

IV Jornada de Riesgos Financieros RiskLab Madrid

| A Black Litterman approach to Credit Derivatives Portfolios

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Optimal Portfolios and Market Views

- **While Derivatives can create complex and highly non-linear payoffs they are generally not the primary source of risk for an enterprise**
- **Tools to understand and incorporate statistical measures of portfolio risk management have been lagging**
- **Black Litterman basic idea that we can look for optimal portfolio weights reflecting the uncertainty on the equilibrium portfolio and incorporate some market view from the Investor as opposed to the mean-variance approach**

Agenda

Current correlation estimation

Dynamic Credit Modelling

MTM challenge . Alternatives .

Our View

Current correlation estimation

Current correlation estimation

- **Alternatives . Asset correlation . Equity correlation . Default correlation . Spread correlation .**
 - **Pairwise Asset correlation .**
 - **Forecasting . KMV . Kamakura .**
- **KMV**
 - **Pairwise correlation estimates .**
 - **From Pairwise correlation to Beta .**
- **Portfolio Beta . Universal Beta .**
 - **Inputs . Outputs .**
 - **Application to the IBOXX Europe**
 - **Application to more complex derivatives ie CDO²**

THE CHOICE OF A REALISTIC CORRELATION ESTIMATE IS A POSTULATION

Correlation estimation

IBOXX EUROPE CORRELATION			
Notes/Assumptions			
		% of total	
No of unmapped names	4	4%	
Mapped Names	96	96%	
Results			
Average pairwise correlations		18.88%	
Std Dev of pairwise correlations		7.04%	
Average Beta		19.85%	
Std Dev of Betas		9.03%	
Companies			
Company	ID	Betas	Pairwise Correlations
ACCOR	G10000	0.1575	1 0.181373 0.176959 0.090785
AEGON N.V.	G12895	0.2454	0.181373 1 0.245015 0.103968
AKZO NOBEL N.V.	G12829	0.2042	0.176959 0.245015 1 0.108274
ALLIED DOMEQC PLC	G13548	0.0692	0.090785 0.103968 0.108274 1
ALTADIS SA	G10584	0.1965	0.17805 0.205686 0.20728 0.100694
ANGLO AMERICAN PLC	W21777	0.1628	0.140066 0.140726 0.169792 0.183141
ASSA ABLOY AB (PUBL)	G18753	0.1040	0.125925 0.134359 0.154508 0.078345

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Correlation estimation

UNIVERSE CORRELATION			
Notes/Assumptions			
	Universe is defined in CPT (tool developed by Structures)		
	Note that names like Korea etc will not be found in KMV		
	FTD names excluded		
			% of total
	No of unmapped names	76	9%
	Mapped Names	748	91%
Results			
	Average pairwise correlations		18.07%
	Std Dev of pairwise correlations		8.01%
	Average Beta		19.27%
	Std Dev of Betas		10.20%
Appendix			
	KMVName	KMVID	Betas
	AETNA INC	8140	0.51243
	AIR PRODUCTS & CHEMICALS INC	9158	0.19726
	BRISA-AUTO ESTRADAS DE PORTUGAL, S.	W12410	0.09891
	ALBERTO-CULVER CO -CL B	13068	0.14273
	ALBERTSONS INC	13104	0.15092

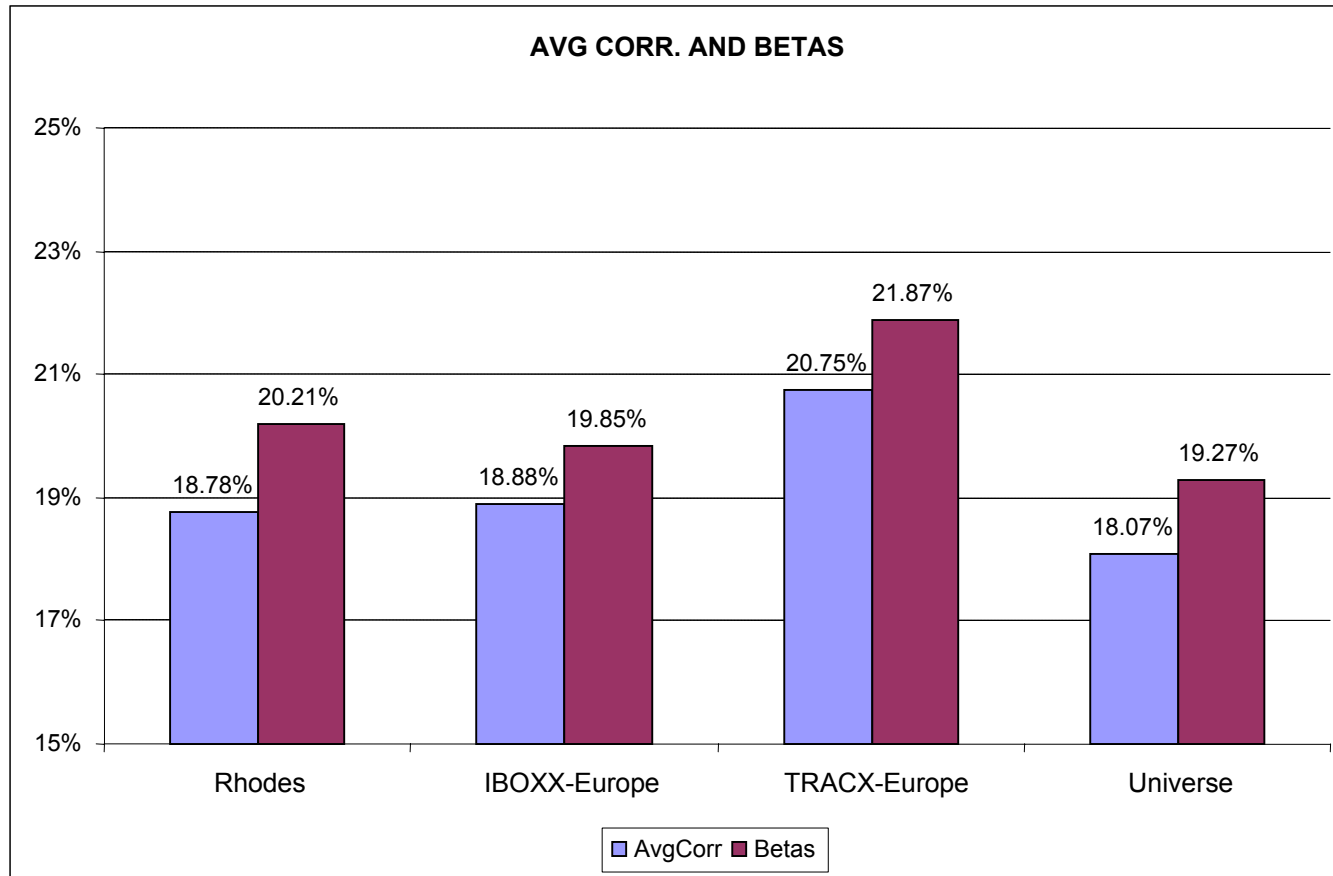
THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Correlation estimation

