, LGD = 0.5$$

- If only c_1 is available and $c_1 \leq 0.03$

$$N = \frac{1}{c_1}, LGD = 0.5$$

Source: BCBS (2014)

RISK CONTROL

External Ratings-Based Approach (SEC-ERBA)

ERBA risk weights for short-term ratings for normal securitisations

External Credit Assessment	A-1/P-1	A-2/P-2	A-3/P-3	All other ratings
Risk Weight	15%	50%	100%	1250%

ERBA risk weights for short-term ratings for STC securitisations

External Credit Assessment	A-1/P-1	A-2/P-2	A-3/P-3	All other ratings
Risk Weight	10%	30%	60%	1250%

EBRA risk weights for long-term ratings for normal securitisations

Rating	Senior Tranche		Non-Senior (Thin) Tranche	
	Tranche Maturity (MT)		Tranche Maturity (MT)	
	1 year	5 years	1 year	5 years
AAA	15%	20%	15%	70%
AA+	15%	30%	15%	90%
AA	25%	40%	30%	120%
AA-	30%	45%	40%	140%
A+	40%	50%	60%	160%
A	50%	65%	80%	180%
A-	60%	70%	120%	210%
BBB+	75%	90%	170%	260%
BBB	90%	105%	220%	310%
BBB-	120%	140%	330%	420%
BB+	140%	160%	470%	580%
BB	160%	180%	620%	760%
BB-	200%	225%	750%	860%
B+	250%	280%	900%	950%
B	310%	340%	1050%	1050%
B-	380%	420%	1130%	1130%
CCC+/CCC/CCC-	460%	505%	1250%	1250%
Below CCC-	1250%	1250%	1250%	1250%

EBRA risk weights for long-term ratings for STC securitisations

Rating	Senior Tranche		Non-Senior (Thin) Tranche	
	Tranche Maturity (MT)		Tranche Maturity (MT)	
	1 year	5 years	1 year	5 years
AAA	10%	10%	15%	40%
AA+	10%	15%	15%	55%
AA	15%	20%	15%	70%
AA-	15%	25%	25%	80%
A+	20%	30%	35%	95%
A	30%	40%	60%	135%
A-	35%	40%	95%	170%
BBB+	45%	55%	150%	225%
BBB	55%	65%	180%	255%
BBB-	70%	85%	270%	345%
BB+	120%	135%	405%	500%
BB	135%	155%	535%	655%
BB-	170%	195%	645%	740%
B+	225%	250%	810%	855%
B	280%	305%	945%	945%
B-	340%	380%	1015%	1015%
CCC+/CCC/CCC-	415%	455%	1250%	1250%
Below CCC-	1250%	1250%	1250%	1250%

Source: BCBS (2014)

RISK CONTROL

Standardised Approach (SEC-SA)

The variable W equals the ratio of the sum of the nominal amount of delinquent underlying exposures to the nominal amount of underlying exposures.

- If the bank does know the delinquency status

$$K_A = (1 - W) \times K_{SA} + W \times 0.5$$

- If the bank does not know the delinquency status

$$K_A = \frac{EAD_{Subpool\ 1\ where\ W\ know}}{EAD\ Total} \times K_A^{Subpool\ 1\ where\ w\ known} + \frac{EAD_{Subpool\ 2\ where\ W\ unknow}}{EAD\ Total}$$

$$K_{SSFA(K_A)} = \frac{e^{a \times u} - e^{a \times l}}{a \times (l - u)},\ a = -\frac{1}{p \times K_A},\ u = D - K_A,\ l = \max(A - K_A, 0)$$

The supervisory parameter p in the context of the SEC-SA is set equal to 1 for a securitisation exposure that is not a re-securitisation exposure. The supervisory parameter p in the context of the SEC-SA is set equal to 0.5 for an exposure to an STC securitisation.

$$RW = \begin{cases} 12.5 & if\ D \le K_A, \\ \max\left(15\%,\ K_{SSFA(K_A)} \times 12.5\right) & if\ A \ge K_A, \\ \max\left(15\%,\ \frac{K_A - A}{D - A} \times 12.5 + \frac{D - K_A}{D - A} \times 12.5 \times K_{SSFA(K_A)}\right) & Otherwise \end{cases}$$

The resulting risk weight is subject to a floor risk weight of 15%. Moreover, when a bank applies the SEC-SA to an unrated junior exposure in a transaction where the more senior tranches (exposures) are rated and therefore no rating can be inferred for the junior exposure, the resulting risk weight under SEC-SA for the junior unrated exposure shall not be lower than the risk weight for the next more senior rated exposure.

Source: BCBS (2014)

RISK CONTROL

Impact Effects of Capital Rules

Risk Weights (Par Weighted Averages)

Most senior tranches

	RBA	SFA	BCBS 303 SEC-IRBA	BCBS 303 SEC-ERBA	BCBS 303 SEC-SA	STS SEC-IRBA	STS SEC-ERBA	STS SEC-SA
RMBS	67%	7%	16%	59%	16%	10%	43%	10%
SME	22%	7%	15%	66%	16%	10%	44%	10%
Other Retail	8%	7%	15%	27%	18%	10%	19%	10%

Mezzanine tranches

	RBA	SFA	BCBS 303 SEC-IRBA	BCBS 303 SEC-ERBA	BCBS 303 SEC-SA	STS SEC-IRBA	STS SEC-ERBA	STS SEC-SA
RMBS	247%	27%	94%	267%	153%	59%	213%	101%
SME	267%	43%	85%	289%	187%	68%	238%	113%
Other Retail	102%	14%	44%	112%	102%	27%	87%	65%

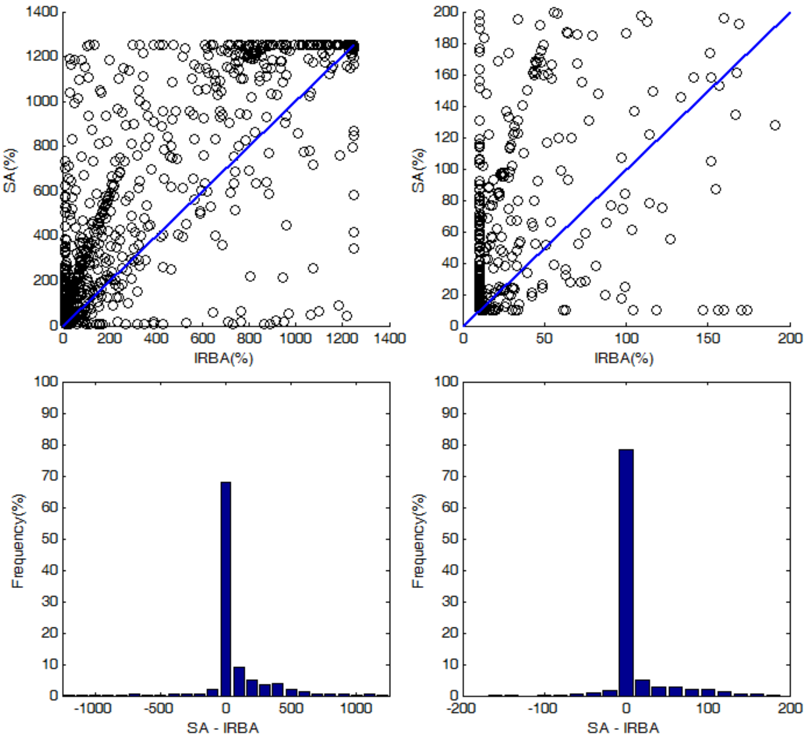
Junior tranches

	RBA	SFA	BCBS 303 SEC-IRBA	BCBS 303 SEC-ERBA	BCBS 303 SEC-SA	STS SEC-IRBA	STS SEC-ERBA	STS SEC-SA
RMBS	548%	202%	390%	528%	419%	311%	483%	352%
SME	777%	267%	376%	631%	537%	329%	561%	431%
Other Retail	267%	165%	309%	344%	489%	236%	301%	402%

- This table displays weighted averages for the Most Senior, Mezzanine and Junior tranches of three asset classes under a number of proposed regulatory approaches.
- Weighted averages are based on par values. Results are given for three securitisation sub-sectors: RMBS, SME loan backed and Other Retail loan backed securitisations.
- All tranches considered are rated to permit comparison with RBA and SEC-ERBA. Averages are provided for two Basel II approaches, the RBA and the SFA, the three BCBS 303 approaches: SEC-IRBA, SEC-ERBA and SEC-SA, and for their variants following EBA (2015b) rescaling.
- See Duponcheele, Linden and Perraudin (2014) for details on the dataset and methodologies used to determine the risk weights.

EBA (2015b) re-scaled STS formulae-based approaches

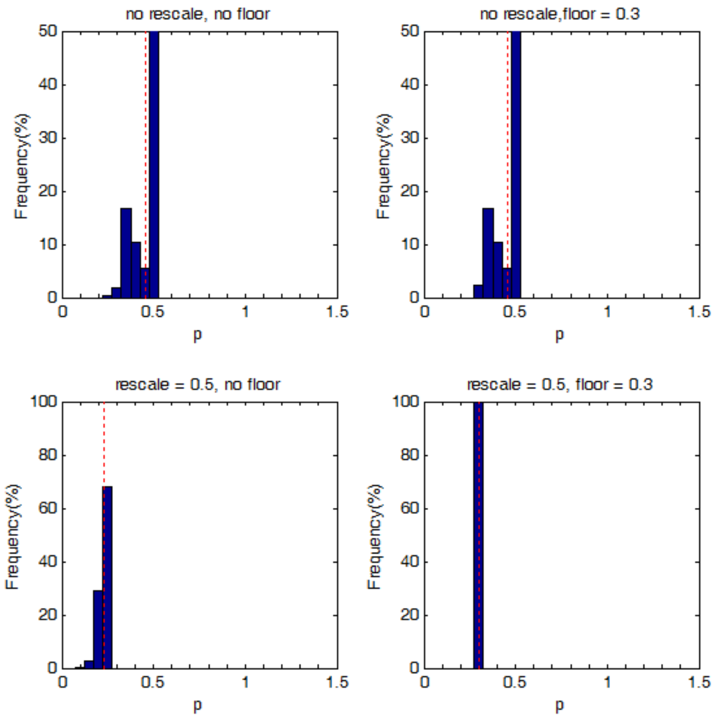
Comparison of the Rescaled STS SEC-IRBA and Rescaled STS SEC-SA



- This Figure displays graphically the risk weights implied by the EBA (2015b) re-scaled STS formulae-based approaches for the 1,771 tranches.
- In the upper panels of the figure, each point represents a comparison between the STS SEC-SA risk weights (shown on the vertical axis) and the STS SEC-IRBA risk weight (on the horizontal axis) for the same individual tranche.
- The left hand panel contains a scatter plot for all the tranches in our dataset while the right hand panel shows a scatter plot only for those tranches that have risk weights less than 200% under both approaches being compared, i.e. the higher credit quality segment of the market.
- The lower panels of the figure show the frequency distribution of the gap between the rescaled STS SEC-SA and STS SEC-IRBA risk weights.

Wholesale p values in SEC-IRBA

Distribution of wholesale p values in SEC-IRBA



- The figure shows histograms for SEC-IRBA p values (under different assumptions) for the 211 corporate or wholesale tranches in our dataset.
- Top left shows the distribution without imposing floor of 0.3 and without EBA (2015)-style rescaling.
- Top right shows results with a 0.3 floor but no rescaling.
- Bottom left shows rescaling but no floor.
- Bottom right shows the distribution with both rescaling and a 0,3 floor.
- The wholesale pools in the European dataset generate p-values between 0.3 and 0.6. The key point to notice is that rescaling the p values (by halving) for STS rescaling, leads all p values to be at the floor of 0.3.

Questions 3

1. Are there any drawbacks of using an ad hoc formula like the SSFA rather than a model-based framework like the AFA?

2. What should the capital premium be in the SSFA? Is a capital premium of 50% for STC justifiable let alone 100% for non-STC?

3. Have you noticed that there is an additional non-neutrality in the rules in that securitisation capital unlike whole loan Basel capital adds in EL and is not UL based?

4. What are the advantages and disadvantages of distinguishing between STC and non-STC securitisations? Was it an advisable step for regulators to take?

5. What challenges may European banks face in implementing the SEC-IRBA?

Agenda

1. Introduction to securitisation
2. Risk analysis and pricing of securitisations
3. Regulation of securitisations
4. Practical exercise 1: PURA RTS
5. Role of the ratings agencies
6. Liquidity of securitisations
7. Market drivers and motives for using securitizations
8. Practical exercise 2: Optimal Tranching

RISK CONTROL

Practical Exercise 1: PURA RTS

- In June 2018, the EBA issued draft Regulatory Technical Standards on what European banks must do in order to employ the SEC-IRBA.
- The framework described build on the permissions already in the CRR for calculation of K_{IRB} in the context of the Purchased Receivables Approach (PURA)
- In this exercise, we shall consider what the EBA should include in the RTS particularly as relates to modellers.
- We shall focus on those articles in the draft RTS that appear most material for quantitative modelling:
    1. Article 5 on "General conditions for risk differentiation"
    2. Article 9 on "Requirements on data"
- We shall go through some material on the issues and then discuss what additional clarification may be advisable.

RISK CONTROL

Access to the SEC-IRBA (1/2)

- Clarifying what banks must do to implement the SEC-IRBA is very important:
    1. To level the playing field with non-EU banks
    2. To ensure bank capital equals that envisaged by Basel
- It has been doubtful whether European banks would be able to employ the SEC-IRBA for securitisation deals other than those for which they themselves are the originators.
- The reason is that national regulators, even within Europe, vary significantly in how strictly they enforce the Basel IRBA data and modelling standards.
- At various stages through the development of the Basel 3 securitisation capital rules, regulators have suggested that K_{IRB} for securitisation capital purposes might be estimated using proxy data.
- But the nature of possible relaxation in data standards has not been clarified as they relate to securitisation activities.
- And no guidance has been given for the specific IRB modelling challenges has been available.

Access to the SEC-IRBA (2/2)

- Key take-aways for modelers from the draft RTS are:
  1. The usual data hierarchy is reversed in that banks should start with data close to the transaction pool in question and should regard internal bank data only as a proxy.
  2. Banks should explicitly take account of the under-writing standards of the originators of the pool exposures.
  3. Top down and bottom up modelling approaches are feasible but in top down approaches in particular no guidance is provided on the degree to which data may deviate from standard Basel definitions.
  4. A central part of IRBA modelling in the securitisation context is the combination of estimates from different data sources. This should be acknowledged and some guidance given as to approaches.

RISK CONTROL

Points for Modellers in the RTS Draft

- In this section, we start by discussing in general terms the challenges faced by banks in PURA modelling.
- Banks likely to use the PURA framework fall into different categories depending on:
    1. Whether they wish to apply the framework to bank originated or non-bank originated assets
    2. Whether they wish to apply the framework to multiple national markets or have a narrow national focus
- The distinction between bank and non-bank assets is important because the nature of the data in the latter case is more difficult to square with standard Basel data and modelling standards
- The distinction between national and multi-market applications is important because markets vary substantially across countries and data sources are more or less complete in different jurisdictions

Article 5: Risk Differentiation

- Article 5 states that:
  "When assigning exposures to grades or pools, institutions shall consider the originator's underwriting standards and the servicer's recovery practices and servicing standards as risk drivers, unless they use different calibration segments for different originators and different servicers in quantifying the risk parameters associated with those grades or pools."
- Such a requirement that the under-writing standards of the originator be explicitly considered is challenging.
- Purchasers of bank loan pools are well aware that the credit performance of loan portfolios depends as much on underwriting standards as on the stage of the business cycle.
- But, observing differences in such standards or being able to measure them statistically is not straightforward.

Article 9: Requirements on data

- Article 9 states that:
  "1. Where the securitised exposures and the obligors of those exposures were, before the transfer of such exposures to the SSPE, not obligors or exposures of the institution calculating KIRB, instead of the requirement of representativeness of the data used for model development in accordance with Article 174(c) of Regulation (EU) No 575/2013, the representativeness of the data shall be assessed in relation to the securitised exposures."
- Also, it states that
  "2. Instead of the requirement in the first sentence of Article 180(2) (c) of Regulation (EU) No 575/2013, institutions shall regard data related to the securitised exposures as the primary source of information for estimating loss characteristics."
- This article effectively reverses the usual data hierarchy encountered in IRB modelling.
- In developing conventional IRB models for a bank's on loan book, internal data are preferred and external data are only applicable if internal data are scarce.
- In the context of PuRA, the EBA is emphasises the need to rely, if these are available, on external data that is closely comparable to the pool under consideration.

