

## The VIX: Rewards and Risks of a Rapidly Growing Market

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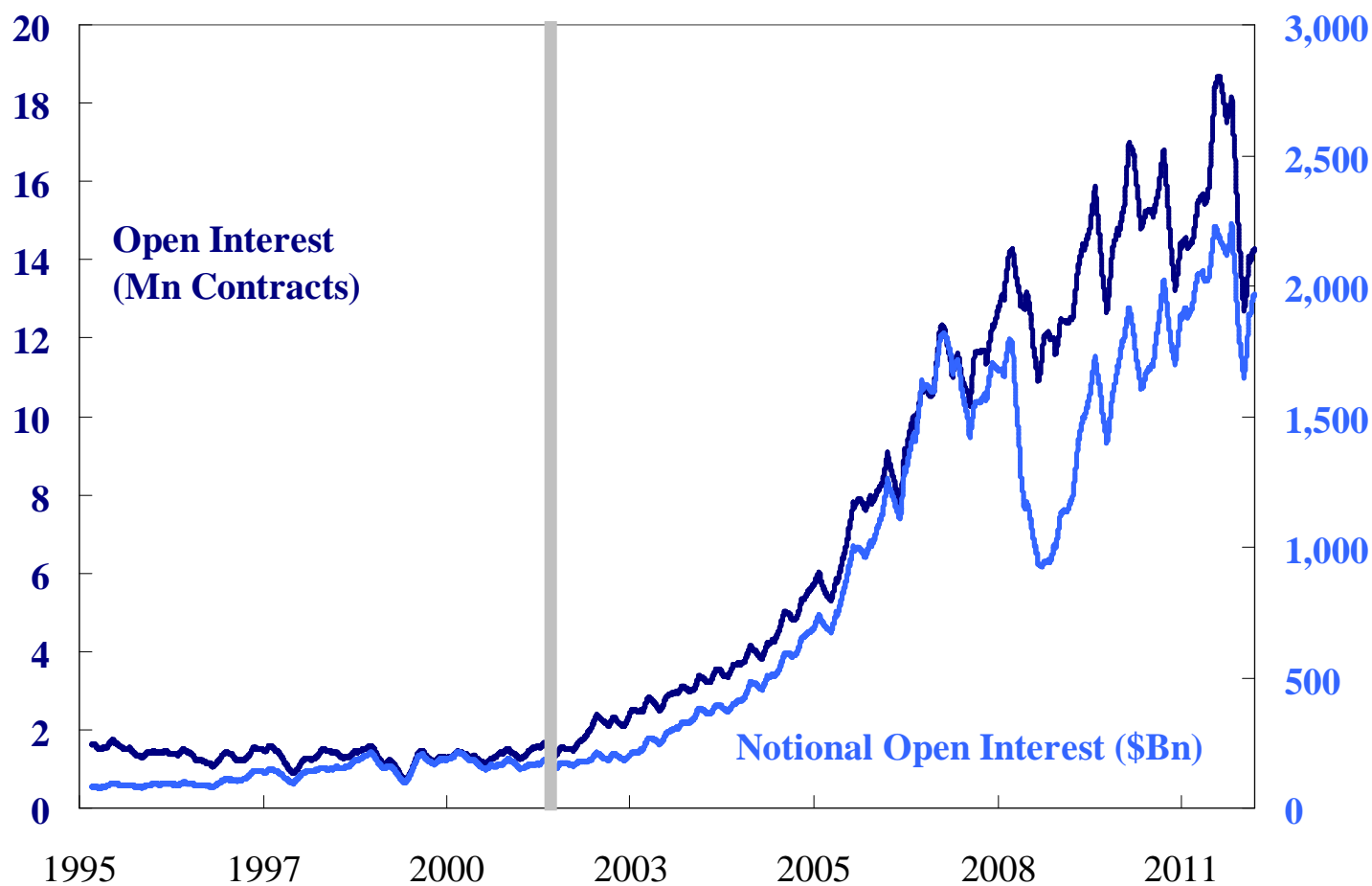
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## Contents

- S&P 500 Options
- VIX Options and Futures
- VIX Exchange Traded Products
- Impact on S&P 500 Implied and Realized Volatility
- VIX Risks: Settlement
- VIX Risks: ETP Premium
- VIX Futures vs. S&P Options
- VIX Options vs. S&P Options
- VIX Term Structure Trading
- Cross-Asset Hedging with VIX
- VIX in Europe: V2X
- V2X - VIX Spread
- Other 'VIX' Indices

## S&P 500 Options

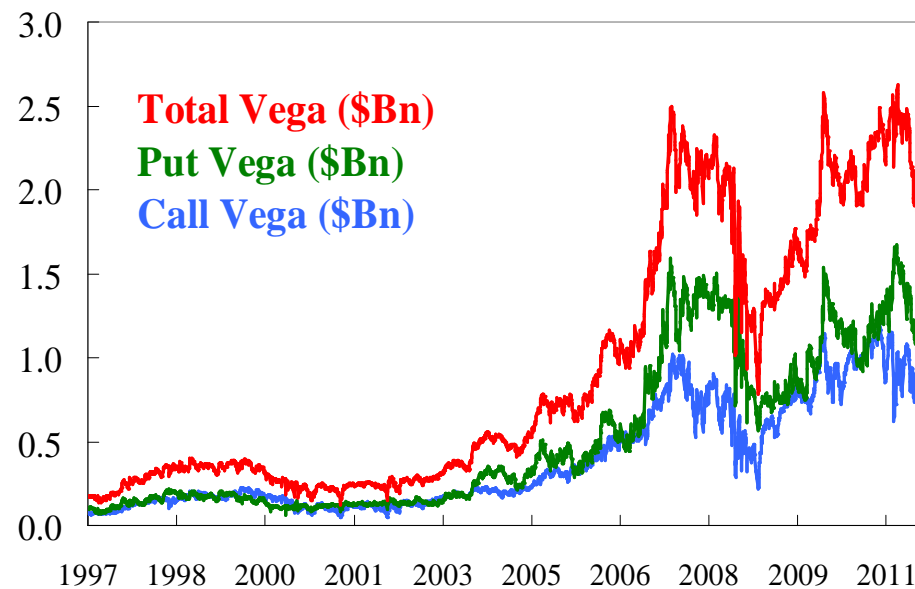
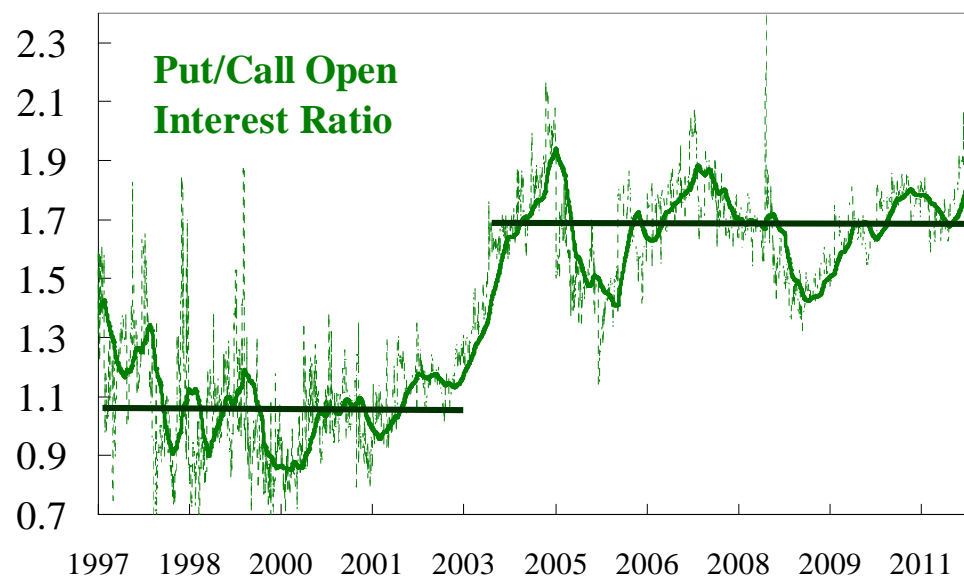
- Started Trading in 1983. Only after 2001-2002 crisis, open interest grew dramatically
- SPY options listed in 2005 and are currently ~15% of open interest



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## S&P 500 Options

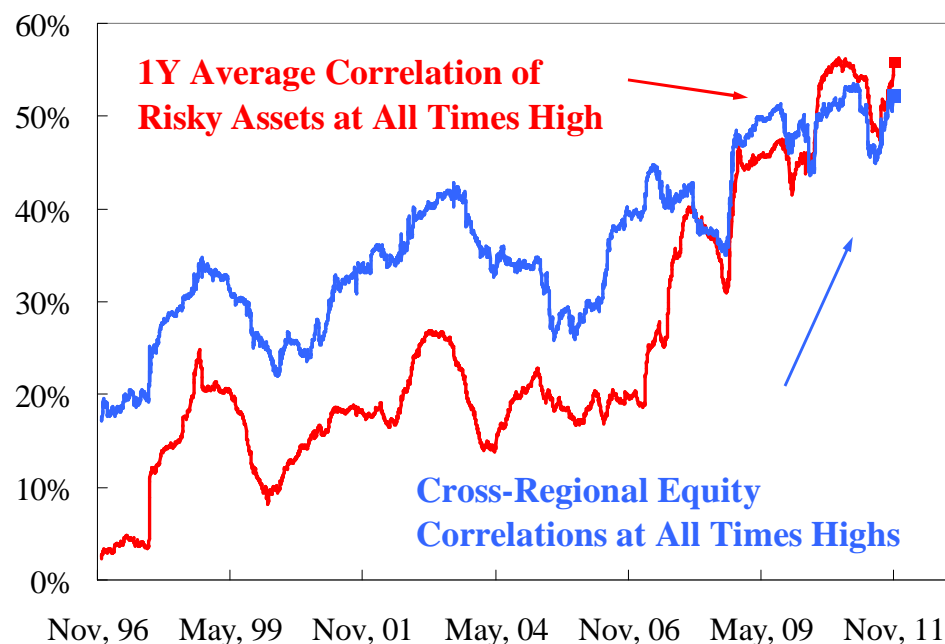
- Largely used for hedging as indicated by P/C ratio post 2001-2002
- As the S&P 500 options market grew, a secondary volatility market developed to facilitate transfer of Volatility risk
- Currently ~\$3bn vega is traded via Options, Variance and Volatility Swaps, VIX options/futures, etc.



