Cross-asset quant research

January 2010

Joint modelling of Credit and Equity derivatives

Credit Quantitative Research

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Cross Asset Research

Overview

- **Cross-asset quant research**
- **Equity-credit modelling**
  - The statistical approach
  - The theoretical approach
  - Bridging the gap between vanilla option smile and credit spreads
  - The current situation
    - Models cannot be fully calibrated
    - Measuring the CDS/Vol dislocation
- **The Equity-Credit Monitor**

Cross-asset quant research

An overview of equity-credit models

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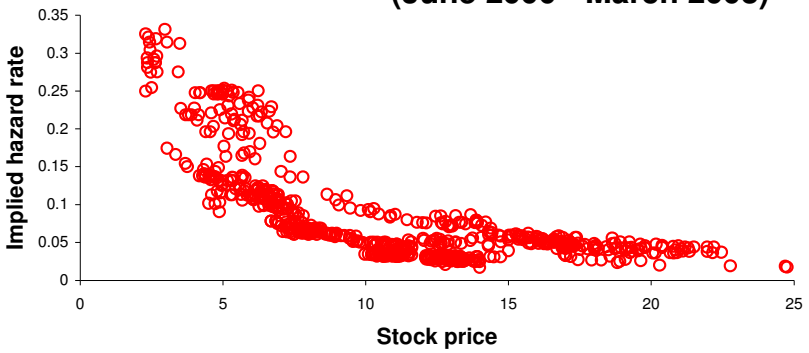
Equity-Credit modelling: the statistical approach

- **A statistical approach can be used in order to model the link between equity and credit instruments**

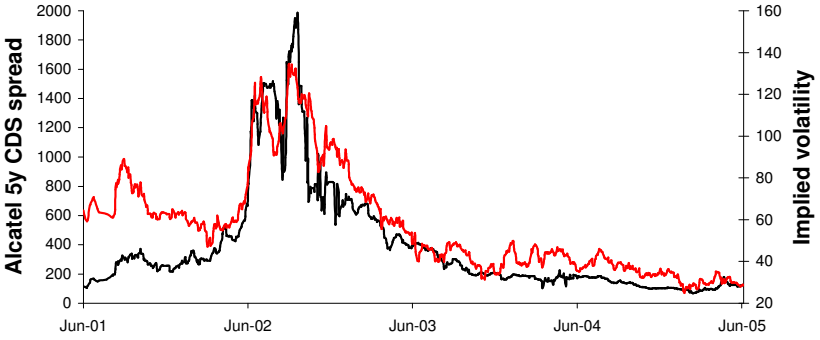
- **The changes in CDS spreads can be related to:**
  - The stock price
  - The ATM implied volatility
  - The implied volatility smile

- **Simple tools**
  - Linear regression
  - Trend following / Mean reverting

Alcatel 5y CDS spread vs. Stock (June 2000 - March 2003)

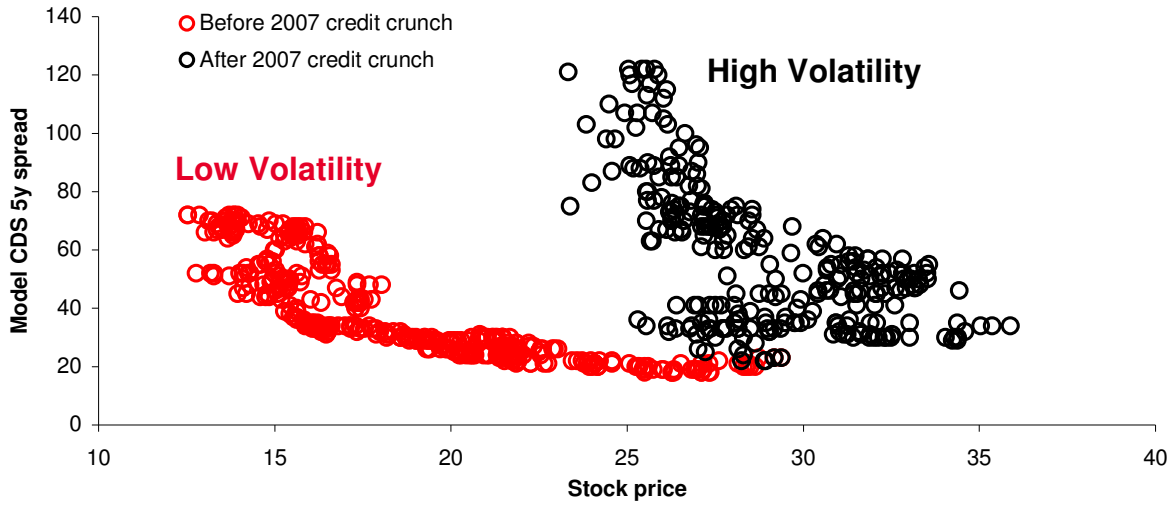


Alcatel 5y CDS spread vs. ATM implied volatility



Pitfalls of the statistical approach

- **Backward looking**
- **Exposed to dislocation risk**
  - CDS vs. Stock relationship undergoes regime changes
  - CDS convexity depends on volatility environment
  - 2 variables may not be enough



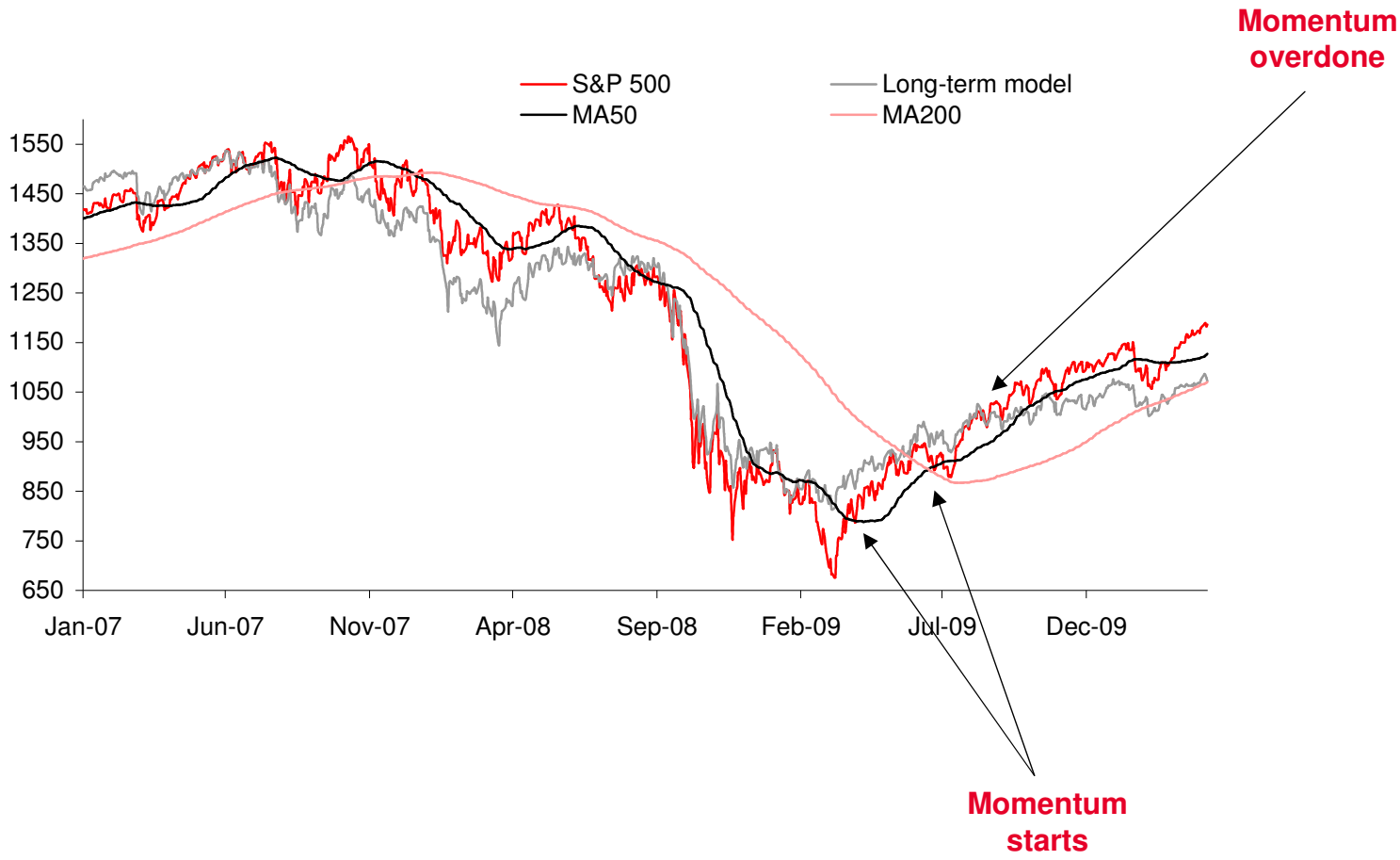
Using our multi-factor Top-down Model

		Betas to risk factors					Variance explained					
		Dollar	Equities	Liquidity	Inflation	EU/US	Dollar	Equities	Liquidity	Inflation	EU/US	Alpha
EQUITIES	EuroStoxx 50	-13.10%	26.64%	23.13%	8.28%	5.62%	14.56%	36.94%	26.25%	1.71%	0.28%	20.27%
	S&P 500	-12.75%	29.65%	12.50%	-0.47%	3.69%	11.76%	51.98%	8.93%	-0.01%	0.16%	27.18%
	Footsie 100	-12.65%	27.46%	18.35%	-12.78%	13.01%	14.79%	39.34%	15.17%	3.69%	1.40%	25.60%
	Nikkei 225	-3.77%	30.74%	16.41%	-18.99%	11.49%	2.26%	48.10%	11.13%	6.65%	1.38%	30.47%
	Hang Seng	17.61%	15.98%	26.03%	21.88%	16.06%	24.04%	12.52%	23.01%	6.59%	2.03%	31.80%
	VIX index	-6.57%	-28.16%	23.06%	-17.48%	-8.34%	25.10%	26.93%	17.71%	5.31%	0.79%	24.16%
	S&P Fins/S&P 500	4.90%	17.96%	-22.09%	21.29%	-37.48%	48.59%	8.50%	8.40%	2.26%	4.87%	27.38%
	S&P 600/S&P 500	26.99%	-4.01%	-8.12%	8.81%	-4.57%	59.31%	1.50%	3.20%	1.36%	0.17%	34.47%
CREDIT	iTraxx Main	-1.86%	-27.71%	15.35%	18.46%	-12.85%	54.50%	27.17%	3.60%	1.02%	1.70%	12.01%
	iTraxx X-Over	-4.38%	-29.43%	-5.76%	1.13%	-26.52%	13.65%	51.44%	0.74%	0.14%	8.02%	26.01%
	CDX IG	-3.75%	-26.18%	16.62%	42.73%	-19.29%	11.54%	30.77%	6.50%	22.76%	3.90%	24.52%
	Credit US/EUR	-12.72%	7.35%	-4.95%	25.23%	-26.44%	14.14%	3.29%	0.39%	3.06%	3.61%	75.51%
	Credit Fin/Non-Fin	7.75%	-18.86%	-0.76%	52.64%	-32.62%	11.54%	27.48%	3.83%	26.53%	2.22%	28.40%
	Credit XO/IG	-3.78%	8.26%	-44.16%	-38.65%	-19.27%	14.57%	9.70%	35.84%	10.08%	4.01%	25.80%