RISK CONTROL

Retail Standards

- PuRA (as set out in the CRR Amendment (2017) and clarified in the RTS) allows banks to use certain IRB modelling approaches that are not generally available in a standard IRB context.
- Specifically, a bank may employ a Retail Standard approach for corporate purchased receivables that satisfy certain requirements.
- Under the Retail Standard (also called the Top Down approach in Basel documents), banks may calculate PDs for homogeneous loan pools rather than by implementing a statistical default prediction model on a loan by loan basis.
- Also, a bank may estimate a pool PD or LGD by using one of these two quantities in conjunction with an estimate of a pool level losses.
- These are important relaxations in data and modelling requirements for receivables from non-financial originators for which data may not be recorded in ways that are standard in the banking industry.
- For example, loss data may be stored rather than default events and recoveries.
- It may also be somewhat more straightforward to calculate pool level PDs and LGDs rather than employing regression-style models to predict defaults and mean LGDs at a loan level.
- However, if conventional loan level securitisation pool data is available then the challenge of implementing loan-level regressions model is not major and so these concessions are not so material.

RISK CONTROL

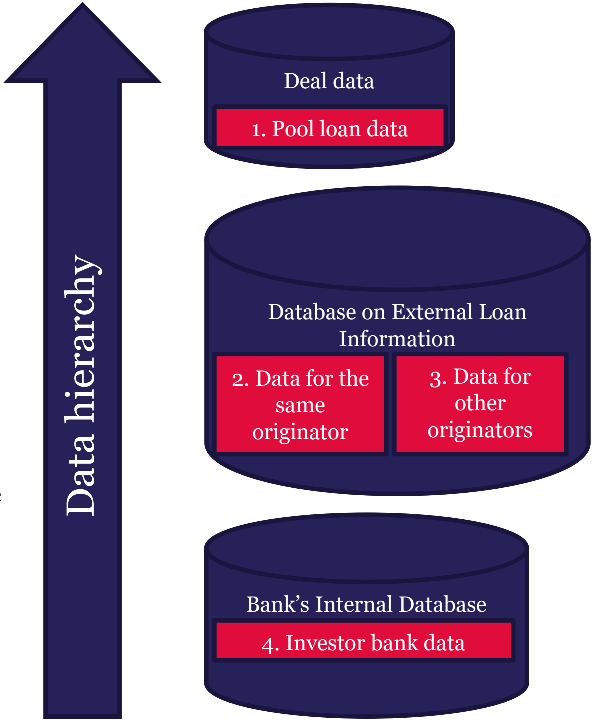
Inverted Data Hierarchy (1/2)

- Different IRB exercises, particularly those that rely on proxy data, require some combination of data. But the task of combining datasets becomes a central concern in the case of PuRA.
- The reason is that the usual data IRB hierarchy is inverted with the key data for calibration consisting of information about exposures closely related to the loan pool for which one seeks to estimate K_{IRB}.
- This means that instead of having a stable data source (such as a large volume of historical data on loans the bank has originated itself or some database provided by an external data vendor or data consortium), the modellers must use different datasets whenever they wish to calculate capital for a particular pool.
- Thus, a PuRA model should be seen as a set of methodologies and procedures that are applied in a dynamic way to multiple deals as they arise and reapplied as long as the bank maintains its exposure to the positions in question.
- Such an approach must be sufficiently flexible that it is practical to apply to multiple, somewhat heterogeneous deals as they are presented to the bank.
- Yet, it must be sufficiently precise in formulation that regulators can be confident that the investor bank is approaching its securitisation risk in an orderly and prudent manner.

RISK CONTROL

Inverted Data Hierarchy (2/2)

- The figure shows the data hierarchy that we envisage would actually apply for a bank implementing a PuRA model.
- At the bottom of the hierarchy is source 4 which consists of data on loans the bank has originated itself. Above that, we expect that the bank would access a 'stable' source of external securitisation pool data.
- This might take the form of loan level from the European Data Warehouse (ED).
- In some jurisdictions such as the UK, substantial volumes of data may be obtained from issuer websites.
- Also, data might be sought from other data providers like Intex.



- For this 'stable' external data, a distinction may be made between data from different originators (source 3) and data on loans issued by the originator of the deal in question (source 2).
- Lastly and at the top of the hierarchy is source 1 consisting of data directly relevant for the deal in question.
- If the loans are newly issued, performance data of the actual deal loans will not be available but the originator may possibly be able to supply data on closely comparable loans (which could be used in addition to the data from source 3).

Combining Data (1/3)

- Given multiple datasets, the issue arises how in practice may a bank combine the information they each yield?
- One possibility would be to pool data from multiple sources. If this is done without some weighting in the combination will place a somewhat arbitrary emphasis on the different data sources and the results of the weighting will be opaque.
- Potentially, models or forecasts may be combined using a formal statistical approach.
- Data is combined in some well-known area of risk management such as in the context of operational risk modelling.
- Typically, data from a small volume of internal loss observations is combined with a dataset obtained from a consortium of financial institutions.
- Comparable methods are required in a PuRA application.

RISK CONTROL

Combining Data (2/3)

Risk Control's response to the RTS consultation briefly set out a possible approach.

One useful way to combine information from different datasets is the method of "conflation" proposed by Hill (2011) and Hill and Miller (2011). This method combines data from independent sources by consolidating a finite number of probability distributions, $P_1, \ldots, P_n$ into a single probability distribution denoted: $\&(P_1, \ldots, P_n)$.

If the input distributions $P_1, \ldots, P_n$ have densities $f_1, \ldots, f_n$ respectively, then the conflation $\&(P_1, \ldots, P_n)$ is continuous with density given by:[7]

$$f(x) = \frac{f_1(x)f_2(x)\ldots f_n(x)}{\int_{-\infty}^{\infty} f_1(y)f_2(y)\ldots f_n(y)dy} \qquad (15)$$

If P_1 and P_2 are two independent normal distributions with means μ_1 and μ_2 and σ_1^2 and σ_2^2, then the conflation $\&(P_1, P_2)$ is also a normal distribution with mean μ and variance σ^2 given by

$$\mu = \frac{\frac{\mu_1}{\sigma_1^2}+\frac{\mu_2}{\sigma_2^2}}{\frac{1}{\sigma_1^2}+\frac{1}{\sigma_2^2}} = \frac{\sigma_1^2\mu_2+\sigma_2^2\mu_1}{\sigma_1^2+\sigma_2^2} \qquad (16)$$

$$\sigma^2 = \frac{1}{\frac{1}{\sigma_1^2}+\frac{1}{\sigma_2^2}} = \frac{\sigma_1^2\sigma_2^2}{\sigma_1^2+\sigma_2^2}. \qquad (17)$$

A number of papers use this method for combining datasets for a variety of applications. Touya, Coupé, Jollec, Dorie and Fuchs (2013) paper utilises conflation to combine geographic datasets. Principe et al. (2015) paper utilises the method of conflation for combining broadband thermal noise data.

In the case of PuRA, we can think of $P_i(X)_{i=1,\ldots,n}$ as estimates of PDs for a given mortgage conditioned on mortgage characteristics described by a vector of variables X. The P_i (here suppressing the argument X) have a distribution f_i reflecting sampling error and data quality issues. The may be biased estimates of the default probabilities of the pool loans in question in that they may be based on data for banks that apply different underwriting standards. To be prudent, a margin of conservatism (MoC) may also be employed.

Combining Data (3/3)

Applying this approach to PURA could also meet EBA 2017 guidelines requirements

In the case of PuRA, we can think of $P_i(X)_{i=1,\dots,n}$ as estimates of PDs for a given mortgage conditioned on mortgage characteristics described by a vector of variables X. The P_i (here suppressing the argument X) have a distribution f_i reflecting sampling error and data quality issues. The may be biased estimates of the default probabilities of the pool loans in question in that they may be based on data for banks that apply different underwriting standards. To be prudent, a margin of conservatism (MoC) may also be employed.

Following the conflation approach, we would obtain an adjusted estimate of mortgage PDs based on the expression:

$$\tilde{P}_i = [P_i + bias\ adjustment(P_i) + MoC(P_i)] \qquad (18)$$

Then, the final estimate might combine multiple PD estimates using the weighted average expression:

$$\sum_{i=1}^{N} \frac{\frac{1}{Variance(P_i)}\tilde{P}_i}{\sum_{j=1}^{N}\frac{1}{Variance(P_j)}}. \qquad (19)$$

Note that (18) includes a bias adjustment as well as a Margin of Conservatism (MoC). While the MoC as discussed in the EBA's 2017 Guidelines does includes some allowance for underwriting standards, we interpret what is referred to there as an allowance for fluctuations in underwriting standards not an adjustment for a bias. In the context of PuRA, allowing for underwriting standards constitutes a central part of the modelling activity and represents more than just making an allowance for an additional source of noise or model risk.

RISK CONTROL

Underwriting Standards (1/2)

- Article 5 of the EBA draft RTS indicates that banks should reflect in their modelling variation in underwriting standards.
- This is challenging as empirical analysis of the effects on credit quality of underlying standards is limited.
- Some academic studies have examined the issue (see O'Keefe, Olin and Richardson (2003), Black, Chu, Cohen and Nichols (2012), Dell'Ariccia and Marquez (2006), Asiedu, Freeman and Nti-Addae (2012), Demyanyk and Van Hemert (2009) and An, Deng, Rosenblatt and Yao (2011)).
- Official publications have focussed on underwriting standards. Financial Stability Board (2011) provides a thematic review of residential mortgage underwriting and origination practices. Subsequently, the FSB published a principles-based framework for sound underwriting practices. The Office of the Comptroller of the Currency (OCC) conducts annual surveys and assessments of credit underwriting standards and practices.
- None of these papers provides what is necessary for PuRA modelling, however, which is a systematic analysis of how loans with identical performances vary in credit performance across countries, banks and origination years.

RISK CONTROL

Underwriting Standards (2/2)

- Here, we sketch how, using the framework described in Section 3, we would go about analysing this issue.
- Given an extensive dataset of loan pool data, one may estimate scoring models by country, bank, deal and origination year.
- National markets are so different that it is sensible to estimate models country by country. Within any given country, one may then estimate models by originator.
- By including right hand side variables within a logit regression (for the PDs) or non-linear regression for the LGDs, one may allow for the fact that the composition of loans differs across banks and years.
- Differences in the average loan performance (in PD or LGD terms) for a given set of loans holding the right hand side variables constant, then reveals how much underwriting standards and macroeconomic conditions vary across banks.
- Variation across banks may be identified directly as an underwriting standard effect.
- Variation across time is more complex to interpret as it could reflect cyclical changes or changes in underwriting standards over time.
- Some judgment may be necessary to untangle these two influences.
- On the basis of the estimates and judgments, we would propose to develop bank and origination-year specific scaling factors for PDs.
- These would then be used to set the bias adjustments in equation (18).

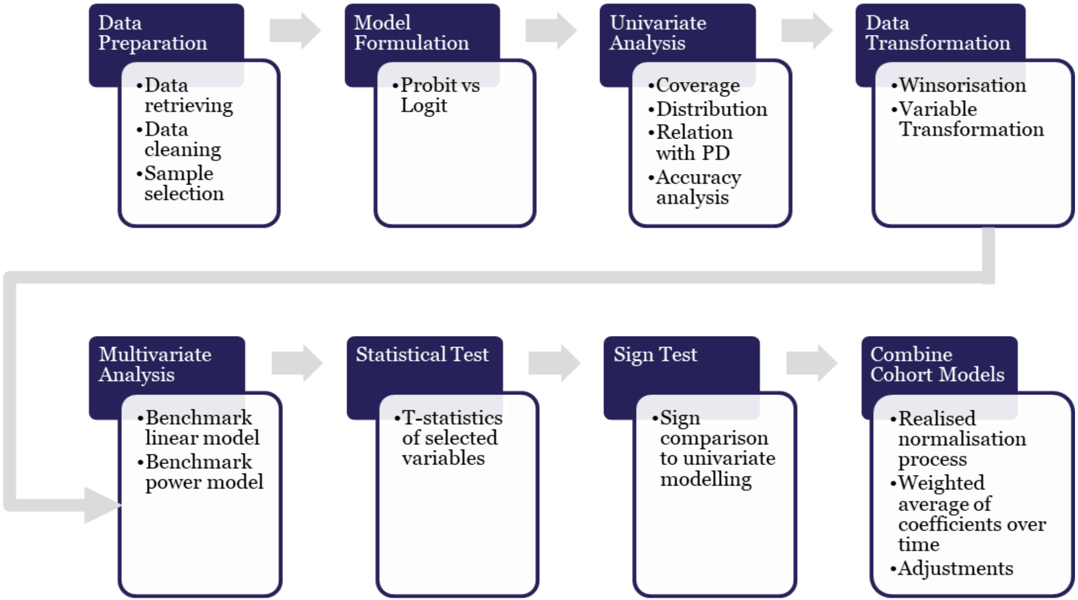
RISK CONTROL

Example Bottom Up Approaches

- It is most straightforward to meet the data standards in a bottom up approach so this may be preferable for bank originated exposures
- Here, we illustrate what would have to be done to implement such a model
- We estimate PDs and LGDs for mortgage loans using data from the European Data Warehouse.
- The exercise is instructive as it shows what a bank may have to do to satisfy the PuRA rules and what additional guidance from the EBA may be helpful to industry modellers.
- The methodology we follow in implementing the model is similar to many IRB models that we have observed in use in major banks.
- We have implemented this methodology in software that can be conveniently applied to large datasets of loan credit histories.

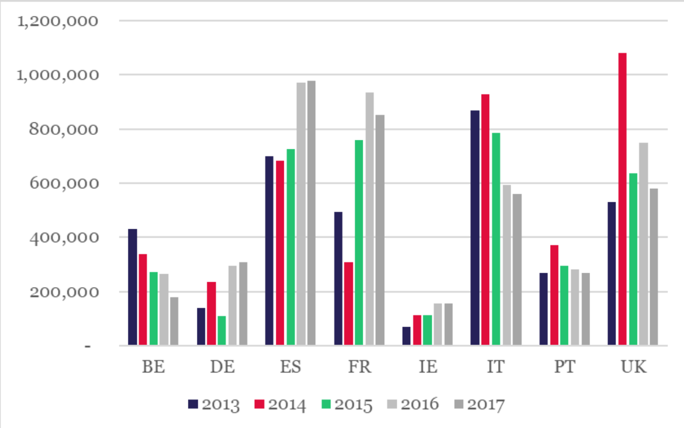
IRBA Modelling Steps

- Let us review the steps involved in a typical IRB modelling exercise in order to understand the challenges involved in doing so for large numbers of different datasets in a dynamic way (as is required by PuRA).
- The steps in our methodology are as follows.

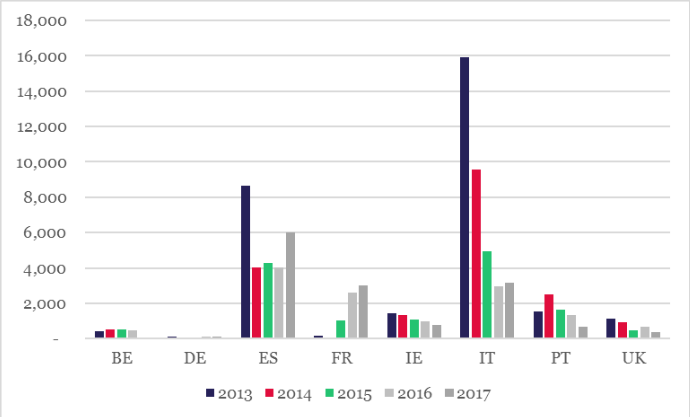


EDW Data Employed

- Number of performing loans at the beginning of each year



- Number of defaulted loans in each year



Examples Models

- We estimate models pooling data from each country

- PD model for BE

$$y = c - \beta_1 x_1^{\frac{1}{3}} - \beta_2 x_1^{\frac{1}{2}} - \beta_3 x_2$$
$$c = 6.32, \beta_1 = -5.47, \beta_2 = 2.77, \beta_3 = 0.03 \tag{7}$$

- PD model for DE

$$y = c - \beta_1 x_1 - \beta_2 x_2$$
$$c = 8.33, \beta_1 = -0.06, \beta_2 = 0.01 \tag{8}$$

- PD model for ES

$$y = c - \beta_1 x_1 - \beta_2 x_2$$
$$c = 7.4, \beta_1 = 0.09, \beta_2 = 0.04 \tag{9}$$

- PD mode for FR

$$y = c - \beta_1 x_1 - \beta_2 x_2$$
$$c = 8.21, \beta_1 = 0.39, \beta_2 = 0.03 \tag{10}$$

- PD model for IE

$$y = c - \beta_1 x_1^{-3} - \beta_2 \log(x_1) - \beta_3 x_2$$
$$c = 3.44, \beta_1 = 0.03, \beta_2 = 0.03, \beta_3 = 0.004 \tag{11}$$

- PD mode for IT

$$y = c - \beta_1 x_1 - \beta_2 x_2$$
$$c = 7.14, \beta_1 = 0.25, \beta_2 = 0.03 \tag{12}$$

PD Estimates by Country

- We calculate PD estimates for a set of countries using this methodology.

