

COCOS: A PRICING MODEL

A pricing model for bank contingent capital

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Synopsis of CoCos report dated 25 March 2014



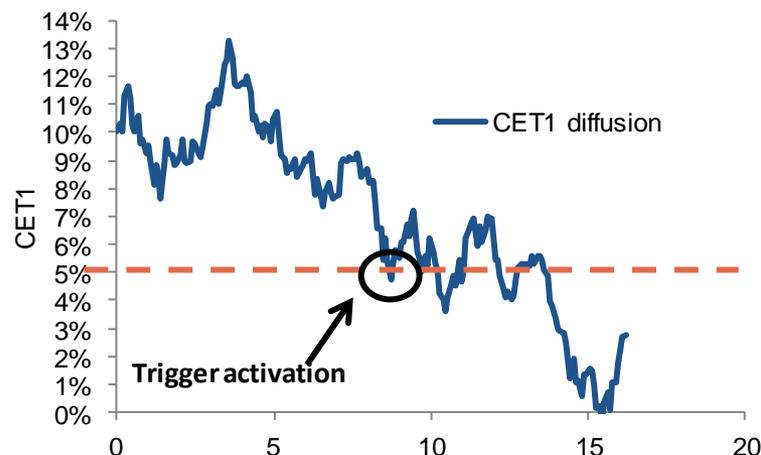
INTRODUCTION

■ A CoCo (Contingent Convertible bond) is the combination of

- a hybrid bond.
- a trigger on a capital ratio (generally CET1 or CT1) which activates the loss absorption feature (capital ratio below a fixed barrier).

■ Loss absorption can be:

- A full/partial write-down
- A conversion to equity
- A temporary write-down (not modelled)



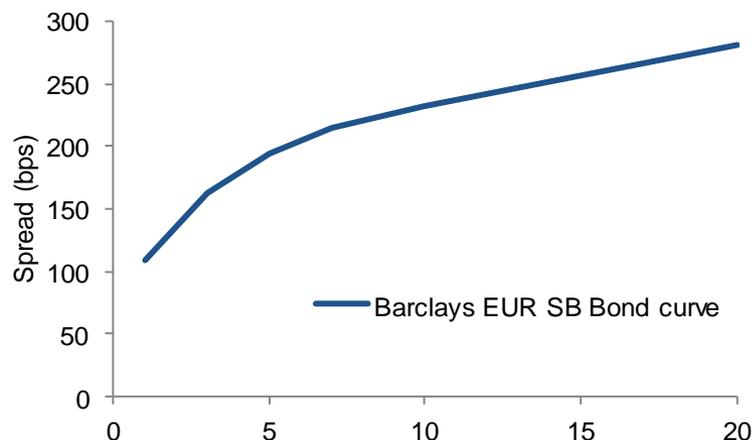
■ Our probabilistic model models sources of risk with stochastic diffusions. We have kept our previously developed hybrid bond pricer and added the capital ratio trigger.

Source: SG Cross Asset Research/Cross Asset Quant

SPREAD DIFFUSION

■ Bond credit curve

- We need very long credit curves as most CoCos are perpetual.
- We use short-term 1Y-10Y bond curves from our bond credit curve model (paper published in Feb 2014).
- We extrapolate the longer end (>10Y) of the bond curves with a CIR model and assume a long-term slope constraint.



■ Spread movements

- Short-term credit spreads follow a log-normal diffusion.
- The base case scenario is implied from the credit curve.
- The long-term volatility (45%) is derived from credit index option volatility adjusted for correlation and maturity gap.