TRACX EUROPE - CORRELATION			
Notes/Assumptions			
		% of total	
No of unmapped names	4	4%	
Mapped Names	96	96%	
Results			
Average pairwise correlations		20.75%	
Std Dev of pairwise correlations		8.25%	
Average Beta		21.87%	
Std Dev of Betas		10.47%	
Companies			
Company	ID	Betas	Pairwise Correlations
THOMSON CORP	C10323	0.0713	1 0.092441 0.127677 0.106418
ACCOR	G10000	0.1468	0.092441 1 0.208411 0.228899
BAYERISCHE MOTOREN WERKE AKTIENGESE	G10010	0.2813	0.127677 0.208411 1 0.247093
LAFARGE S.A.	G10019	0.2027	0.106418 0.228899 0.247093 1
BAYER AG.	G10035	0.2397	0.112695 0.197473 0.320022 0.233794
DEUTSCHE LUFTHANSA AG	G10045	0.2457	0.124261 0.190601 0.309547 0.22429
CARREFOUR	G10150	0.1636	0.100311 0.205361 0.217223 0.237356
SUEZ	G10241	0.1742	0.099322 0.205636 0.219548 0.237466
E.ON AG	G10255	0.2060	0.108912 0.169274 0.279847 0.1986
CONTINENTAL AG	G10259	0.3059	0.129759 0.223257 0.378983 0.265936

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Correlation estimation



THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Realistic Credit Modelling

- The Hybrid Model .
 - Inputs
 - Universal application
 - Application to the IBOXX Europe
- The One Factor Gaussian copula (Conditional loss model) :
 - Inputs
 - Application to the IBOXX Europe
 - Not usable for CDO²
- The large portfolio approximation .
 - Inputs
 - Application to the IBOXX Europe
 - Base correlation in this context

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Index Information

- Itraxx
 - 125 European names
 - Average Spread 44.8 bps
 - Average Asset Correlation = 19.5 % . Average Beta = 20.9%
- CDX
 - 125 US names
 - Average Spread 61.1 bps
 - Average Asset Correlation = 25.2% Average Beta = 26.6 %
- Market tranche information
 - iTracXX .
 - CDX .

INDEX INFORMATION IN THE CONTEXT OF EMPIRICAL INFORMATION

Index Information

#	Index / Tranches	Running Bid / Offer	Upfront Bid / Offer	Compound Correlation Bid / Offer	Base Correlation Mid	Delta Mid
	DJ iTraxx Europe Sep-09	45.0bp				
1	0.0% - 3.0%	500.0 / 500.0bp	29.0 / 30.6%	20 / 18%	19%	16.4
2	3.0% - 6.0%	195.0 / 210.0bp	/	3 / 4%	28%	7.2
3	6.0% - 9.0%	86.0 / 92.0bp*	/ *	15 / 16%*	33%	3.6
4	9.0% - 12.0%	51.0 / 56.0bp*	/ *	22 / 24%*	36%	2.3
5	12.0% - 22.0%	20.0 / 23.0bp	/	28 / 30%	46%	1.0
6	3.0% - 100.0%	14.0 / 15.0bp	/	17 / 19%		

INDEX INFORMATION IN THE CONTEXT OF EMPIRICAL INFORMATION

Index Information

#	Index / Tranches	Running Bid / Offer	Upfront Bid / Offer	Compound Correlation Bid / Offer	Base Correlation Mid	Delta Mid
	iBOXX CDX North America Main Sep-09	62.0bp				
1	0.0% - 3.0%	500.0 / 500.0bp	39.8 / 42.3%	22 / 19%	20%	12.5
2	3.0% - 7.0%	340.0 / 365.0bp	/	2 / 4%	27%	8.1
3	7.0% - 10.0%	124.0 / 135.0bp*	/ *	16 / 18%*	30%	3.9
4	10.0% - 15.0%	44.0 / 57.0bp	/	18 / 21%	37%	1.8
5	15.0% - 30.0%	10.5 / 16.0bp	/	24 / 29%	57%	0.5
6	3.0% - 100.0%	22.5 / 28.5bp	/	15 / 27%	82%	

INDEX INFORMATION IN THE CONTEXT OF EMPIRICAL INFORMATION

Index Information

#	Index / Tranches	Running Bid / Offer	Upfront Bid / Offer	Compound Correlation Bid / Offer	Base Correlation Mid	Delta Mid
	DJ iTraxx Europe Sep-14	58.0bp				
1	0.0% - 3.0%	500.0 / 500.0bp	45.4 / 47.9%	20 / 18%	19%	8.3
2	3.0% - 6.0%	399.0 / 443.0bp	/	50 / 41%	27%	8.4
3	6.0% - 9.0%	196.0 / 212.0bp	/	82 / 76%	32%	5.1
4	9.0% - 12.0%	125.0 / 139.0bp	/	12 / 15%	35%	3.6
5	12.0% - 22.0%	63.0 / 69.0bp	/	25 / 28%	43%	2.1
6	3.0% - 100.0%	28.0 / 31.0bp	/	1 / 10%		

INDEX INFORMATION IN THE CONTEXT OF EMPIRICAL INFORMATION

Realistic Modelling

		IBOXX-EUROPE PRICING		
		Hybrid Model	Market Mids	Conditional Loss
		Fair Spreads		Fair Spreads
0%	3%	500bp + 32%	500bp + 28.5	500bp + 29%
3%	6%	312	201	311
6%	9%	95	85	104
9%	12%	33	52	40
12%	22%	6	21	8