## S&P 500 Options

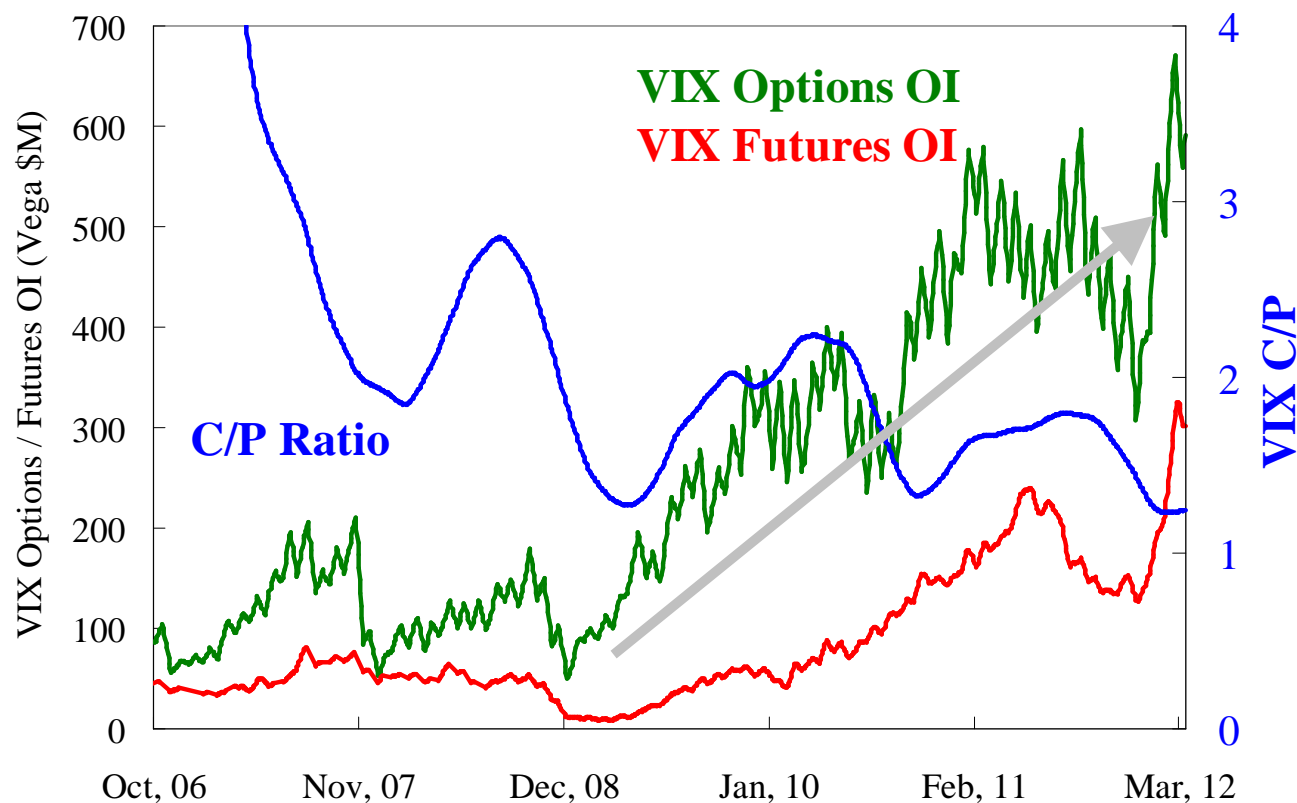
- Post 2008 crisis, S&P 500 is used for hedging equity-like exposure globally
- It is the most liquid listed index option market, comprising 46% of Global index option open interest globally
- Given high cross-regional equity and cross-asset correlation, frequently used as a proxy hedge for foreign equities, credit, etc.

Notional OI of Listed Options in \$Bn					
US		EMEA		Asia	
SPX	<b>2,006</b>	SX5E	<b>1,155</b>	NKY	<b>366</b>
NDX	102	DAX	222	KOSPI2	<b>100</b>
RUY	112	UKX	202	HSI	<b>41</b>
OEX	7	SMI	36	HSCEI	<b>22</b>



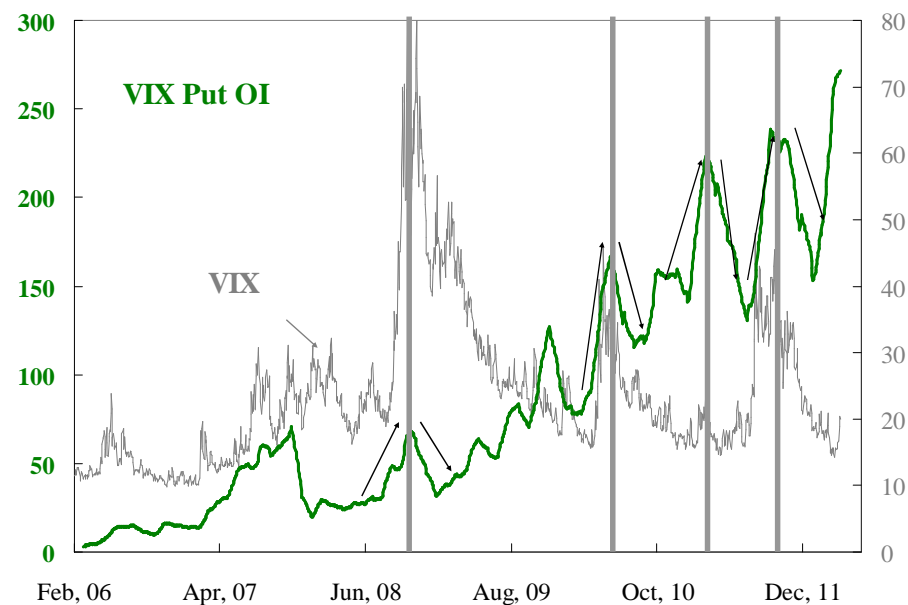
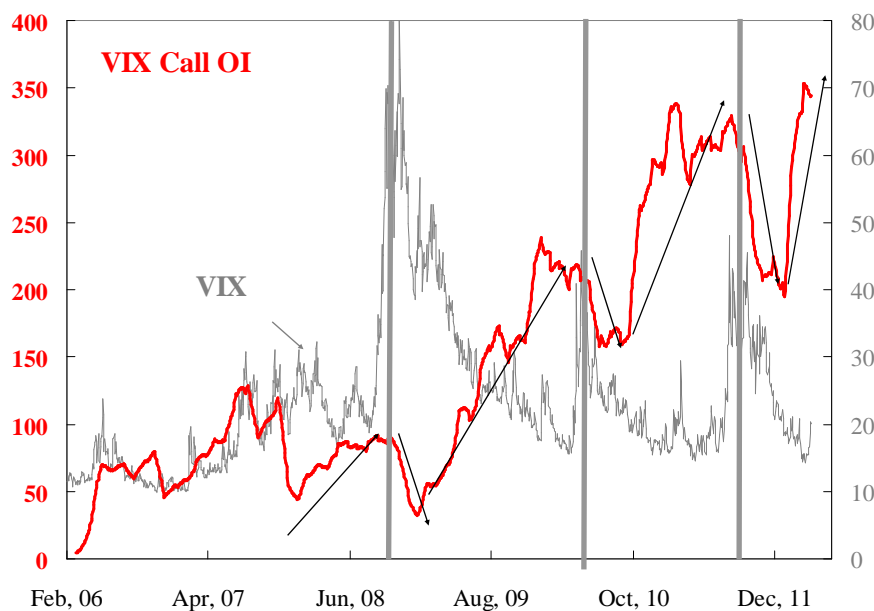
## VIX Options and Futures

- VIX futures started trading in 2004, options in 2006
- Use of VIX options dramatically increased post 2008 crisis
- Open interest larger in options than futures
- Largely used for hedging equity, cross-asset and tail risks
- Hedging demand indicated by C/P ratio. Recently, more puts traded (e.g., short volatility trades, risk reversals, etc.)



## VIX Options and Futures

- VIX Call OI builds up in low volatility periods as investors enter hedges, and drops during VIX spikes (as investors unwind hedges)
- VIX Put OI builds up in high volatility as investors buy puts to sell volatility

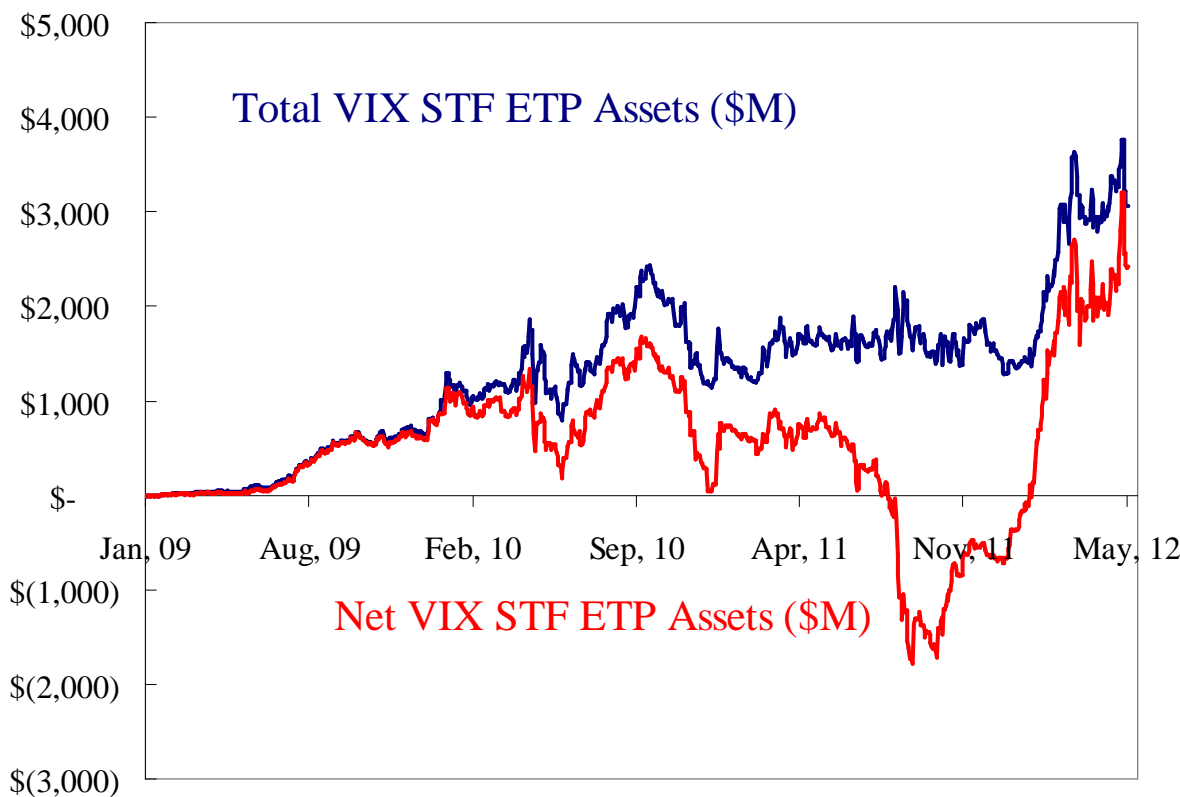


# VIX Exchange Traded Products

- Currently \$5bn in all VIX ETPs: short-term futures, mid-term futures, inverse and leveraged ETPs, and other VIX strategies
- Largest assets are in short-term futures ETPs (~Net \$3bn)