Source: SG Cross Asset Research/Cross Asset Quant

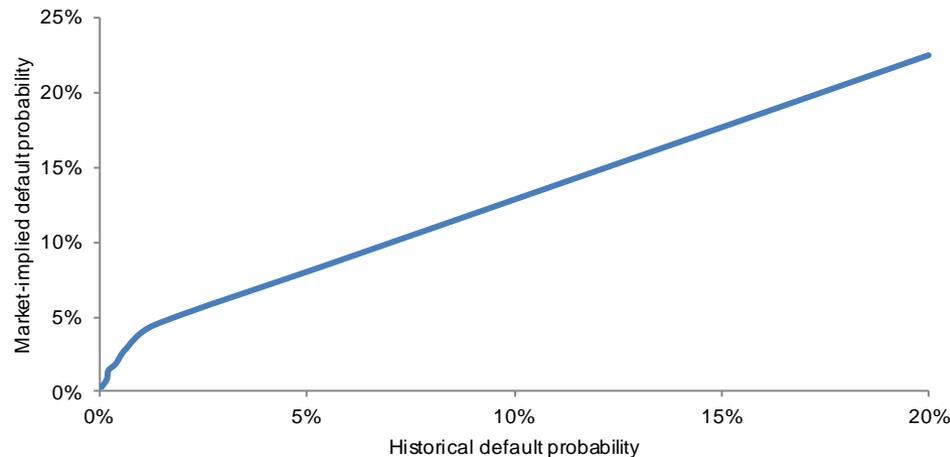
PRICING THE LOSS ABSORPTION RISK

■ The capital ratios follow a mean-reverting process and are negatively correlated with credit spread

- Speed of reversion: 0.14 (5-year half-life to return to equilibrium),
- Volatility parameter: 2.5%,
- Correlation between the financial ratio and credit spread: -60%,
- Long-term average = current level

■ Incorporation of an additional risk premium

- We add a risk premium linked to the differential between real default events statistics reported by Moody's and market-implied probabilities of default by rating.



Source: SG Cross Asset Research/Cross Asset Quant

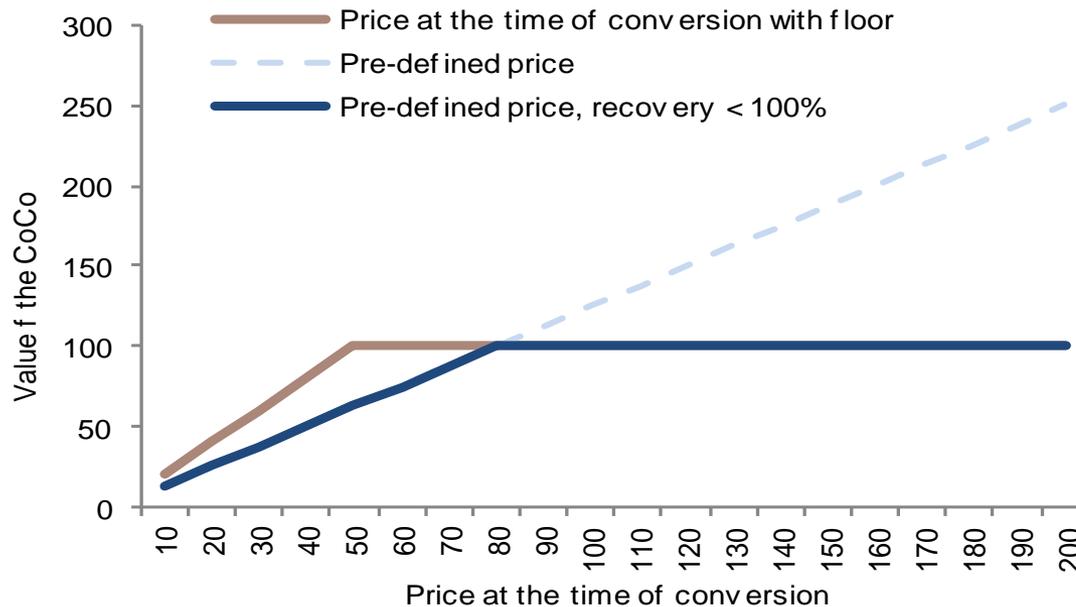
WHAT HAPPENS IN CASE OF TRIGGER ACTIVATION?