	BE	DE	ES	FR	IE	IT	PT	UK
BE	100	98	65	9	87	34	73	89
DE	98	100	70	15	89	40	78	93
ES	65	70	100	77	92	92	99	90
FR	9	15	77	100	52	96	69	46
IE	87	89	92	52	100	72	96	98
IT	34	40	92	96	72	100	86	67
PT	73	78	99	69	96	86	100	94
UK	89	93	90	46	98	67	94	100
Mean PDs	0.13%	0.06%	1.94%	0.46%	0.49%	1.56%	1.69%	0.27%

Results by Bank (for Spain)

	ES	Bancaja	Caja Madrid	Banco de Valencia	Caja Rural de Granada, S.C.C.	BBVA	ES-deal
LTV Ratio	0.04	0.04	0.05	0.05	0.05	0.03	0.001
Debt to Income Ratio	0.08	0.07	0.16	0.07	0.03	0.02	-0.11
Smoothed Odds Ratio of Loan Origination Year	0.49	1	1.17	0.8	0.71	1.47	0.83
Constant	7.58	7.69	11	7.48	6.55	8.09	6.97

	ES	Bancaja	Caja Madrid	Banco de Valencia	Caja Rural de Granada, S.C.C.	BBVA	ES-deal
ES	100	66	90	84	88	83	35
Bancaja	66	100	74	58	84	54	67
Caja Madrid	90	74	100	85	94	90	41
Banco de Valencia	84	58	85	100	78	74	14
Caja Rural de Granada, S.C.C.	88	84	94	78	100	87	54
BBVA	83	54	90	74	87	100	36
ES-deal	35	67	41	14	54	36	100
Mean PDs	1.67%	2.05%	0.23%	2.79%	6.97%	1.75%	0.26%

- Model parameters by bank
- PD estimates by bank

Top down modelling

- Top down approaches will often be necessary for certain pools, in particular non-bank receivables because exposure level data may not be available and data may be recorded as arrears rates and loss rates
- The general messages of earlier sections will still apply:
    1. The data hierarchy is inverted
    2. Combining data sources is a central issue
    3. Allowing for underwriting standards is key
- In this case, the major challenge is to infer PDs from time series of numbers of loans/receivables in different arrears buckets
- Basel requires that PDs be estimated by tracking a set of loans that are not in default at a given moment and check whether they have been more than in arrears for a period of more than 90 days (or otherwise have been categorised as in default) within the following year
- LGDs estimates should be based on the same loans employed in the PD estimation

RISK CONTROL

Unscrambling Arrears Data (1/2)

- Here, we set out techniques for inferring PDs from time series observations of the number of loans in different arrears buckets
- The approach uses transition matrices to unscramble the dynamics of movements between the different arrears buckets.
- From the figure below, one may observe that loans in a particular arrears category (i.e., some range of days overdue) either "cure" in that they become performing or "roll" in that they move into the next category or bucket of arrears (corresponding to a longer period overdue).
- Loans in the 90-180 days past due bucket may remain in this bucket (since the bucket exceeds a single month). The >180 days overdue bucket is assumed to be absorbing.

RISK CONTROL

Unscrambling Arrears Data (2/2)

Days past due	Performing	0-30 days	30-60 days	60-90 days	90-180 days	> 180 days
Performing	c1	1-c1	0	0	0	0
0-30 days	c2	0	1-c2	0	0	0
30-60 days	c3	0	0	1-c3	0	0
60-90 days	c4	0	0	0	1-c4	0
90-180 days	c5	0	0	0	1-c5-r5	r5
> 180 days	0	0	0	0	0	1

- The figure shows the rates at which NPLs move between the 6 categories corresponding to "performing" and non-performing for different numbers of days.
- The parameters c1 to c5 represent cure rates, i.e., the rates at which NPLs become Performing Loans in the next monthly period.
- The roll rates denoted 1-c1, 1-c2, 1-c3, 1-c4 and r5 represent the rates at which NPLs migrate over a month to the next range of days overdue.
- Loans in the 90-180 days past due bucket may remain in this bucket (since the bucket exceeds a single month). The >180 days overdue bucket is assumed to be absorbing.
- One may fit the transition matrix using aggregate data at some frequency (monthly or quarterly) for individual pools or originator datasets.
- To do this, the vector of loan values in each bucket for one quarter is multiplied on the right by the third power of the transition matrix shown in the figure, to forecast the arrears breakdown for the next quarter.
- For each quarter, this forecast is compared to the actual value, and values of c1, c2, c3, c4, c5 and r5 are chosen to minimize the sum of the squared residuals.

RISK CONTROL

Questions 4: What Additional Clarifications in the RTS Are Needed?

1. Consider your general attitude to what the EBA is trying to achieve. Do you believe that there should be concessions in IRBA standards so that calculating K_{IRB} to serve as an input to the SEC-IRBA is more straightforward? (In this context, be aware that US regulators have authorised US banks to develop elaborate frameworks for estimating K_{IRB} for SEC-IRBA purposes.)

2. The options for relaxation of the standards include the use of top-down modelling as ratings agencies typically do for measuring movements between different arrears buckets. It is hard to achieve strict adherence to Basel standards in this because the data consists of fractions of pools in different buckets rather than loan level information about loans that are performing and then data on whether they have been more than 90 days overdue within the following year. Should clarification on top-down modelling be provided?

3. The EBA's emphasis on making allowance for the underwriting standards of the loan originator appears reasonable but raises the bar for modelling. But is it sensible if the objective is to encourage use of the SEC-IRBA?

4. Does it matter if the EBA does not fully clarify what European banks must do to access the SEC-IRBA? Might it be better to allow practices to emerge as banks and supervisors become familiar with their use in practice?

RISK CONTROL

Clarifications Suggested by Risk Control

- We recognise that, by their nature, RTS are concise statements of regulatory requirements placed on banks implementing regulatory approaches and do not constitute guidelines
- Nevertheless, we believe that the RTS should more directly reflect the key modelling challenges raised by
  1. the inverted hierarchy,
  2. the need to allow for originator standards, sampling error and data quality limitations
  3. the fact that PURA will be applied both to bank and non-bank securitisation pools for which very different data is likely to be available
- On 1, the RTS should clearly state that a PURA model is a scoring methodology
  - that is applicable in a dynamic way to individual deal pools
  - that may appropriately combine data from different sources
  - that may involve a new estimation for individual deals
- On 2, the RTS should state that these may be addressed through a combination of data-driven exercises and prudent judgment
- On 3, the RTS should clarify that models based on loan level information and aggregate arrears data are acceptable with appropriate margins of conservatism

RISK CONTROL

CRR Requirements on IRBA PD Modelling (1/2)

Category	Article	Text
Default definition	178(1)(b)	"the obligor is past due more than 90 days on any material credit obligation to the institution, the parent undertaking or any of its subsidiaries. Competent authorities may replace the 90 days with 180 days for exposures secured by residential property or SME commercial immovable property in the retail exposure class, as well as exposures to public sector entities…"
	178(4)	"Institutions that use external data that is not itself consistent with the definition of default laid down in paragraph 1, shall make appropriate adjustments to achieve broad equivalence with the definition of default."
Length of data	180(1)(h)	"the length of the underlying historical observation period used shall be at least five years for at least one source…. institutions which have not received the permission … to use own estimates of LGDs or conversion factors may use, when they implement the IRB Approach, relevant data covering a period of two years…"
	180(2)(e)	"irrespective of whether an institution is using external, internal or pooled data sources or a combination of the three, for their estimation of loss characteristics, the length of the underlying historical observation period used shall be at least five years for at least one source…. Subject to the permission of the competent authorities, institutions may use, when they implement the IRB Approach, relevant data covering a period of two years. The period to be covered shall increase by one year each year until relevant data cover a period of five years"

CRR Requirements on IRBA PD Modelling (2/2)

Representativeness	174(c)	"the data used to build the model shall be representative of the population of the institution's actual obligors or exposures"
	179(2)(b)	"the pool is representative of the portfolio for which the pooled data is used"
Comprehensiveness	179(1)(a)	"an institution's own estimates of the risk parameters PD, LGD, conversion factor and EL shall incorporate all relevant data, information and methods…"
	180	"For purchased retail receivables, institutions may use external and internal reference data. Institutions shall use all relevant data sources as points of comparison."
Benchmarking	185(c)	"institutions shall also use other quantitative validation tools and comparisons with relevant external data sources…"
Maintenance	176(2)	"For exposures to corporates, institutions and central governments and central banks, and for equity exposures …. institutions shall collect and store: (a) complete rating histories on obligors and recognised guarantors … (g) data on the PDs and realised default rates associated with rating grades and ratings migration."

RISK CONTROL

CRR Requirements on IRBA LGD Modelling (1/2)

Category	Article	Text
Default definition	178(1)(b)	"the obligor is past due more than 90 days on any material credit obligation to the institution, the parent undertaking or any of its subsidiaries. Competent authorities may replace the 90 days with 180 days for exposures secured by residential property or SME commercial immovable property in the retail exposure class, as well as exposures to public sector entities…"
	178(4)	"Institutions that use external data that is not itself consistent with the definition of default … shall make appropriate adjustments to achieve broad equivalence with the definition of default."
Length of data	181(1)(j)	"for exposures to corporates, institutions and central governments and central banks, estimates of LGD shall be based on data over a minimum of five years, increasing by one year each year after implementation until a minimum of seven years is reached, for at least one data source…"
	181	"For retail exposures, estimates of LGD shall be based on data over a minimum of five years…. Subject to the permission of the competent authorities, institutions may use, when they implement the IRB Approach, relevant data covering a period of two years. The period to be covered shall increase by one year each year until relevant data cover a period of five years."

RISK CONTROL

CRR Requirements on IRBA LGD Modelling (2/2)

Representativeness	174(c)	"the data used to build the model shall be representative of the population of the institution's actual obligors or exposures"
	179(2)(b)	"the pool is representative of the portfolio for which the pooled data is used"
Comprehensiveness	179(1)(a)	"an institution's own estimates of the risk parameters PD, LGD, conversion factor and EL shall incorporate all relevant data, information and methods…."
	181(1)(a)	"institutions shall estimate LGDs by facility grade or pool on the basis of the average realised LGDs by facility grade or pool using all observed defaults within the data sources (default weighted average)"
	181(2)(c)	"For purchased retail receivables use external and internal reference data to estimate LGDs…"
Benchmarking	185(c)	"institutions shall also use other quantitative validation tools and comparisons with relevant external data sources…"
Maintenance	176(4)(g)	"Institutions using own estimates of LGDs and conversion factors shall collect and store…data on the components of loss for each defaulted exposure."
	176(5)(c)	"For retail exposures, institutions shall collect and store…. the identity of obligors and exposures that defaulted"

RISK CONTROL

Agenda

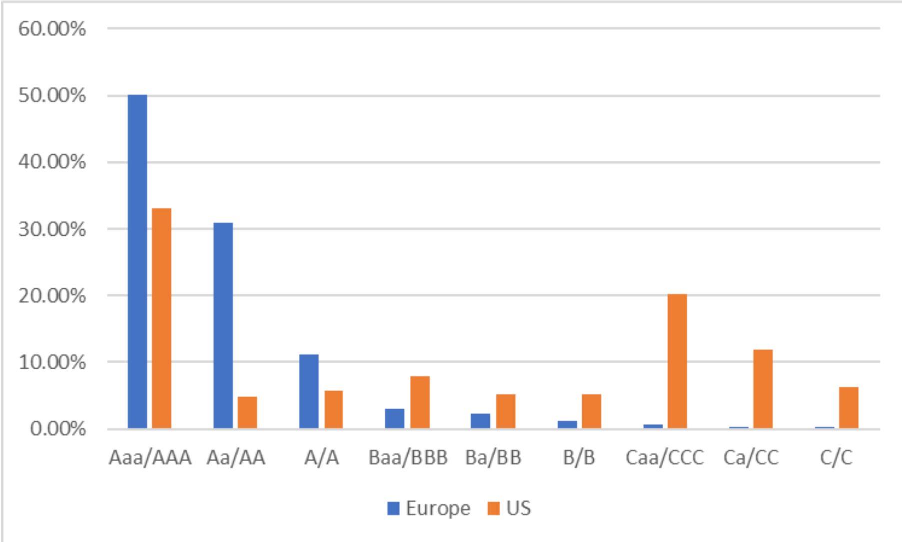
RISK CONTROL

Outstandings by Moody's Investors Service Ratings

	Europe	US
Aaa/AAA	50.16%	33.07%
Aa/AA	30.94%	4.75%
A/A	11.11%	5.66%
Baa/BBB	2.99%	7.87%
Ba/BB	2.28%	5.26%
B/B	1.24%	5.16%
Caa/CCC	0.69%	20.20%
Ca/CC	0.33%	11.79%
C/C	0.25%	6.25%
Total	100.00%	100.00%

Outstandings by Moody's Investors Service Ratings: Q3 2018 (as a percentage of total Moody's rated securitisations)

Source: Macquarie, Moody's Investors Service, S&P Global Ratings



- A large fraction of the rated universe of US securitisations remains in distress (38% are CCC or below).
- European securitisations include a higher fraction in AAA and particularly AA rating than US.

RISK CONTROL

Upgrades/Downgrades by Country

DBRS

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
France	10/2	13/0	20/0
Germany	24/0	18/0	25/0
Italy	52/10	52/8	66/8
Netherlands	10/0	1/0	2/4
Spain	54/0	24/5	29/5
UK	3/22	0/1	19/4
Multinational	25/0	12/14	19/14
European Total	178/34	120/28	180/35
US	1286/47	1449/330	1801/354

Fitch Ratings

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
France	11/10	8/3	16/7
Germany	5/7	12/24	19/33
Italy	45/4	39/132	42/132
Netherlands	54/6	14/46	30/47
Spain	238/13	90/29	105/34
UK	130/21	254/29	314/54
Multinational	4/0	8/0	8/0
European Total	550/196	447/314	572/359
US	2504/1053	1535/1600	3124/2242

Moody's Investors Service

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
France	1/0	5/0	9/0
Germany	8/1	12/2	19/2
Italy	5/0	24/0	33/0
Netherlands	7/3	10/1	11/2
Spain	158/2	69/4	99/7
UK	31/16	138/17	264/31
Multinational	35/2	121/6	181/7
European Total	274/27	442/8	903/8
US	1446/284	2000/82	2694/82

S&P Global Ratings

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
France	1/0	2/0	2/0
Germany	7/0	14/8	16/9
Italy	11/1	14/5	105/8
Netherlands	6/6	25/7	28/7
Spain	207/8	74/10	79/12
UK	104/12	127/32	333/33
Multinational	36/24	172/53	181/61
European Total	372/51	428/115	744/130
US	2146/1708	1090/982	1426/1217

Source: DBRS, Fitch Ratings, Moody's Investors Service, S&P Global Ratings

- Ratings agencies have recently tended to upgrade securitisation ratings.
- Moody's has been particularly bullish.
- S&P has revised up European ratings more than US ratings.
- Agencies have taken different approaches to individual European markets in some cases.
- For example, Fitch was pessimistic about Italy in 2017 and DBRS was negative about the UK in 2018.