Ticker	Name	Index	Leverage	Assets (M\$)*	Index Beta**	Index Correlation**
<b>Long VIX Short-Term Futures</b>						
VXX US	Barclays/iPath USA S&P 500 VIX ST Fut.	SPVXSTR	+1x	1,804	0.57	89%
TVIX US	CS/VLS Securities S&P 500 VIX ST Fut.	SPVXSP	+2x	498	0.57	89%
UVXY US	ProShares ETFs S&P 500 VIX ST Fut.	SPVXSPID	+2x	156	0.57	89%
VIXY US	ProShares ETFs S&P 500 VIX ST Fut.	SPVXSPID	+1x	137	0.57	89%
1552 JP	ProShares ETFs S&P 500 VIX ST Fut.	SPVXSTR	+1x	124	0.57	89%
HVU CN	BetaPro S&P 500 VIX ST Fut.	SPVXSP	+2x	45	0.57	89%
VIX US	CS/VLS Securities S&P 500 VIX ST Fut.	SPVXSP	+1x	26	0.57	89%
VIXS LN	Source Mkts/Ireland S&P 500 VIX ST Fut.	SPVXSTR	+1x	24	0.57	89%
VXIS LN	Barclays/iPath S&P 500 VIX ST Fut.	SPVXSTR	+1x	6	0.57	89%
VXCC US	UBS/E-TRACS ETNs SPX VIX Fut. 3M	SPVIX3MT	+1x	6	0.31	83%
HUV CN	BetaPro S&P 500 VIX ST Fut.	SPVXSP	+1x	7	0.57	89%
VXBB US	UBS/E-TRACS ETNs SPX VIX Fut. 2M	SPVIX2MT	+1x	5	0.39	86%
2030 JP	Barclays/iPath S&P 500 VIX ST Fut.	SPVXSTR	+1x	5	0.57	89%
VXAA US	UBS/E-TRACS ETNs S&P 500 VIX ST Fut.	SPVXSTR	+1x	4	0.57	89%
<b>Short VIX Short-Term Futures</b>						
XIV US	CS/VLS Securities S&P 500 VIX ST Fut.	SPVXSP	-1x	403	0.57	89%
SVXY US	ProShares ETFs S&P 500 VIX ST Fut.	SPVXSPID	-1x	26	0.57	89%
XXV US	Barclays/iPath USA S&P 500 VIX ST Fut.	SPVXSP	-0.2x	16	0.57	89%
AAVX US	UBS/E-TRACS ETNs S&P 500 VIX ST Fut.	SPVXSP	-1x	14	0.57	89%
BBVX US	UBS/E-TRACS ETNs SPX VIX Fut. 2M	SPVIX2ME	-1x	14	0.39	86%
CCVX US	UBS/E-TRACS ETNs SPX VIX Fut. 3M	SPVIX3ME	-1x	13	0.31	83%
IVOP US	Barclays/iPath USA S&P 500 VIX ST Fut.	SPVXSP	-1x	5	0.57	89%
<b>Long VIX Medium-Term Futures</b>						
VXZ US	Barclays/iPath USA S&P 500 VIX MT Fut.	SPVXMTR	+1x	297	0.22	78%
VIXM US	ProShares ETFs S&P 500 VIX MT Fut.	SPVXMPID	+1x	107	0.22	78%
VXIM LN	Barclays/iPath S&P 500 VIX MT Fut.	SPVXMTR	+1x	8	0.22	78%
VXFF US	UBS/E-TRACS ETNs SPX VIX Fut. 6M	SPVIX6MT	+1x	8	0.19	76%
VXEE US	UBS/E-TRACS ETNs S&P 500 VIX MT Fut.	SPVXMTR	+1x	7	0.22	78%
VXDD US	UBS/E-TRACS ETNs SPX VIX Fut. 4M	SPVIX4MT	+1x	7	0.25	79%
VIZ US	CS/VLS Securities S&P 500 VIX MT Fut.	SPVXMP	+1x	7	0.22	78%
2029 JP	Barclays/iPath S&P 500 VIX MT Fut.	SPVXMTR	+1x	0	0.22	78%
TVIZ US	CS/VLS Securities S&P 500 VIX MT Fut.	SPVXMP	+2x	5	0.22	78%
1561 JP	CS/VLS Securities S&P 500 VIX MT Fut.	SPVXMTR	+1x	5	0.22	78%
VZZB US	Barclays/iPath USA S&P 500 VIX MT Fut.	SPVXMTR	+1x	2	0.22	78%
<b>Short VIX Medium-Term Futures</b>						
DDVX US	UBS/E-TRACS ETNs SPX VIX Fut. 4M	SPVIX4ME	-1x	13	0.25	79%
EEVX US	UBS/E-TRACS ETNs S&P 500 VIX MT Fut.	SPVXMP	-1x	12	0.22	78%
FFVX US	UBS/E-TRACS ETNs S&P 500 VIX Fut. 6M	SPVIX6ME	-1x	12	0.19	76%
ZIV US	CS/VLS Securities S&P 500 VIX MT Fut.	SPVXMP	-1x	10	0.22	78%
<b>Other VIX Futures Strategies</b>						
VOLT LN	Nomura / Source S&P 500 VIX MT Fut.	NMEDVMU3	+1x	544	0.15	69%
MHUU LN	J.P. Morgan Macrohedge US TR	JPMZMHUT	+1x	238	0.17	49%
XVZ US	Barclays/iPath S&P 500 Dynamic VIX Fut.	SPDVXTR	+1x	221	0.19	65%
LVOL FP	Lyxor S&P 500 VIX Fut. Enhanced Roll	SPVIXETR	+1x	134	0.31	73%
MHDU LN	J.P. Morgan Macrohedge Dual TR	JPMZMHHT	+1x	84	0.04	12%
XVIX US	UBS/E-TRACS ETNs S&P 500 VIX Fut. LS	SPVXTSER	+1x	23	-0.06	-52%
CVOL US	Citigroup Funding Citi Volatility Index TR	CVOLT	+1x	9	1.04	90%
<b>Long VSTOXX Futures</b>						
VSTX LN	Etfx Bofami Ivstoxx Etf	IVSTOXX	+1x	29	0.35	68%
VSXX IM	lpath Vstoxx Short-Term Fut	VST11MT	+1x	5	0.44	75%
VSXY IM	lpath Vstoxx MT Future	VMT5MT	+1x	3	0.17	68%

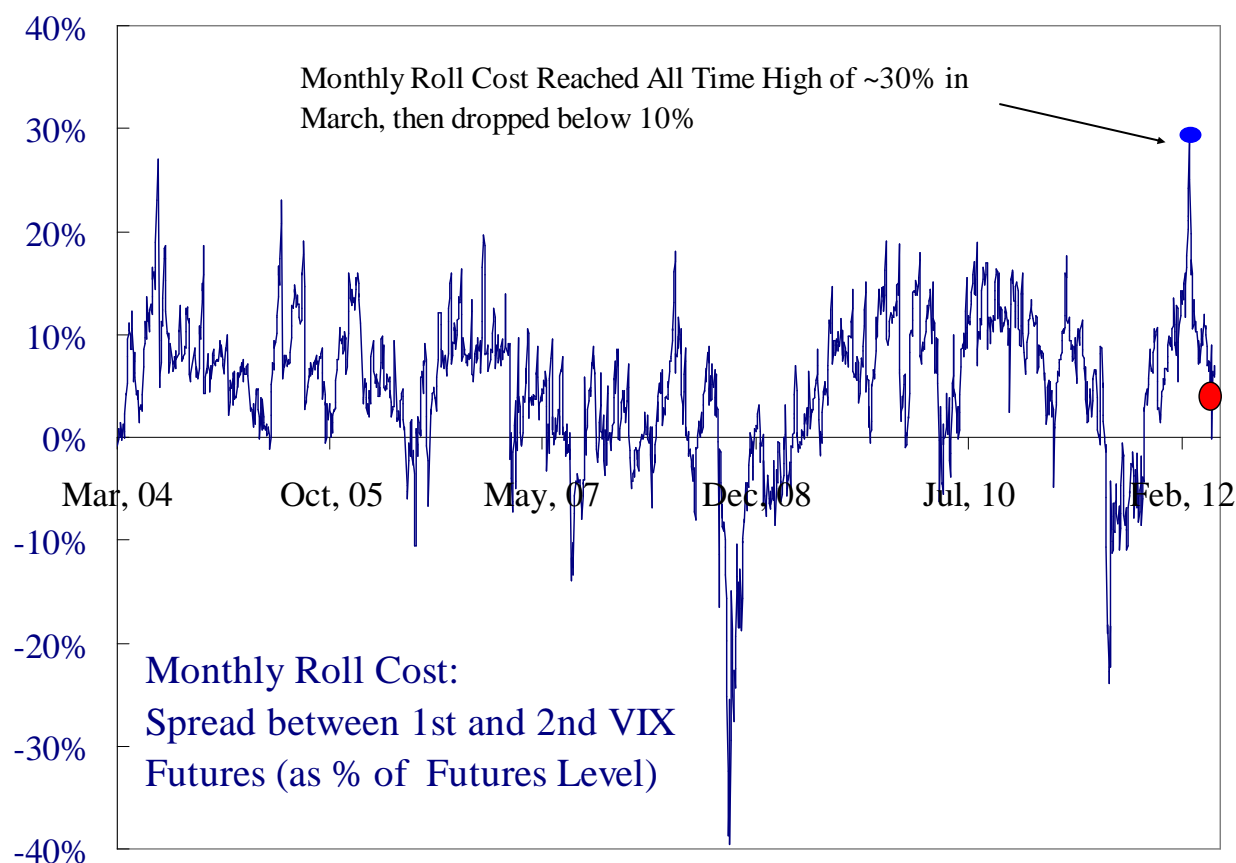
\* As of 4/9/2012 \*\* Weekly returns of Index and VIX returns over the past year





## VIX Exchange Traded Products

- ETPs largely used to obtain long VIX exposure
- VIX typically has an attractive feature: it provides positive and convex payoff in a market selloff
- However, there is a cost of maintaining VIX exposure
- Term structure is typically upward sloping (~80% of time since 1989), leading to a significant roll cost

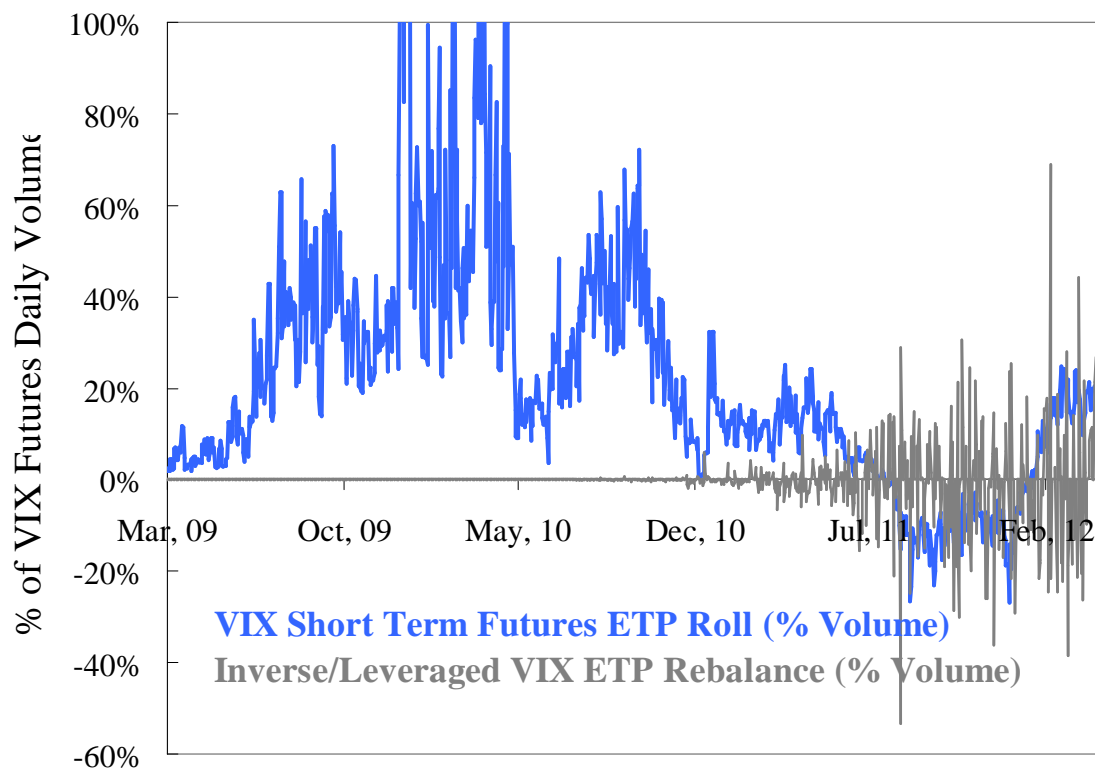


Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

# VIX Exchange Traded Products

- VIX ETPs need to rebalance their holdings daily. For instance, VIX short-term futures index needs to buy 2<sup>nd</sup> and sell 1<sup>st</sup> month VIX future
- Levered and Inverse ETPs need to rebalance due their short gamma exposure
- Combined flows can have a significant impact on VIX futures