■ If the financial ratio drops below the fixed barrier, loss absorption is activated

- In the case of a partial (x%) or full write-down (100%), the investor gets paid the recovery (1-x)% or 0%.
- In the case of a conversion to equity, we use our equity credit model EC hedge ($S_t = \text{Spread}$, $E_t = \text{equity}$) to calculate the equity price at the instant of the trigger:

$$S_t = b(e^{\mu t} / E_t)^\alpha$$

■ Conversion to equity pay-off



Source: SG Cross Asset Research/Cross Asset Quant

HYBRID RISK

- **Use of specific characteristics of each CoCo**

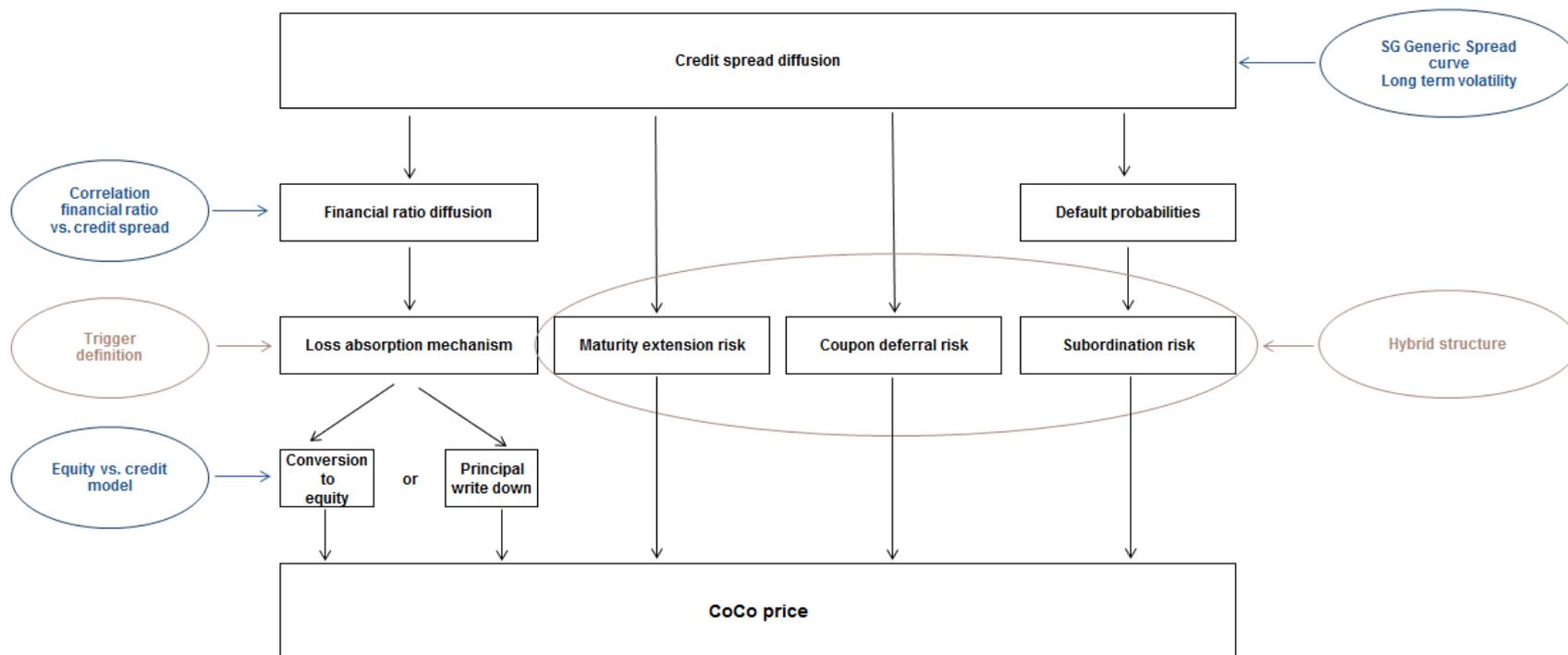
- **Default risk: 0% recovery in the case of default**

- **Extension risk: At each possible redemption date, the company decides whether it wants to call the security depending on the current price of the security; no reputation cost.**