RISK CONTROL

Europe Upgrades/Downgrades by Collateral

DBRS

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	25/26	26/0	38/0
CDO	17/4	23/13	33/13
CMBS	18/1	0/6	0/10
Credit Card	22/2	21/2	31/2
RMBS (prime)	51/1	41/6	65/9
RMBS (non-prime)	6/0	4/1	7/1
Other ABS	38/0	5/0	6/0
Total	177/34	120/28	180/35

Fitch Ratings*

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	19/3	16/7	25/7
Credit Card	3/0	3/0	13/0
Other ABS	51/128	26/67	35/70
CDO	79/6	82/37	130/38
CMBS	7/10	22/39	22/53
RMBS (prime)	301/25	99/149	140/157
RMBS (non-prime)	68/4	185/6	191/25
Other RMBS	22/0	14/9	16/9
Total	550/196	447/314	572/359

*The European totals may not match the constituent parts as a small number of European RMBS transactions are not categorised as either Prime or Nonconforming.

Moody's Investors Service

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	18/2	11/6	20/14
CDO	18/0	121/4	251/5
CMBS	1/1	2/23	7/38
Credit Card	0/0	2/0	4/0
RMBS (prime)	197/6	162/15	295/65
RMBS (non-prime)	40/4	144/5	326/11
Total	274/27	442/53	903/133

S&P Global Ratings

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	16/0	11/0	12/0
CDO	40/14	198/39	218/47
CMBS	9/23	9/56	14/58
Credit Card	0/0	0/0	0/0
RMBS (prime)	214/9	112/16	204/21
RMBS (subprime/non-conforming)	93/5	98/4	296/4
Total	372/51	428/115	744/130

Source: DBRS, Fitch Ratings, Moody's Investors Service, S&P Global Ratings

US Upgrades/Downgrades by Collateral

DBRS

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	190/1	141/0	161/0
CDO	30/0	24/28	33/43
CMBS	49/23	115/281	160/284
Credit Card	30/0	10/0	10/0
RMBS	873/22	1085/15	1350/21
Other ABS	114/1	74/6	87/6
Total	1286/47	1449/330	1801/354

Fitch Ratings

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	91/0	71/0	105/0
Credit Card	0/0	11/0	11/0
Other ABS	39/34	125/88	170/119
CDO	110/43	139/22	149/24
CMBS	177/143	174/173	204/209
RMBS (prime)	245/384	206/718	221/771
RMBS (subprime)	559/149	28/262	1129/662
Other RMBS	1283/300	781/337	1135/457
Total	2504/1053	1535/1600	3124/2242

Moody's Investors Service

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	117/0	164/0	318/0
CDO	48/20	258/12	426/22
CMBS	101/38	228/115	393/232
Credit Card	0/0	0/0	0/0
RMBS	1180/226	1246/91	2221/203
Total	1446/284	1896/218	3358/457

Source: DBRS, Fitch Ratings, Moody's Investors Service, S&P Global Ratings

S&P Global Ratings

	2018 (Q1 to Q3)	2017 (Q1 to Q3)	2017 (Q1 to Q4)
Auto	229/1	245/0	319/0
CDO	57/20	218/27	252/37
CMBS	103/82	267/116	328/153
Credit Card	17/0	0/0	12/0
RMBS (prime)	634/428	186/591	229/691
RMBS (subprime/non-conforming)	1106/1177	174/248	286/336
Total	2146/1708	1090/982	1426/1217

Questions 5a

1. Which securitisation market appears the heathier post crisis?

2. Do you see any evidence of lower reliance on ratings in some market versus others?

3. Do the ratings agency judgments evident in recent downgrades and upgrades correspond to what you would have thought based on your knowledge of economic developments in different sectors and countries?

Role of Rating Agencies

- Here we consider the role that agency ratings have played in the securitisation market particularly in a regulatory context.

- Key points we wish to emphasise are:

  1. Extreme procyclicality of ratings and sovereign ceilings have created chaos for bank capital management since the crisis
  2. Regulatory developments immediately following the crisis reinforced the role of agency ratings in securitisation capital contrary to prominent policy statements made by European regulators
  3. Subsequently, the European regulators backed away from this, actually deviating from Basel in the hierarchy of securitisation capital approaches

Policy Objectives (1/2)

1. G20 meeting in Toronto in June 2010 which stated:

   "*We committed to reduce reliance on external ratings in rules and regulations. We acknowledged the work underway at the BCBS to address adverse incentives arising from the use of external ratings in the regulatory capital framework, and at the FSB to develop general principles to reduce authorities' and financial institutions' reliance on external ratings.* [..]" (Appendix II, Paragraph 27)

2. The Dodd-Frank act in the US states (section 931(5)) that inaccurate credit ratings on structured financial products "*contributed significantly to the mismanagement of risks by financial institutions and investors, which in turn adversely impacted the health of the economy in the United States and around the world.*"

3. Dodd-Frank requires US regulatory agencies to remove dependence on external ratings from their rules and regulations

4. European regulators have adopted the objective of reducing reliance on external ratings in financial regulation substantially within Europe

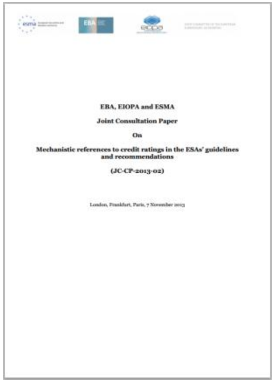
G20 TORONTO
CANADA 2010


DODD-FRANK WALL STREET REFORM AND CONSUMER PROTECTION ACT

Sortable Table Key	Moody's	Fitch	S&P
Highest grade credit	Aaa	AAA	AAA
Very high grade credit	Aa1, Aa2, Aa3	AA+, AA, AA-	AA+, AA, AA-
High grade credit	A1, A2, A3	A+, A, A-	A+, A, A-
Good credit grade	Baa1, Baa2, Baa3, Baa4	BBB+, BBB, BBB-	BBB+, BBB, BBB-
Speculative grade credit	Ba1, Ba2, Ba3	BB+, BB, BB-	BB+, BB, BB-
Very speculative credit	B1, B2, B3	B+, B, B-	B+, B, B-
Substantial risks - In default	Caa1, Caa2, Caa3, Ca	CCC, CC, C, RD, D	CCC+, CCC, CCC-, CC, C, D

Policy Objectives (2/2)

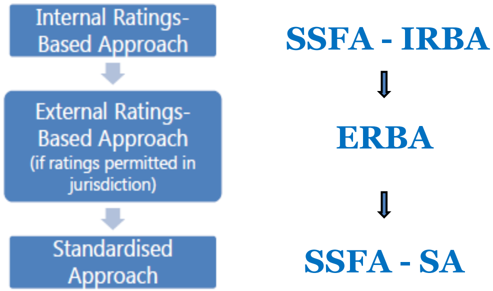
- In May 2013 the European Parliament and Council adopted regulation on credit rating agencies which included reduction of reliance on credit ratings as a stated aim
- Article 6 of the May regulation states: "*The Union is working towards reviewing, at a first stage, whether any references to credit ratings in Union law trigger or have the potential to trigger sole or mechanistic reliance on such credit ratings and, at a second stage, all references to credit ratings for regulatory purposes with a view to deleting them by 2020, provided that appropriate alternatives to credit risk assessment are identified and implemented.*"
- In February 2014, the Joint Committee of the European Supervisory Authorities (EBA, ESMA and EIOPA - ESAs) published on "Mechanistic references to credit ratings" which said:
  a) "Further work is needed however, especially in the international context (most notably, the Basel Committee Task Force on the Standardised Approach) to find alternatives for the mapping to external ratings in the standardised approach and the mapping for securitisation exposures
  b) EBA, ESMA and EIOPA will take into account the reliance on external ratings when developing the ITS on ECAIs mapping required by Regulation (EU) No 575/201313"



Current Proposals Reinforce Dependence on Ratings

- BCBS 269 in December 2014 streamlined the securitisation framework to a single hierarchy based on three approaches(*):
  1. The proposals encouraged banks investing in third party securitisation to use the SEC IRBA whenever possible, provided they had internal modelling approval;
  2. This was followed by the SEC ERBA Most European banks investing in third party securitisation will have to use the SEC ERBA
  3. This creates a regional bias as US banks are not allowed to use external ratings for regulatory purposes and will use the SEC IRBA or SEC SA.

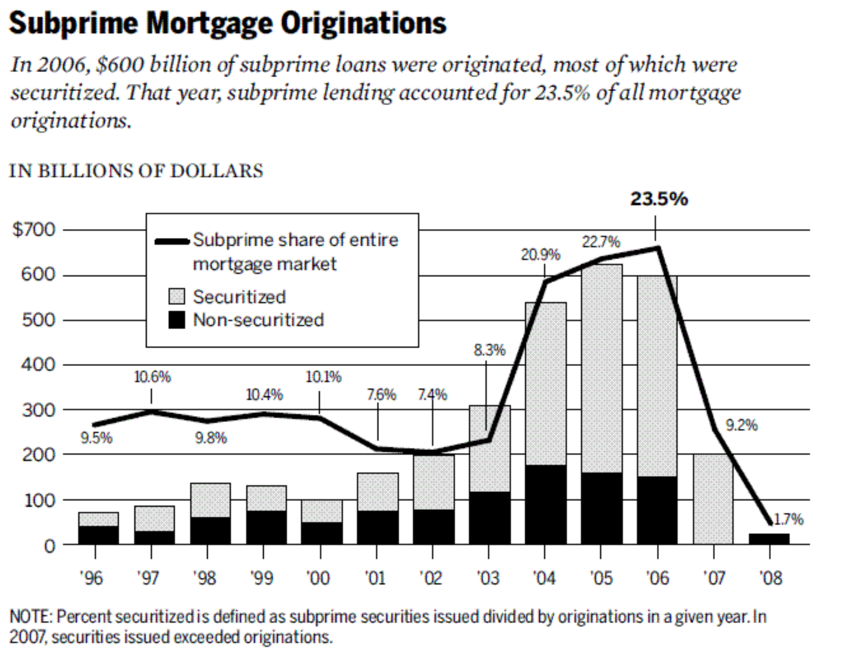
(*) The Internal Assessment Approach (IAA) has been retained for unrated ABCP exposures, subject to regulators' approval



- The pattern of extending reliance on ratings was evident in other aspects of financial regulation in Europe:
  1. Liquidity Coverage Ratio (LCR) criteria includes ratings criteria.
  2. Proposals for Solvency II Category A securitisations include ratings criteria (even if relatively undemanding)
  3. Proposals for Money Market Fund regulations

Criticisms of Agency Ratings for Securitisation (1/3)

- The background to the G20 resolution and the consequent change in the direction of US and European regulation is the major debate on why ratings agencies failed to foresee the crisis in sub-prime mortgage lending
- A common view is that the agencies contributed to the crisis by providing over-optimistic credit assessments of securitisations used to finance sub-prime lending
- Much of the academic analysis has focused on the incentives ratings agencies faced to offer over-optimistic credit assessments
- Ratings agencies switched in the 1970s from a business model in which ratings were paid for by investor subscriptions to one in which issuers paid to secure a rating



RISK CONTROL

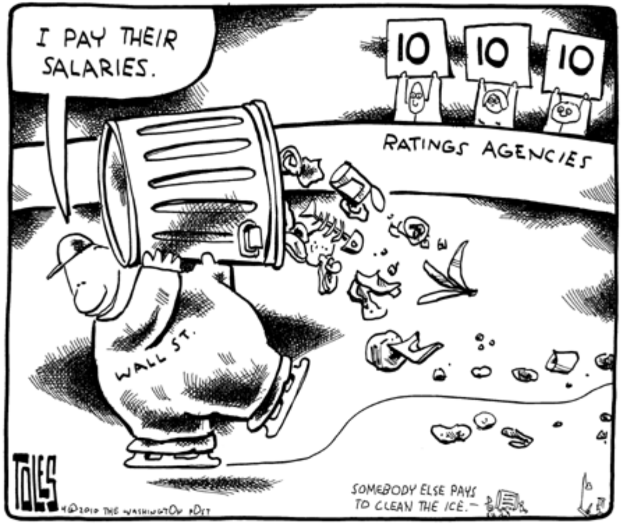
Criticisms of Agency Ratings for Securitisation (2/3)

- Partnoy (2009) argues that the progressively wider use of ratings for regulatory purposes allowed a small group of ratings agencies to share a quasi-monopoly rent from providing regulatory "dispensations" and that this diverted them from their traditional role of providing expert opinions on credit
- As the main rationale of ratings shifted from credit evaluations (aimed at investors) to regulatory dispensations (aimed at regulated issuers and regulated investors), the incentives for agencies to focus narrowly on accurately assessing credit quality diminished
- Kisgen and Stahan (2010) provide empirical support for this view, demonstrating that the gain to issuers in obtaining a higher rating was a significant lowering of the spread
- Bolton, Shapiro and Freixas (2012) and Mathis, McAndrews and Rochet (2009) analyse the incentives of agencies to attract business by over-stating credit quality
- He, Qian, and Strahan (2011) present empirical evidence consistent with this point

Criticisms of Agency Ratings for Securitisations (3/3)

The incentive for agencies to rate generously was probably more intense in the field of structured product ratings than in traditional corporate ratings

- Securitisation ratings were a rapidly expanding and highly lucrative business in the run up to the crisis, in which the agencies were scrambling to gain market share
- Fitch was a more credible challenger to the two established ratings agencies in securitisation ratings than it was in the more stable area of corporate ratings and so competitive pressures were greater
- This may have diluted rating agency incentives to rate securitisations cautiously, especially in the largest securitisation market based on US residential mortgages



RISK CONTROL

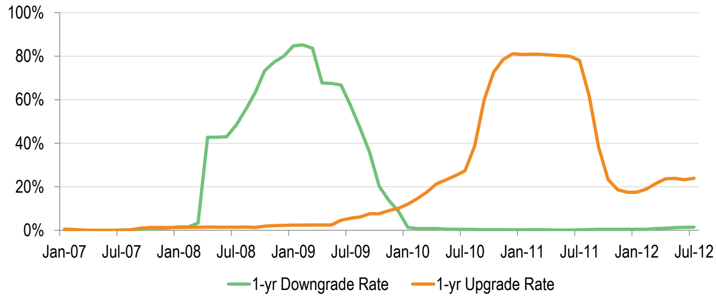
Our Critique of Agency Ratings

1. We focus more here on a critique of agencies since the crisis.
2. Struggling to restore their reputation, agencies have adopted sudden and drastic changes in methodology that have imparted an extreme form of procyclicality to securitisation ratings
3. Absent changes in methodology, the operation of caps and triggers included by agencies in their ratings evaluations to allow for transfer, convertibility and counterparty risk have had undesirable consequences particularly for banks located in unfavoured countries.
4. This caused major problems for securitisation markets in European periphery countries that suffered sovereign downgrades
5. The agencies' practices in reviewing securitisation ratings (with intermittent and unsystematic surveillance) are not compatible with the frequency of capital calculations
6. The complexity and lack of transparency in structured product ratings, uncertainty about the agencies' future ratings policies, inconsistency between rating agencies' and regulators' evaluations of risk hampered the recovery of the market

Focus on Methodology Changes

- Ratings agencies made wholesale changes in ratings post the crisis by adopting changes in methodology
- These seem, in some cases, to have been managerial decisions rather than the result of new information
- An example is the stresses that Moody's adopted for CLOs in 2009
- These resulted in a wave of downgrades
- The agency withdrew the stress in 2011 with no fanfare or explanation
- The consequence was a wave of upgrades

Moody's 1-yr downgrade and upgrade rates on global CLOs

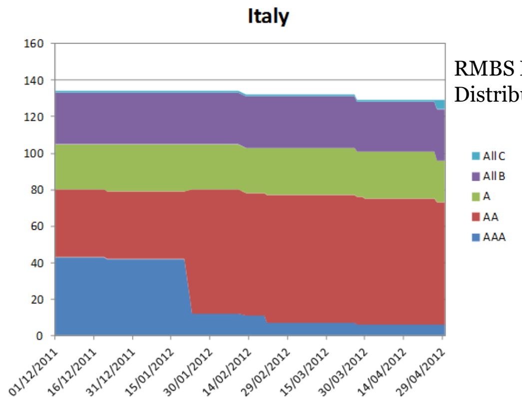


Source: BNP Paribas and Moody's.