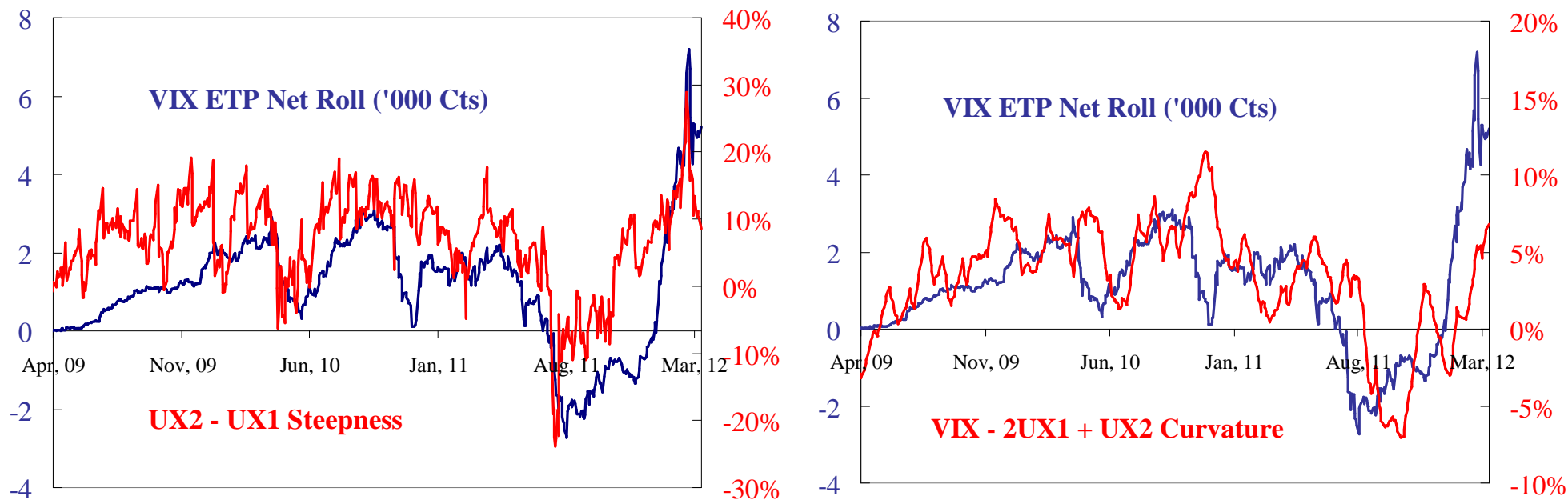
Ticker	Lev.	Assets (M\$)*	SI (%)	Asset Net	Position T		Roll		Gamma	
					UX1	UX2	UX1	UX2	UX1	UX2
<i>Long VIX STF</i>										
VXX US	1	1,804	40	996	7,165	39,967	-2,388	2,220	0	0
TVIX US	2	498	12	925	6,660	37,154	-2,220	2,064	-66	-583
UVXY US	2	156	6	283	2,037	11,361	-679	631	-20	-178
VIXY US	1	137	4	137	988	5,510	-329	306	0	0
1552 JP	1	124	--	124	895	4,992	-298	277	0	0
HVU CN	2	45	5	84	603	3,364	-201	187	-6	-53
VIX US	1	26	47	14	102	570	-34	32	0	0
VIXS LN	1	24	--	42	299	1,668	-100	93	0	0
VXIS LN	1	6	--	7	53	296	-18	16	0	0
VXCC US	1	6	0	7	50	277	-17	15	0	0
HUV CN	1	7	0	7	47	264	-16	15	0	0
VXBB US	1	5	0	6	42	236	-14	13	0	0
2030 JP	1	5	--	5	38	214	-13	12	0	0
VXAA US	1	4	1	5	34	189	-11	10	0	0
<i>Short VIX STF</i>										
XIV US	-1	403	7	-366	-2,635	-14,698	878	-817	-52	-461
SVXY US	-1	26	11	-23	-162	-906	54	-50	-3	-28
XXV US	-0.2	16	2	-3	-23	-127	8	-7	0	-2
AAVX US	-1	14	0	-13	-97	-542	32	-30	-2	-17
BBVX US	-1	14	0	-13	-95	-530	32	-29	-2	-17
CCVX US	-1	13	1	-12	-86	-480	29	-27	-2	-15
IVOP US	-1	5	1	-5	-33	-182	11	-10	-1	-6
<b>Total</b>							<b>-5,294</b>	<b>4,922</b>	<b>-154</b>	<b>-1,361</b>



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

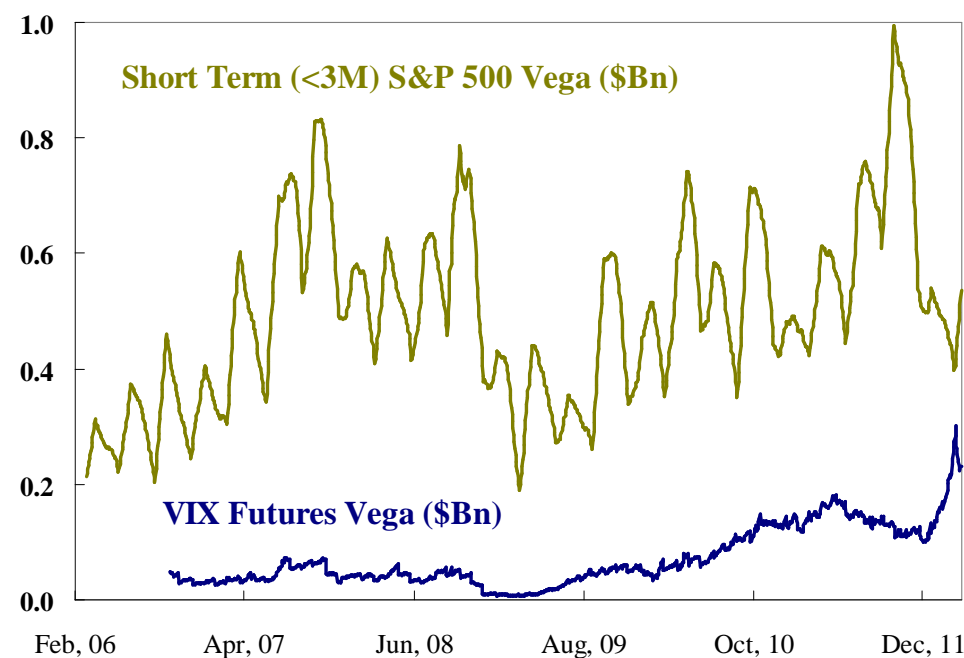
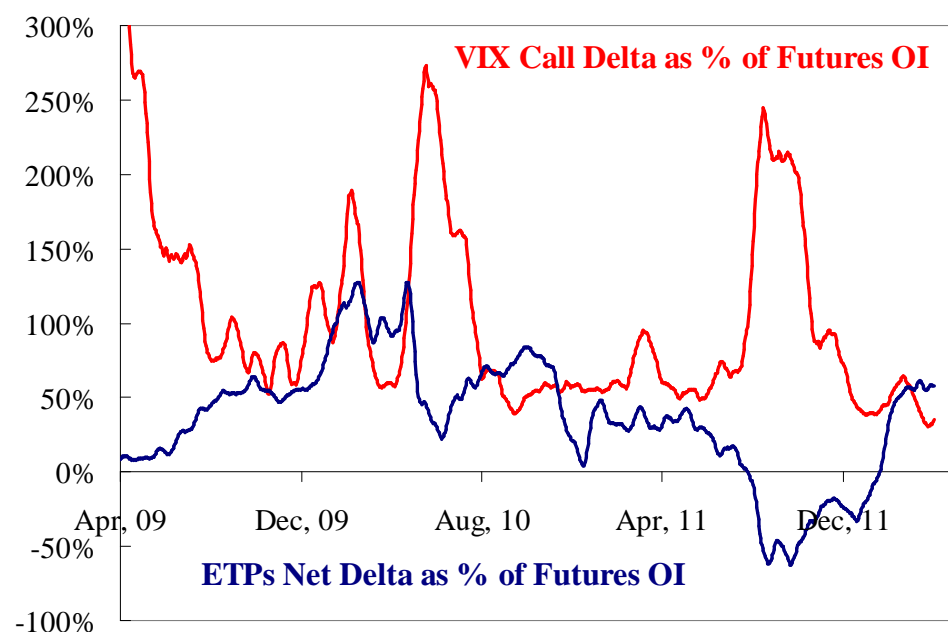
## Impact on Implied Volatility: VIX Term Structure

- Daily roll of VIX short-term and mid-term futures causes steepening of VIX term structure
- Daily roll also causes curvature of short end of term structure ( $VIX - 2 \cdot UX1 + UX2$ )