- **Deferral risk: optional deferral for AT1 bonds**
 - Link to the company's financial health; trigger when short-term spreads reach a given threshold (700bp on the senior spread)
 - Non-cumulative deferral

Source: SG Cross Asset Research/Cross Asset Quant

PRICING FRAMEWORK

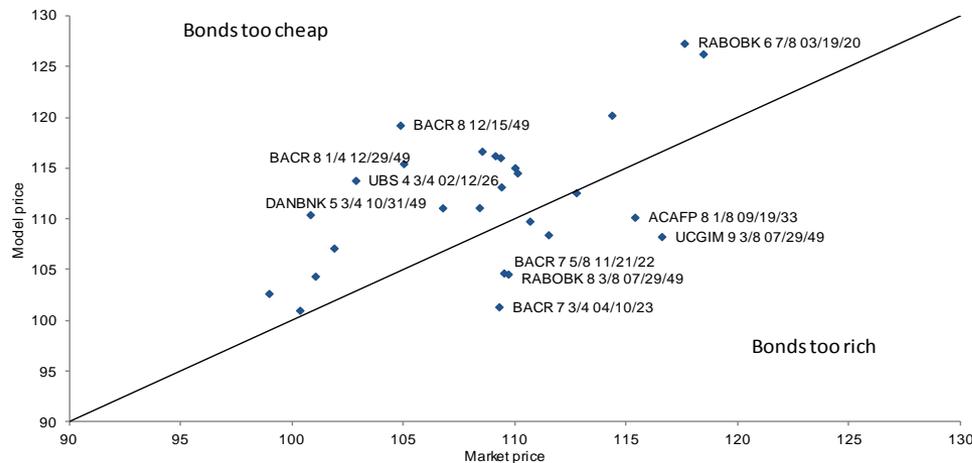


Source: SG Cross Asset Research/Cross Asset Quant

PRICING RESULTS

■ We sort bonds by descending market / model price ratio and find:

- Richest: BACR 7 3/4 04/10/23 \$ T2, UCGIM 9 3/8 07/29/49 € AT1, BACR 7 5/8 11/21/22 \$ T2, ACAFP 8 1/8 09/19/33 \$ T2 and RABOBK 8 3/8 07/29/49 \$ AT1;
- Cheapest: BACR 8 12/15/49 € AT1, DANBNK 5 3/4 10/31/49 € AT1, UBS 4 3/4 02/12/26 € T2, RABOBK 6 7/8 03/19/20 € Snr and BACR 8 1/4 12/29/49 \$ AT1.



■ CoCos are on average too cheap – market price: 109; model price: 112

■ Impact of the different CoCos' specific risks on the market price:

- Loss absorption: -2
- Coupon deferral: -2 (-5 for AT1, 0 for Snr and T2)
- Extension option: -4
- Subordination: -4