- The point here is not that ratings agencies should refrain from employing new data or the best and latest techniques for forecasting credit market outcomes
- It is more that apparently arbitrary reactions to a crisis situation by ratings agencies may produce very substantial fluctuations in bank capital with little transparency as to the evidence that justifies such discrete (and, as it turned out, contrary) reactions

Focus on Sovereign Ceilings

- Sovereign ratings ceilings for European securitisation tranches generated wide-spread downgrades in entire country-specific sub-sections of the securitisation market in recent years
- The policies followed by ratings agencies in imposing sovereign ceilings on securitisation ratings are complex and apparently arbitrary
- Fitch imposes an absolute rule that the rating of a securitisation tranche cannot be more than 4 notches above the rating of the corresponding sovereign
- Moody's methodology is less clear cut in that the maximum gap between sovereign and structured product ratings is more variable
- It is not clear from rating agency documentation exactly how reduced credit standing of a sovereign affects the rating of securitisations within the corresponding jurisdiction



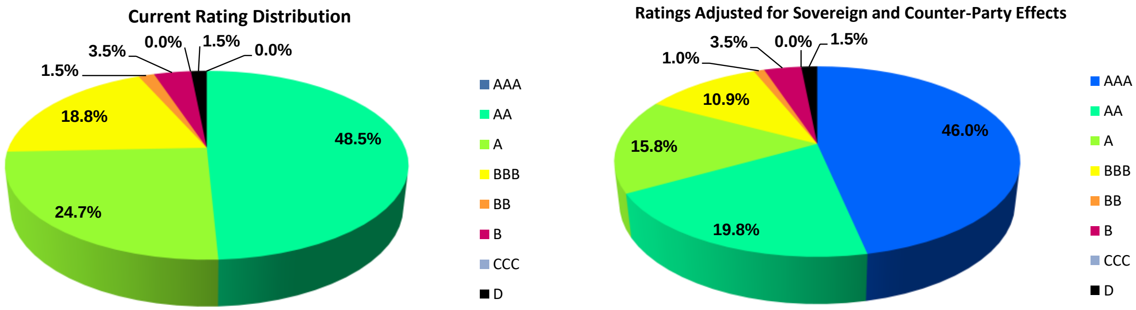
RMBS Ratings Distributions

- The link may reflect considerations of convertibility, reduced chances of a bailout or general macroeconomic correlations between sovereign default and pool performance
- Convertibility is much less relevant for a local bank investing in local securitisations
- Reduced chances of a bailout does not appear a relevant factor for regulatory capital. Should general correlation between sovereign default and pool performance justifies a hard link like a sovereign ceiling?

Focus on Transparency

- The fact that ratings (and hence capital) changes occur both because of alterations in credit quality and other issues such as sovereign ceilings and methodology changes serves to reduce transparency
- Apart from US RMBS, most securitisations downgrades in recent years have occurred for reasons other than collateral performance, such as counterparty criteria, methodology changes, and sovereign linkage
- When ratings criteria become so variable that they predominate in the reasons for ratings actions, the very meaning of a rating - i.e. the risk it purports to signify – becomes unclear

Q3 2013 Italian RMBS Ratings



RISK CONTROL

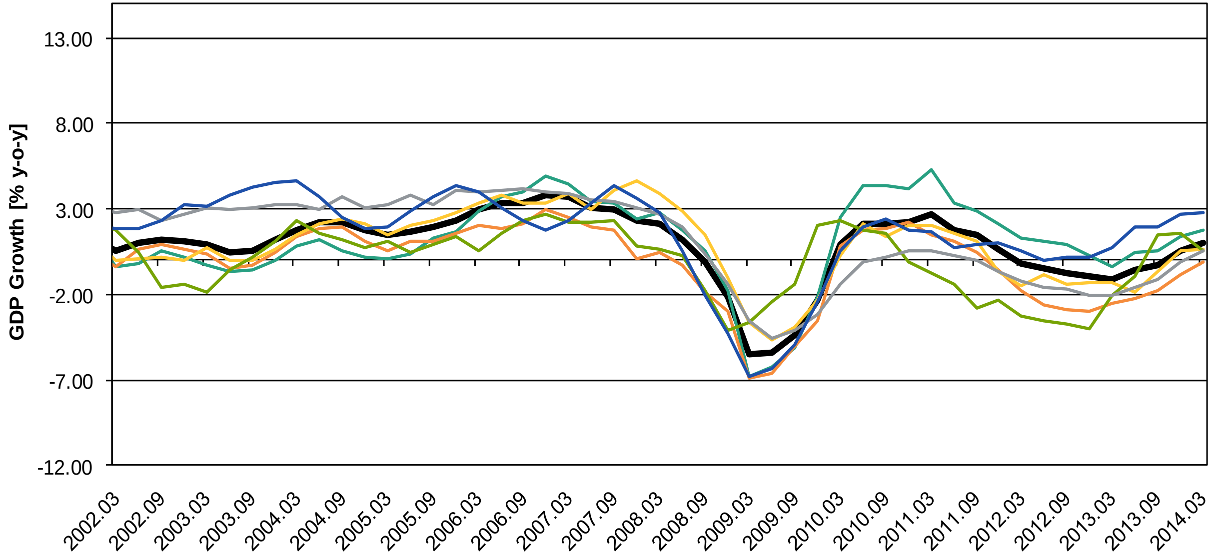
Regulator/Agency Risk Rankings

- The relative risk measure from ratings agencies is sometimes not compatible with the risk measure of policy makers and regulators
  - For example, a portfolio of SME exposures has a risk weight of 75% compared to 100% for a portfolio of BBB/BB large corporate exposures. In theory, if external ratings and regulatory risk measures were compatible, a securitised portfolio of SME should thus require less capital than a securitised portfolio of BBB/BB large corporate exposures. If this is not so, as in the case of SME, then there is a clear anti-SME bias in the risk assessment done by ratings agencies
  - In Standard & Poor's (2013b), the SME CLO "*criteria uses the concept of an archetypical European SME pool for which [S&P] have assigned an average credit quality assessment of 'b+' as the starting point for obligor default analysis when assigning 'AAA' ratings. The archetypical pool represents [S&P] view of the average characteristics typically featured by SME portfolios securitised in Europe.*"
  - In fact, actual default data on SME pools in Europe do not support this arbitrary assumption of B+ since defaults rate tend be much lower than implied by a B+ rating. Moreover this overall B+ assumption does not reflect the reality of historical defaults even during the crisis. Interestingly, B+, which is more appropriate for highly leveraged corporate loans, has a risk weight of 150%, twice the level that is required for SME, at a 75% risk weight
- With a B+ assumption by S&P (Moody's also considers European SMEs as a 'B1' quality), the tranching of a 75% risk-weighted SME pools will be much more capital intensive than the tranching of a 100% risk-weighted BBB/BB corporate portfolio. There is an inversion in the measure of risk

RISK CONTROL

Case Study: European SME ABS (1/2)

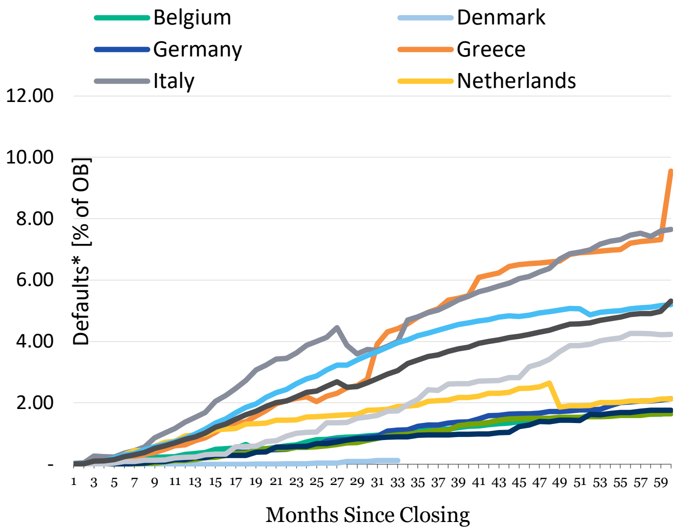
Despite a major recession in the periphery…



Source: Moody's Analytics (ECCA) Forecast; Deutsche Bundesbank; Central Statistics Office (CSO); Italian National Institute of Statistics (ISTAT); Statistics Netherlands; National Institute of Statistics (INE); U.K. Office for National Statistics (ONS)

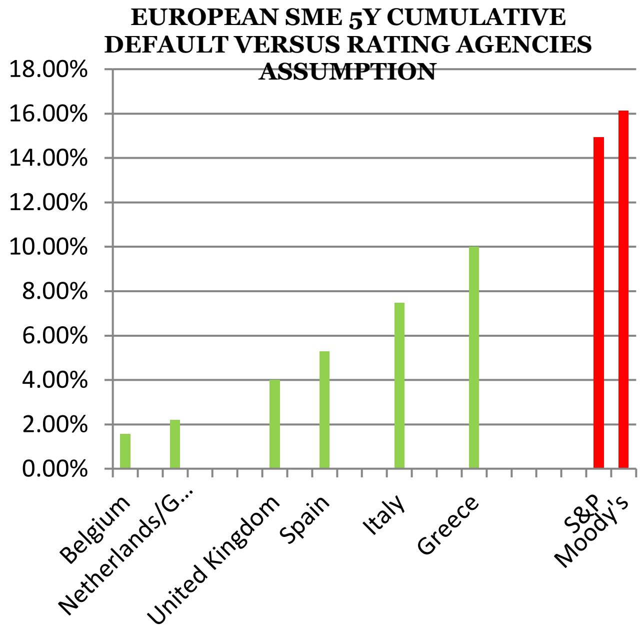
Case Study: European SME ABS (2/2)

…5Y cumulative default rate of European SMEs remains limited



Source: Moody's Investors Service, Moody's Performance Data Service,

Rating agencies are penalizing SME ABS by assuming too high default rates for their base case (before stress)



Methodology flaw by rating agencies when assigning ratings to SME securitisations → Ratings should not be used for capital or other regulations, especially so for SMEs

Reducing the Role of Ratings

- The issues linked to ratings (methodological changes, rating triggers, sovereign linkage, etc… mixed in an opaque manner with collateral performance) have, in recent years, created major problems for European banks
- Negative shocks to bank capital, particularly in periods of crisis, generate forced asset sales and a credit crunch affecting new lending. Unnecessary volatility in regulatory capital requirements is, therefore, costly and tends to undermine financial stability
- In the CRR implementation of the Basel III securitisation capital rules, the European authorities deviated from the hierarchy contained in the final BCBS 2017 document, BCBS d374 in that European banks that are unable to use the SEC-IRBA should now use the SEC-SA for all except (i) low rated STS tranches, (ii) a broader set of non-STS tranches, (iii) cases in which the bank has told the authorities it will systematically employ the SEC-ERBA before the SEC-SA, or (iv) complex deals for which the SEC-SA would not be appropriate.
- This deviation from Basel reflects the concerns described above.

CRR Text on the Hierarchy

Article 254

Hierarchy of methods

1. Institutions shall use one of the methods set out in Subsection 3 to calculate risk-weighted exposure amounts in accordance with the following hierarchy:

(a) where the conditions set out in Article 258 are met, an institution shall use the SEC-IRBA in accordance with Articles 259 and 260;

(b) where the SEC-IRBA may not be used, an institution shall use the SEC-SA in accordance with Articles 261 and 262;

(c) where the SEC-SA may not be used, an institution shall use the SEC-ERBA in accordance with Articles 263 and 264 for rated positions or positions in respect of which an inferred rating may be used.

2. For rated positions or positions in respect of which an inferred rating may be used, an institution shall use the SEC-ERBA instead of the SEC-SA in each of the following cases:

(a) where the application of the SEC-SA would result in a risk weight higher than 25 % for positions qualifying as positions in an STS securitisation;

(b) where the application of the SEC-SA would result in a risk weight higher than 25 % or the application of the SEC-ERBA would result in a risk weight higher than 75 % for positions not qualifying as positions in an STS securitisation;

(c) for securitisation transactions backed by pools of auto loans, auto leases and equipment leases.

More text…

Questions 5b

1. Would ratings not be the natural basis for capital in markets for which exposures are extremely heterogeneous in their degree of subordination and in the nature of underlying risks? Do you agree with the objective of reducing reliance on ratings?

2. How could ratings be made more consistent and reliable? For example, should there be ratings of securitisations that strip out the effects of sovereign/country? Are there other changes that could be made that would make ratings a better basis for regulatory use?

3. In the post-crisis regime, ratings agencies are regulated by the SEC and ESMA. In general, the approach consists of evaluating them against their own policies. Is this appropriate? Should the accuracy of their evaluations be a criterion that regulators apply in evaluating ratings agencies?

Agenda

1. Introduction to securitisation
2. Risk analysis and pricing of securitisations
3. Regulation of securitisations
4. Practical exercise 1: PURA RTS
5. Role of the ratings agencies
6. Liquidity of securitisations
7. Market drivers and motives for using securitizations
8. Practical exercise 2: Optimal Tranching

RISK CONTROL

Key aspects of LCR Implementation

- Understanding the liquidity of different asset classes is important for deciding appropriate rules on bank liquidity
- Regulators have recently faced important decisions about the Liquidity Coverage Ratio
- Under LCR rules, banks must hold High Quality Liquid Assets (HQLA) in excess of potential liability run-offs that might occur in a crisis.
- Two key aspects of the regulation are:
  – How are the run-offs defined? (not our focus here)
  – Which assets are eligible for inclusion as HQLA?
- Different vintages and regulatory interpretations of Basel proposals, have led to different proposed and implemented HQLA treatments.
- Generally, the Basel proposals:
  i. Break HQLA into Category 1 and 2 assets (Category 1 are extremely HQLA).
  ii. Permit Category 2 to be no more than a set fraction of total HQLA.
  iii. Require that Category 2 assets are subject to haircuts

RISK CONTROL

Jurisdictional HQLA definitions

Approach	Category definitions: 1	Category definitions: 2a	Category definitions: 2b	Minimum
BCBS (2010)	Cash; central bank reserves, and securities guaranteed by sovereigns, central banks (or similar) with 0% Basel II risk weight	No distinction between 2a and 2b. Level 2 are claims on or guaranteed by sovereigns, central banks (or similar) with 20% Basel II risk weight. Corporate and Covered bonds rated at least AA-.		15% on Level 2.
BCBS (2013): Introduced Level 2b	Cash; central bank reserves, and securities guaranteed by sovereigns, central banks (or similar) with 0% Basel II risk weight	Claims on or guaranteed by sovereigns, central banks, (or similar) with 20% Basel II risk weigh. Corporate and covered bonds rated at least AA-.	RMBS rated AA or higher, corporate debt securities rated between A+ and BBB- ; and certain unemcumbered equities.	15% on 2a. Higher haircuts on 2b: 50% on corporate debt, 50% on equities, and 25% on RMBS.
US: "Proposed Rule"	Fed Bank Balances; Foreign Withdrawable Reserves; Securities Issued or Guaranteed by: US Treasury or Government Agencies, Central Bank, Sovereign Entity, the BIS, IMF, ECB, EC or by a multilateral development bank; certain debt securities issued by soverign entities.	Claims on or guaranteed by US GSEs and certain claims on or guaranteed by sovereign entities or a multilateral development bank that are not included in Level 1 and have 20% Basel II risk weight.	Certain publically traded corporate debt securities and publically traded shares of common stock.	15% on 2a. 50% on 2b.
Sweden: Followed BCBS (2010)	Cash, Central Bank Balances, Sovereign Debt, Securities with Zero Risk Weight	No distinction between 2a and 2b. Level 2 defined as: securities with a risk weight of 20% issued or guaranteed by sovereigns, central banks, public sector bodies, or multilateral development banks, Covered and Corporate Bonds of Credit Quality Level 1.		15% on Level 2.
Australia: Followed BCBS (2010)	Cash, Balances held with RBA, Commonwealth Government and Semi-Government securities;	No Australian Category 2 assets are recognised.		

- Where Level 2 assets are defined, they must comprise no more than 40% of the total stock of High Quality Liquid Assets.
- Similarly, 2b assets must (where defined) comprise no more than 15% of the total stock of High Quality Liquid Assets.

RISK CONTROL

EBA recommendations on EHQLA and HQLA classification (in November 2013)

Extremely HQLA	Rating	Min. Isssue	
Sovereign Bonds issued in Domestic Currency	ECAI 1	€250m	
Covered Bonds	ECAI 1	€500m	
Central Bank reserves	-	-	
Notes	-	-	
Coin	-	-	
HQLA	**Min. ECAI**	**Min. Isssue**	**Max time to maturity**
Sovereign Bonds issued in domestic curency	ECAI 2	€100m	-
Covered Bonds	ECAI 1	€250m	-
Corporate Bonds	ECAI 4	€250m	10 years
RMBS	ECAI 1	€100m	5 years
Bonds issued by supranational institutions in EEA currencies	ECAI 1	€250m	-
Bonds issued by local government institutions in EEA currencies	ECAI 2	€250m	-
Insufficiently liquid Assets			
Equities			
Gold			
Credit Claims			
ABS not backed by residential mortgages			
Central Bank Securities			
Securities issued by financial institutions			
Bank-issued government guaranteed bonds			
Bonds issued by promotional banks			

The Final Delegated Act Announced October 2014

This showed some slight movement compared to the initial EBA recommendations

Level 1 HQLA

- These may be used without limit in the liquidity buffer and are not subject to a discount (or haircut) to their market value.
- They include: cash, deposits at the central bank, government1 or government guaranteed bonds, and covered bonds that meet certain specific conditions.
- However, the last are subject to a 70% cap in the liquidity buffer and a 7% haircut.