## Impact on Implied Volatility: S&P 500

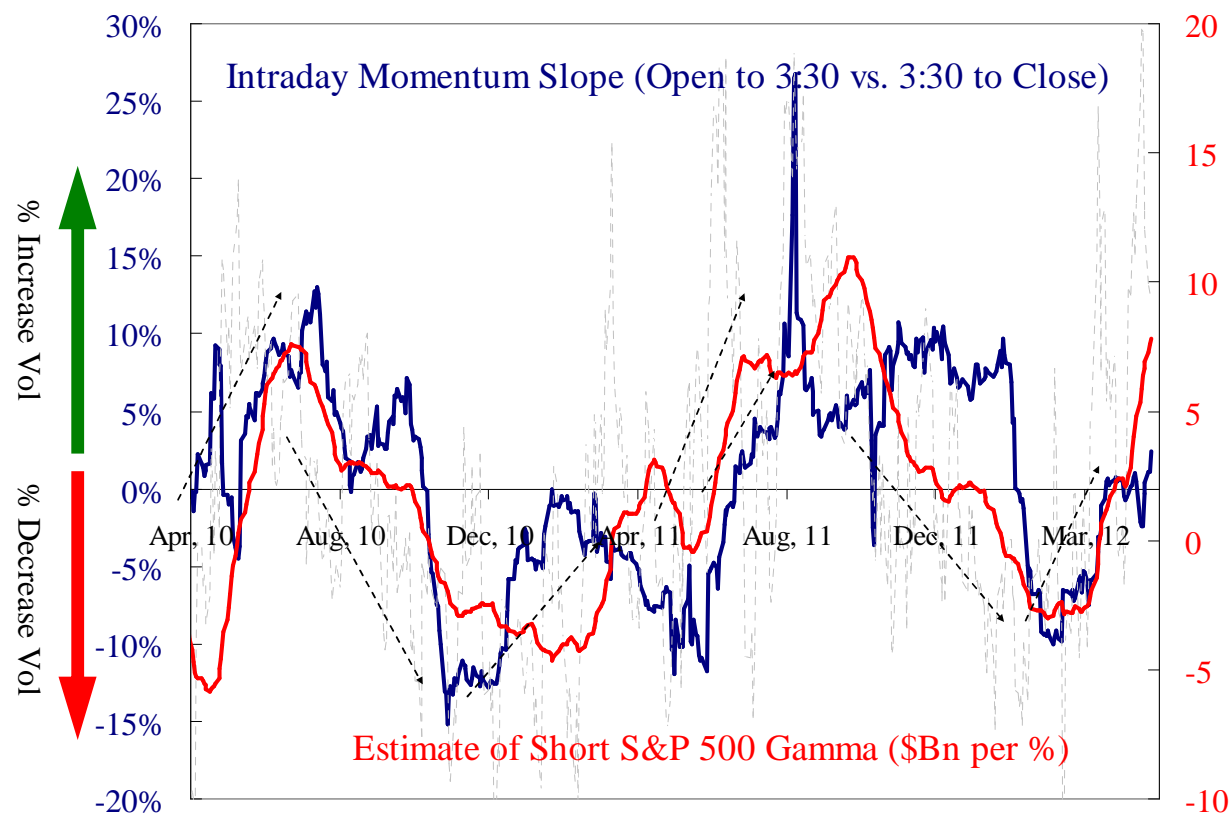
- With over 200M Vega, exposure of VIX call and ETPs is often larger than VIX futures open interest
- Clients are typically long VIX calls and ETPs. This leaves dealers short VIX vega.
- This exposure is likely hedged in a much deeper short-term S&P 500 options market (~3 times the size of the VIX futures market).
- Demand for VIX products supports levels of S&P 500 implied volatility, volatility term structure, skew, and implied - realized volatility premium



## Impact on Realized Volatility: Long Gamma

- Investors buy VIX (Vega), but dealers hedge with products that have both S&P 500 Vega and Gamma
- ~200M of VIX Vega, hedged with S&P 500 options and variance could add ~1-3 \$Bn of long gamma exposure
- Investors buying VIX are also less likely to buy S&P 500 puts, reducing overall short gamma exposure
- This can create positive feedback loops, putting pressure on realized volatility
- Still dominant contribution to hedged gamma positions is from S&P 500 options (dealers short gamma)

\$1M Vega Hedge	Gamma \$M
1M Var Swap	5
2M Var Swap	2
3M Var Swap	2
1M Straddle	67
2M Straddle	33
3M Straddle	22
<i>Average</i>	22



## Impact on Realized Volatility: Long Gamma

- Hedging of S&P 500 long gamma put additional pressure on realized volatility in Q1 2012



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## Impact on Realized Volatility: Short Gamma

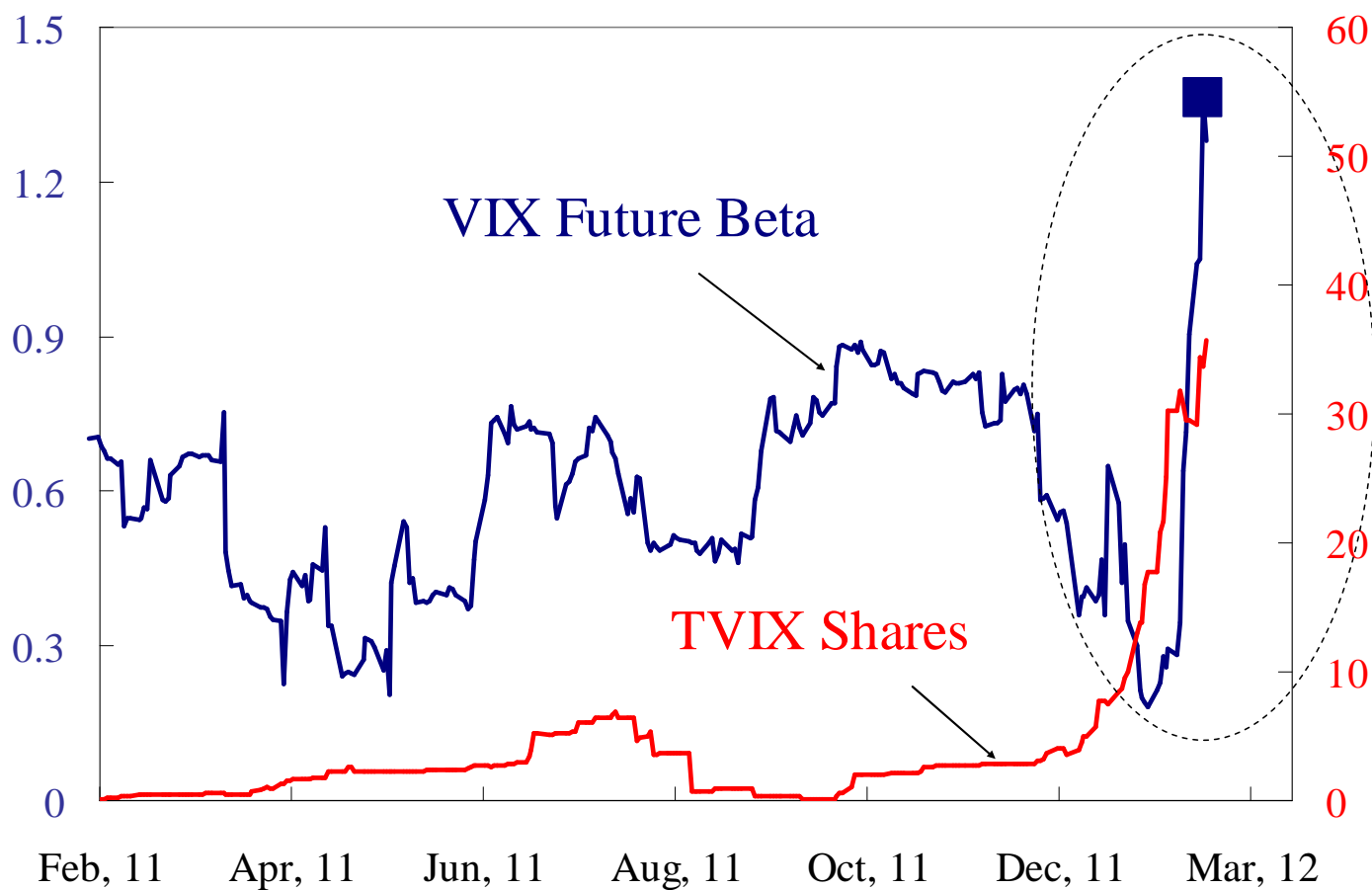
- Significant part of intraday volatility in August 2011 was caused by gamma hedging
- S&P 500 options were the largest contributor, but net short assets in VIX ETPs may have added to it



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## Impact on Volatility of Volatility

- Levered and Inverse ETP Rebalancing causes higher volatility of VIX futures (volatility of volatility)
- This is related to implied volatility skew

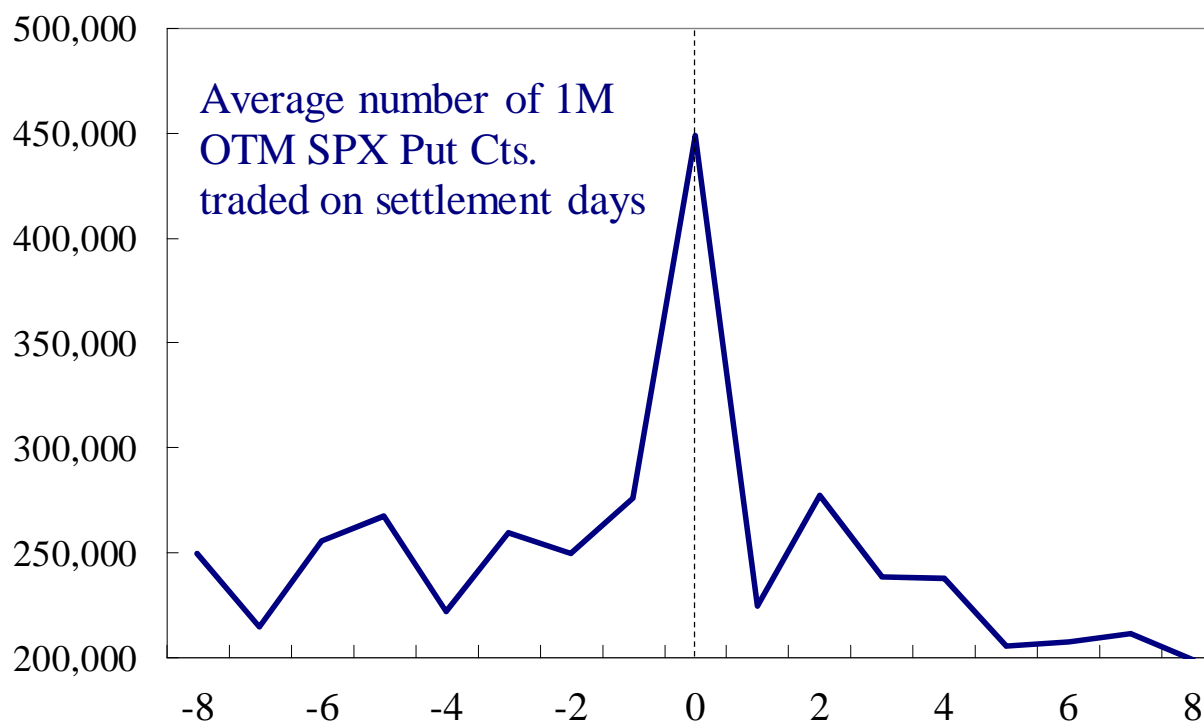


Source: J.P. Morgan Equity Derivatives Strategy



## VIX Risks: Settlement

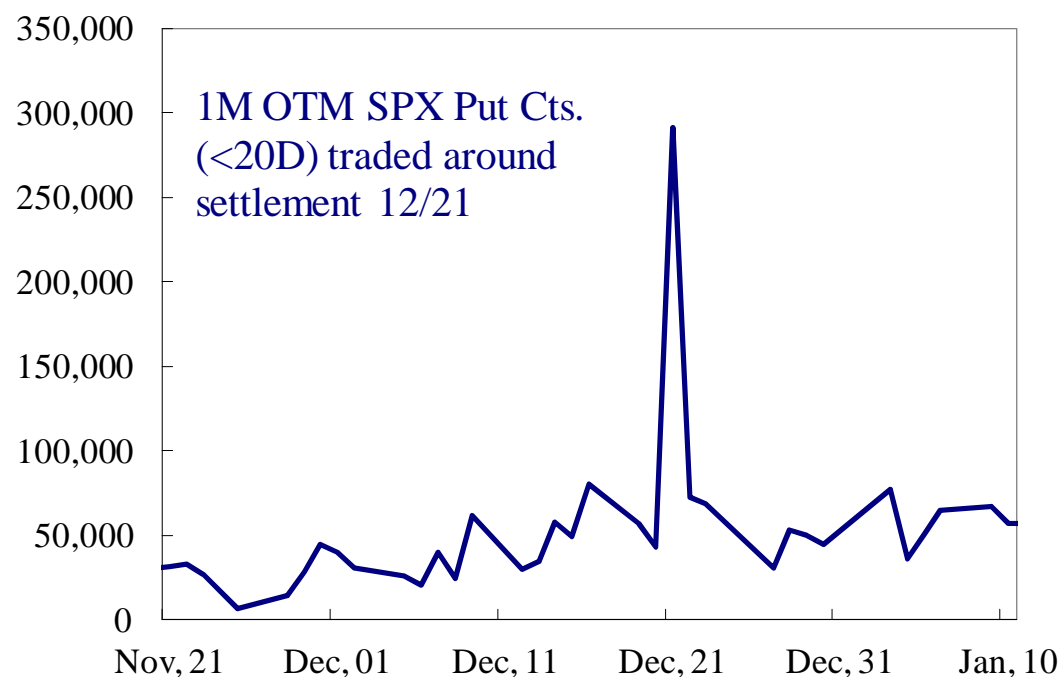
- “ ...there may be a substantial disparity between the final settlement value for expiring VIX futures and the reported indicative values of VIX. Such a disparity will occur if there are substantial order imbalances significantly weighted on the same side of the market in the Constituent Options that trade during the ROS opening on the settlement date.” CBOE
- “...investors should be prepared in case a substantial disparity occurs, and should consider closing out the VIX futures position prior to settlement, rolling the VIX futures position into another contract month (see link below for current Roll Market information) or hedging their VIX futures position.” CBOE