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

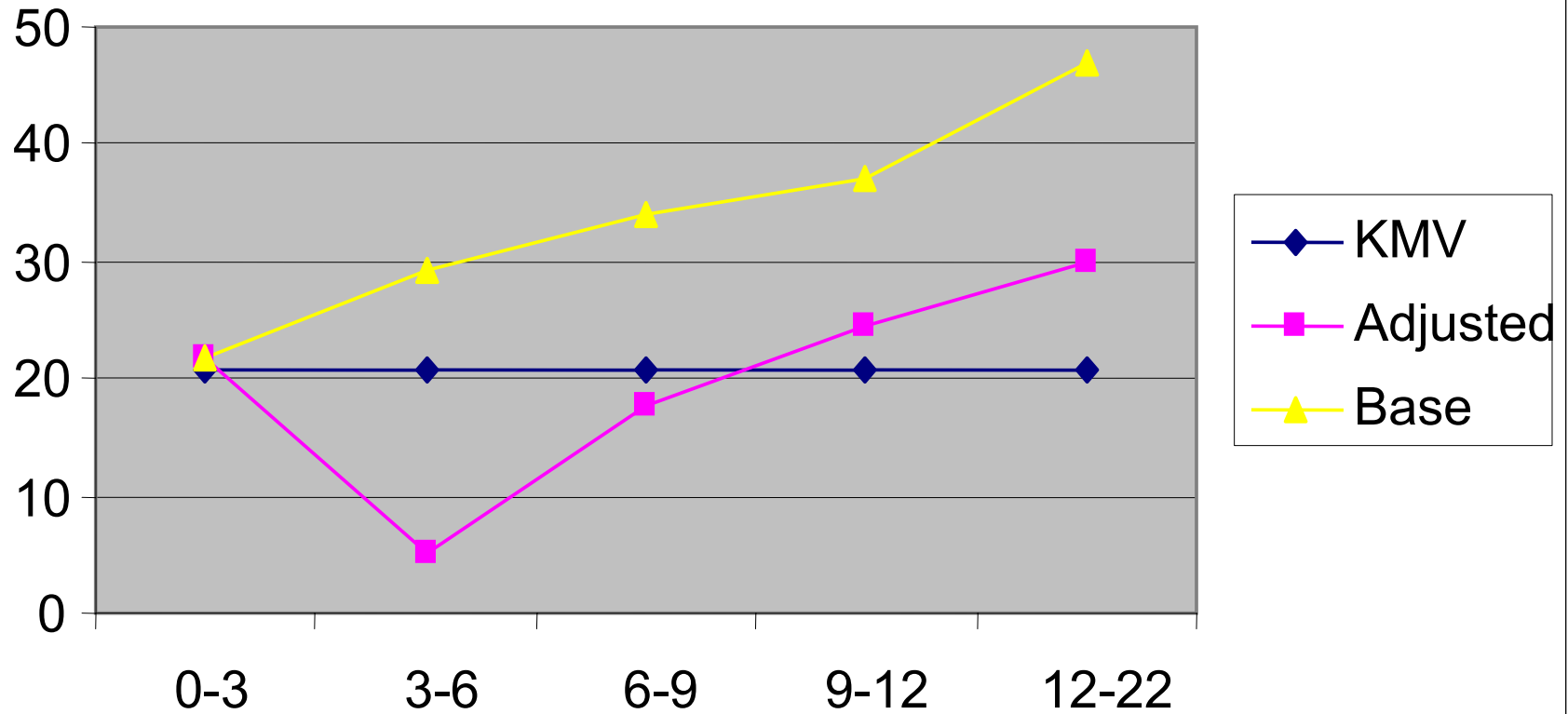
MTM Challenge

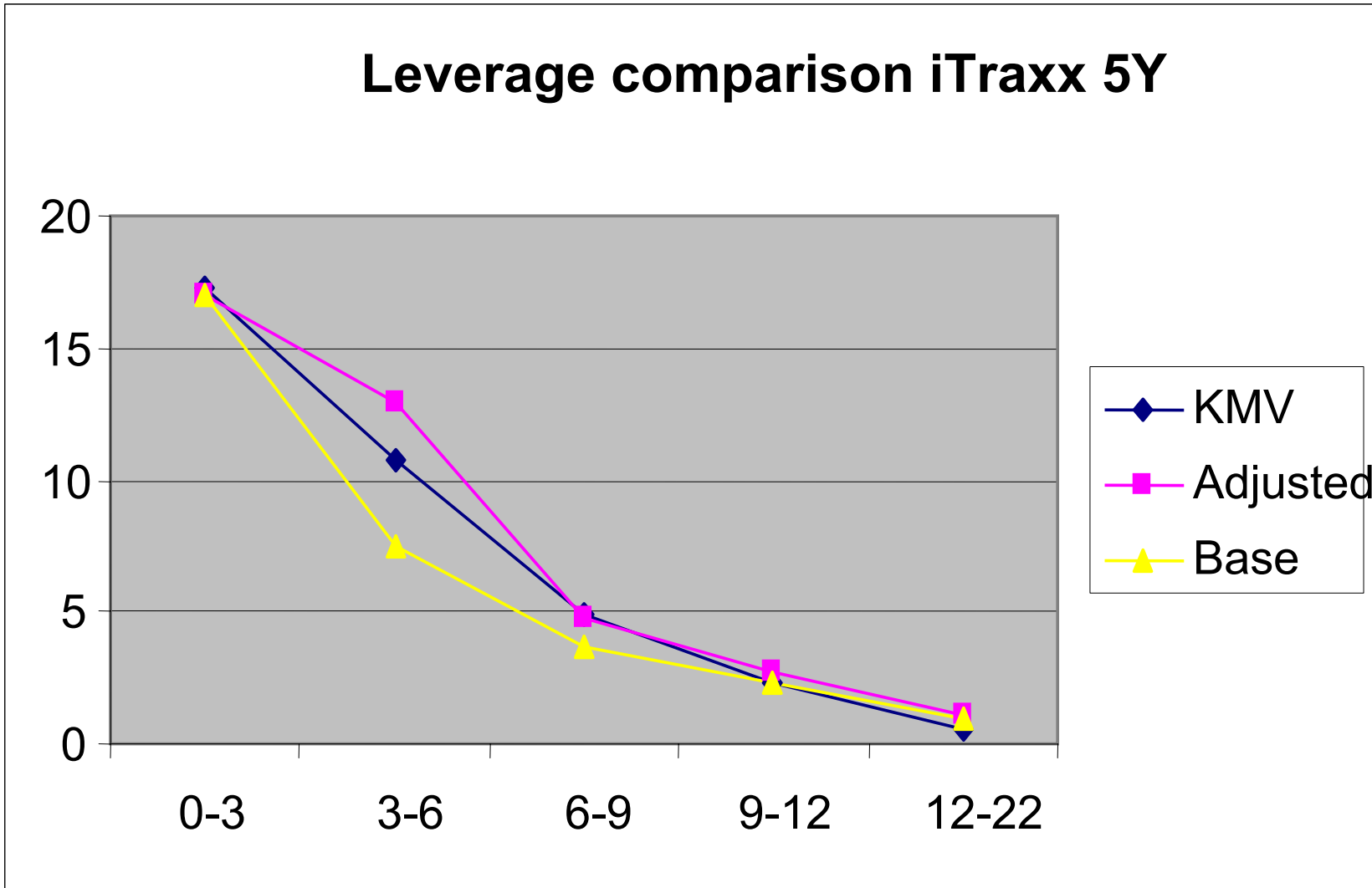
	Total	000-003	003-006B	003-006C	003-100	006-009B	006-009C	009-012B	009-012C	012-022B
Deltas	2,867,928K	647,592K	401,022K	401,022K	729,949K	184,344K	184,344K	86,895K	86,895K	72,932K
Leverage	1.66	17.27	10.69	10.69	0.60	4.92	4.92	2.32	2.32	0.58
Average Adjusted Beta		20.9%	20.9%	20.9%	20.9%	20.9%	20.9%	20.9%	20.9%	20.9%
			20.9%			20.9%		20.9%		20.9%
	Total	000-003	003-006B	003-006C	003-100	006-009B	006-009C	009-012B	009-012C	012-022B
5Y EQUIVALENTS										
Anglo American Plc	21,921K	5,725K	3,109K	3,109K	5,324K	1,289K	1,289K	575K	575K	463K
Abbey National plc	25,222K	3,962K	3,459K	3,459K	6,990K	1,900K	1,900K	947K	947K	829K
Accor	20,934K	6,088K	2,962K	2,962K	4,876K	1,152K	1,152K	492K	492K	378K
Aegon NV	24,922K	4,188K	3,467K	3,467K	6,824K	1,785K	1,785K	899K	899K	804K
Akzo Nobel NV	22,615K	5,390K	3,191K	3,191K	5,664K	1,409K	1,409K	645K	645K	536K
Allied Domecq plc	20,352K	6,618K	2,780K	2,780K	4,518K	1,040K	1,040K	442K	442K	347K
Allianz AG	26,084K	3,485K	3,576K	3,576K	7,426K	2,043K	2,043K	1,051K	1,051K	916K
Assicurazioni Generali SpA	26,662K	3,199K	3,549K	3,549K	7,723K	2,120K	2,120K	1,146K	1,146K	1,056K
Aventis SA	21,782K	5,941K	3,009K	3,009K	5,215K	1,261K	1,261K	568K	568K	475K
Aviva plc	26,424K	3,347K	3,543K	3,543K	7,597K	2,070K	2,070K	1,108K	1,108K	1,019K
Axa SA	25,903K	3,626K	3,552K	3,552K	7,329K	1,976K	1,976K	1,027K	1,027K	920K
BAA plc	21,686K	5,970K	3,026K	3,026K	5,171K	1,237K	1,237K	554K	554K	456K
Energie Baden-Wuerttemberg AG	23,821K	4,761K	3,383K	3,383K	6,267K	1,597K	1,597K	764K	764K	652K
Capitalia SpA	25,193K	3,926K	3,603K	3,603K	6,977K	1,892K	1,892K	913K	913K	736K
BAE Systems plc	20,437K	6,496K	2,815K	2,815K	4,584K	1,061K	1,061K	451K	451K	352K
British American Tobacco plc	21,766K	5,698K	3,123K	3,123K	5,276K	1,277K	1,277K	559K	559K	436K
Banca Intesa SpA	26,227K	3,440K	3,524K	3,524K	7,499K	2,052K	2,052K	1,082K	1,082K	985K
Banco Bilbao Vizcaya Argentaria, S.A.	26,527K	3,264K	3,479K	3,479K	7,657K	2,143K	2,143K	1,139K	1,139K	1,042K
Banco Comercial Portugues SA	23,272K	5,122K	3,241K	3,241K	5,975K	1,504K	1,504K	716K	716K	627K
Bertelsmann AG	22,417K	5,481K	3,191K	3,191K	5,566K	1,366K	1,366K	620K	620K	508K