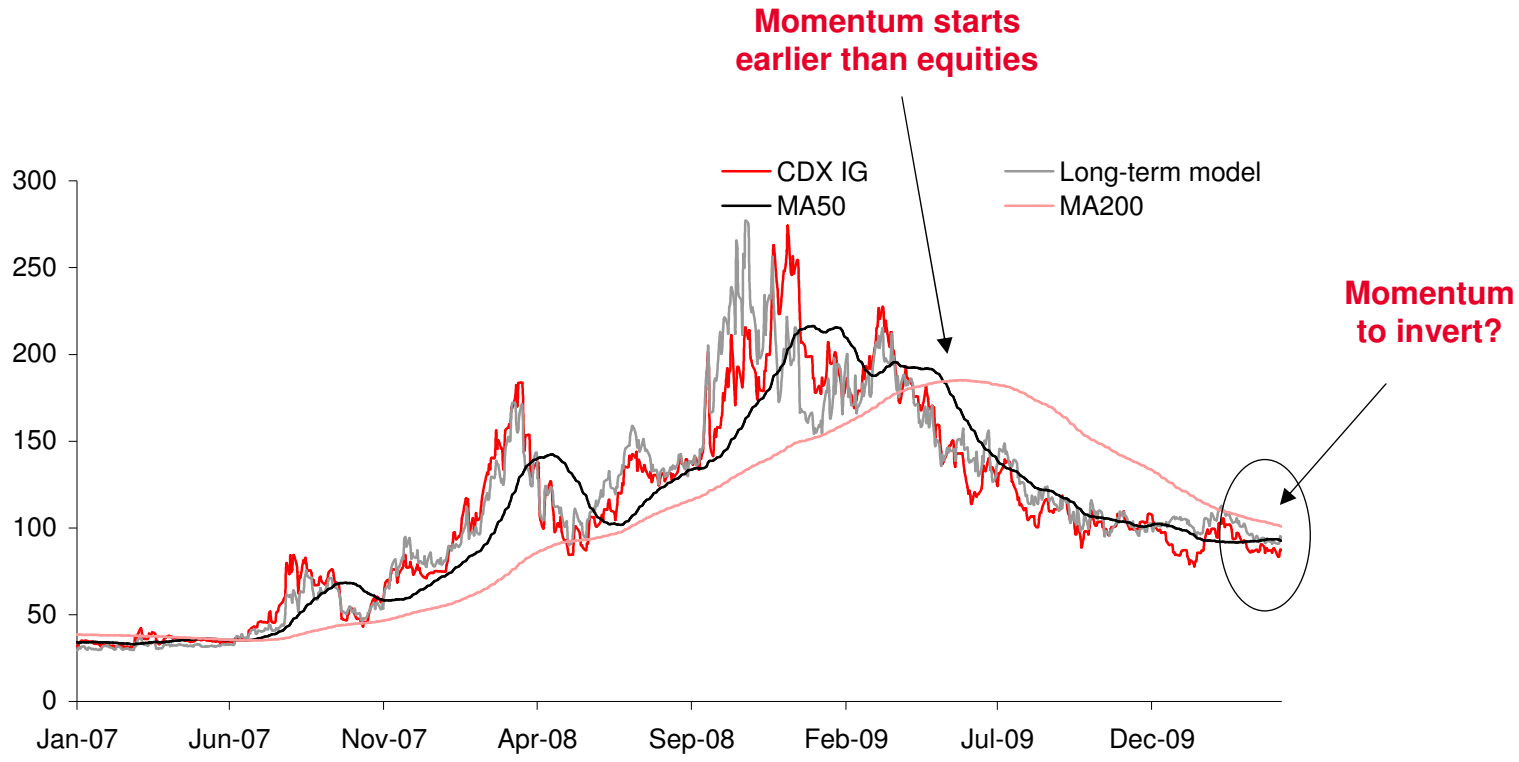
Equity vs Credit opportunities

		LONG-TERM FAIR VALUE						HIGH-FREQUENCY TRADING SIGNAL					
		Price	Fair value	Spread to: Fair value	Year start	1Y Hi/Lo	z-score	Price... ...1w change	...1m change	Fair value... ...1w change		z-score
EQUITIES	EuroStoxx 50	2977	2666	10.4%	21.6%	------|-----v	1.93	-1.18% ↘	4.00% ↗	-1.03% ↘		-0.24
	S&P 500	1136	1038	8.69%	25.8%	------|-----v	1.72	-0.03% ↘	2.69% ↗	-0.63% ↘		1.05
	Footsie 100	5499	4599	16.4%	24.0%	------|-----v	2.89	-0.43% ↘	4.51% ↗	-0.73% ↘		0.46
	Nikkei 225	10879	9732	10.5%	22.8%	------|-----v	1.47	1.85% ↗	7.63% ↗	0.08% ↗		1.14
	Hang Seng	22327	20687	7.34%	55.2%	------|----v-	0.87	0.21% ↗	1.94% ↗	0.10% ↗		0.08
	VIX index	18.25	21.31	-3.06	-21.8	v-----|------	-1.26	-1.1 ↘	-3.34 ↘	0.68 ↗		-1.24
	S&P Fins/S&P 500	0.30	0.39	-33.4%	6.55%	------|--v---	-1.29	-0.12% ↘	0.25% ↗	-0.56% ↘		0.19
	S&P 600/S&P 500	0.30	0.35	-18.9%	-0.27%	------|---v--	-1.76	-0.11% ↘	1.00% ↗	0.57% ↗		-1.18
CREDIT	iTraxx Main	68.00	79.99	-17.6%	-59.5%	v-----|------	-1.20	-3.40% ↘	-16.0% ↘	-0.78% ↘		-1.10
	iTraxx X-Over	392.00	485.90	-24.0%	-58.2%	v-----|------	-1.73	-2.41% ↘	-19.1% ↘	-0.69% ↘		-0.88
	CDX IG	78.00	113.55	-45.6%	-58.1%	v-----|------	-2.24	-4.43% ↘	-17.9% ↘	-1.00% ↘		-1.15
	Credit US/EUR	1.15	1.25	-9.07%	3.46%	---v--|------	-0.68	-1.24% ↘	-2.69% ↘	0.05% ↗		-0.49
	Credit Fin/Non-Fin	1.68	1.77	-5.73%	34.0%	----v-|------	-0.44	-9.76% ↘	-11.4% ↘	-0.29% ↘		-1.18
	Credit XO/IG	5.76	6.07	-5.38%	3.22%	---v--|------	-0.82	5.84% ↗	-22.5% ↘	0.09% ↗		0.58