Source: CBOE, J.P. Morgan Equity Derivatives Strategy, Bloomberg

## VIX Risks: Settlement

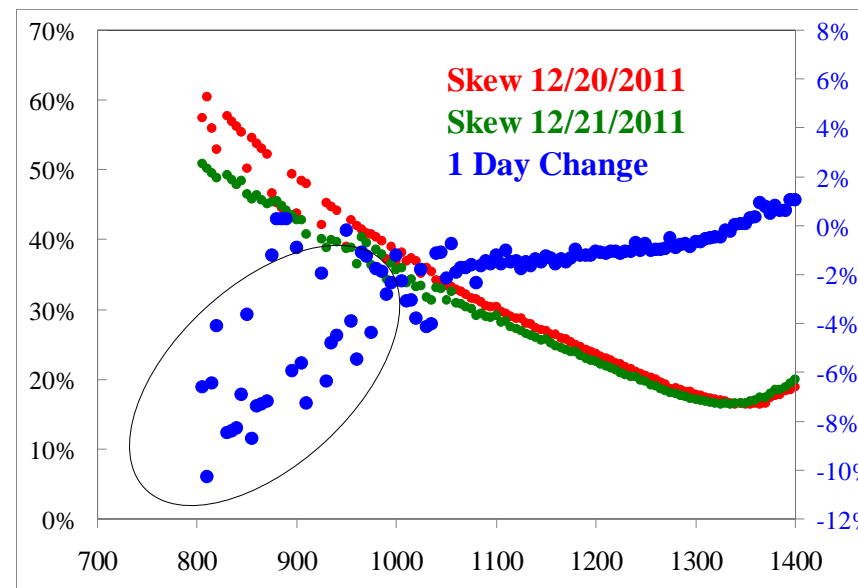
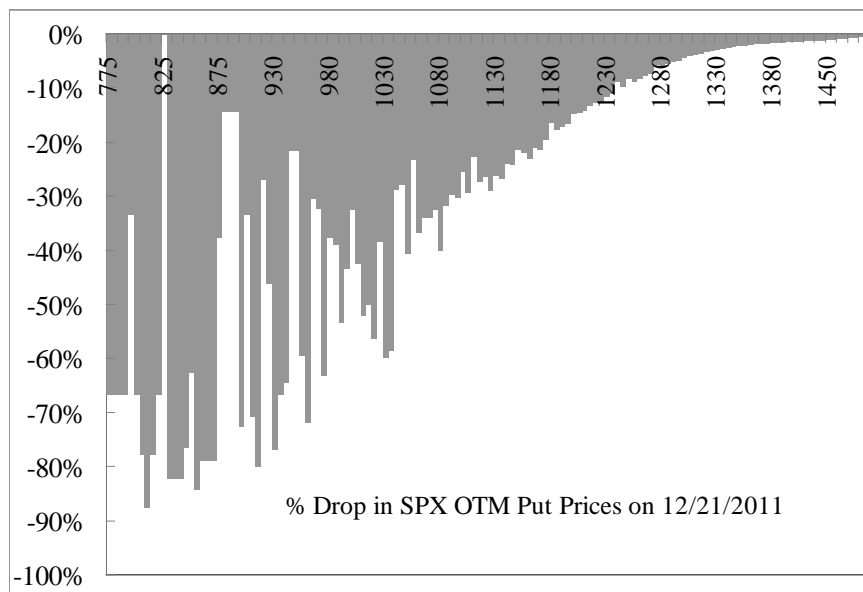
- On December 2011 expiry VIX settled 1.86 points below previous day's close
- VIX Futures exhibited large down move, while other asset classes didn't react significantly
- OTM SPX Puts traded ~6 times more than average



Risk	Dec, 20	Dec, 21	% Change	Z-score
S&P 500	1241.3	1243.7	0%	-0.2
VIX	23.22	21.43	-8%	-1.8
UX1	23.85	21.36	-10%	-2.5
UX2	26.55	24.5	-8%	-2.6
UX3	27.65	25.85	-7%	-2.8
VXN	22.5	22.3	-1%	-0.1
VXEEM	32.4	31.3	-3%	-0.4
V2X	30.3	30.3	0%	0.0
VDAX	27.0	27.5	2%	0.3
CDX HY	713.0	706.2	-1%	-0.4
CDX IG	126.5	124.5	-2%	-0.7
EUR CDSI	179.6	177.0	-1%	-0.5
TLT	120.8	119.1	-1%	-1.2
EUR	1.3	1.3	0%	0.3
HGA	338.6	341.1	1%	-0.3
GVZ	21.3	21.2	-1%	-0.1

# VIX Risks: Settlement

- Analysis of the VIX move on the full day shows that it largely came on account of drop in prices of OTM S&P 500 Puts (< 20 Delta)

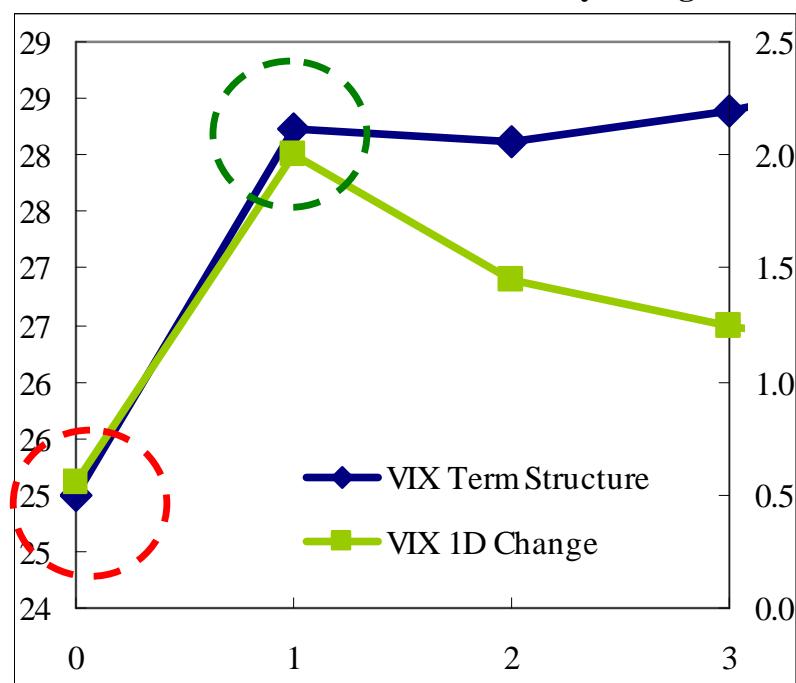


Drop in VIX Due to		Selling all <20D Puts on 12/21 covering on 12/22 (\$M)	
< 10D Puts	0.95	Proceeds	39.3
< 20D Puts	1.35	Cost to cover	38.1
< 30D Puts	1.63	Delta PnL	-10.4
All Options	1.79	<i>Total</i>	-9.2

## VIX Risks: Settlement

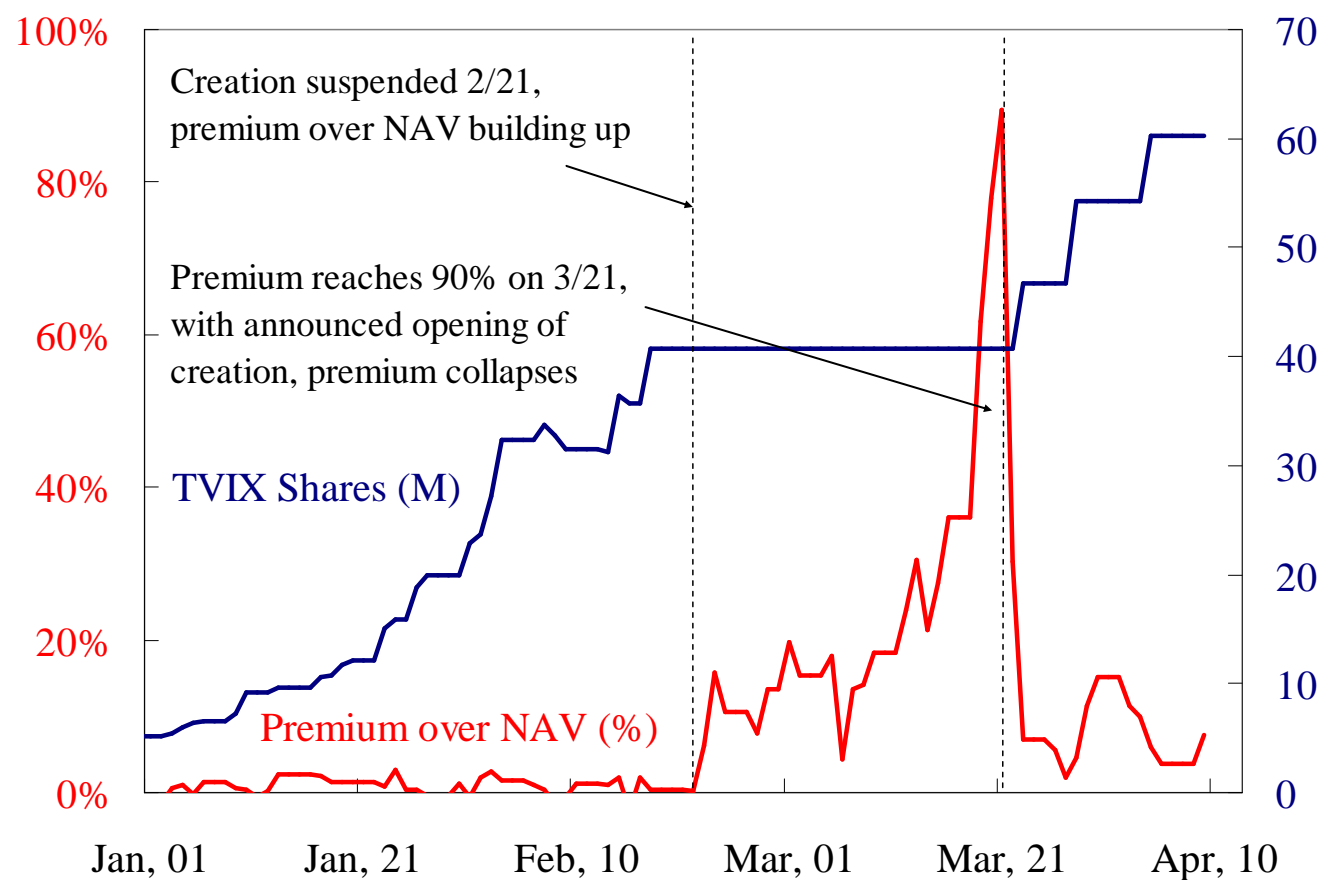
- VIX contracts settle on Wednesdays 30 days prior to 3rd Fridays. S&P 500 options expire on 3rd Fridays. This difference is usually not significant, but can influence the pricing of VIX
- May 18, 2012: spot VIX calculated largely based on S&P 500 options expiring on June 15, while VIX futures expire on June 20.
- The difference would not matter were it not for the Greek elections on June 17. Regular June S&P 500 options do not cover Greek elections on the 17th, while VIX futures do cover it and are hence traded at a higher level and term structure inversion (first two contracts).