Source: SG Cross Asset Research/Cross Asset Quant

FULL LIST

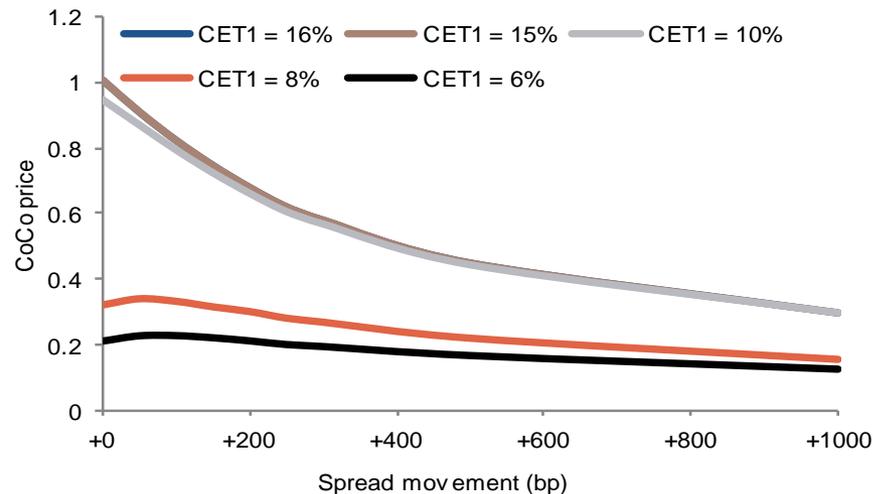
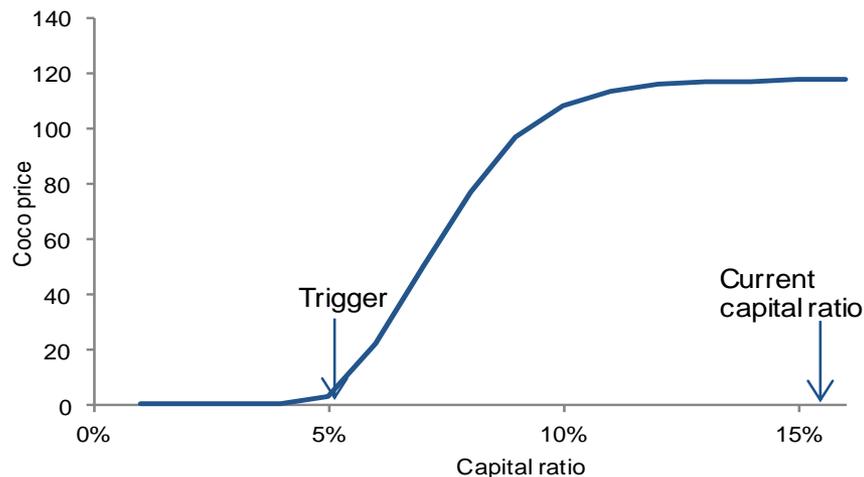
Cocos from cheapest to richest versus model