MTM Challenge

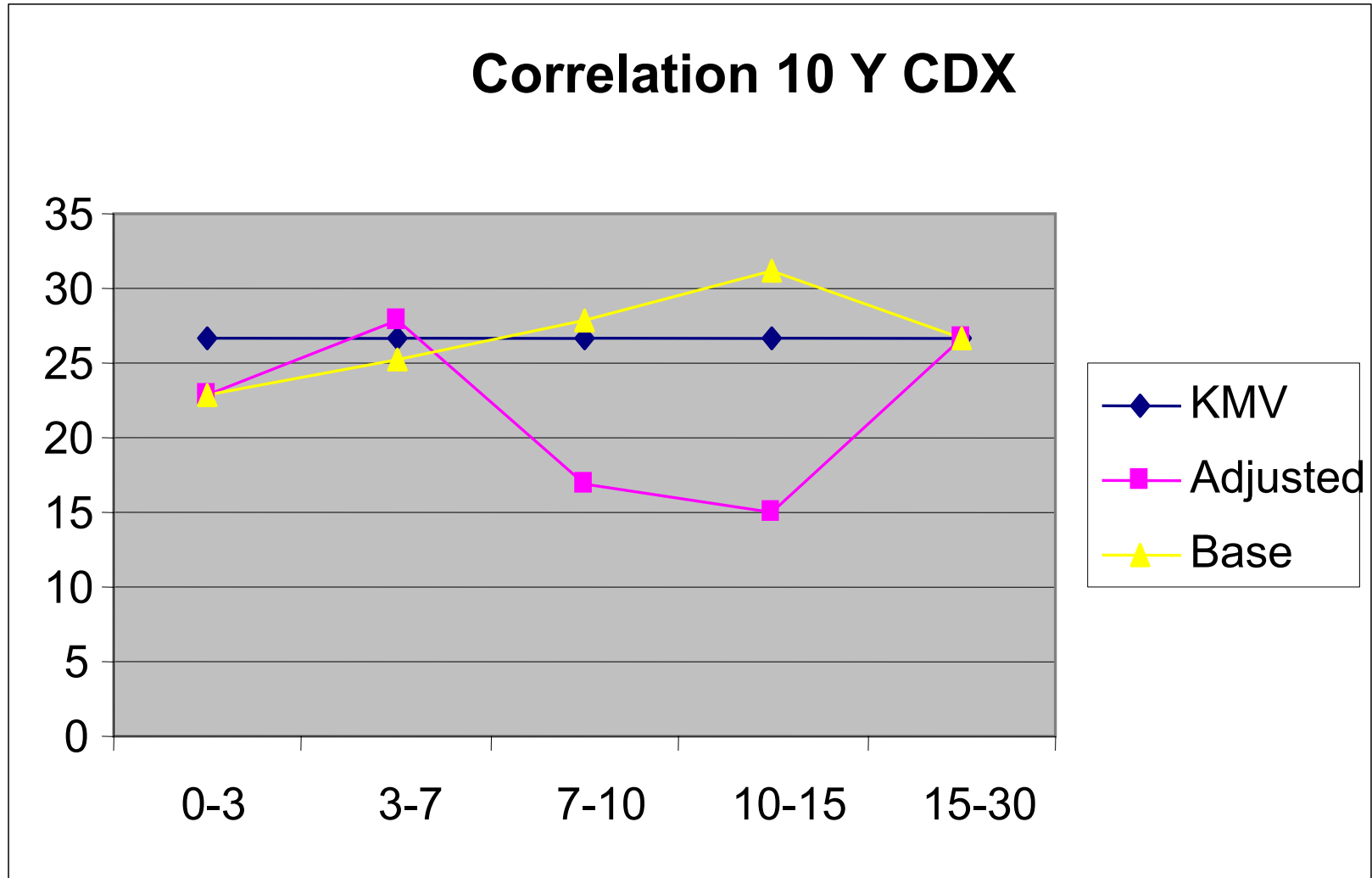
	Total	000-003	003-006B	003-006C	003-100	006-009B	006-009C	009-012B	009-012C
Deltas	2,893,699K	639,443K	282,639K	483,190K	723,958K	138,153K	176,251K	86,005K	100,695K
Leverage	1.68	17.05	7.54	12.89	0.60	3.68	4.70	2.29	2.69
Average Adjusted Beta		21.6%	21.6%	5.1%	20.8%	29.3%	17.6%	33.9%	24.6%
			29.3%			33.9%		37.1%	
	Total	000-003	003-006B	003-006C	003-100	006-009B	006-009C	009-012B	009-012C
	5Y EQUIVALENTS								
Anglo American Plc	22,123K	5,677K	2,279K	3,677K	5,274K	1,010K	1,218K	598K	672K
Abbey National plc	25,310K	3,889K	2,264K	4,156K	6,913K	1,358K	1,828K	891K	1,080K
Accor	21,265K	6,059K	2,277K	3,529K	4,834K	946K	1,086K	534K	573K
Aegon NV	24,783K	4,206K	2,306K	4,187K	6,655K	1,245K	1,683K	820K	1,001K
Akzo Nobel NV	22,651K	5,352K	2,266K	3,709K	5,583K	1,074K	1,327K	650K	746K
Allied Domecq plc	20,654K	6,586K	2,081K	3,427K	4,482K	816K	976K	462K	523K
Allianz AG	26,210K	3,515K	2,375K	4,438K	7,251K	1,441K	1,944K	971K	1,157K
Assicurazioni Generali SpA	26,863K	3,148K	2,226K	4,626K	7,619K	1,401K	2,063K	995K	1,276K
Aventis SA	21,756K	5,889K	2,103K	3,538K	5,153K	935K	1,183K	561K	669K
Aviva plc	26,534K	3,318K	2,252K	4,554K	7,468K	1,381K	2,000K	968K	1,229K
Axa SA	25,981K	3,615K	2,327K	4,440K	7,186K	1,364K	1,891K	929K	1,141K
BAA plc	21,659K	5,984K	2,167K	3,591K	5,045K	927K	1,142K	548K	635K
Energie Baden-Wuerttemberg AG	23,889K	4,697K	2,328K	4,010K	6,197K	1,176K	1,520K	747K	883K
Capitalia SpA	25,581K	3,857K	2,505K	4,325K	6,914K	1,440K	1,819K	927K	1,047K
BAE Systems plc	20,759K	6,463K	2,128K	3,439K	4,549K	847K	998K	478K	532K
British American Tobacco plc	21,986K	5,683K	2,357K	3,664K	5,198K	1,031K	1,198K	595K	643K
Banca Intesa SpA	26,396K	3,365K	2,227K	4,465K	7,419K	1,386K	1,996K	963K	1,220K
Banco Bilbao Vizcaya Argentaria, S.A.	26,729K	3,188K	2,155K	4,452K	7,577K	1,436K	2,092K	1,002K	1,279K
Banco Comercial Portugues SA	23,120K	5,057K	2,170K	3,787K	5,898K	1,074K	1,423K	678K	832K
Bertelsmann AG	22,568K	5,429K	2,299K	3,758K	5,511K	1,053K	1,292K	635K	723K