5/18/2012 VIX Term Structure and 1-Day Change



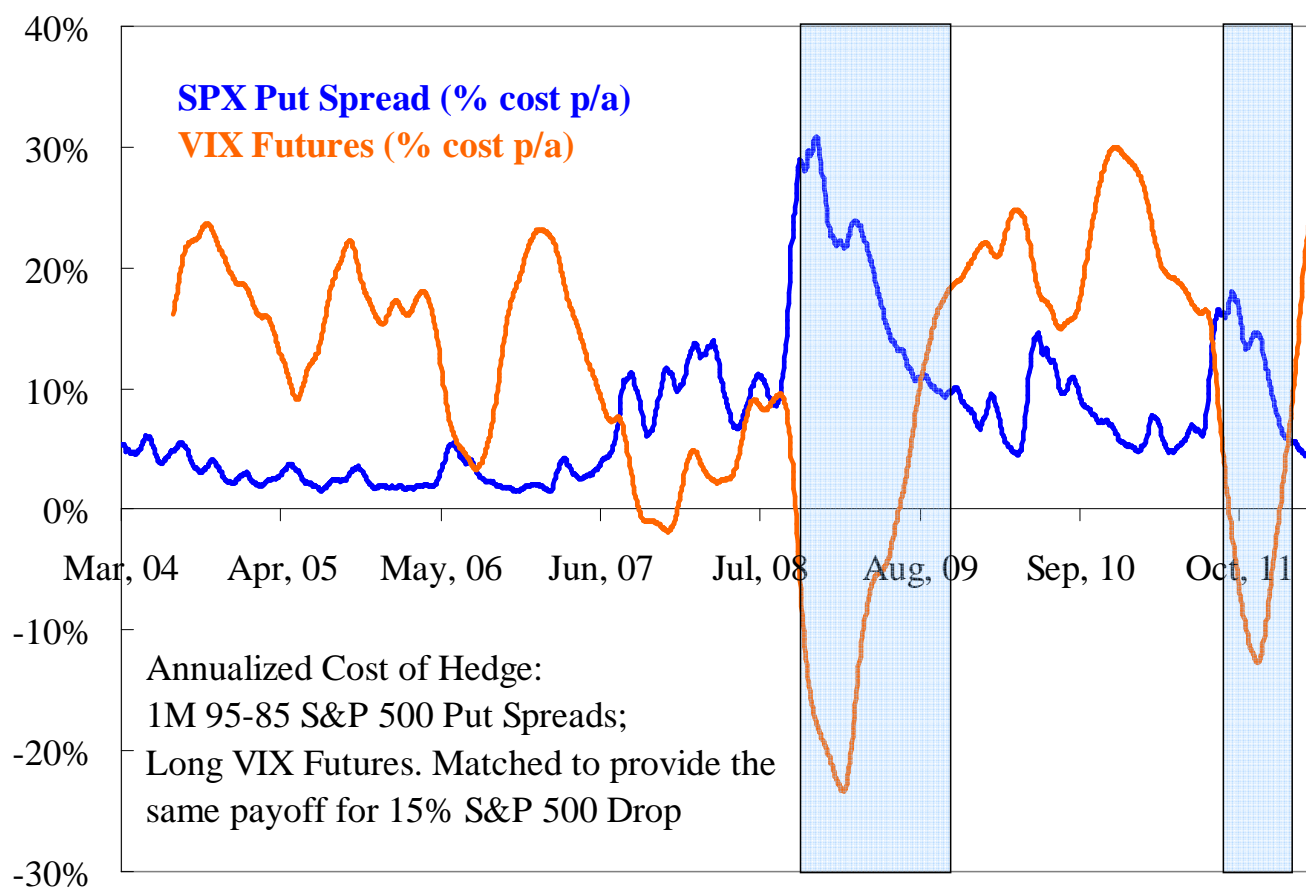
## VIX Risks: ETP Premium

- Growth of TVIX impacted VIX term structure and VIX futures price action
- Suspension of creation caused buildup of premium over Net Asset Value (NAV)



## Cost of a Hedge: VIX Futures / ETPs vs. S&P 500 Puts

- VIX reacts to market shocks regardless of S&P 500 level
- This is similar to an S&P 500 put that is constantly re-struck
- This VIX feature comes at a cost (roll-down) that can be compared to a cost of rolling short-term S&P 500 Options



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

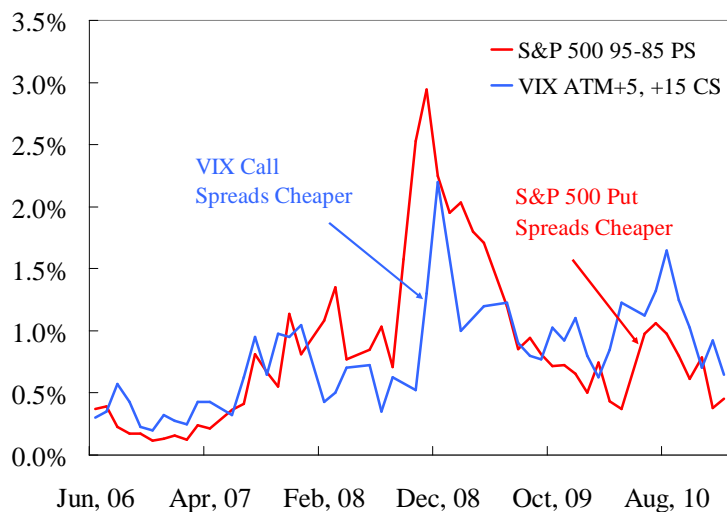
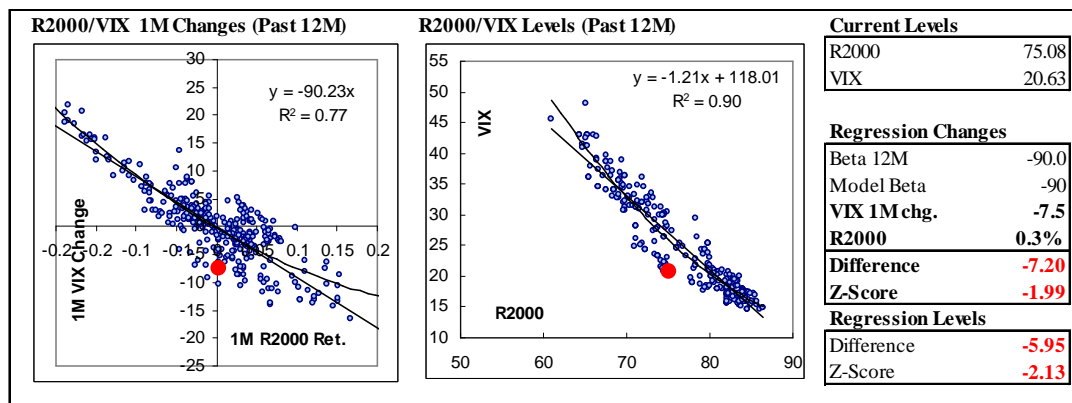
# Cost of a Hedge: VIX Options vs. S&P 500 Puts

- Given different properties of VIX Options and Equity Index Prices, not easy to compare
- VIX Call-Spread to S&P 500 Put-Spread Comparison at expiry
- Comparison of Entry-Points (Z-score analysis)

Cost of SPX Puts (Mid)			Cost VIX C. Spreads - Cost of SPX P. Spreads					
Put	Strike	Cost	SPX	ATM	+5%	+10%	+15%	+20%
SPX 100P	1295	2.43%	ATM	1.7%	0.7%	0.9%	1.2%	1.4%
SPX 95P	1230	1.00%	+5%	--	1.0%	0.2%	0.5%	0.7%
SPX 90P	1165	0.40%	+10%	--	--	0.7%	0.3%	0.5%
SPX 85P	1100	0.19%	+15%	--	--	--	0.5%	0.2%
SPX 80P	1035	0.12%	+20%	--	--	--	--	0.3%

Cost of VIX Calls (Mid)			Option Expiry / Days		
Call	Strike	Cost	SPX	Feb, 18	39
VIX 100C	20.0	4.22	VIX	Feb, 15	36
VIX +5' C	25.0	1.99			
VIX +10' C	30.0	1.15			
VIX +15' C	35.0	0.65			
VIX +20' C	40.0	0.41			



Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

# VIX Term Structure Trading: Beta/Slide

- Shorter-dated VIX futures provide more volatility exposure than longer-dated VIX futures but typically suffer a larger term structure slide. One method is to select the VIX future that offers the highest volatility exposure for the same term structure slide.
- Flows from VIX structured products, ETFs and ETNs can result in term structure shifts that favor holding one future over another, and even create long volatility positive carry opportunities.