Level 2A HQLA

- These can be used up to maximum of 40% in the liquidity buffer and are subject to a
- minimum 15% haircut.
- They include third country government bonds and bonds issued by public entities with a 20% risk weight, EU covered bonds with an ECAI2 2 rating, non-EU covered bonds rated ECAI 1 and corporate bonds rated ECAI 1.

Level 2B HQLA

- These can be used up to maximum of 15% in the liquidity buffer and are subject to a minimum haircut varying between 25 and 50%.
- They include: high quality securitisations for RMBS (retail mortgage backed securities), auto, SME and consumer loans; corporate bonds rated at least ECAI 3, shares that are part of a major stock index and other high quality covered bonds.

Questions 6a

1. The approach of the LCR eligibility criteria is to include or exclude different assets based on an assessment of their risk and liquidity.

2. There are caps on some exposures but these are set quite high. Would it not be better to encourage diversification by allowing a broader range of assets so long as none dominates in the basket?

3. Does it make sense to allow low grade sovereign bonds some of which are quite illiquid to be in category 2A?

RISK CONTROL

Some perspectives on ABS liquidity

- **Common presumption among regulators has been that:**
  - Covered Bonds are much more liquid than ABS
  - Among ABS, RMBS are significantly more liquid than anything else and so
  - RMBS are the only ABS sub-class that should be considered liquid.
- **We are able to shed light on these views.**
- There are many indicators of liquidity that have used to have been used to look at different dimensions of liquidity
- The EBA examined the following indicators:
  1. The Amihud illiquidity ratio
  2. An un-scaled price impact measure
  3. The Roll measure
  4. Trading volume
  5. Turnover ratio
  6. The number of zero trading days
  7. Price volatility
- Bid-ask spreads are perhaps the most obvious indicator of liquidity. These were (surprisingly) not employed by the EBA.
- Here, we present a comparison of bid-ask spreads for individual European ABS and Covered Bonds to shed light on the relative liquidity/illiquidity of these asset classes.

Data sources

Covered Bonds data:

- Daily bid and ask quotes are obtained from Bloomberg on components of BoA Merrill Lynch Euro CB Index
- We focus on Euro-denominated, investment grade covered bonds publicly traded in the Eurobond or Euro member domestic markets.
- We require at least one year remaining term to final maturity, fixed coupon schedules, and minimum amounts outstanding of EUR 250 million.
- Sample period runs from 26th of May 2009 to 30th of September 2013.
- Number of AAA bid-ask spread observations is 1,334,538.

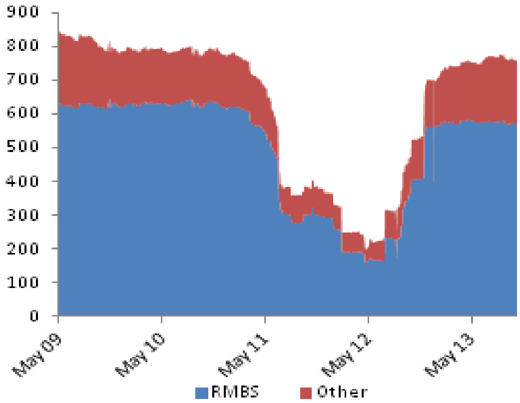
ABS data:

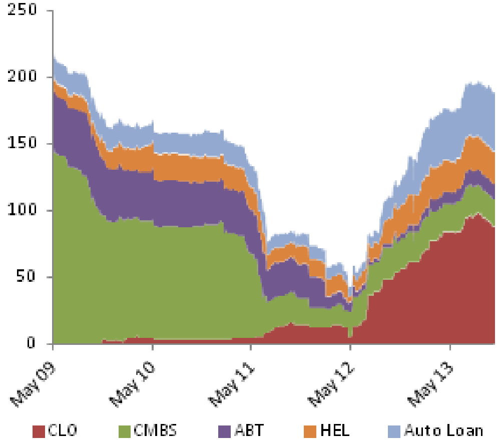
- Provided by Standard and Poor's:
- Contains daily bid and ask quotes, characteristic information and cash flow projections for pricing - e.g. prepayment rates and weighted-average lives).
- The sample period runs from 26th May 2009 to 30th September 2013.
- Number of AAA bid-ask spread observations is 722,613; 564,467 are RMBS.

RISK CONTROL

Securitisation data

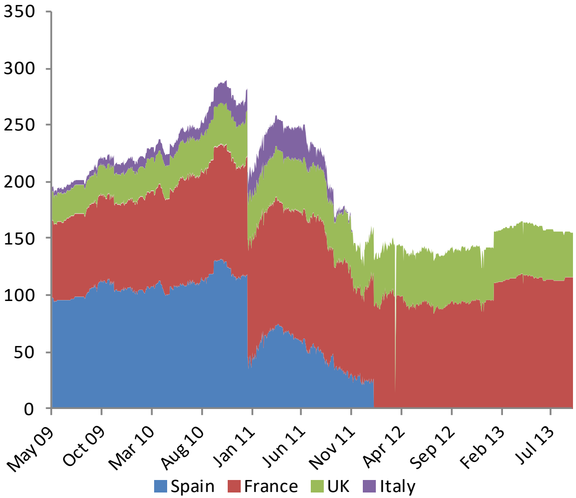
- We focus on AAA-rated ABS since these seem most relevant for a HQLA definition
  - although, for some asset categories, the EBA has admitted AA and other ratings.
- Most observations in our sample are RMBS.
- In the middle of our sample there is a *marked decline in the number of observations*, this:
  - mostly reflects downgrades and,
  - in some cases, subsequent upgrades, and
  - to some extent, changes in the coverage of the S&P dataset.
- The breakdown of the non-RMBS data exhibits considerable changes in composition – most notably for CLOs and CMBS.

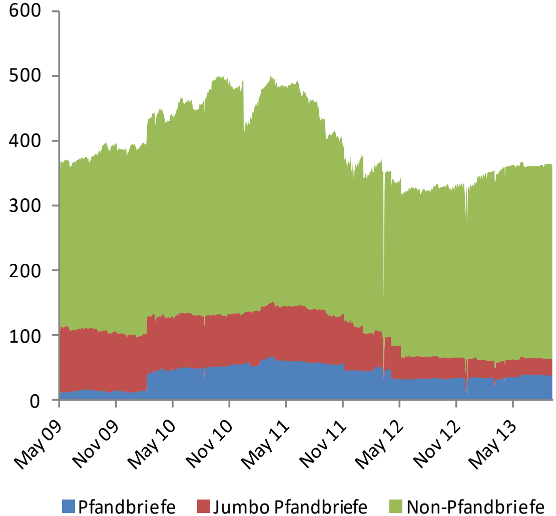




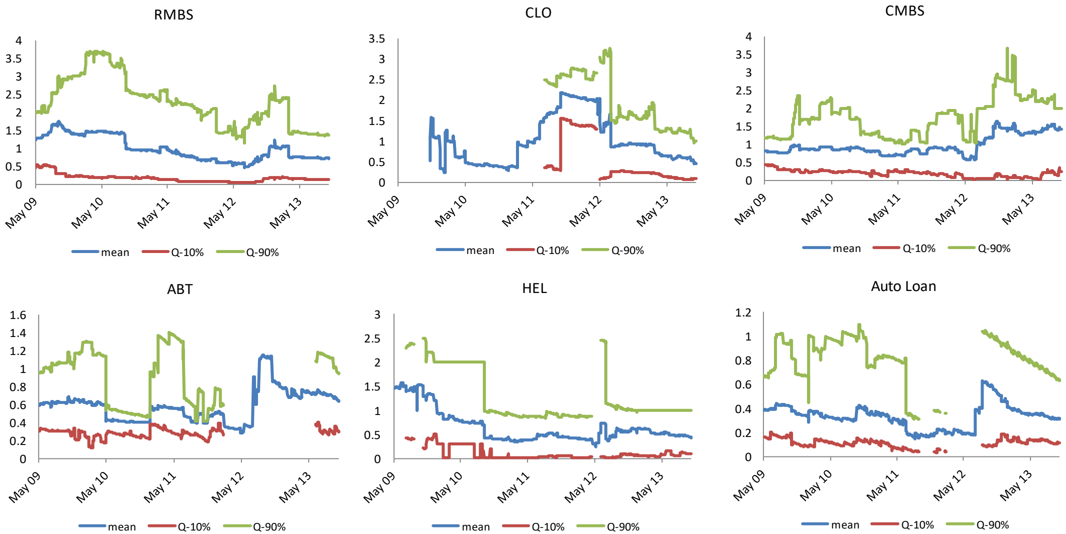
Covered Bonds data

- Distribution of Covered bonds by subsector shows that **most of the data is for Non-Pfandbriefe.**
- All Pfandbriefe are from the German market - with a split between standard and Jumbo Pfandbriefe.
- Non-Pfandbriefe come from the United Kingdom, Spain, France, and Italy.
- Our observations from Spain and Italy exhibit **effects of the sovereign ratings ceiling**:
  - after a certain date, as countries were downgraded, no Covered Bonds could obtain AAA ratings.
  - This explains the sharp decline in early 2011





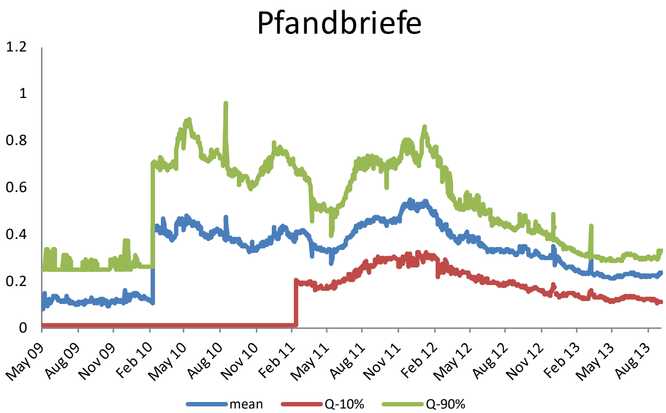
Bid-Ask spreads for ABS

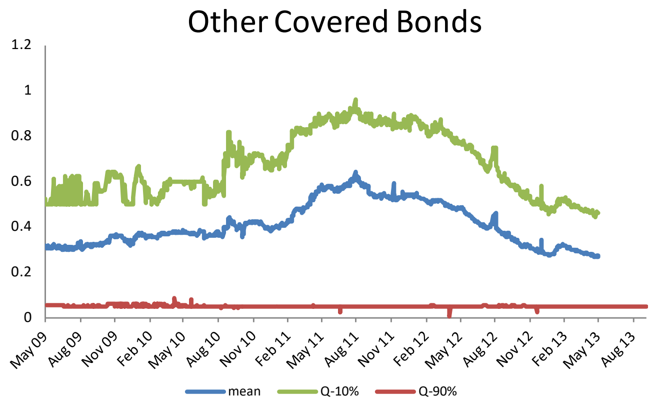


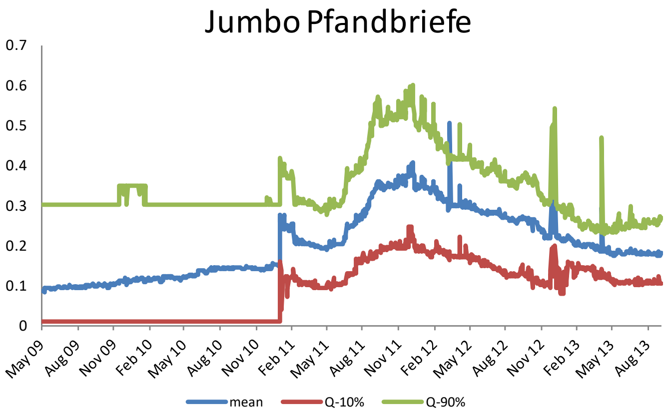
- The first exercise we perform with our data is to examine the evolution over time of bid-ask spreads for different asset-class sub-categories of the securities in our sample.
- The broad picture that emerges is one in which:
  1. for house-market-sensitive ABS (RMBS and HEL), bid-ask spreads, on average, tend to decline over the sample period as concerns about the quality of mortgage lending in the countries in question gradually fell, while
  2. spreads for CLOs and CMBS tended to increase initially before subsequently declining

RISK CONTROL

Covered Bonds by type







- Some jumps occur in the series reflecting changes in the coverage of the data available.
- Broad picture is of a rise in covered bond spreads (particularly Non-Pfandbriefe) during the 2011 Sovereign debt crisis.
- Impact of the major ECB interventions of 2012 is evident – a “Draghi effect” – in the sustained recovery that occurs in the first half of 2012.

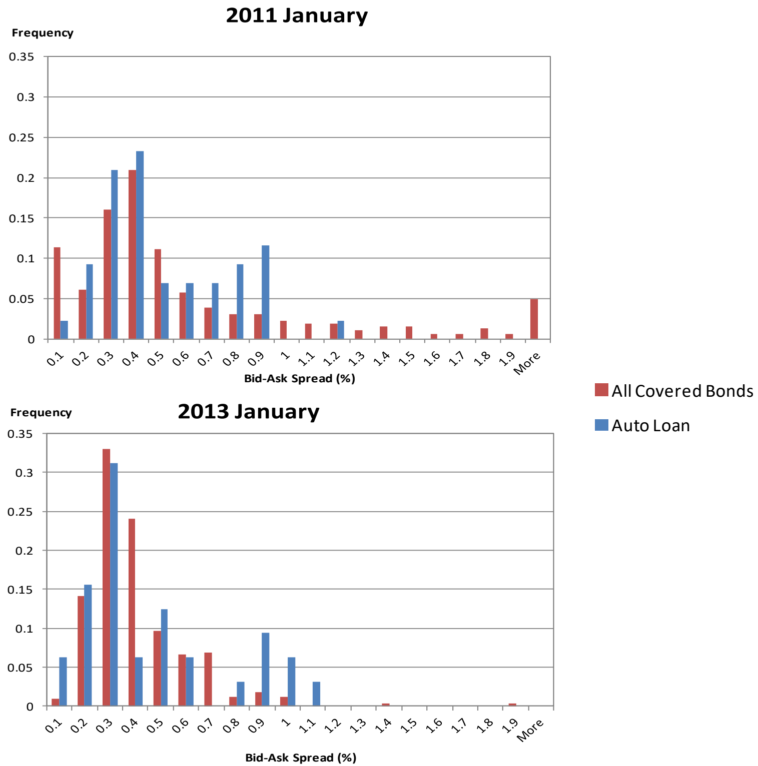
RISK CONTROL

Assets by asset sub-class

		Whole sample period				*2011 onward*			
		Mean	**Avg SD**	**Avg 90% quantile**	**Avg 10% quantile**	**Mean**	**Avg SD**	**Avg 90% quantile**	**Avg 10% quantile**
Covered Bonds	**Pfandbriefe**	0.32	0.16	0.51	0.12	0.35	0.13	0.52	0.18
	Jumbo Pfandbriefe	0.20	0.11	0.34	0.09	0.25	0.10	0.36	0.14
	Other Covered Bonds	0.40	0.18	0.66	0.19	0.44	0.19	0.72	0.22
ABS	**RMBS**	0.98	1.00	2.27	0.16	0.77	0.89	1.89	0.11
	CLO	0.96	0.11	1.82	0.42	1.07	0.61	1.82	0.42
	CMBS	0.97	0.83	1.75	0.18	1.03	0.88	1.82	0.14
	ABT	0.58	0.29	0.91	0.28	0.61	0.31	0.93	0.29
	HEL	0.65	0.49	1.27	0.10	0.47	0.39	0.99	0.04
	Auto Loan	0.33	0.23	0.81	0.11	0.31	0.21	0.75	0.10