Correlation comparison iTraxx 5Y

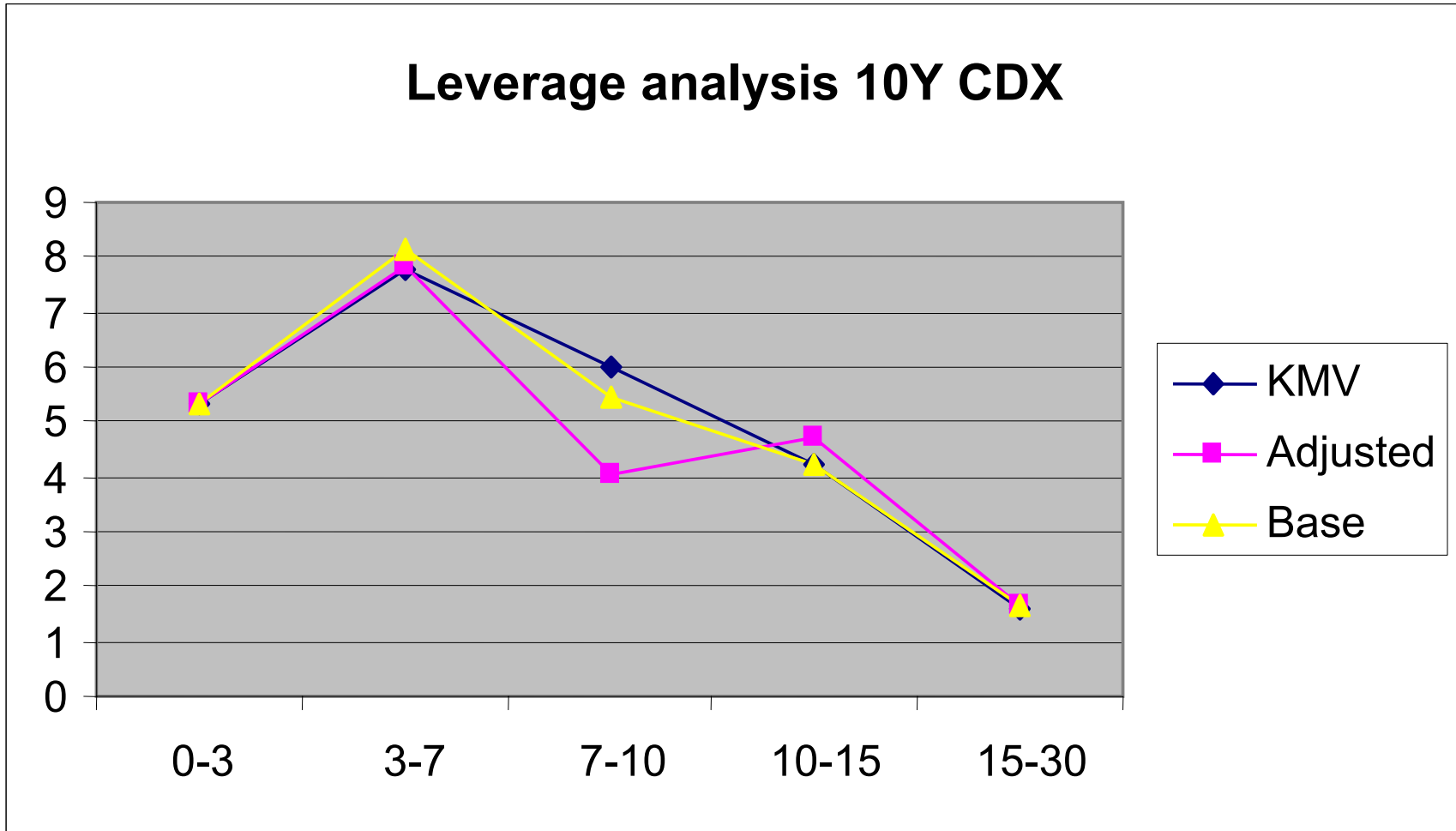




MTM Challenge



Leverage analysis 10Y CDX

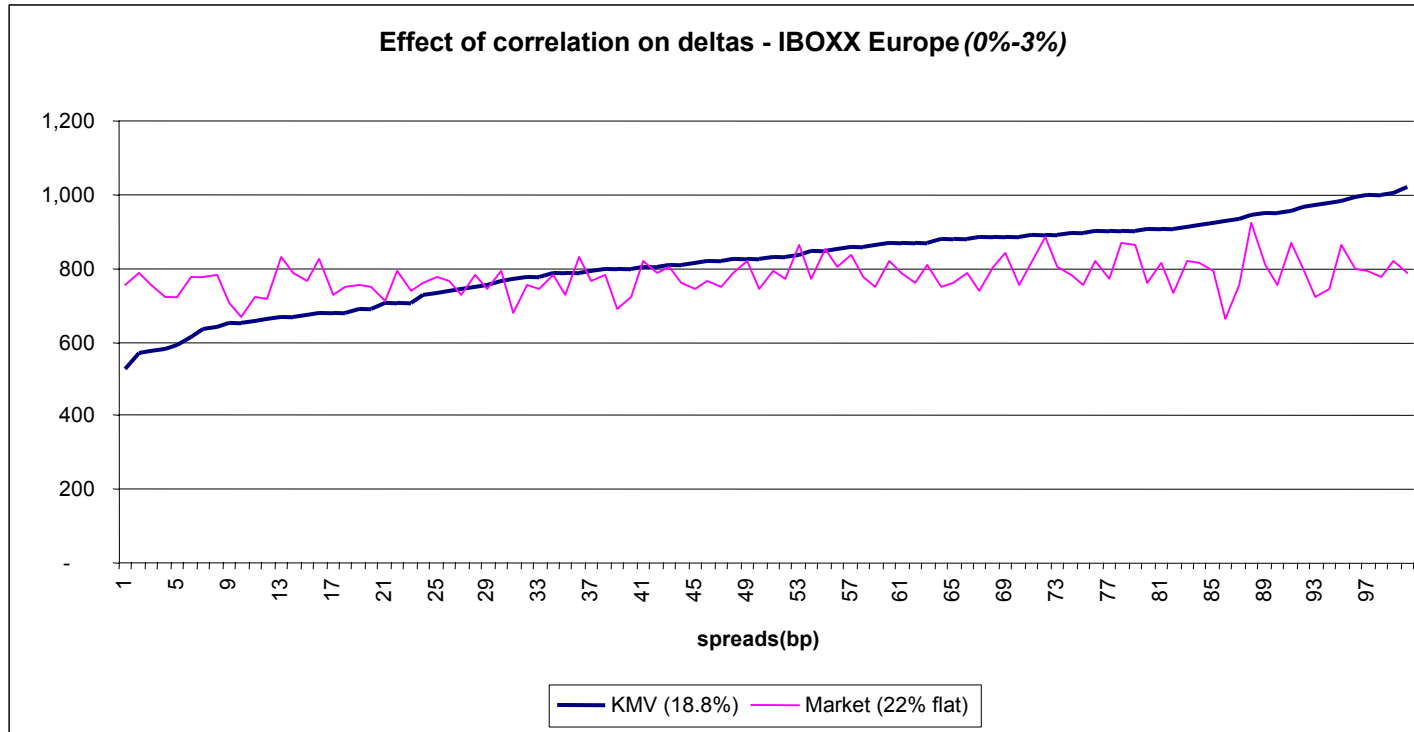


Implications for Risk Management

- **Using our Model for the traded tranches of IBOXX . Hybrid Model .**
 - **Inputs . KMV vs Flat correlation for tranche using**
 - **Our model vs Portfolio Beta**
 - **Deltas from our model**
- **The BOOK ANALYSIS**