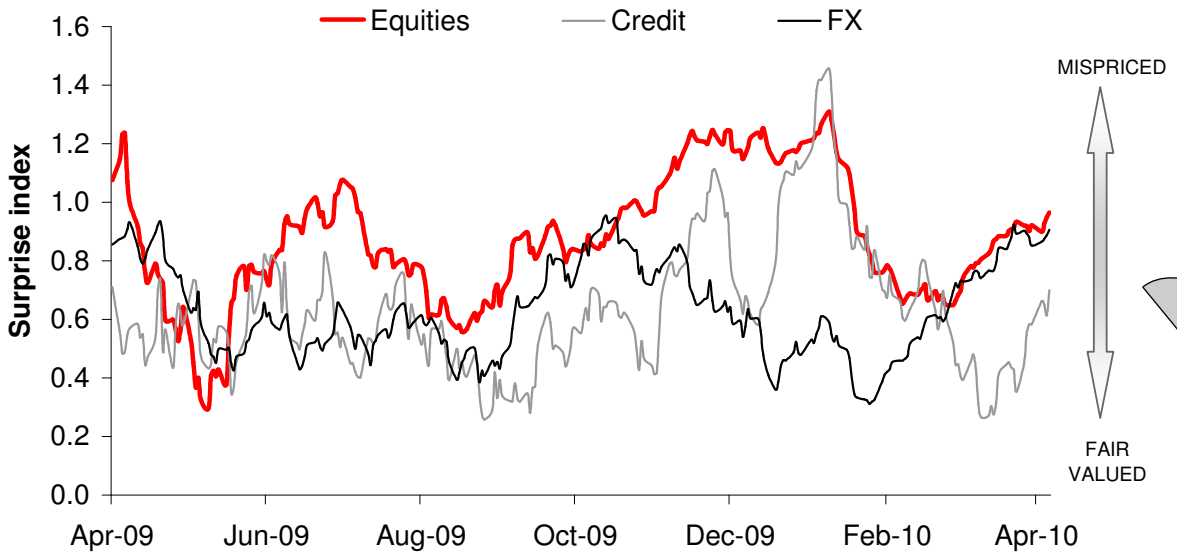
Equity momentum is overdone



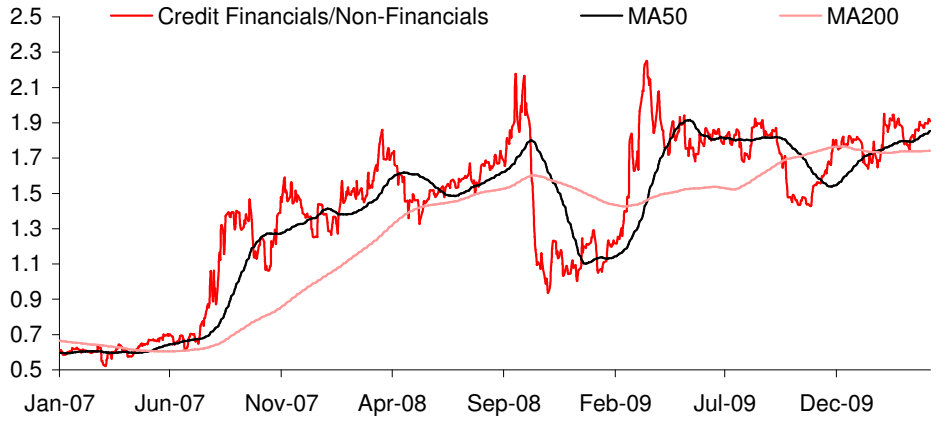
Credit spreads are roughly fair valued



But credit surprise index is rising



Financial spreads are wide vs corps reflecting sovereign risk



Some detailed results

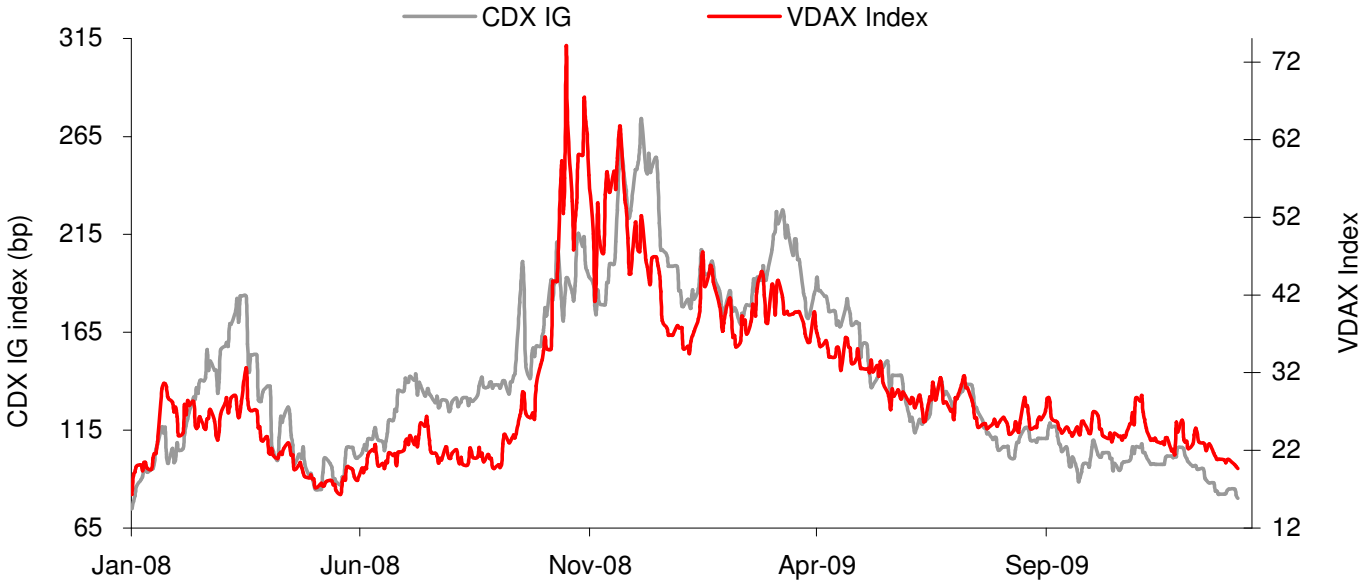
EQUITY

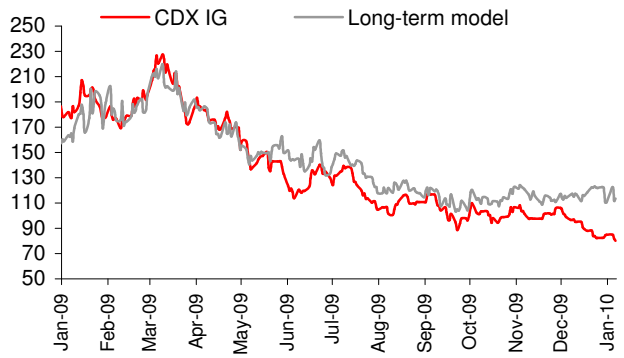
		LONG-TERM FAIR VALUE						HIGH-FREQUENCY TRADING SIGNAL				
		Price	Fair value	Spread to: Fair value	Year start	1Y Hi/Lo	z-score	Price... ...1w change	...1m change	Fair value... ...1w change	z-score
Euro	EuroStoxx 50	2942	2814	4.37%	-0.81%	------|----V-	0.85	0.38% ↗	1.13% ↗	-0.25% ↘	0.96
Euro	DJ Banks	223	213	4.66%	0.94%	------|---V--	0.97	0.41% ↗	1.68% ↗	0.01% ↗	0.41
Euro	MSCI Europe	92.3	83.4	9.61%	4.54%	------|-----V	1.82	0.94% ↗	2.92% ↗	-0.09% ↘	1.23
Euro	MSCI Eu. SmallCap	177	159	10.1%	12.5%	------|-----V	1.24	2.73% ↗	6.47% ↗	0.71% ↗	1.29
Euro	MSCI Emerging Eu.	499	478	4.14%	7.96%	------|-----V	0.44	1.83% ↗	5.21% ↗	2.07% ↗	-0.18
Euro	VDAX Index	17.6	15.0	2.59	-3.21	V-----|------	0.89	0.75 ↗	0.27 ↗	0.33 ↗	0.78
Euro	DJ Banks / Stoxx 50	7.59%	7.49%	1.31%	1.76%	-----V|------	0.19	0.03% ↗	0.55% ↗	0.26% ↗	-0.31
Euro	MSCI SmallCap / Eu.	191%	190%	0.59%	7.57%	------|-----V	0.12	1.77% ↗	3.45% ↗	0.80% ↗	1.21
US	S&P 500	1186	1073	9.57%	6.40%	------|-----V	1.89	1.45% ↗	3.56% ↗	-0.13% ↘	1.30
US	S&P Banks	363	348	4.10%	12.9%	------|-----V	0.69	4.17% ↗	7.11% ↗	-0.43% ↘	1.36
US	S&P 600 SmallCap	371	354	4.44%	11.4%	------|-----V	0.69	2.86% ↗	3.58% ↗	0.59% ↗	1.27
US	VIX Index	16.5	20.0	-3.49	-5.2	V-----|------	-1.43	-1.11 ↘	-2.09 ↘	0.12 ↗	-1.20
US	S&P Fins / S&P 500	30.6%	32.2%	-5.32%	6.09%	------|V-----	-0.87	2.68% ↗	3.42% ↗	-0.31% ↘	1.28
US	S&P 600 / S&P 500	31.2%	32.7%	-4.77%	4.72%	------|----V-	-0.49	1.39% ↗	0.02% ↗	0.72% ↗	1.05

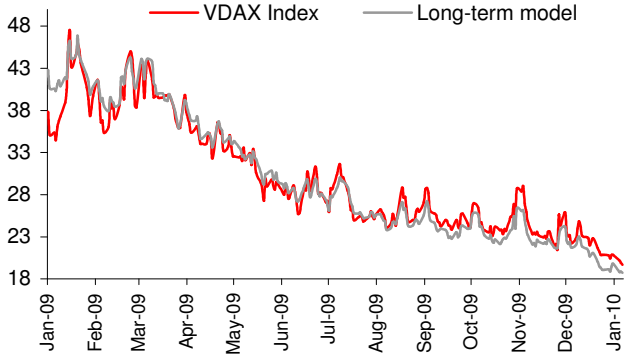
CREDIT

		LONG-TERM FAIR VALUE						HIGH-FREQUENCY TRADING SIGNAL			
		Price	Fair value	Spread to: Fair value	Year start	1Y Hi/Lo	z-score	Price... ...1w change	...1m change	Fair value... ...1w change	z-score
CDS	iTraxx Main	82.50	76.37	7.43%	10.0%	-V----|------	1.06	5.26% ↗	8.37% ↗	-2.41% ↘	1.30
CDS	iTraxx X-Over	434.00	440.91	-1.59%	-6.28%	V-----|------	-0.14	1.74% ↗	-1.81% ↘	-1.57% ↘	1.17
CDS	CDX IG	87.00	93.93	-7.96%	0.10%	V-----|------	-0.63	-1.24% ↘	0.12% ↗	-2.73% ↘	0.73
CDS	SubFin	157.50	144.18	8.46%	16.1%	--V---|------	0.53	7.24% ↗	17.7% ↗	-2.14% ↘	1.31
CDS	Germany CDS	33.00	24.50	25.8%	25.2%	-----V|------	1.17	4.76% ↗	29.4% ↗	-3.73% ↘	1.36
CDS	Japan CDS	72.00	54.35	24.5%	6.29%	------|-V----	0.98	6.67% ↗	27.4% ↗	-1.11% ↘	1.24
Curves	Main curve	12.25	12.37	-0.12bp	-5.37bp	------|--V---	-0.07	-3.07bp ↘	-3.7bp ↘	0.48bp ↗	-1.44
Curves	X-Over curve	16.00	-12.78	28.8bp	7.63bp	------|----V-	1.41	-1.38bp ↘	2.06bp ↗	1.27bp ↗	-0.78
Curves	CDX IG curve	17.00	14.53	2.47bp	-5.43bp	------|---V--	0.47	1.41bp ↗	0.41bp ↗	0.61bp ↗	0.65
Curves	SubFin curve	5.50	8.68	-3.18bp	-6.23bp	------|-V----	-0.64	-4.6bp ↘	-2.29bp ↘	0.09bp ↗	-1.60
Spreads	Adjusted basis	-2.04	-8.16	6.12bp	4.06bp	------|---V--	1.18	2.02bp ↗	-0.14bp ↘	-0.54bp ↘	0.96
Spreads	High yield/IG	5.26	5.77	-9.74%	-14.8%	V-----|------	-1.34	-3.35% ↘	-9.39% ↘	0.86% ↗	-1.26
Spreads	Financials/NonFis	1.91	1.66	13.3%	5.53%	------|----V-	1.03	1.88% ↗	8.63% ↗	-0.09% ↘	0.61
Spreads	US/EUR	1.05	1.14	-7.85%	-9.01%	V-----|------	-0.60	-6.17% ↘	-7.62% ↘	0.15% ↗	-1.32

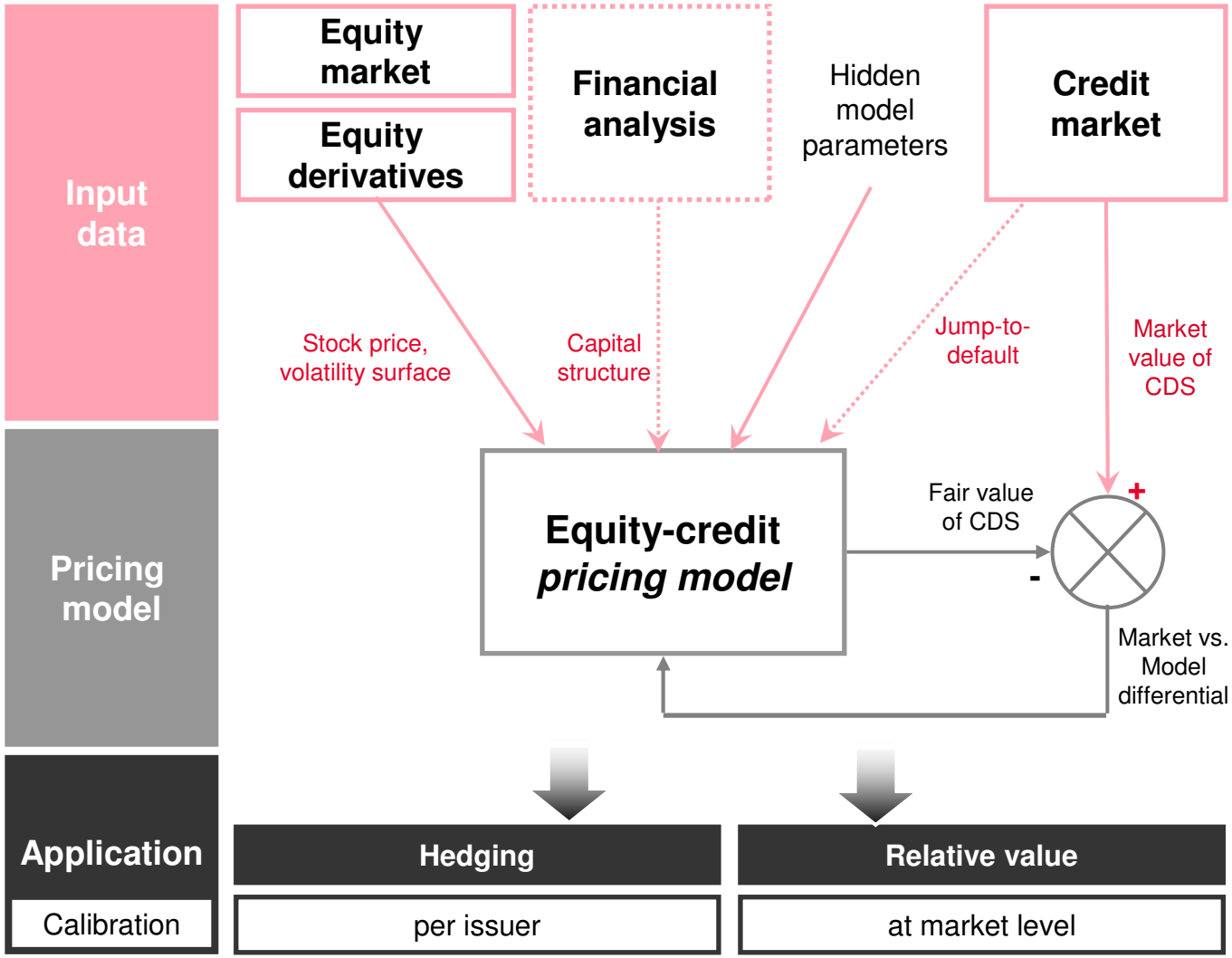
Trade idea: Buy CDX protection / Sell SX5E vol