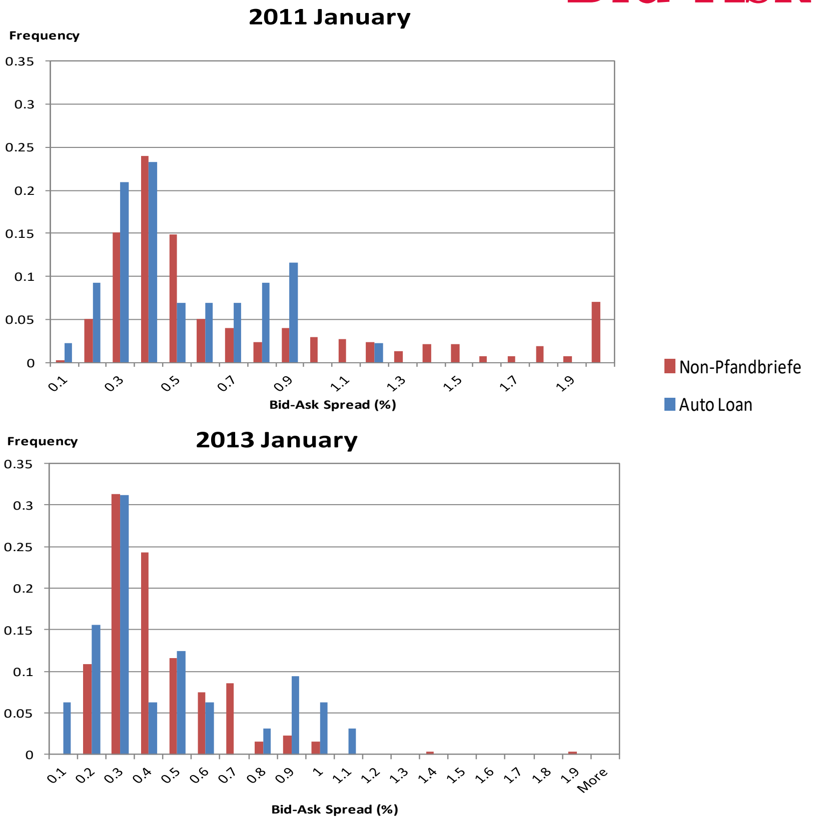
- Over the sample period, Covered bond bid-ask spreads are less than those of ABS.
- However, Auto-Loan ABS are comparable in liquidity to Pfandbriefe and more liquid than both Jumbo Pfandbriefe and other Covered Bonds.
- In the crisis (from 2011 onwards), the 10% quantiles of RMBS and HEL show greater liquidity than Covered Bonds
  – This suggests that the most liquid ABS are more liquid than the most liquid covered bonds.

Auto-Loan versus All Covered Bonds: Bid-Ask spread distributions



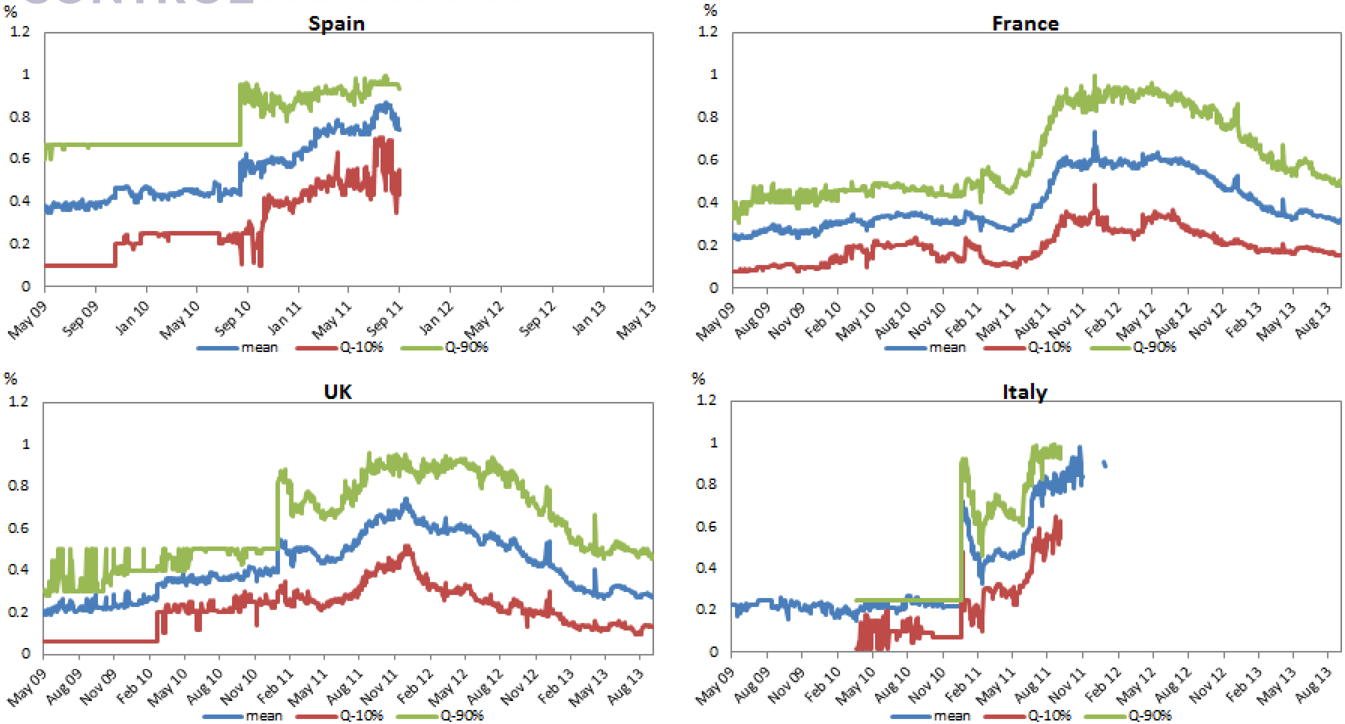
- The key message is that auto-loan ABS and Covered Bonds have comparable liquidity

Non-Pfandbriefe vs. Auto-Loan ABS: Bid-Ask Spread Distributions



- The key message is that, when compared to non-Pfandbriefe Covered Bonds, Auto-Loan ABS are superior in liquidity.

Covered Bonds by Jurisdiction



- Spanish and Italian spreads terminate early because of the effects of the sovereign ratings ceiling.
- French bid-ask spreads peak just before Draghi intervention; UK bid-ask spreads remain high for longer.

RISK CONTROL

Assets by country of issuance

		Whole sample period				2011 onward			
		Mean	Avg SD	Avg 90% quantile	Avg 10% quantile	Mean	Avg SD	Avg 90% quantile	Avg 10% quantile
Covered Bonds (a)	**Spain**	0.51	0.19	0.75	0.27	0.68	0.18	0.90	0.44
	France	0.40	0.16	0.61	0.19	0.45	0.19	0.71	0.22
	UK	0.41	0.16	0.62	0.21	0.48	0.18	0.73	0.25
	Italy	0.37	0.11	0.51	0.22	0.62	0.18	0.75	0.34
Covered Bonds (b)	**Spain**	0.58	0.16	0.76	0.35	0.68	0.15	0.83	0.45
	Italy	0.54	0.11	0.67	0.37	0.73	0.14	0.83	0.47
RMBS (a)	**Spain**	1.45	1.06	2.76	0.27	1.20	1.07	2.62	0.08
	Italy	1.45	0.58	2.20	0.46	1.55	0.43	2.17	0.34
	UK	0.81	0.92	2.08	0.18	0.49	0.66	1.14	0.09
RMBS (b)	**Spain**	1.40	0.92	2.49	0.34	1.24	0.85	2.28	0.31
	Italy	1.34	0.78	2.31	0.47	1.34	0.78	2.36	0.43

- In the rows designated (a) securities drop out of our sample when the sovereign downgrade forces them to lose their AAA ratings.
- In the rows marked (b) securities in our sample are fixed at their pre-sovereign downgrade levels, and so do not drop out of the sample. This is done to prevent a loss of observations.
- Again, Covered Bonds appear more liquid than RMBS over the entire sample period.
- The post-2011 comparability of CB and ABS liquidities is even more pronounced when looking at these national markets.

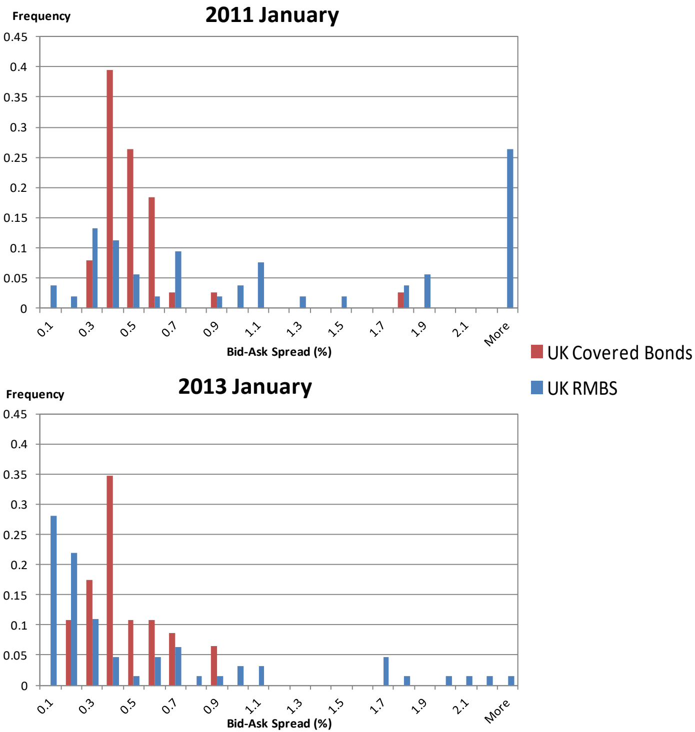
RISK CONTROL

A comment on country effects

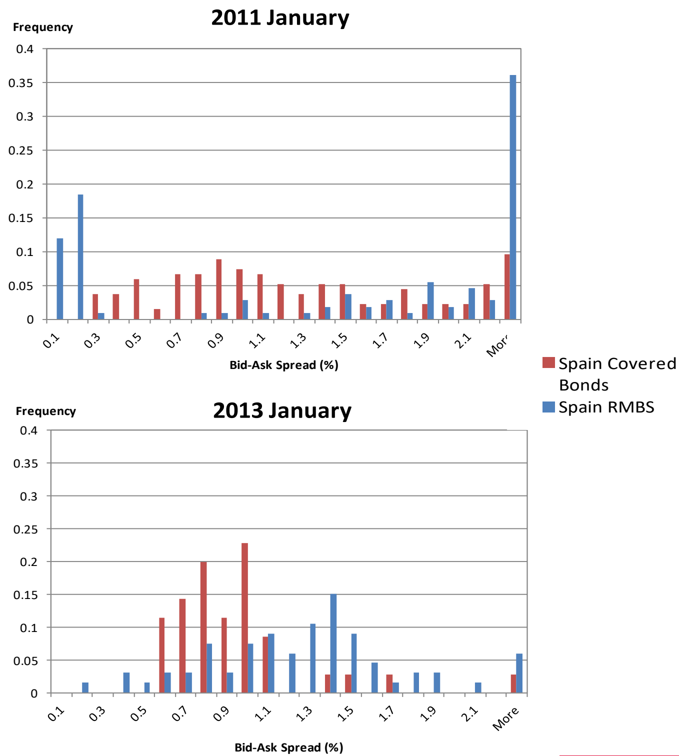
- One might expect the securities' domiciles to influence both liquidity and risk indicators (such as the bid-ask spread).
- The calibration exercise implemented by the EBA to determine the LCR eligibility buckets, the EBA does not explore country-effects in its analysis for understandable reasons
- Ex ante, one would expect country effects to be powerful, as worries about different economies' growth prospects and banking sector and sovereigns' solvencies evolved over time.
- Leaving out country effects means that analysis suffers from an important '*omitted variables*' problem.
- If one finds, for example, that differences in the regulation of Covered Bond markets have an influence on liquidity, it may be that this simply reflects an omitted country effect.

Bid-Ask Spread Distributions for Countries

UK Covered Bonds vs. RMBS:



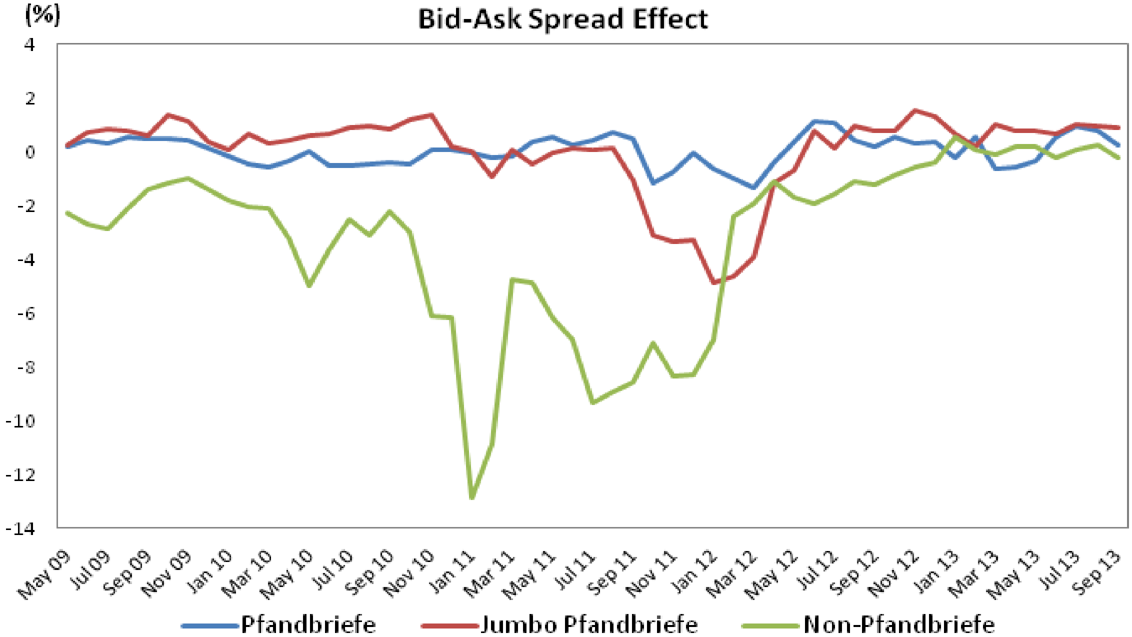
Spanish Covered Bonds vs. RMBS:



Future price discounts as well as immediate transactions costs

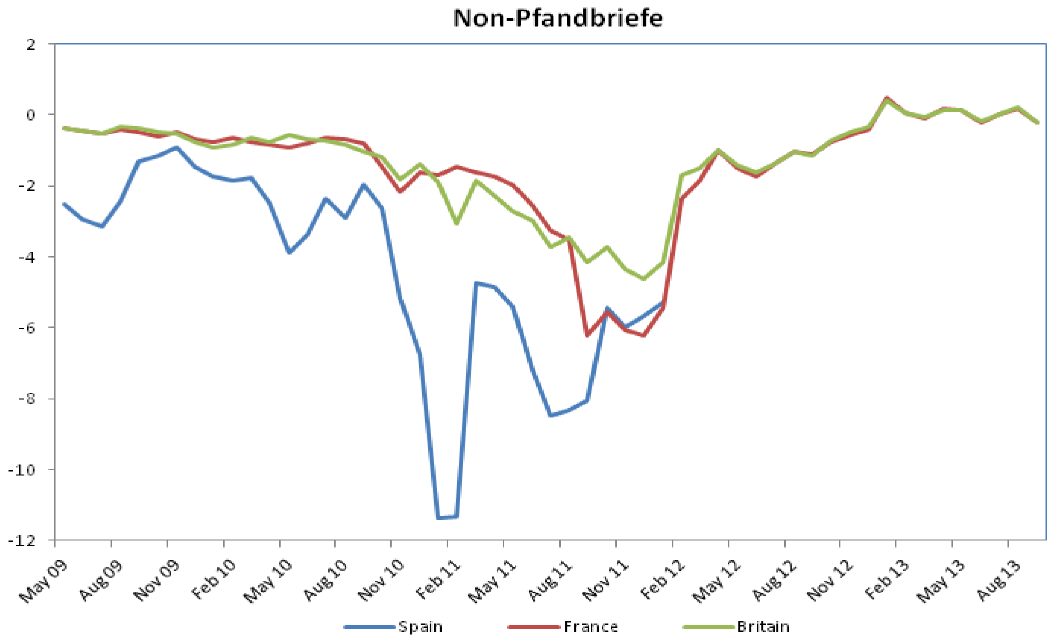
- One may also look at the problem of comparing the relative liquidities of Covered Bonds and ABS from a somewhat different perspective.
- In valuing an asset now, market participants will allow for the discounted costs of future - rather than current - transactions costs.
  - Since sales may occur in crisis periods, their size may be substantial.
  - Transactions costs in crises may be large and subject to significant risk premiums.
- Such discounts for future transactions costs reduce both the bid and ask prices of securities.
- By investigating the level of such discounts and how they behave over time, we obtain a perspective on how concerned the market has been about transactions costs for different asset classes in periods of crisis.