 - **Deltas using KMV vs Flat correlation vs KMV adjusted to Market ?**
 - **Correlation 01 . Default values .**
- **SOME RISK MANAGEMENT CONSEQUENCES**
 - **DRAWDOWN LIMITATIONS**
 - **COMBINATION WITH THE VOLATILITY BOOK**

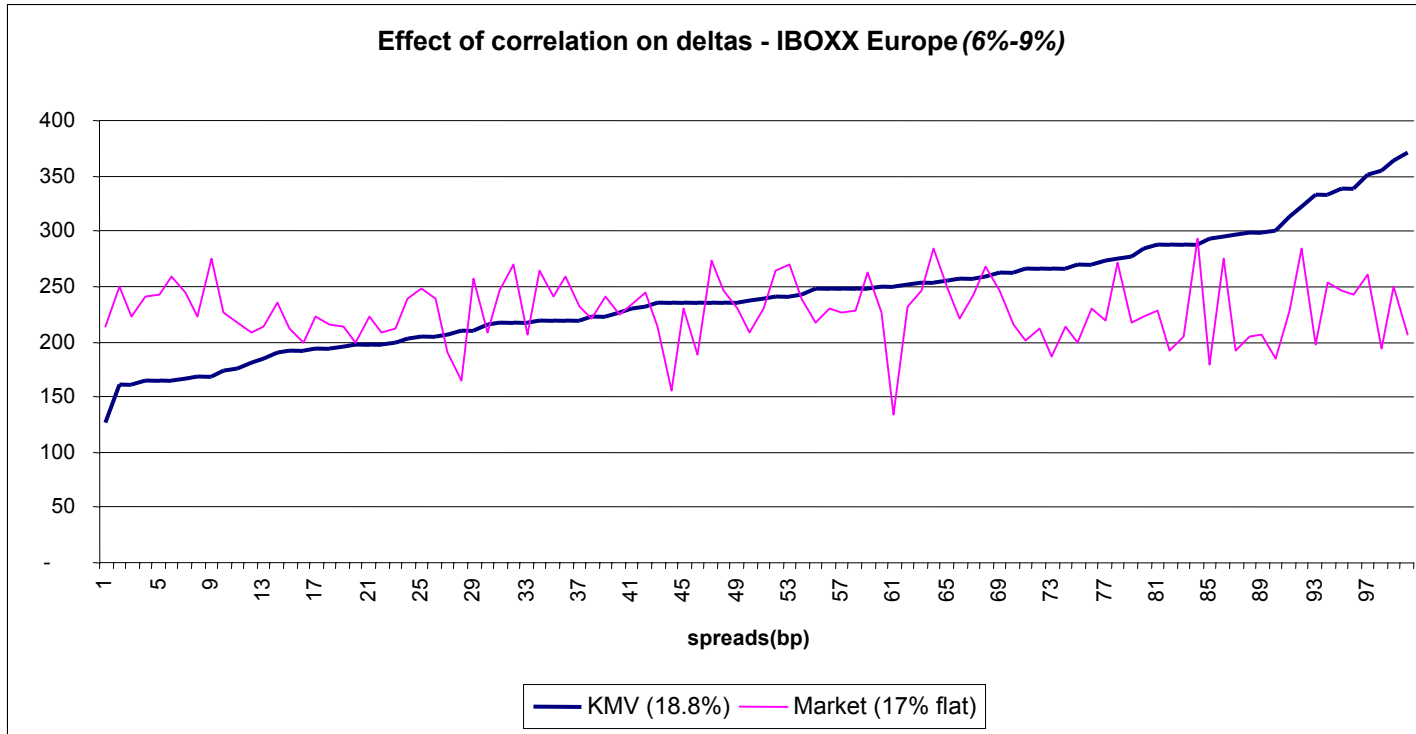
THE CHOICE OF A REALISTIC CALIBRATION HAS MAJOR CONSEQUENCES FOR RM

Implications for Risk Management



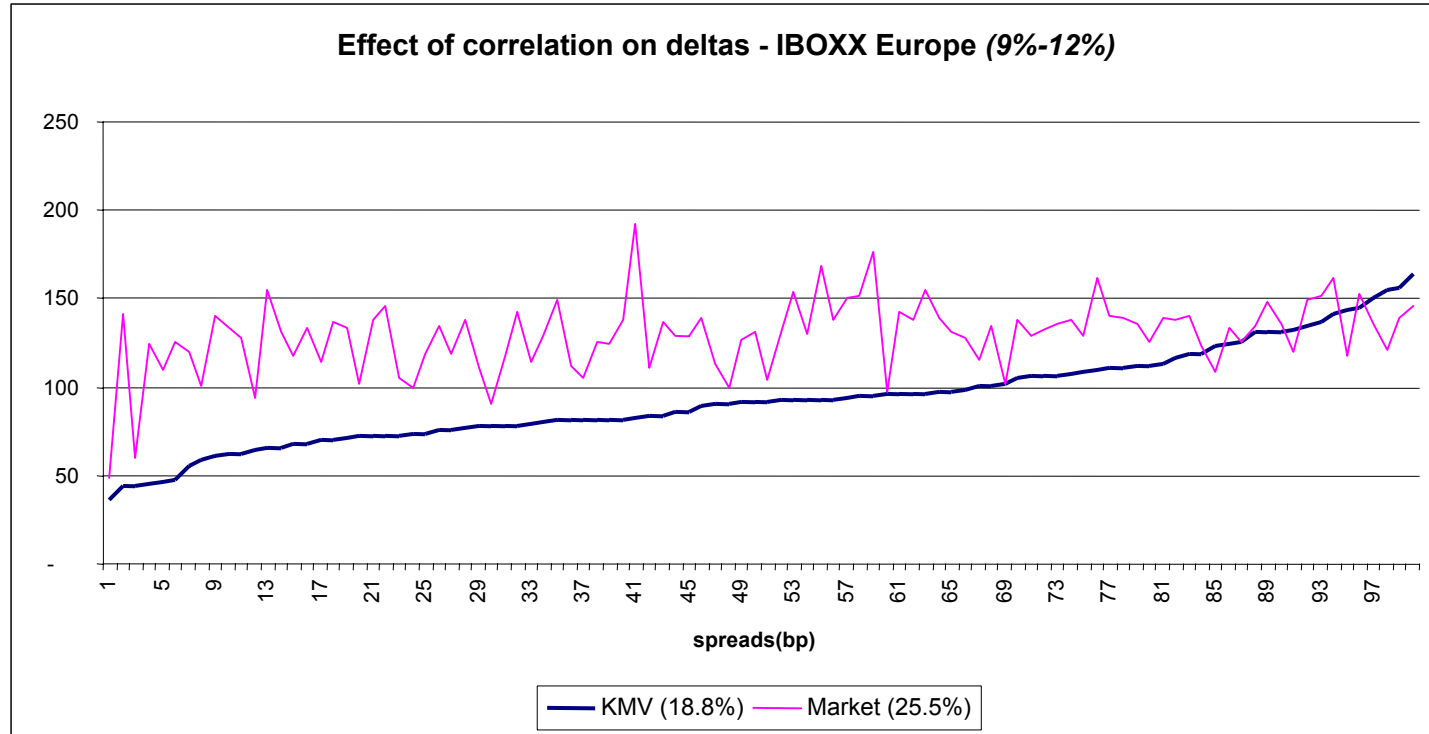
THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management



THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management



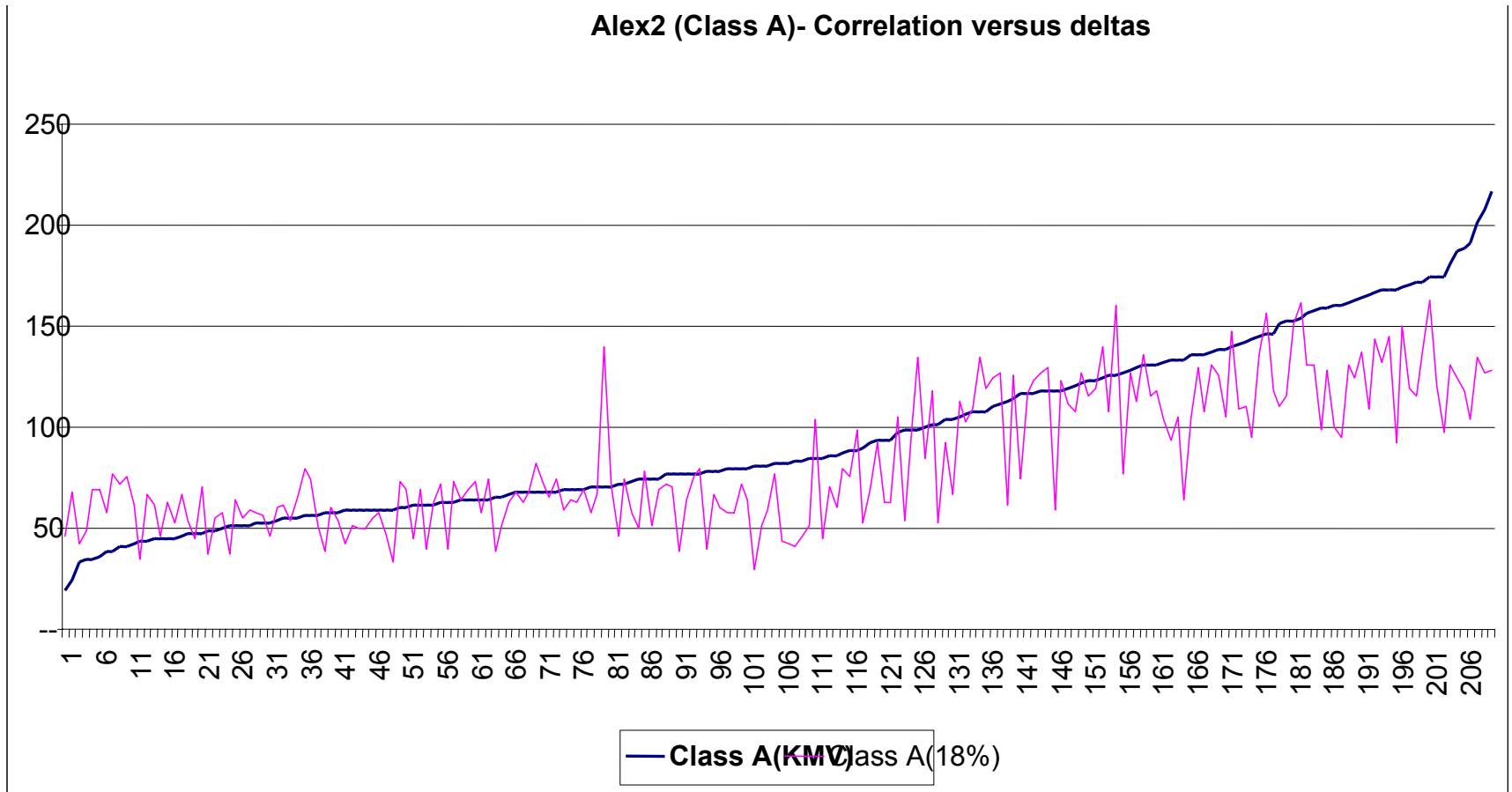
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Implications for Risk Management

ALEX-2 - Changing Beta									
Using KMV correlation					Using flat KMV correlation				
		Class A	Class B	Class C		Class A	Class B	Class C	
-3%	-	43,250	37,814	29,258	-	44,715	34,802	24,204	
-2%	-	27,907	24,583	18,752	-	29,395	22,598	15,986	
-1%	-	14,570	11,023	7,631	-	14,148	10,633	8,356	
1%		13,866	10,925	7,117		13,344	11,372	7,101	
2%		26,751	21,755	15,724		26,300	21,937	12,903	
3%		39,287	32,463	23,810		37,594	32,638	16,890	
Note: Normalised for size of the tranche = 10,000,000									

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management



THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management

UpShift						
Bumped PV - all shift		6,458,835	8,168,658	4,826,405	2,224,878	412,513
Baseline		3,448,633	4,696,287	2,738,302	1,242,843	234,043
Parallel Delta		3,010,203	3,472,371	2,088,104	982,036	178,470
Notional		156,250,000	127,000,000	58,500,000	25,000,000	5,000,000
	Spreads	Class A	Class B	Class C	Class D	Class C-Sinopac
KIMBCLA_MR-EUR-LDN	10	905	1,517	912	356	78
SYSCO-EUR-LDN	10	1,171	1,708	695	436	59
NOVART_MM-EUR-LDN	11	1,036	1,556	799	358	68
PROGRCO-EUR-LDN	11	1,145	1,425	715	321	61
WALMART_MR-EUR-LDN	12	1,246	1,211	706	316	60
SONOCO-EUR-LDN	16	1,072	1,199	759	409	65
ALLCORP-EUR-LDN	17	1,118	881	794	343	68
GAZDF_MM-EUR-LDN	17	1,237	1,153	828	460	71
BACR-Bank_SUB_MM-EUR-LDN	18	1,001	1,527	494	294	42
SCOHYD_MM-EUR-LDN	18	1,088	801	1,072	392	92
AIGUSA-EUR-LDN	20	1,015	1,229	615	279	53
FRANKLI-EUR-LDN	22	1,176	897	671	385	57
HEWPACO_MR-EUR-LDN	22	1,157	1,260	822	387	70
INTNED-BankNV_SUB_MM-EUR-LDN	22	938	972	560	424	48
SCOTPO-Ukplc_MM-EUR-LDN	22	1,637	2,196	1,159	498	99
SHERWIN-EUR-LDN	22	896	1,064	720	409	62
CCE_MR-EUR-LDN	23	1,047	1,016	790	410	68
DANHACO_MR-EUR-LDN	23	953	1,089	631	403	54