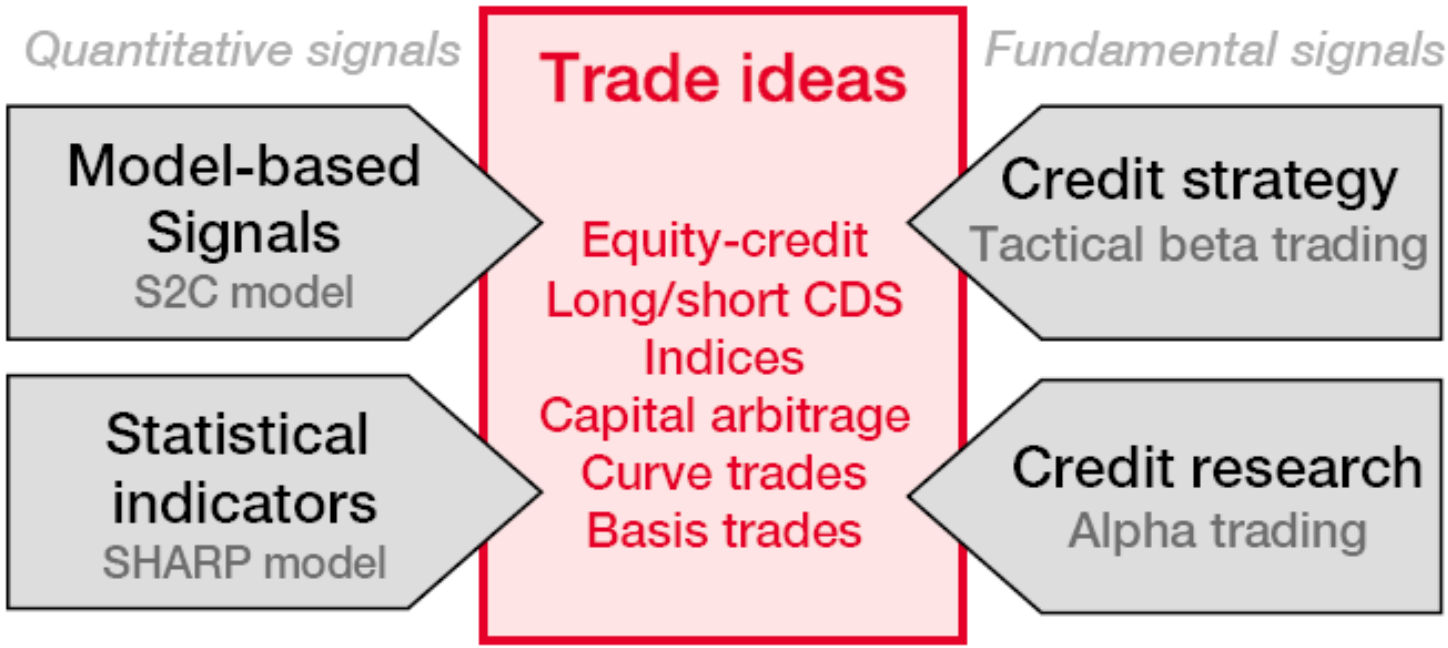




Equity-Credit models: the big picture



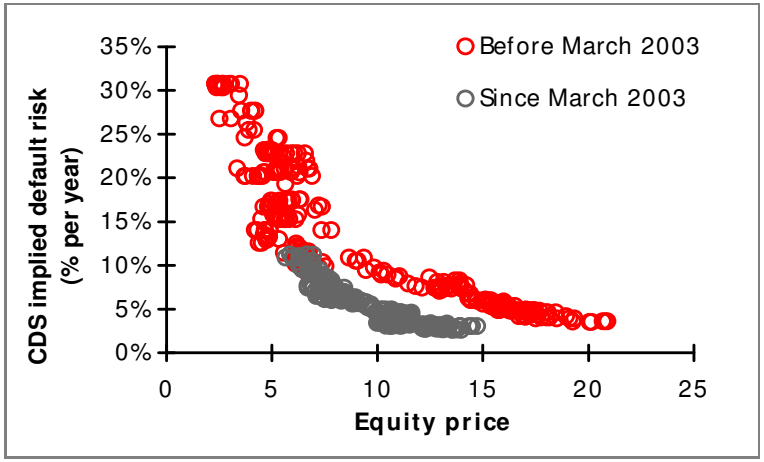
Putting the pieces together



Relating the intensity of default to Equity prices

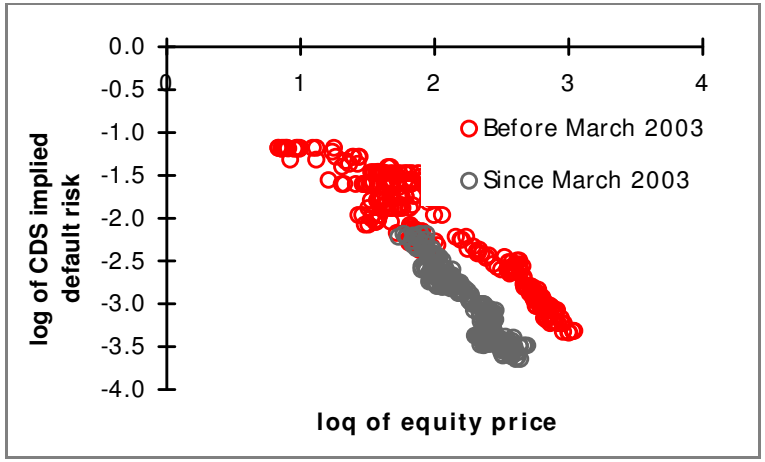
- **The model we introduce now relates directly default risk to Equity prices.**

Alcatel: implied default risk vs. stock price



Source: SG Credit Research

Log-default risk is a linear function of stock price



Source: SG Credit Research

- Empirically, there is a strong relationship between CDS-implied default intensity and stock price.
- Taking the log of default risks and equity, the relationship is linear, at least piecewise

A simple relationship

- **This suggests a simple way to model the relationship between credit risk and equities:**
  - define the log-intensity as a linear function of the log-stock price

$$\lambda(t) = \frac{b}{S^{\alpha}}$$

  - α = a scale parameter
  - b = a credit-equity sensitivity coefficient
- There are a few more points the model should take into account:
  - Pure credit component
  - Trend effect on the stock market

The EC-Hedge model

- **This leads us to a more complete relationship**

$$\lambda(t) = a + \frac{b}{\left(S\ e^{-\mu t}\right)^{\alpha}}$$

  - μ = growth rate of debt
    - Risk decreases only when stock price increases faster than debt
    - Standart assumption: μ = Swap rate (or any riskless rate). Risk decreases only when equity yields better than money market
  - a = pure credit component
    - This parameter is fixed arbitrarily at 0.1%. If recovery rate at default is assumed to be 40%, this leads to a 6bp minimum credit spread.

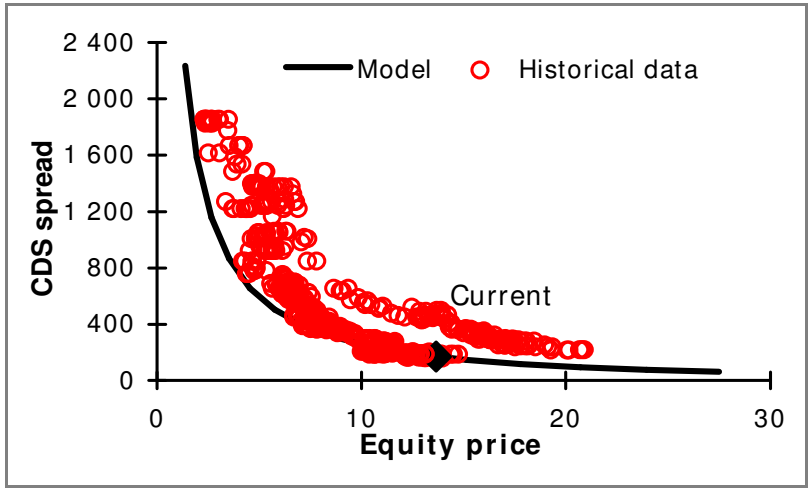
- Assumption on the dynamics of the stock price.
  - Simplifying assumption: volatility of the stock price is constant.

- Loss rate in the CDS in case of a default (60% on Senior debt)

Hedging a CDS with an equity

Case study: Alcatel 5Y CDS vs. stock

Alcatel: theoretical relationship between CDS spread and stock price



Stock price = 13.75€, 5y CDS = 168bp, 1M ATM put volatility = 41.5%
Source: SG Credit Research

- Estimated on current market data, the model helps simulate the CDS spread as a function of how the stock price might change
- It fits well with past market data
- It incorporates more recent and forward-looking market data,
  - including the current Equity implied volatility

Long CDS/ long Equity

- **Traders can buy 100€ 5y CDS protection and invest 10.4€ in stock in order to hedge directional risk.**

Hedging the CDS using equity: long CDS / long equity

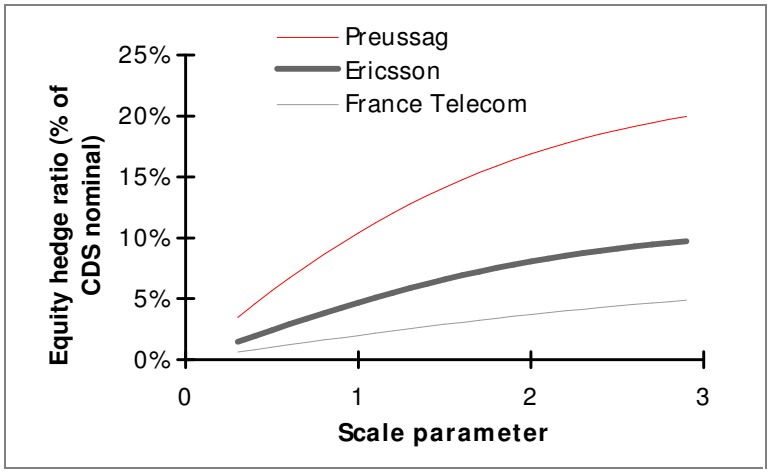
CDS nominal is 100 €<
Source: SG Credit Research

- As estimated by the model, the marked-to-market gain of the arbitrage is a convex function of the stock price.
- Therefore, the transaction would benefit from a sharp change in equity price, whatever its direction.
- In the case of Alcatel,
  - a 30% decrease in equity would bring an up-front gain as high as 4% of CDS nominal.
  - A 30% rise would bring a 2.5% gain.

Estimating the scale parameter

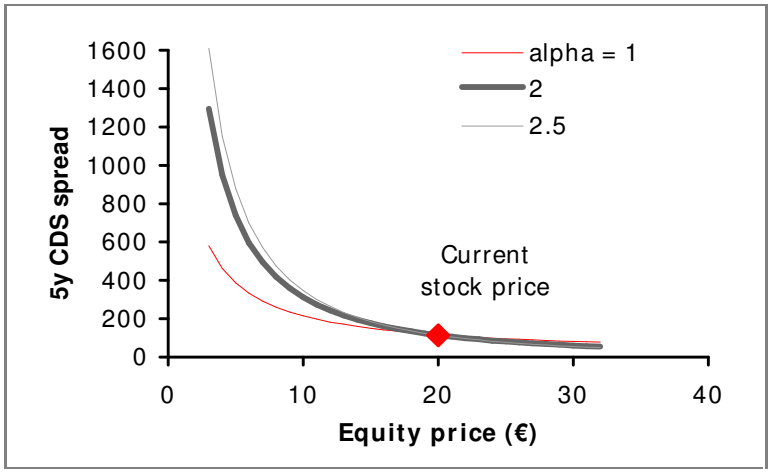
- The scale parameter (the a) quantifies how sharp changes in stock price influence credit spreads
  - The greater the extreme risks, the more extended the region in which by contrast the equity-credit relationship is not influenced by the α, and therefore the lower the impact of this parameter on hedge ratios
    - Scale parameter is closely linked to gamma

Hedge ratio is higher when scale parameter increases, but this effect tends to be smoothed…