Covered Bond Liquidity Price Effect



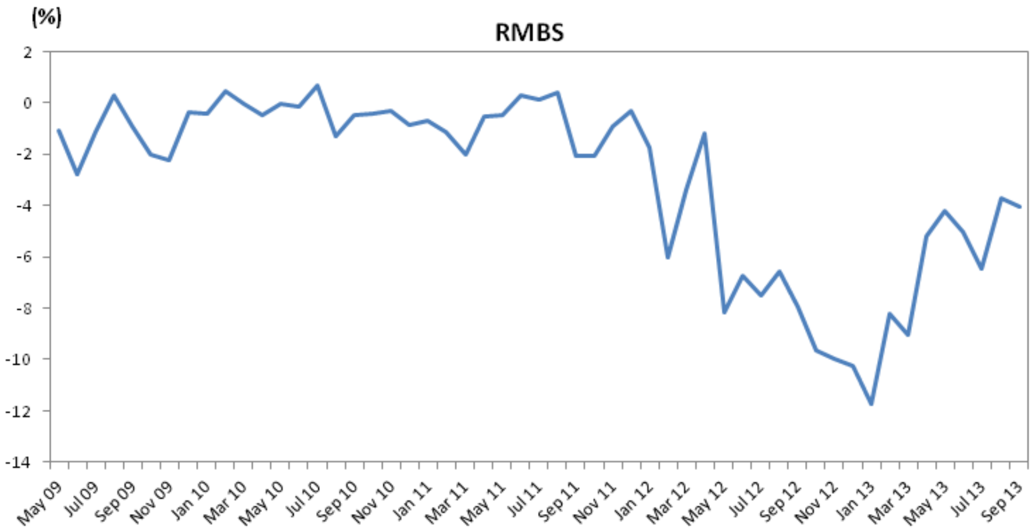
- The Draghi effect is very evident
- There are substantial differences between Pfandbriefe and other Covered Bonds.

Non-Pfandbriefe Liquidity Price Effect



- The illiquidity discounts are greatest for Spanish securities.
- There is major volatility in discounts in the Spring of 2011
- The timing is different for France and Britain - peak discounts in late 2011

Euro RMBS Liquidity Price Effect



- Liquidity discounts for AAA RMBS are large and similar sizes to Spanish CB.
- The emergence of liquidity discounts occurs later, however.
- We interpret this as showing that, when RMBS spreads narrow in 2011, the narrowing occurs first for liquid issues, opening a gap between liquid and illiquid RMBS.

Conclusions

- This section provide perspectives on the relative liquidity of two important European asset classes, Covered Bonds and ABS. We focus on evidence from bid-ask spread data - data neglected in the recent EBA analysis of asset class liquidity.
- We present:
  1. simple, transparent calculations of bid-ask spread distributions and
  2. more elaborate calculations that illustrate the contribution of market worries about future crisis-period transactions costs to individual security discounts.
- Both approaches suggest that Covered Bonds and ABS are not as different as some have suggested:
  - i. The more liquid ABS exhibit greater liquidity than Covered Bonds.
  - ii. In general, in the sovereign crisis period around 2011, Covered Bonds appear to have been less liquid than ABS.
  - iii. One category of short-dated, non-mortgage-related ABS, auto-loan-backed ABS, ranked very low for liquidity by the EBA, has tight spreads and so appears comparable to the most liquid Covered Bonds.
- As a result, taken together, we believe our analysis implies a different picture of the relative liquidity of asset classes than is common among regulators

Questions 6b

1. Did you find the data analysis convincing or not?

2. Can liquidity be reliably evaluated based on past episodes? Most banks regarded high-grade securitisations as highly liquid prior to the crisis.

3. Will the LCR rules be self-vindicating in that the designation of LCR eligible will make certain assets more liquid? Is this a concern?

RISK CONTROL

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RISK CONTROL

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True-sale vs Synthetic Securitisation

Based on the mechanism of credit risk transfer to the capital markets, there are two types of securitisation:

- In a true-sale securitisation, the originator passes the loan ownership to an SPV.
- This removes the loans from the originator's balance sheet and the SPV gaining entitlement to their cash flows.
- In a synthetic securitisation, the originator transfers the credit risk of bundled loans via credit derivatives such as CDS or guarantees to the capital markets.
- The loans themselves remain on the originator's balance sheet.
- Often balance sheet synthetic securitisation take this form but in some cases the originator does not own the underlying loans and buys the credit protection solely for arbitrage opportunities. These are known as arbitrage synthetic securitisation.

Comparison of the two securitisation types

	True-sale	Synthetic
Portfolio of loans	Passed onto an SPV	Remains on bank balance
Purpose	Funding	Credit risk/ capital management
Typical underlying portfolio	Mortgages, consumer loans	Corporate exposures, SME loans
Investor return	Cash flows of underlying	CDS premium

Source: Deutsche Bank Research (2017)

Synthetic Securitisation: Motivations

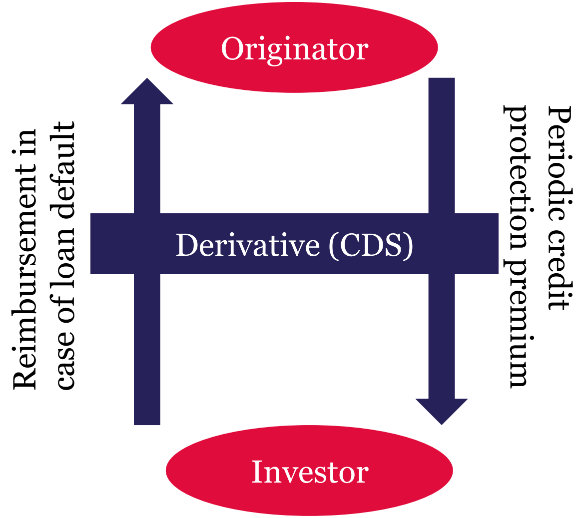
i) Synthetic securitisation has fewer administrative and legal requirements than true-sale transactions which require sale and insolvency-proof transfer of the underlying loan.

ii) Responsible approaches to such risk transfer require, in the language of Basel capital regulation, Simple Transparent and Standardised (STS) securitisation structures.

iii) For non-synthetic securitisations, Basel has prescribed a set of standards that must be met if deals are to be categorised as SST in which case they attract lower capital when held in bank's portfolios.

iv) EBA (2017) sets out the issues, listing possible features of an SST that might lead it to be considered as achieving significant risk transfer (SRT) which would allow the originator to employ the beneficial STS risk weights for the retained securitisation positions.

Balance sheet synthetic securitisation



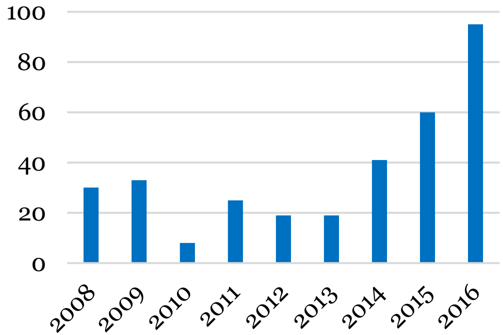
Source: Deutsche Bank Research (2017)

Synthetic Securitisation: EU Market

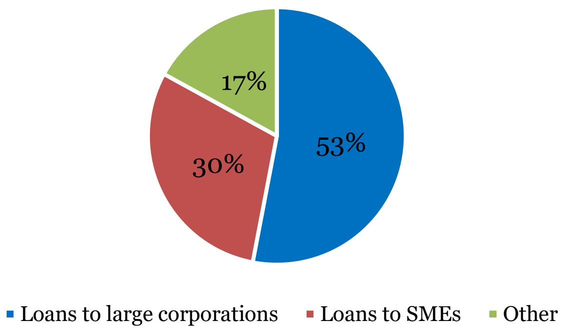
The market is bilateral in that deals are typically unrated and are placed privately with buy-side institutions such as hedge funds, pension funds and insurers. The data in the figure below shows steady growth in issuance since 2013 and indicates that the large majority of underlying assets are either large corporate or SME loans.

Impetus to SST issuance has been provided by the relatively conservative nature of risk weights for corporates under Basel 3 rules. The introduction in Basel 3 of Standardised Approach floors to Internal Ratings Based (IRB) capital is likely to increase further the pressure on banks to transfer the risk of their corporate exposures through SSTs or other measures. Figure below shows the evolution of SST issuance in Europe up to 2016. Since the crisis volumes grew markedly as banks tried to economise on the high capital charges for corporate exposures.

Bilateral SSTs in Europe (EUR Billion)



EU SST by asset class (% of 2015 issuance)



RISK CONTROL

Introduction to the Exercise

- We will look at example synthetic securitisations.
- We will look at possible securitisation of non-corporate loans by prominent Multilateral Development Banks (MDBs).
- The approach to evaluating securitisation is not different from how it might be looked at by a commercial bank although in practical applications there is perhaps less "optimisation" and more tatonnement as parties examine different deal structures and their implications.
- MDBs may engage in an SST to economise on 'ratings agency capital' and economic capital. In contrast, commercial banks' primary preoccupation is in the freeing up the regulatory capital.
- The exercise is explained in a note that will be distributed in printed form and is implemented in an Excel workbook with executable VBA code.
- We will go through the document and then you will explore different recalibrations, examining how the optimal tranching changes as the parameters of the underlying pool and of the pricing change.

Optimal Tranching: Problem

i. Using publicly available MDB data, we determine the optimal tranching structure if an MDB were to securitise its non-sovereign exposures using a synthetic securitisation transaction.

ii. We consider four tranches: junior (retained), private investor, public investor and senior (retained). Let the thickness of the four tranches be denoted by h_1, h_2, h_2 and h_4. We assume the private investor tranche is fully collateralised.

iii. The optimal tranching structure is obtained by maximizing a benefit to cost ratio where the benefit is measured in terms of the reduction in bank's RWA and the cost is measured in terms of the reduction in bank's margin from the transaction.

iv. The problem is formulated as,

$$\max_h f(h) = \frac{\frac{\mathrm{RW}_1 h_1 + RW_2 h_2 + RW_3 h_3 + RW_4 h_4}{RW_{Before\ SST}} - 1}{\frac{m - (h_2 \times c_1 + h_3 \times c_2)}{m} - 1}$$

subject to the constraints:

$$h_1 + h_2 + h_3 + h_4 = 1$$
$$RW_{Before\ SST} - (RW_1 h_1 + RW_2 h_2 + RW_3 h_3 + RW_4 h_4) \geq 0$$
$$h_1 + h_2 + h_3 \geq PLR$$
$$m - (h_2 \times c_1 + h_3 \times c_2) \geq 0$$
$$c_1 = -\frac{1}{\tau} log\left(1 - EL_{Thick}(h_1, h_1 + h_2)\right) + (0.7h_2)^2$$

Optimal Tranching: Constraints

i. The first constraint requires that the percentage tranche thicknesses of the tranches sum to 1.
ii. The second constraint requires that the total RW after SST should be no greater than the total before SST (where the current value is inferred from S&P report).
iii. The third constraint states that the detachment point of protection should be greater than the PLR so that the senior tranche is rated A.
iv. The fourth constraint requires that the cost be less than the bank margin. We assume a bank margin of 3.8% denoted by m.
v. The fifth constraint states that the cost of the private investor tranche denoted by c_1 is the tranche spread, where τ is the maturity and EL_{Thick} can be calculated as follows:

$$EL_{Thick}(A, D) = \frac{(1-A)EL_{Senior}(A) - (1-D)EL_{Senior}(D)}{D-A}$$

$$EL_{Senior}(X) = \frac{LGD \times \bar{N}_2 - X \times PD_{Tranche}(X)}{1-X}$$

$$\bar{N}_2 \equiv N_2\left(N^{-1}(PD), N^{-1}\left(PD_{Tranche}(X)\right), \sqrt{\rho_{pool}}\right)$$

$$PD_{Tranche}(X) = N\left(\frac{N^{-1}(PD) - \sqrt{1-\rho_{pool}}N^{-1}(X/LGD)}{\sqrt{\rho_{pool}}}\right)$$

Optimal Tranching: S&P

i. We perform the optimisation first using S&P Risk Weights and then repeat the exercise using Basel Risk Weights.

ii. The old S&P methodology applies , $RW_1 = 1250\%$ for the junior retained tranche, $RW_2 = 3\%$ for the private investor tranche that is fully collateralised, $RW_3 = 3\%$ for the public investor tranche where the public institution is rated "AA-" or higher and $RW_4 = 50\%$ for the senior retained tranche that is rated "A".

iii. The "A" rating of the senior retained tranche is realised only if the detachment point of the protected tranche is lesser than the portfolio loss rate (PLR). For estimating the PLR, we first calculate the total loss as the sum of three-year normalised expected loss, EL_{3Year} and the unexpected loss, UL as,

$$EL_{3Year} = 3 \times (EAD_{FI} \times LR_{FI} + 0.75EAD_{Corporate}\left(0.95 \times LR_{Corp} + 0.05 \times LR_{CRE}\right)$$

where, EAD_{FI} and $EAD_{Corporate}$ denote the financial institution and corporate exposures, $LR_{FI}, LR_{Corp}, LR_{CRE}$ denote the loss rates for financial institution, corporate and construction and real-estate exposures.

$$UL = \frac{RWA_{FI} + RWA_{Corporate}}{12.5}$$

where, RWA_{FI} and $RWA_{Corporate}$denote the financial institution and corporate RWAs. Then,

$$PLR = \frac{TL}{EAD_{FI} + EAD_{Corporate}}$$

Optimal Tranching: Basel

i. For the case with using Basel risk weights, the RW before transaction is calculated as,

$$RW_{before\ SST} = K \times 12.5,$$

$$K = LGD \times \left(N\left(\frac{N^{-1}(PD) - \sqrt{R}N^{-1}(0.001)}{\sqrt{1-R}} \right) - PD \right) \times \frac{(1+(M-2.5)b)}{1-1.5b},$$

$$b = \left(0.11852 - 0.05478 \times Ln(PD)\right)^2$$

$$R = \frac{0.12 \times (1-e^{-50PD})}{1-e^{-50}} + 0.24\left(1 - \frac{(1-e^{-50PD})}{(1-e^{-50})}\right)$$

ii. To get the RW after transaction, we apply, $RW_1 = 1250\%$ for the junior retained tranche, $RW_2 = 3\%$ for the private investor tranche, $RW_3 = 3\%$ for the public investor tranche and RW_4 is determined as follows,

$$RW_4 = \begin{cases} 1250\%, if KIRB \geq 1 \\ K_{SSFA(KIRB)} \times 12.5, if\ h_1 + h_2 + h_3 \geq KIRB \\ \frac{12.5(KIRB - h_1 - h_2 - h_3)}{1 - h_1 - h_2 - h_3} + \frac{(1-KIRB) \times 12.5 \times K_{SSFA(KIRB)}}{1 - h_1 - h_2 - h_2}, otherwi \end{cases}$$

RISK CONTROL

Optimal Tranching: Basel

$$KIRB = LGD \times \left(N\left(\frac{N^{-1}(PD) - \sqrt{R}N^{-1}(0.001)}{\sqrt{1-R}} \right) \right) \times \frac{(1 + (M - 2.5)b)}{1 - 1.5b}$$

$$K_{SSFA(KIRB)} = \frac{e^{au} - e^{al}}{a(u-l)}$$

$$u = 1 - KIRB$$

$$l \quad = \max(h_1 + h_2 + h_3 - KRIB, 0)$$

$$a = -\frac{1}{p \times KIRB}$$

$$p = \max\left(0.3, A + B\left(\frac{1}{N}\right) + C \times KIRB + D \times LGD + E \times M_T\right)$$

where, A = 0.00, B=3.56, C=-1.85, D=0.55, E=0.02 and N is assumed to be large enough so that 1/N is close to zero.

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