Cocos description											Market vs model results						Options cumulative impact on model price					
Bond	Issuer	Next call date	Maturity date	Currency	Seniority	Type	Pricing type	Ratio type	Current ratio	Trigger level	Model hit trigger proba	Model ext. proba	Market price	Model price	Market / Model price	Market Z-spread	100% write down	+ No coco trigger	+ No coupon deferral	+ No exten sion	+ senior unsec	5Y spd
BACR 8 12/15/49	Barclays	15-Dec-20	PERPETUAL	EUR	SB	AT1	Conversion to equity	Fully-Loaded	9%	7%	48%	30%	105	119	88%	598	-55	2	6	11	16	194
UBS 4 3/4 02/12/26	UBS	12-Feb-21	12-Feb-26	EUR	SB	T2	100% write-down	Transition	19%	5%	0%	24%	103	114	90%	289	0	0	0	4	7	94
BACR 8 1/4 12/29/49	Barclays	15-Dec-18	PERPETUAL	USD	SB	AT1	Conversion to equity	Fully-Loaded	9%	7%	48%	28%	105	115	91%	557	-50	-4	0	5	9	231
DANBNK 5 3/4 10/31/49	Danske Bank	6-Apr-20	PERPETUAL	EUR	SB	AT1	100% write-down (*)	Transition	15%	7%	4%	39%	101	110	91%	445	0	1	3	8	11	155
RABOBK 6 7/8 03/19/20	Rabobank	NO CALL	19-Mar-20	EUR	SU	Snr	75% write-down	Equity Capital Ratio	15%	7%	0%	87%	118	127	92%	236	0	1	1	1	1	87
BBVASM 9 05/29/49	BBVA	9-May-18	PERPETUAL	USD	SB	AT1	Conversion to equity	Transition	12%	5%	3%	31%	109	117	93%	539	-2	0	0	4	8	269
UBS 7 5/8 08/17/22	UBS	NO CALL	17-Aug-22	USD	SB	T2	100% write-down	Transition	19%	5%	0%		118	126	94%	249	0	0	0	0	5	131
CS 5 3/4 09/18/26	Credit Suisse	18-Sep-20	18-Sep-26	EUR	SB	T2	100% write-down	Transition	16%	5%	0%	21%	109	116	94%	283	0	0	0	3	7	149
CS 7 1/2 12/11/49	Credit Suisse	11-Dec-23	PERPETUAL	USD	SB	AT1	100% write-down	Transition	16%	5%	0%	40%	109	116	94%	363	0	0	0	6	13	186
UBS 4 3/4 06/22/23	UBS	22-May-18	22-May-23	USD	SB	T2	100% write-down	Transition	19%	5%	0%	22%	102	107	95%	279	0	0	0	4	6	131
POPSM 11 1/2 10/29/49	Banco Popular Espanol	10-Oct-18	PERPETUAL	EUR	SB	AT1	Conversion to equity	Transition	11%	5%	6%	46%	114	120	95%	705	-5	-4	5	10	16	372
UBS 7 1/4 02/22/22	UBS	22-Feb-17	22-Feb-22	USD	SB	T2	100% write-down	Transition	19%	5%	0%	6%	110	115	96%	266	0	0	0	3	4	131
ACAFF 7 7/8 01/29/49	Crédit Agricole	23-Jan-24	PERPETUAL	USD	SB	AT1	100% write-down (*)	Transition (ACAFF)	12%	7%	13%	44%	107	111	96%	444	0	6	10	15	22	172
CS 6 1/2 08/08/23	Credit Suisse	NO CALL	8-Aug-23	USD	SB	T2	100% write-down	Transition	16%	5%	0%		110	115	96%	253	0	0	0	0	7	186
SANTAN 6 1/4 03/12/49	Banco Santander	12-Mar-19	PERPETUAL	EUR	SB	AT1	Conversion to equity	Transition	11%	5%	11%	59%	99	103	96%	964	-3	-2	3	12	16	245
BkIR 10 07/30/16	Bank of Ireland	NO CALL	30-Jul-16	EUR	SB	T2	Conversion to equity	Transition	14%	8%	0%		109	113	97%	511	-3	0	0	0	4	437
BBVASM 7 12/29/49	BBVA	19-Feb-19	PERPETUAL	EUR	SB	AT1	100% write-down	Transition	12%	5%	3%	53%	101	104	97%	592	0	1	7	14	18	232
CS 7 7/8 02/24/41	Credit Suisse	24-Aug-16	24-Feb-41	USD	SB	T2	Conversion to equity	Transition	16%	7%	0%	29%	108	111	98%	353	0	0	0	3	5	186
NWIDE 6 7/8 49	Nationwide Building Society	20-Jun-19	PERPETUAL	GBP	SB	AT1	100% write-down (*)	Fully-Loaded	13%	7%	9%	57%	100	101	99%	488	0	2	7	14	18	182
KBC 8 01/25/23	KBC	25-Jan-18	25-Jan-23	USD	SB	T2	100% write-down	Transition	13%	7%	3%	18%	113	113	100%	311	0	4	4	6	9	217
ISPIM 9 1/2 10/29/49	Intesa San Paolo	1-Jun-16	PERPETUAL	EUR	SB	AT1	100% write-down	Total Capital	14%	6%	0%	37%	111	110	101%	379	0	0	3	4	5	251
RABOBK 8.4 11/29/49	Rabobank	29-Jun-17	PERPETUAL	USD	SB	AT1	100% write-down	Equity Capital Ratio	15%	8%	1%	41%	112	108	103%	356	0	2	7	10	12	194
RABOBK 8 3/8 07/29/49	Rabobank	26-Jul-16	PERPETUAL	USD	SB	AT1	100% write-down	Equity Capital Ratio	15%	8%	2%	47%	110	105	105%	345	0	3	6	10	11	194
ACAFF 8 1/8 09/19/33	Crédit Agricole	19-Sep-18	19-Sep-33	USD	SB	T2	100% write-down	Transition (ACAFF)	12%	7%	13%	32%	115	110	105%	283	0	9	9	12	15	172
BACR 7 5/8 11/21/22	Barclays	NO CALL	21-Nov-22	USD	SB	T2	100% write-down	Transition	11%	7%	14%		110	105	105%	374	0	14	14	14	22	231
UCGIM 9 3/8 07/29/49	Unicredit Italiano	21-Jul-20	PERPETUAL	EUR	SB	AT1	100% write-down	Total Capital	15%	6%	0%	57%	117	108	108%	491	0	0	10	14	22	291
BACR 7 3/4 04/10/23	Barclays	10-Apr-18	10-Apr-23	USD	SB	T2	100% write-down	Transition	11%	7%	14%	36%	109	101	108%	387	0	14	14	17	20	231
Average											7%	39%	109	112	97%	405	-4	2	4	8	11	206