Source: SG Credit Research

… as scale parameter impacts mainly extreme risks

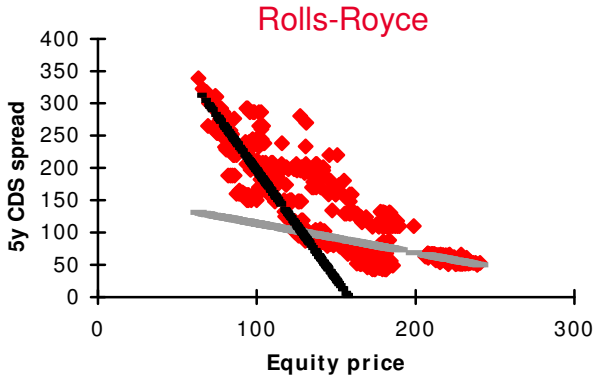


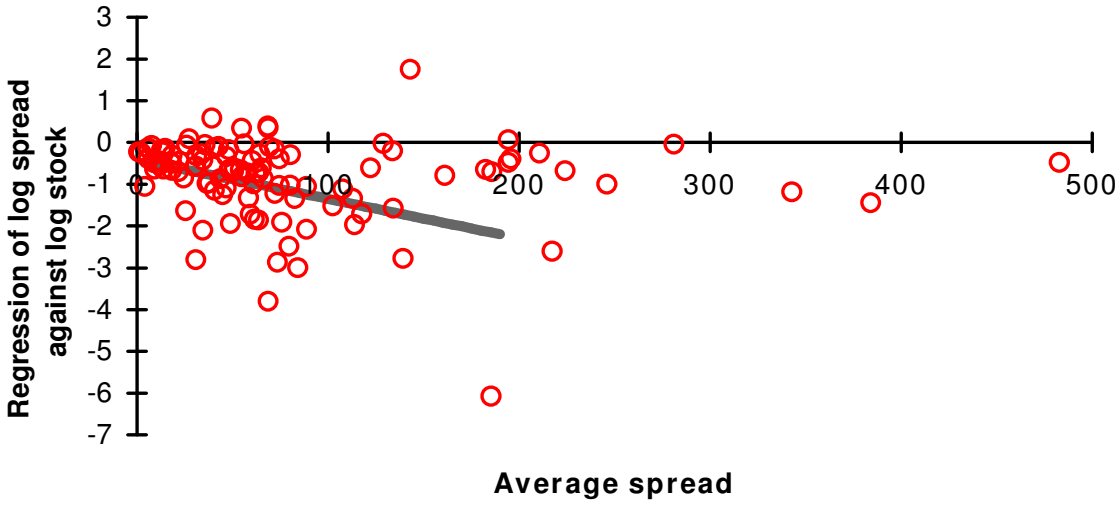
Case study on Ericsson

Source: SG Credit Research

Estimating the scale parameter

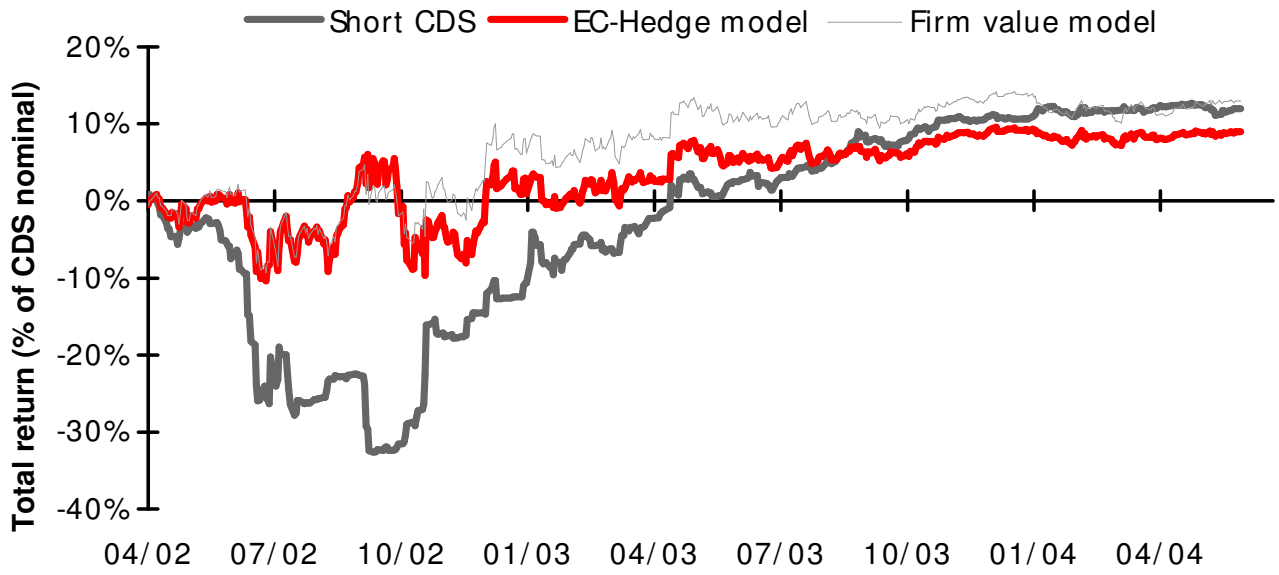
- Convexity in the 100bp-200bp area
  - an estimate at 2 is quite in line with observation on an issuer whose spread has been on average around 100-200bp





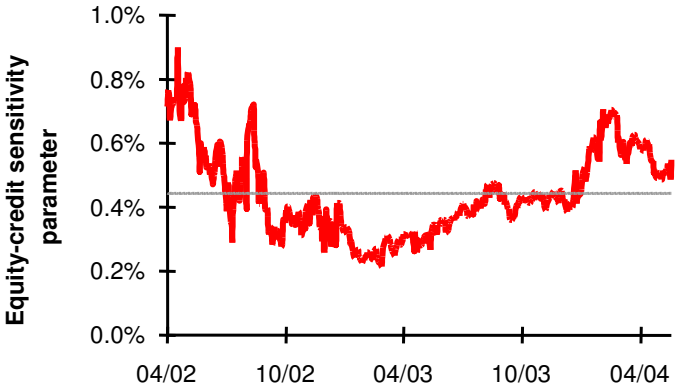
Case study: Alcatel

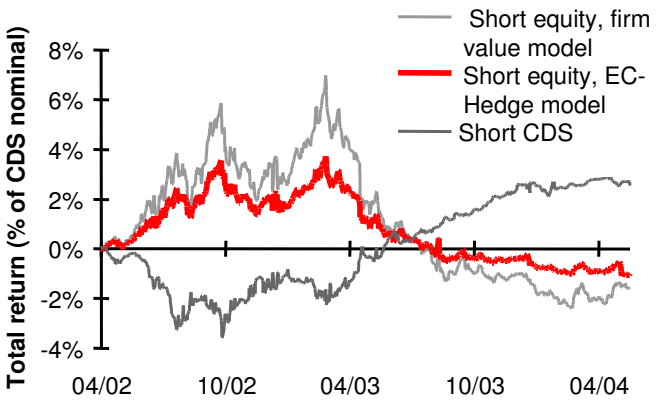
- Hedging strategy leads to a strong reduction in volatility
- Positive trend on a short CDS/ short stock:
  - Credit outperformance
  - Capital increase



Backtesting analysis

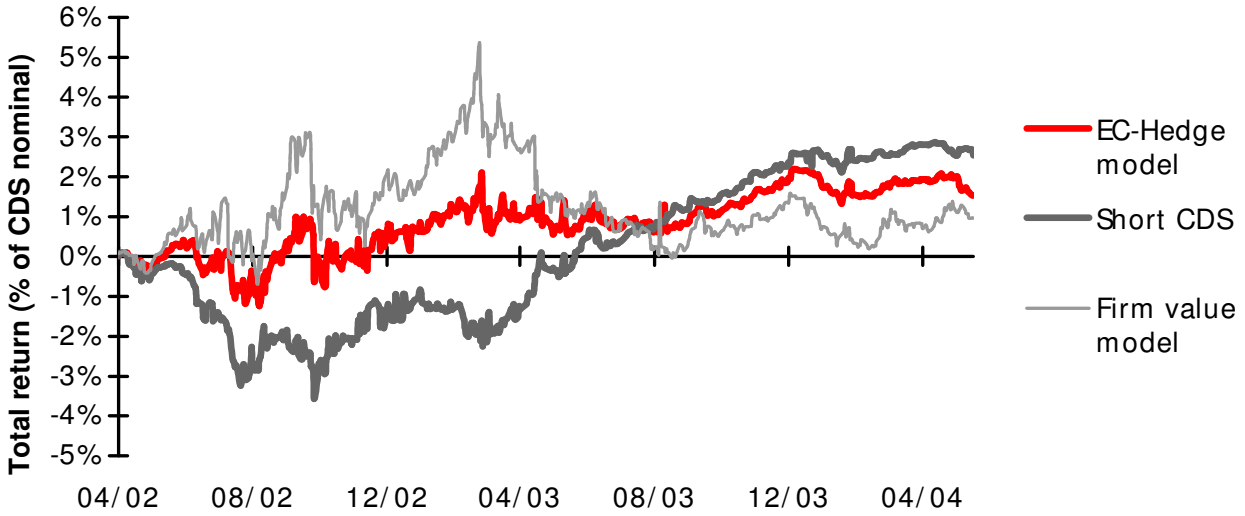
- **Backetsting on a basket of 11O € issuers**
- **We first test the stability of the equity-credit sensitivity parameter**
  - our choice for the scale parameter may be too high indeed
  - However, a lower scale parameter would lead to a lower hedge ratio that may not be able to offset spread changes during a crisis
- **Firm value approach: delta is too high during the 2002 crisis**





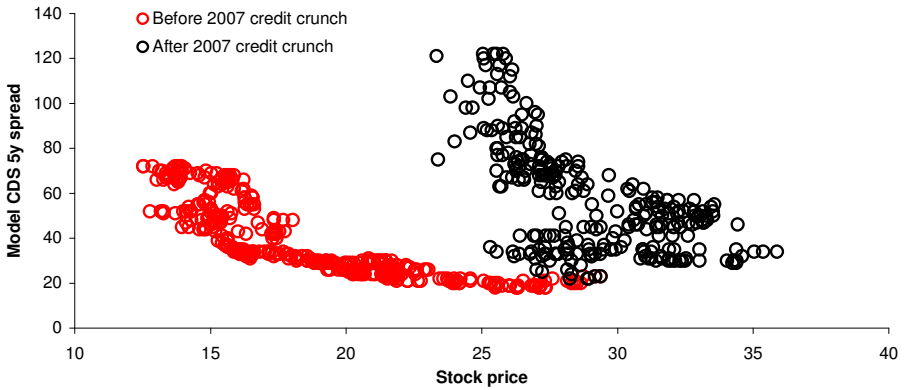
Final verdict

- Hedging strategies help to stabilize performance and keep it bounded within a reasonable range
- Compared to a standard firm value model, our EC-Hedge model brings a significant improvement to the efficiency of hedge ratios.
  - A key point here is its ability to take profit from information brought by equity options



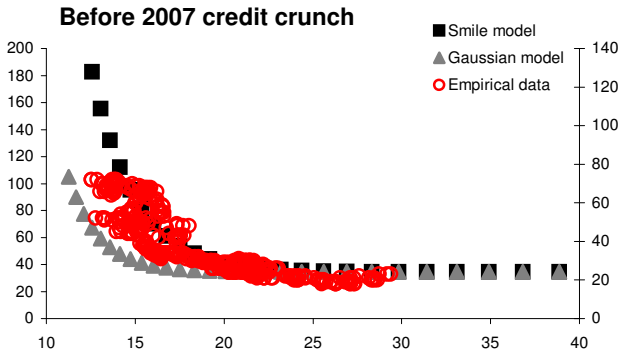
CDS vs. Stock: modelling a changing relationship

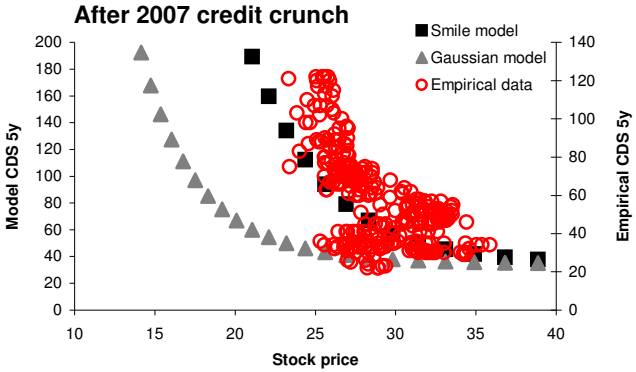
- **Standard firm value models do not capture CDS' convexity**
- **A smile model is necessary…**
- **… with enough flexibility to adapt to changing markets**