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management

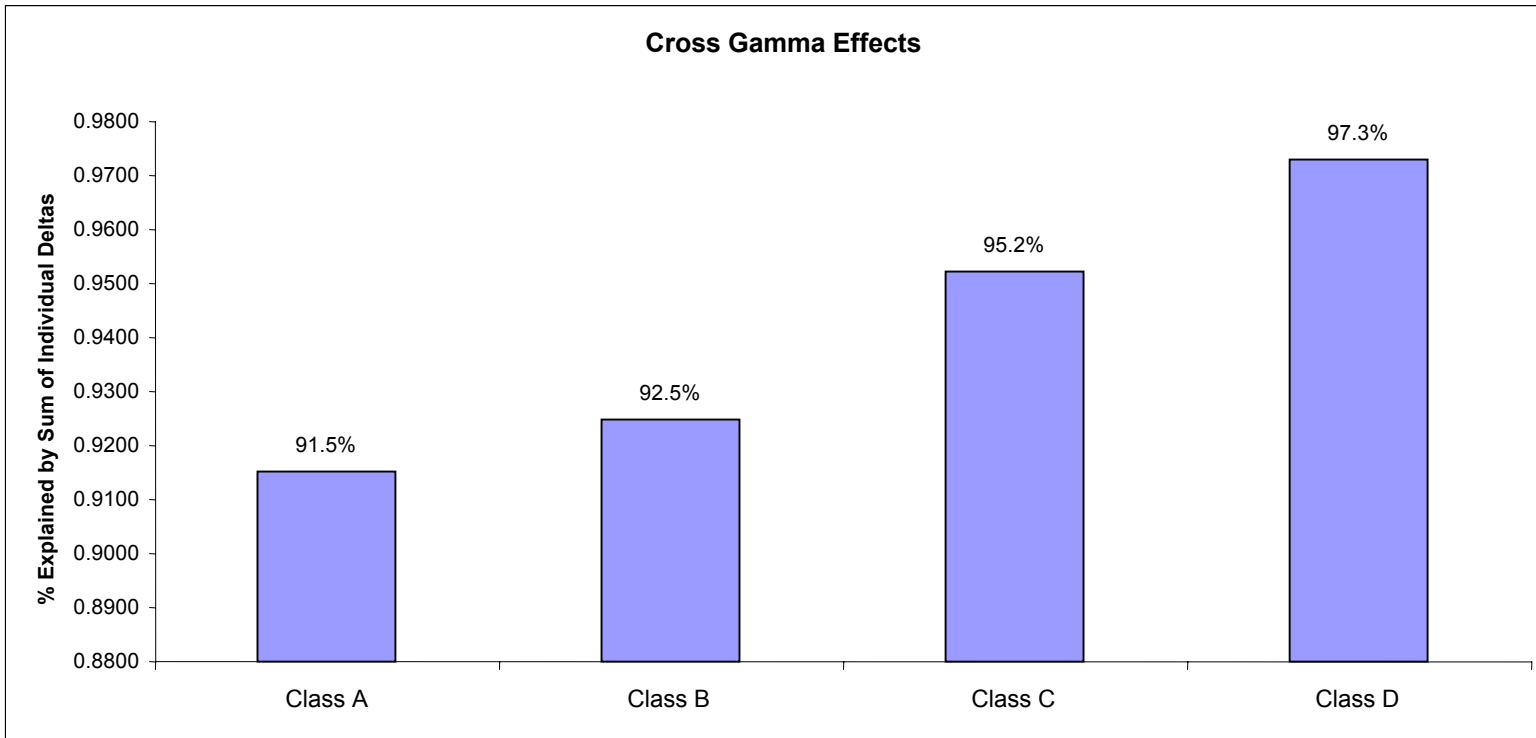
DownShift					
Bumped PV - all shift	903,798	1,648,236	850,411	344,405	72,685
Baseline	3,510,486	4,765,805	2,785,800	1,263,058	238,103
	-2,606,688	-3,117,569	-1,935,389	-918,653	-165,418
	156,250,000	127,000,000	58,500,000	25,000,000	5,000,000
	Class A	Class B	Class C	Class D	Class C-Sinopac
KIMBCLA_MR-EUR-LDN	-1,035	-1,274	-727	-385	-62
SYSCO-EUR-LDN	-1,120	-838	-939	-383	-80
NOVART_MM-EUR-LDN	-1,481	-1,562	-796	-545	-68
PROGRCO-EUR-LDN	-1,356	-1,535	-1,114	-499	-95
WALMART_MR-EUR-LDN	-1,200	-1,279	-811	-382	-69
SONOCO-EUR-LDN	-1,433	-944	-806	-373	-69
ALLCORP-EUR-LDN	-937	-1,496	-756	-362	-65
GAZDF_MM-EUR-LDN	-1,176	-1,358	-510	-312	-44
BACR-Bank_SUB_MM-EUR-LDN	-1,239	-861	-562	-348	-48
SCOHYD_MM-EUR-LDN	-1,089	-1,284	-714	-263	-61
AIGUSA-EUR-LDN	-1,074	-1,445	-875	-325	-75
FRANKLI-EUR-LDN	-1,195	-1,329	-624	-397	-53
HEWPACO_MR-EUR-LDN	-1,166	-1,503	-870	-296	-74
INTNED-BankNV_SUB_MM-EUR-LDN	-1,112	-1,148	-1,150	-535	-98
SCOTPO-Ukplc_MM-EUR-LDN	-2,423	-2,639	-1,364	-559	-117
SHERWIN-EUR-LDN	-1,276	-885	-701	-381	-60
CCE_MR-EUR-LDN	-991	-1,382	-754	-286	-64
DANHACO_MR-EUR-LDN	-810	-2,038	-717	-348	-61

THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Implications for Risk Management

I-GAMMA					Avg Delta				
Class A	Class B	Class C	Class D	Class C-Sinopac	Class A	Class B	Class C	Class D	Class C-Sinopac
-130	243	185	-29	16	970	1,396	820	371	70
50	870	-244	54	-21	1,145	1,273	817	409	70
-445	-5	3	-187	0	1,259	1,559	798	452	68
-211	-110	-399	-178	-34	1,250	1,480	914	410	78
46	-68	-105	-67	-9	1,223	1,245	758	349	65
-361	255	-46	36	-4	1,253	1,071	782	391	67
181	-615	37	-19	3	1,028	1,189	775	352	66
61	-205	318	148	27	1,206	1,255	669	386	57
-238	665	-68	-55	-6	1,120	1,194	528	321	45
-1	-482	358	129	31	1,088	1,043	893	328	76
-59	-216	-260	-46	-22	1,045	1,337	745	302	64
-18	-432	47	-12	4	1,186	1,113	648	391	55
-9	-242	-48	91	-4	1,161	1,382	846	341	72
-174	-176	-590	-111	-50	1,025	1,060	855	479	73
-786	-443	-205	-61	-18	2,030	2,418	1,261	529	108
-381	179	19	29	2	1,086	974	710	395	61

Implications for Risk Management



THE CHOICE OF A REALISTIC MODEL IS A POSTULATION

Optimal Portfolios and Market Views

- **Fundamental correlation view has a very important consequence for portfolio weights and Risk Management**
- **Forget the Black Box approach we need to have a good intuition of what are the dynamics of the investment method**
- **Some complex modelling problems can also be viewed in the context of the right asset allocation and a portfolio view . I think that this is the case for complex portfolios of Credit Derivatives .**