Source: SG Cross Asset Research/Cross Asset Quant, (*) partial write-down and potential write-up but we assume 100% write-down, (**) conversion into CCDS, but we assume 100% write-down

SENSITIVITY ANALYSIS – CS 7.5 2049

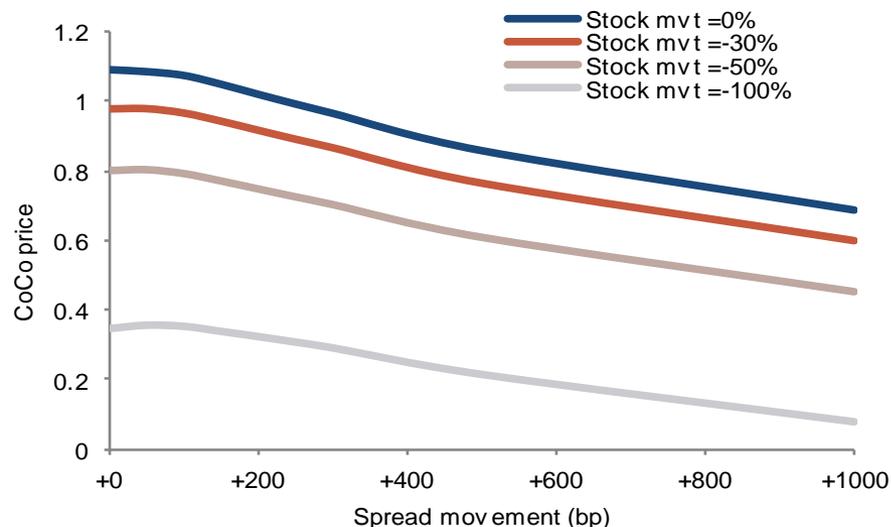
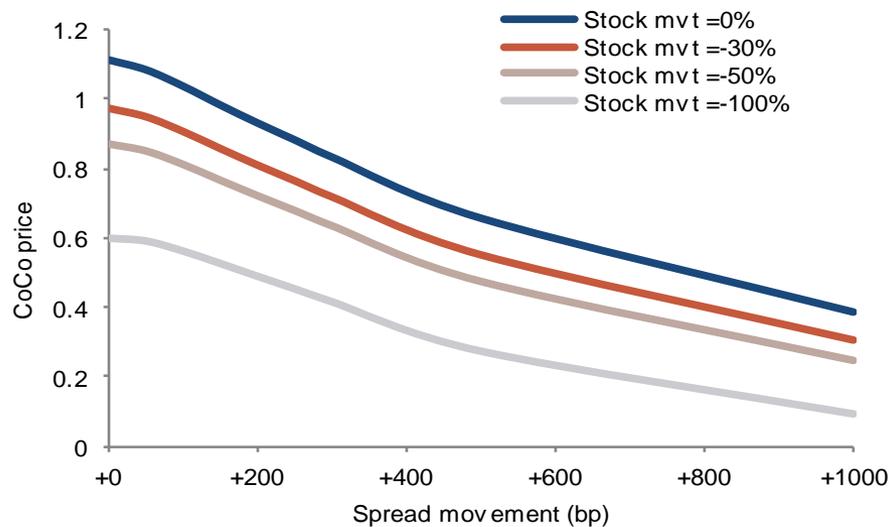
- CS 7.5 2049: low trigger AT1 CoCo; the current capital ratio is at 16% and the trigger level is at 5.125%. There is a full principal write-down if the capital ratio falls below the trigger.
- The distance to the trigger is key in the price impact of CoCos.