Low Vol

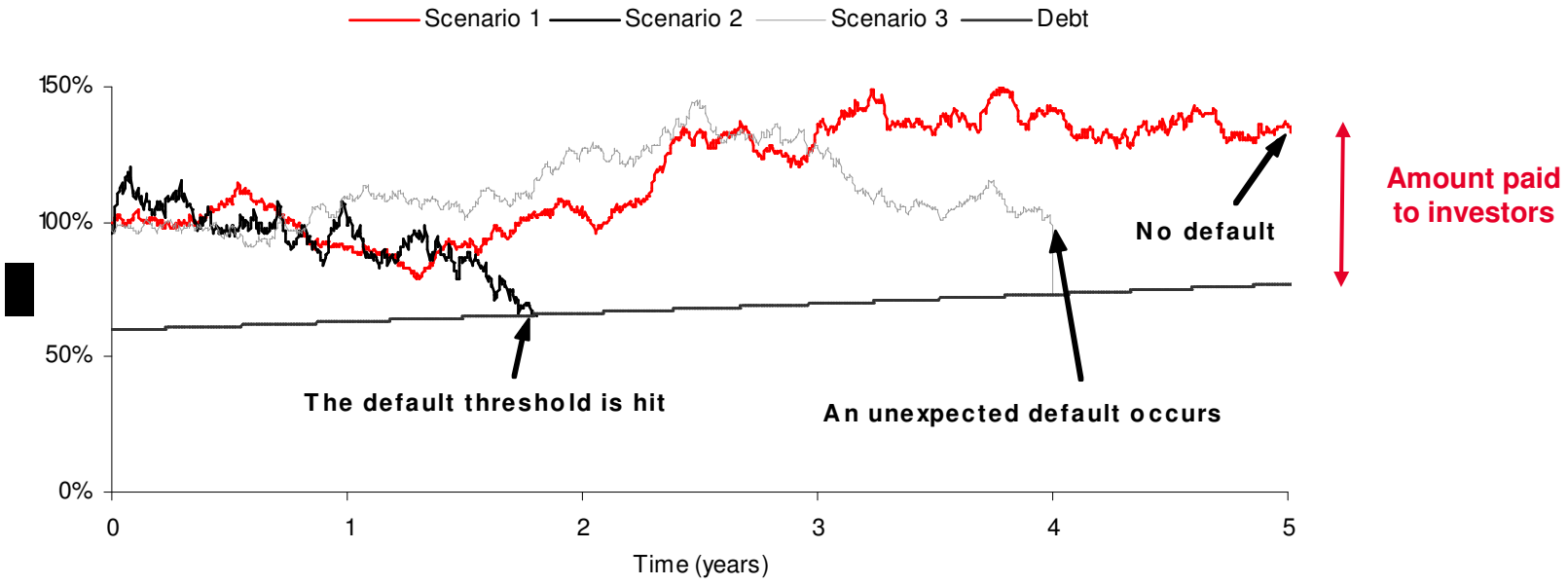
High Vol





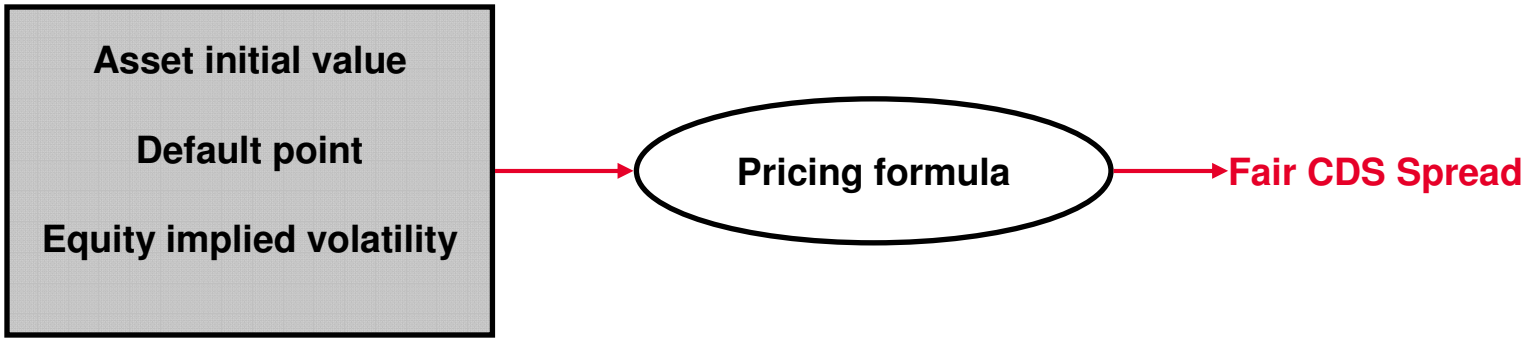
Equity-Credit modelling: the theoretical approach

- **Merton-like frameworks can be used to model a « default » event through a set of scenarios on the stock price**
  - The default threshold can be linked to the company's debt



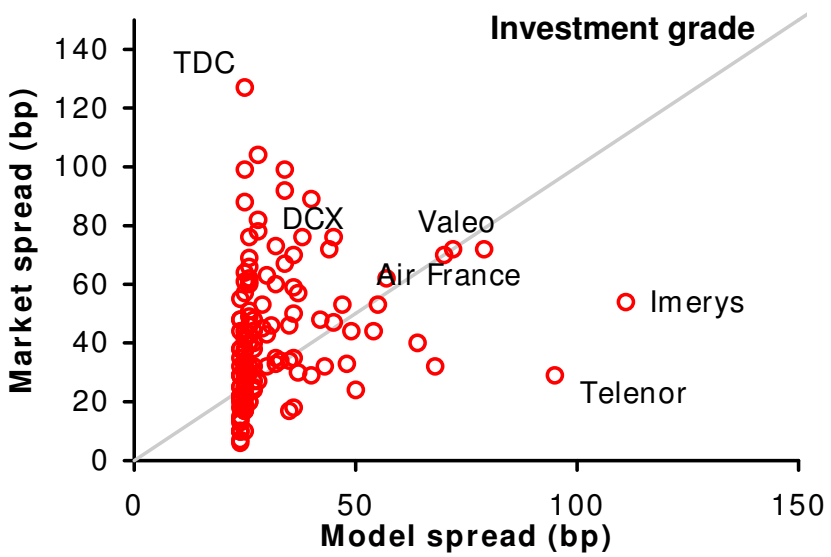
A first simple Equity-credit model

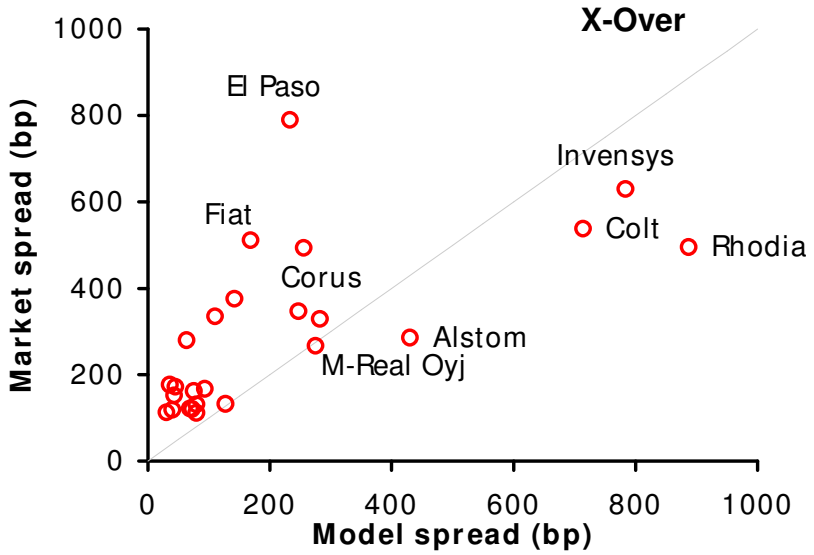
- **A first simple model makes the company's Firm value a Black & Scholes process with jumps**
  - Let us denote by μ the trend, σ the volatility, and λ the intensity of the jump
- **With a constant jump intensity, the survival probability can be obtained with closed-form formulas as the price of a binary down-and-out option**



Pricing power: constant jump intensity model

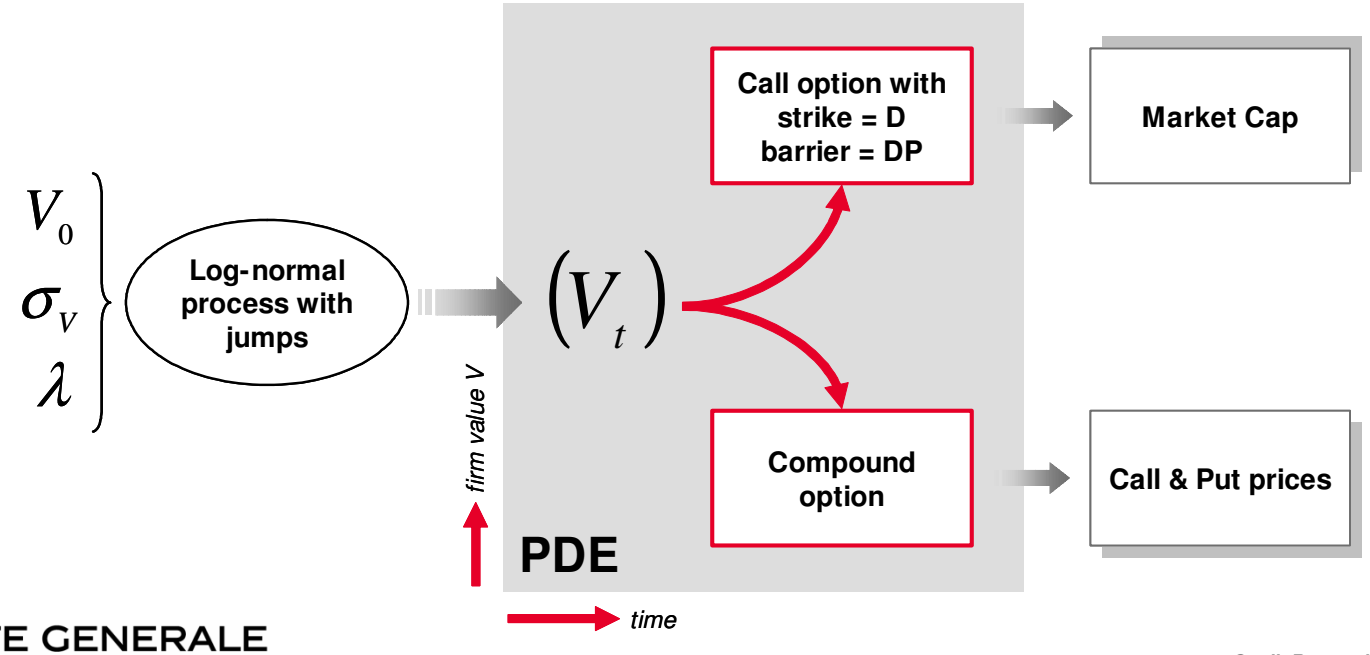
- **With a constant jump intensity, the model does not fit extremely well to market data**
  - Model underestimates the steepness of the equity volatility smile
  - Hard default risk should increase with credit spreads
  - This makes the model recursive: spreads depend on hard default risk, which itself depends on spreads





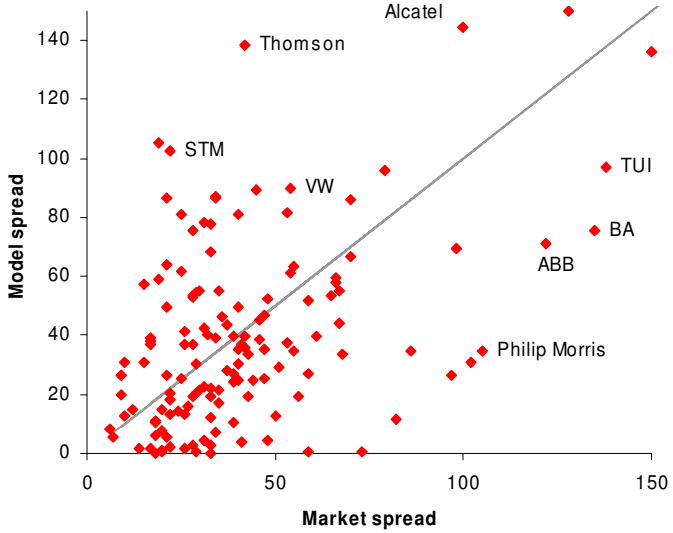
Equity-Credit modelling: another attempt

- **The Market cap of the company is defined as the price of a call option on the firm value with a strike equal to the default point at maturity**
  - This allows calibrating the initial value of the Firm value V_0
- **Standard equity options are compound options on the Firm value**
  - This allows calibrating the Firm value volatility σ_V, and hard default rate λ to the implied volatility and to the volatility skew



Pricing power: stochastic jump intensity model

- **The pricing power is improved, especially in the Investment grade universe**
  - Relating the hard default to the distance to default allowed a better pricing of tighter spreads



- **Main issues**
  - Weak link to balance sheet dat
  - Poor pricing of the CDS curve
  - Poor modelling of the CDS convexity

Cross-asset quant research

The S2C model

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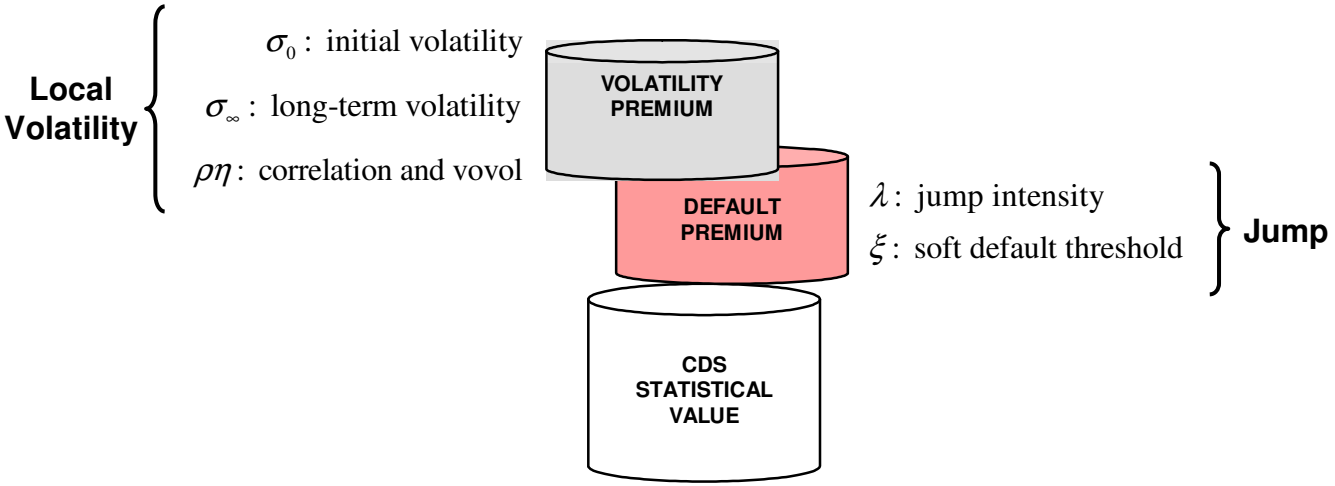
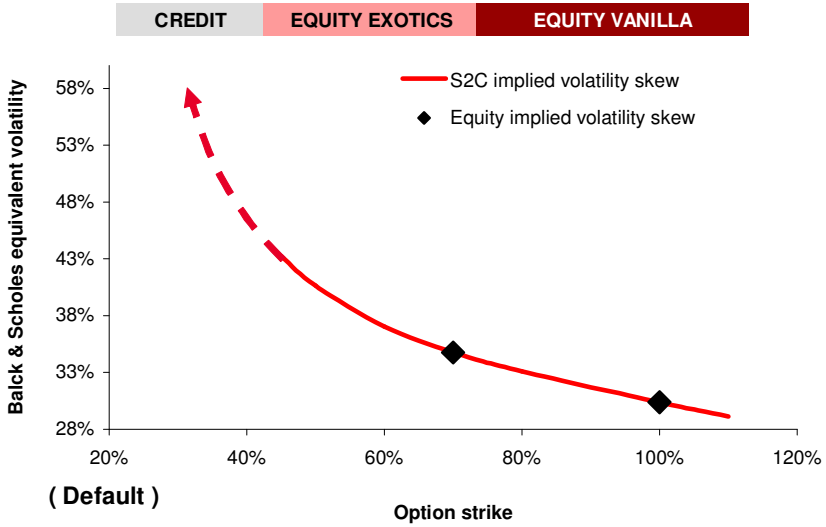
Introducing the S2C model

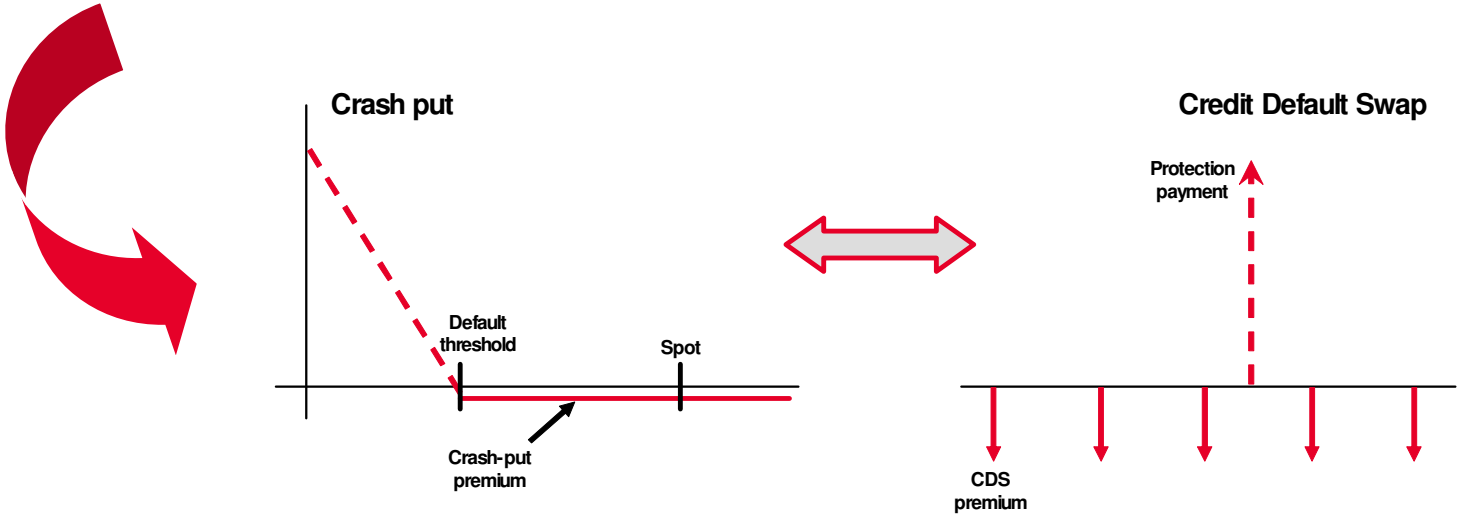
- **Local volatility: projected Heston model**
  - Understanding the vanilla option smile
- **Adding jumps…**
  - … to understand CDS spreads
- **Calibration challenge**



S2C has separate smile dynamics for equity and credit

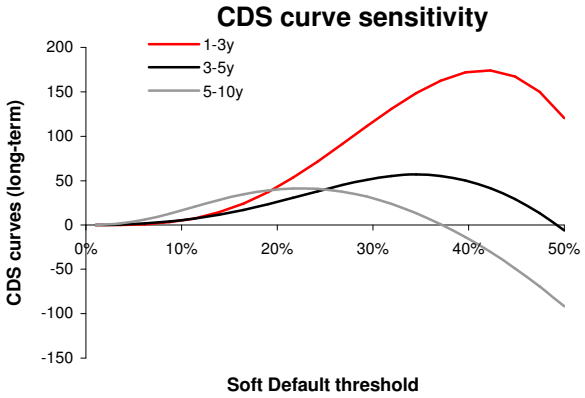


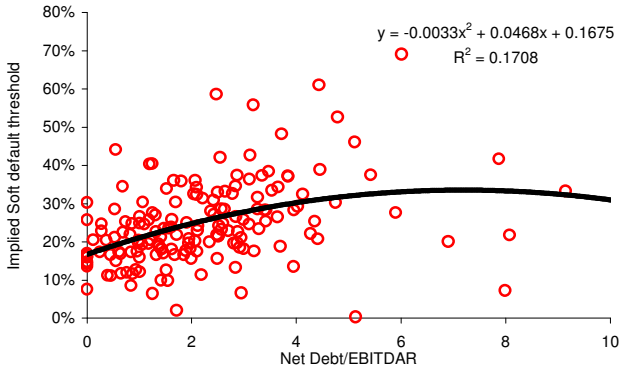
- **We need two distinct smile components:**
  - One for vanilla equity options…
  - … and one for credit derivatives

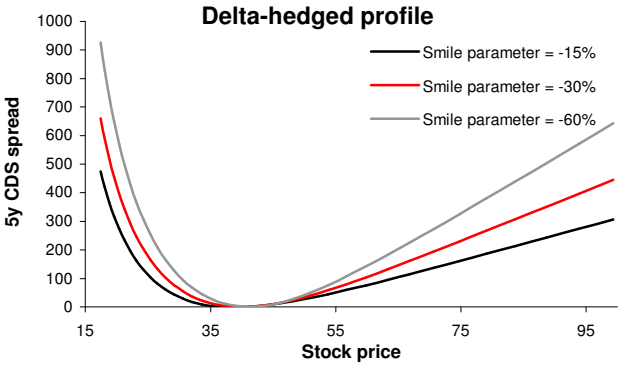


Some features of the S2C model

- **Locating the inflexion point in CDS curves**
- **Estimating CDS' convexity**
- **Relating to fundamental analysis**
  - Default threshold vs. Net Debt / EBITDAR
  - Jump intensity vs. Liquidit ratios

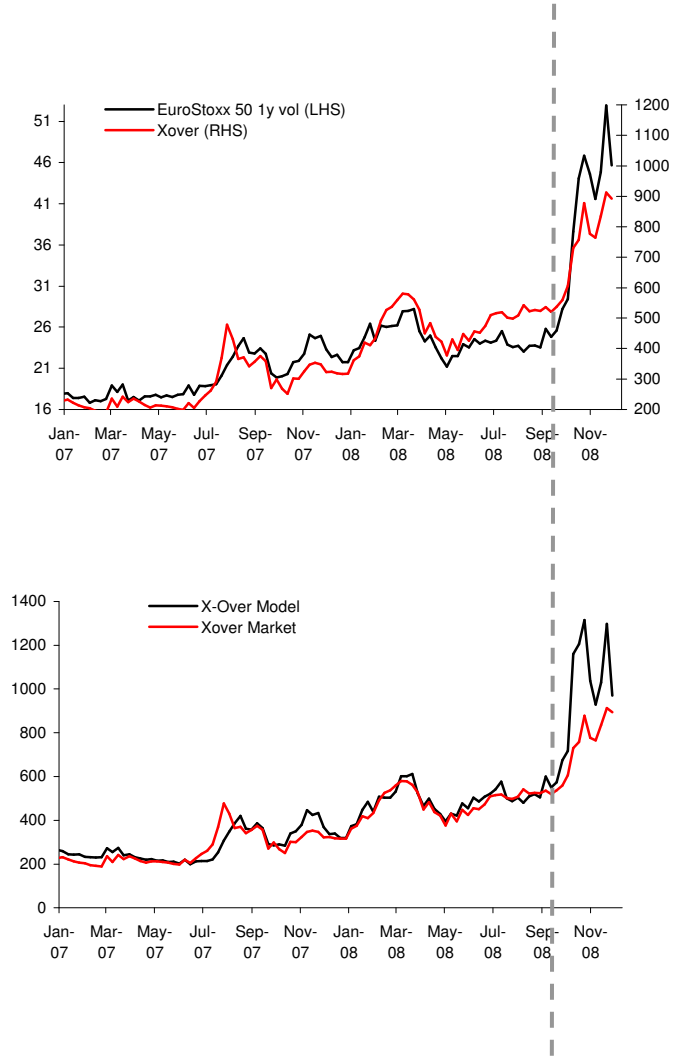






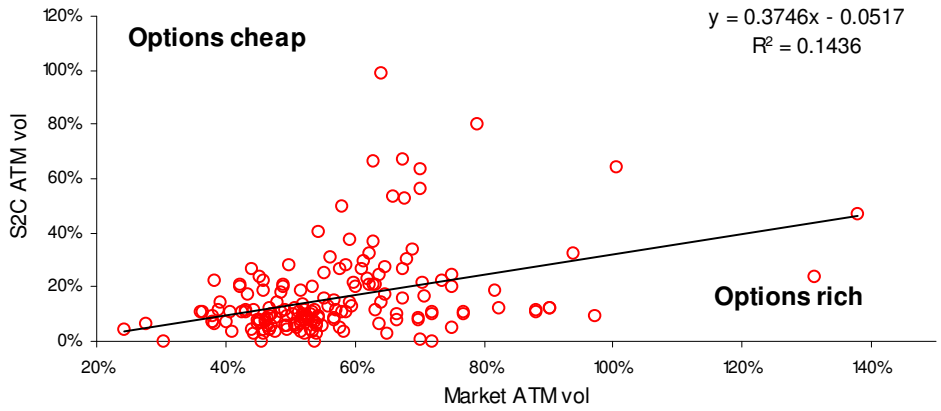
Fitting the model – June'09

- **CDS spreads and volatility have been well correlated since the beginning of 2008**
  - Consistent with a high-volatility regime
- **Following Lehman's failure, the jump in volatility created a sharp equity-credit dislocation**
  - Statistical models provide a biased quantification of the dislocation
  - Equity-credit models are more difficult to calibrate to both vanilla options and CDS curves



Quantifying the CDS/Vol dislocation

- **Following Sep-08 dislocation, the S2C model doesn't provide a perfect simultaneous fit to both vanilla options and CDS curves**
  - Similarly to the statistical approach, volatility is found too high
  - The model can be calibrated to CDS curves only and used to value theoretical volatility levels in a second step



- **Our conclusion**
  - The base level of volatility is too high but the volatility smile is too flat. This means credit overweighs extreme events compared to vanilla options.