Source: SG Cross Asset Research/Cross Asset Quant

SENSITIVITY ANALYSIS – BACR 8.25 2049

- **BACR 8.25 2049: high trigger AT1 CoCo; current capital ratio is 9.3% and the trigger level is 7%. The loss absorption is via a conversion to equity with a pre-defined stock price (165 pence sterling).**
- **It becomes more sensitive to the equity level and less sensitive to the credit spread level as the capital ratio moves closer to the trigger.**



Source: SG Cross Asset Research/Cross Asset Quant

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- Coco Monitor** N XL
- Bond Credit Curve N XL
- SHARP Monitor XL

EQUITY

COCO MONITOR

The coco monitor shows the outputs of our coco pricer. The model is based on a stochastic diffusion of credit spreads and of the trigger ratio where both sources of risk are correlated. The model prices are updated on a regular basis.

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Coco Monitor

Quantitative Credit Strategy
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Corporate coco bonds - model vs. market prices and spreads
Date **20-Mar-14**

Bond	Issuer	Next call	Maturity	Curre	Senk	T	Pricing type	Ratio type	Current	Trig
B&CR 8 12/15/49	Barclays	15-Dec-20	PERPETUAL	EUR	SB	AT1	Conversion to equity	Fully Loaded	3.300%	
UBS 4 3/4 02/12/26	UBS	12-Feb-21	12-Feb-26	EUR	SB	T2	RR's write-down	Transition	18.500%	
B&CR 8 1/4 12/29/49	Barclays	15-Dec-18	PERPETUAL	USD	SB	AT1	Conversion to equity	Fully Loaded	3.300%	
D&NBK 6 3/4 10/31/49	Danske Bank	6-Apr-20	PERPETUAL	EUR	SB	AT1	RR's write-down	Transition	14.700%	
R&BOBK 6 7/8 03/19/20	Rabobank	NO CALL	19-Mar-20	EUR	SU	Sr	RR's write-down	Equity Capital Ratio	15.200%	
BBVASM 9 05/29/49	BBVA	9-May-18	PERPETUAL	USD	SB	AT1	Conversion to equity	Transition	11.600%	
UBS 7 5/8 08/17/22	UBS	NO CALL	17-Aug-22	USD	SB	T2	RR's write-down	Transition	18.500%	
CS 5 3/4 09/18/25	Credit Suisse	18-Sep-20	18-Sep-25	EUR	SB	T2	RR's write-down	Transition	16.000%	
CS 7 1/2 12/11/49	Credit Suisse	11-Dec-23	PERPETUAL	USD	SB	AT1	RR's write-down	Transition	16.000%	
UBS 4 3/4 05/22/23	UBS	22-May-18	22-May-23	USD	SB	T2	RR's write-down	Transition	18.500%	
POPSM 11 1/2 10/29/49	Banco Popular Espanol	10-Oct-18	PERPETUAL	EUR	SB	AT1	Conversion to equity	Transition	10.900%	
UBS 7 1/4 02/22/22	UBS	22-Feb-17	22-Feb-22	USD	SB	T2	RR's write-down	Transition	18.500%	
A&AFP 7 7/8 01/29/49	Crédit Agricole	23-Jan-24	PERPETUAL	USD	SR	AT1	RR's write-down	Transition (A&AFP)	11.900%	

Source: SG Cross Asset Research/Cross Asset Quant

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- #3 Global Economics

Fixed Income

EUROMONEY 2013

- #1 Overall Credit Strategy
- #1 Overall Trade Ideas
- #1 in Sovereigns
- #1 in 3 sector teams

Commodities

Risk & Energy Risk COMMODITY RANKINGS 2014

- #1 Best Overall Commodity Research
- #1 Research in Oil (Europe, Asia)
- #1 Research in Natural Gas Europe
- #1 Research in Base Metals
- #1 Research in Coal

Equity

EXTEL SURVEYS 2013

IDENTIFYING EXCELLENCE

- #2 Equity Quant
- #2 Index Analysis
- #3 SRI Research
- 12 sector teams in the Top 10