Conclusion

- **A statistical approach to equity-credit gives a good indication for hedge ratios but suffers from market dislocations**

- **Flexible equity-credit models can capture information from vanilla options and CDS spreads and adapt to changing environments**

- **The current situation doesn't allow to properly calibrate an equity-credit model**
  - CDS-implied volatilities are much lower than market volatilities…
  - … but CDS-implied volatility smiles are much steeper

Cross-asset quant research

December 2008

The Equity-Credit Monitor

Inside the S2C model

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The S2C model in practice

Sensitivities & prices

List of companies

Market inputs

Model outputs

Model signals

Timing indicator

1) Market inputs

n CDS Spreads & volatility smile

CDS 1Y	CDS 3Y	CDS 5Y	CDS 7Y	CDS 10Y	Stock	Market v	OTM vol	OTM stri	Maturity	1Y Skew
71	74	**72**	69	67	17.96	**41.10%**	44.85%	80.00%	1	9.13%
110	116	**125**	118	110	30.595	**38.44%**	42.06%	70.00%	1	9.42%
92	99	**105**	101	98	45.76	**40.17%**	45.99%	80.00%	1	14.47%
123	133	**140**	130	125	46.92	**41.46%**	53.22%	70.00%	1	28.36%
1584	1629	**1521**	1323	1183	4.77	**83.69%**	88.96%	80.00%	1	6.30%
251	275	**270**	265	260	4.87	**64.55%**	73.18%	70.00%	1	13.37%
223	240	**240**	235	230	4.87	**64.55%**	73.18%	70.00%	1	13.37%
499	584	**632**	626	617	10.37	**62.75%**	65.90%	80.00%	1	5.02%
59	69	**78**	73	71	25.33	**52.81%**	56.23%	80.00%	1	6.47%
86	91	**100**	100	100	8.488	**29.37%**	34.70%	75.00%	1	18.14%
386	435	**405**	385	365	10.805	**48.60%**	50.89%	70.00%	1	4.71%
46	48	**51**	52	54	66.025	**30.20%**	36.79%	70.00%	1	21.80%
555	570	**618**	594	578	17.88	**77.09%**	81.27%	80.00%	1	5.42%
61	76	**82**	83	85	33.44	**36.55%**	44.36%	70.00%	1	21.38%
566	703	**760**	733	713	1.941	**60.91%**	63.39%	70.00%	1	4.07%

2) Model outputs

Market model

where the CDS spread should be trading based on financial ratios?

Calibration results

Is it possible to explain both CDS spreads and volatility ?

Default threshold & Financial ratios

Volatility signals

Default barrier (%stc	Net Debt/EBITDA (mo	Net Debt/EBITDA (ac	S2C CDS spread	CDS Market-moc	Market volatility	S2C volatility	Model-market
7.12%					41.10%	41.27%	-0.1%
5.00%					38.44%	38.23%	-0.9%
5.00%					40.17%	40.17%	-0.4%
5.00%					41.46%	41.45%	-0.3%
25.94%	8.72				83.69%	78.51%	-0.4%
5.00%					64.55%	57.10%	-4.9%
5.00%					64.55%	59.09%	-3.0%
36.67%	14.33	5.16	206	426	62.75%	63.02%	2.6%
5.00%					52.81%	48.26%	-3.5%
14.48%	2.73	1.21	75	25	29.37%	33.82%	2.7%
22.64%	7.00	7.27	415	-10	48.60%	49.95%	1.9%
10.99%	0.91	2.84	75	-24	30.20%	32.09%	0.3%
18.80%	4.99				77.09%	68.77%	-4.3%
7.41%		3.57	191	-109	36.55%	36.54%	-0.9%
36.40%	14.19	9.22	449	311	60.91%	56.47%	-2.4%
10.27%	0.53				65.25%	55.98%	-6.7%
5.00%					41.28%	41.06%	-0.5%
5.00%					41.28%	41.23%	-0.4%
5.00%					49.28%	45.98%	-2.6%
7.96%					45.60%	45.41%	0.0%
15.18%	3.10	1.47	64	27	28.62%	28.53%	-1.9%
14.81%	2.91	1.47	64	23	28.62%	28.53%	-1.9%
49.17%	20.85				156.16%	161.56%	19.0%

3) Model signals and timing

Market model results
based on financial ratios
(S2C model spread)

Volatility signal
if we can't explain both
CDS and equity smile

Timing indicators

Trading Recom ndations | Market Timing (Weekly changes)

Balance sh	Volatility	Fundamental credit opini	Fundamental CDS re	Market CDS	Stock price (%	Volatility 1y AT	S2C volatility	OTM volatili	Volatility ske
	BUY CDS	Stable	Neutral	-8.00	2.6%	-1.5%	-1.3%	-2.3%	0.7%
	BUY CDS	Stable	Neutral	-23.00	-3.0%	-3.0%	-3.0%	-9.9%	-2.9%
	BUY CDS			-14.98	4.4%	-1.5%	-1.5%	-1.5%	-0.1%
	BUY CDS	Negative	Buy	-15.00	-1.3%	-0.9%	-0.9%	-0.1%	1.9%
	BUY CDS			-423.00	9.9%	-11.2%	-11.9%	-10.3%	-0.2%
	BUY CDS	N/A	N/A	-35.00	5.7%	-4.4%	-2.1%	6.9%	1.1%
	BUY CDS	N/A	N/A	-40.00	5.7%	-4.4%	-3.7%	3.2%	1.1%
SELL CDS	SELL CDS			-150.00	18.4%	1.4%	-4.1%	1.3%	-0.8%
	BUY CDS			-17.46	1.2%	-2.3%	-1.4%	3.3%	0.9%
SELL CDS	SELL CDS	Positive	Neutral	-22.00	-1.4%	-0.5%	-0.5%	-6.7%	-8.2%
BUY CDS	SELL CDS	Negative	Neutral	5.00	1.2%	-0.9%	-1.6%	-12.5%	0.0%
BUY CDS	SELL CDS	Stable	Neutral	-12.00	2.0%	-1.0%	-0.7%	-3.2%	0.3%
	BUY CDS			-84.00	35.1%	-7.3%	-0.3%	6.3%	1.0%
BUY CDS	BUY CDS	Stable	Buy	-17.00	0.4%	-0.5%	-0.5%	-1.1%	-0.1%
SELL CDS	BUY CDS	Negative	Neutral	-46.70	9.7%	-2.0%	-1.5%	5.4%	2.0%
	BUY CDS			-40.00	23.3%	-1.4%	-1.0%	4.4%	0.7%
	BUY CDS	Positive	Neutral	-19.00	4.0%	-3.4%	-2.7%	-3.4%	1.8%
	BUY CDS	Positive	Neutral	-13.00	4.0%	-3.4%	-2.9%	-3.5%	1.8%
	BUY CDS			-30.14	-4.3%	-2.1%	-1.0%	1.1%	0.1%
	SELL CDS	Stable	Neutral	-18.00	2.8%	-4.0%	-4.0%	-12.4%	-0.1%
SELL CDS	BUY CDS	Positive	Neutral	-7.75	2.4%	0.7%	0.6%	-2.2%	-1.2%
SELL CDS	BUY CDS	Positive	Neutral	-7.49	2.4%	0.7%	0.6%	-2.2%	-1.2%
	SELL CDS			-298.00	6.8%	-12.8%	-6.0%	-21.1%	0.6%
BUY CDS	BUY CDS			-8.97	3.7%	-0.5%	-0.5%	-2.7%	0.4%

SG Credit research recommendation

4) Sensitivites

- **All the model sensitivities:**
  - Delta
    expressed for a €1 movement in the stock
  - Gamma
  - Vegas
  - Jump-to-default
- **Some other useful data:**
  - Option prices

Last update: sell CDS

Reference entity	Ticke	Sector	CDS 5Y	Market vol	S2C vola	Fundament	Fundamen	Market C	Stock price	Volatility
Telecom Italia	TIT IM	Telecom	91	29%	48%	Positive	Sell	-6	-3,8%	5,2%
Prosiebensat1 Media	PSM GF	Media	547	43%	53%	Negative	Neutral	-28	3,5%	4,0%
Stora Enso	STERV I	Industrial & Building Mat	286	34%	43%			6	-1,8%	11,4%
M-Real	MRLBV	Industrial & Building Mat	891	43%	50%	Negative	Neutral	-41	-2,5%	14,8%
Banca Monte dei Paschi di Sien	BMPS IM	Financials	93	24%	33%	Negative	Buy	-16	4,8%	0,8%
Banca Monte dei Paschi di Sien	BMPS IM	Financials	66	24%	32%	Negative	Buy	-5	4,8%	0,8%
Banco Comercial Portugues	BCP PL	Financials	73	27%	35%	Stable	Neutral	-4	2,1%	-1,4%
Rhodia	RHA FP	Chemical & Pharma	342	35%	42%	Stable	Sell	0	-0,5%	-6,1%
Banco Comercial Portugues Sut	BCP PL	Financials	114	27%	35%	Stable	Neutral	-16	2,1%	-1,4%
Seat Pagine Gialle	PG IM	Media	1076	53%	57%	Negative	Buy	1	7,6%	
Colt Telecom Group	T6C GR	Telecom	149	30%	37%			0	0,7%	-3,2%
Sol Melia	SOL SM	Travel & Leisure	378	37%	43%	Negative	Buy	-20	-3,6%	
Hannover Re Sub	HNR1 GI	Insurance	70	25%	32%	Positive	Neutral	-6	-4,5%	-2,5%
CIR	CIR IM	Consumer Goods	325	30%	37%			-15	1,1%	-1,5%
TUI	TUI1 GR	Travel & Leisure	788	50%	54%	Negative	Neutral	-99	4,1%	14,0%
Hannover Re	HNR1 GI	Insurance	51	25%	32%	Positive	Neutral	-1	-4,5%	
Unicredito Italiano	UCG IM	Financials	77	34%	40%	Stable	Neutral	-10	-2,9%	11,1%
Intesa San Paolo	ISP IM	Financials	52	29%	35%	Stable	Sell	-1	0,0%	-4,4%
Intesa San Paolo Sub	ISP IM	Financials	82	29%	35%	Stable	Sell	-8	0,0%	-1,9%
Generali Sub	G IM	Insurance	74	24%	32%	Stable	Neutral	-16	-2,0%	-1,2%
Ahold	AH NA	Retailers	72	22%	29%	Positive	Sell	2	-0,9%	-0,9%
Unicredito Italiano Sub	UCG IM	Financials	115	34%	40%	Stable	Neutral	-18	-2,9%	0,4%
Fresenius AG	FME GR	Chemical & Pharma	164	23%	30%	N/A	N/A	-10	-0,6%	
Havas	HAV FP	Media	186	34%	40%	Stable	Neutral	-35	5,2%	

SG leader in Global Cross Asset Research

Strategy & Cross Asset

EXTEL SURVEYS 2009
IDENTIFYING EXCELLENCE

#1 Global Strategy
#1 Cross Asset Research
#1 SRI Research

Equity

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#1 Research on French Equity
#1 Thematic Research
22 sector teams in the Top 10

Fixed Income

EUROMONEY 2009

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#1 in 11 out of 14 categories

Economics

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#2 Research in Metals
#3 Research in Power and Gas

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Equity Derivatives Research
#3 Flow Product
#3 Structured Product

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