## VIX Term Structure Analysis

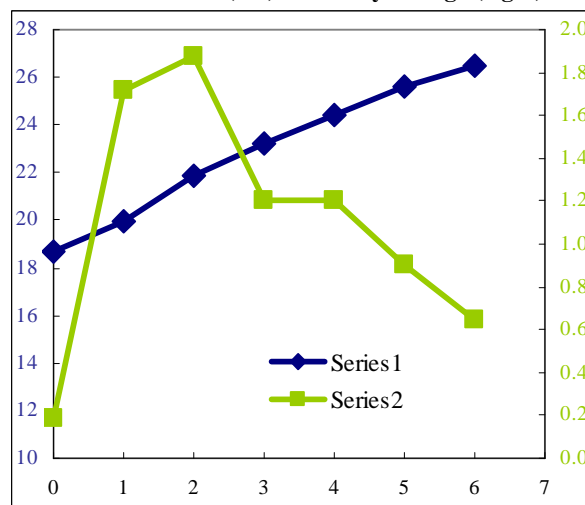
VIX Term Structure, Changes, and Futures Slide

Future	Level	Change		Slide (and % -tile)		
	Curr.	1D	1W	Curr.	4Y%	1Y%
VIX Spot	18.65	0.19	-1.37	--	--	--
UX1	19.92	1.72	-0.78	1.27	64%	64%
UX2	21.83	1.88	-0.52	1.91	64%	71%
UX3	23.20	1.20	-0.50	1.37	78%	64%
UX4	24.45	1.20	-0.25	1.25	93%	89%
UX5	25.60	0.90	-0.35	1.15	94%	80%
UX6	26.50	0.65	-0.60	0.90	91%	78%

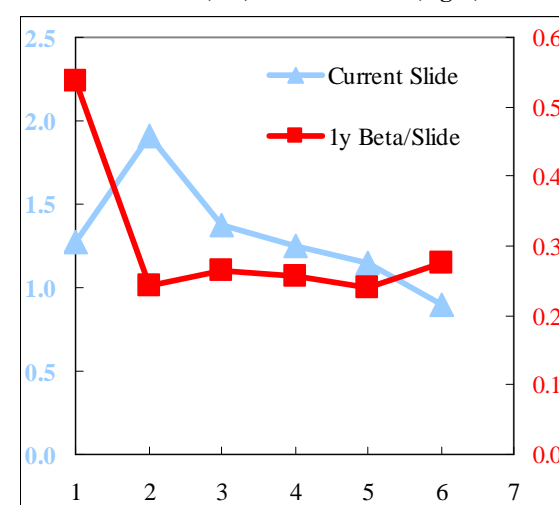
Futures Beta to VIX, Beta/Slide

Future	Beta to VIX				Beta/slide	
	4Y	2Y	1Y	6M	4Y	1Y
UX1	0.62	0.66	0.68	0.77	0.49	0.54
UX2	0.41	0.48	0.46	0.64	0.21	0.24
UX3	0.34	0.39	0.36	0.52	0.25	0.26
UX4	0.30	0.35	0.32	0.45	0.24	0.26
UX5	0.26	0.31	0.28	0.41	0.23	0.24
UX6	0.23	0.28	0.25	0.39	0.26	0.28

VIX Term Structure (left) and 1-Day Change (right)



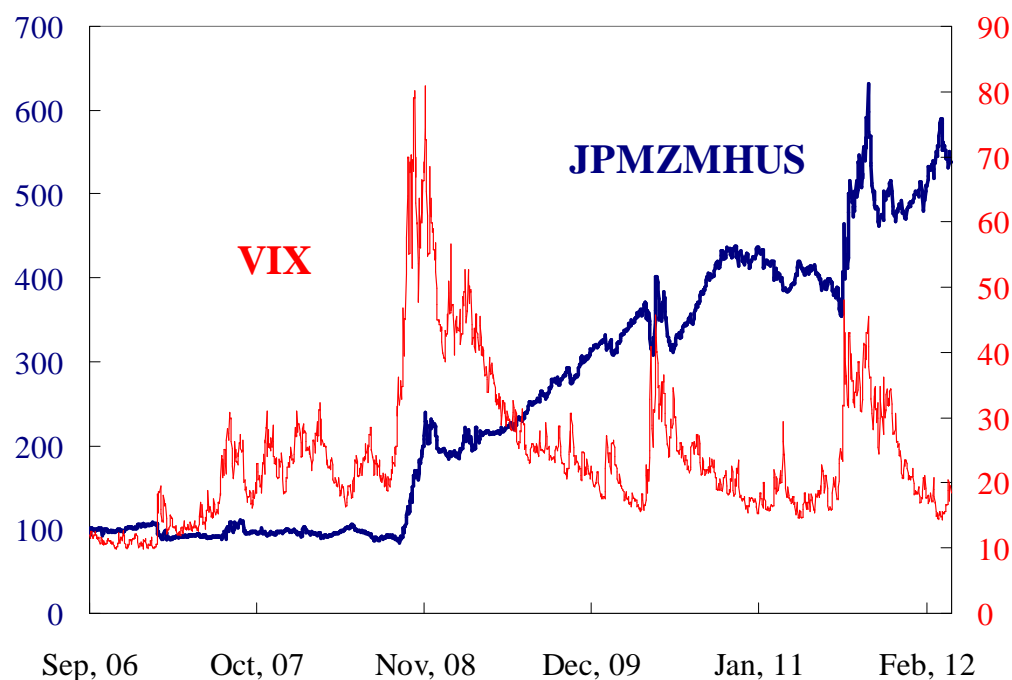
VIX Futures Slide (left) and Beta/Slide (right)





## VIX Term Structure Trading: J.P. Morgan Macro Hedge

- The index is long 2<sup>nd</sup> and 3<sup>rd</sup> VIX future, and opportunistically short 1<sup>st</sup> and 2<sup>nd</sup> month VIX future. Short leg is gradually removed after 3 days of term structure inversion.
- Collects roll-down of steep VIX term structure. Short leg creates risk of a large spike and inversion.
- Historically, largest spikes in VIX happened only after term structure inverted.



VIX above	70	60	50	40
# of times since 1990	17	36	64	207
No inversion 3D prior	0	0	3	51
Average VIX 3D prior	62.4	61.5	56.8	45.9
Min VIX 3D prior	52.7	48.0	23.5	23.5
No inversion 6D prior	0	0	3	62
No inversion 8D prior	0	0	3	67

Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## VIX Term Structure Trading: J.P. Morgan Macro Hedge

- Second-generation 'Macro Hedge' indices use dynamic allocation and defensive positioning

	Index	Description	Long Exposure	Short Exposure
1 <sup>st</sup> Generation	Macro Hedge US JPMZMHUS	Subsidises the cost of a fixed long volatility position by <u>opportunistically initiating short exposure</u> when term structure is upward sloping  Launched 3 May 2010	100% long exposure to 2 <sup>nd</sup> and 3 <sup>rd</sup> month <u>VIX</u> futures	0-100% short exposure to 1 <sup>st</sup> and 2 <sup>nd</sup> month <u>VIX</u> futures
	Macro Hedge Enhanced JPMZMHEN	Improves carry by initiating long exposure to <u>longer-dated VIX futures</u> curve  Launched 1 Mar 2011	75-100% long exposure to 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup> month <u>VIX</u> futures	0-75% short exposure to 1 <sup>st</sup> and 2 <sup>nd</sup> month <u>VIX</u> futures
	Macro Hedge Dual Enhanced JPMZMHHG	Gains <b>additional pickup</b> in stressed market conditions through <u>exposure to VSTOXX</u> futures  Launched 29 Jul 2011	100% long exposure to 4 <sup>th</sup> , 5 <sup>th</sup> , 6 <sup>th</sup> and 7 <sup>th</sup> month <u>VIX</u> futures  0-25% long exposure to 2 <sup>nd</sup> and 3 <sup>rd</sup> month <u>VSTOXX</u> futures	0-100% short exposure to 1 <sup>st</sup> and 2 <sup>nd</sup> month <u>VIX</u> futures
2 <sup>nd</sup> Generation	Macro Hedge Curve JPMZMHCU	Optimises carry by <u>dynamic allocation</u> to the part of the VIX/VSTOXX futures curve with the best expected carry  Launched 30 Dec 2011	100% long exposure and 0-100% short exposure across 5 distinct buckets in the <u>VIX</u> and <u>VSTOXX</u> futures curves  Allocation changes 5% per day	
	Macro Hedge Vepo JPMZVEPO	Provides <b>defensive positioning</b> by <u>dynamically capping the short exposure</u> such that the net position is vega-positive  Launched 2 Apr 2012	100% long exposure and 0-100% short exposure across 5 distinct buckets in the <u>VIX</u> and <u>VSTOXX</u> futures curves  Allocation changes 5% per day	

Source: J.P. Morgan Equity Derivatives Structuring, Bloomberg.

# Cross-Asset Hedging with VIX

- Correlation of Assets driven by macro Volatility - one can use Volatility to hedge across Assets
- Cross-asset hedging can be optimal if the proxy hedge is more liquid, costs less, or provides a better entry point compared to a direct hedge

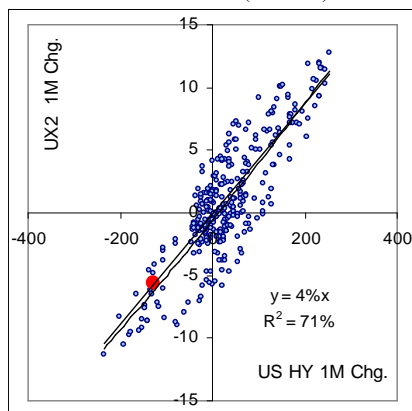
	S&P 500	R2000	VIX	UX1	UX2	UX3	R2000 Vol	NDX Vol	EM Vol	SX5E Vol	DAX Vol	HSI Vol	NKY Vol	KOSPI Vol	Correlation	HY US	IG US	IG EU	HY EU	20y TSY	1y IR Vol	10y IR Vol	Eur Vol	Yen Vol	Euro	Oil	Oil Vol	Copper	GDX Vol	GLD Vol
<b>S&amp;P 500</b>	--	98%	-95%	-94%	-91%	-87%	-94%	-94%	-92%	-92%	-92%	-89%	-52%	-89%	-68%	-84%	-85%	-84%	-84%	-78%	-61%	-65%	-76%	-21%	38%	83%	-81%	65%	-84%	-88%
<b>R2000</b>	98%	--	-94%	-95%	-94%	-92%	-96%	-92%	-94%	-92%	-94%	-91%	-44%	-91%	-75%	-89%	-88%	-89%	-90%	-84%	-65%	-68%	-80%	-12%	48%	83%	-82%	74%	-87%	-90%
<b>VIX</b>	-95%	-94%	--	98%	93%	90%	99%	99%	96%	97%	96%	94%	58%	94%	67%	84%	84%	83%	83%	77%	62%	73%	81%	30%	-28%	-80%	89%	-64%	90%	92%
<b>UX1</b>	-94%	-95%	98%	--	97%	95%	99%	96%	97%	97%	98%	95%	54%	95%	74%	89%	91%	90%	90%	84%	67%	73%	82%	19%	-38%	-78%	88%	-72%	89%	95%
<b>UX2</b>	-91%	-94%	93%	97%	--	99%	96%	91%	95%	94%	96%	92%	47%	92%	82%	94%	95%	94%	90%	71%	68%	82%	7%	-48%	-71%	83%	-80%	85%	93%	
<b>UX3</b>	-87%	-92%	90%	95%	99%	--	94%	88%	93%	92%	95%	91%	42%	90%	87%	95%	96%	96%	96%	92%	73%	68%	83%	0%	-52%	-67%	80%	-83%	83%	91%
<b>R2000 Vol</b>	-94%	-96%	99%	99%	96%	94%	--	98%	98%	97%	97%	95%	52%	95%	72%	87%	88%	88%	88%	82%	66%	76%	83%	21%	-38%	-80%	89%	-71%	92%	95%
<b>NDX Vol</b>	-94%	-92%	99%	96%	91%	88%	98%	--	95%	93%	93%	61%	92%	63%	81%	81%	82%	80%	79%	73%	61%	73%	78%	33%	-26%	-80%	89%	-61%	90%	90%
<b>EM Vol</b>	-92%	-94%	96%	97%	95%	93%	98%	95%	--	95%	96%	95%	45%	94%	70%	88%	90%	87%	86%	81%	70%	82%	86%	17%	-53%	-81%	91%	-72%	93%	93%
<b>SX5E Vol</b>	-92%	-92%	97%	97%	94%	92%	97%	95%	95%	--	99%	95%	55%	95%	72%	87%	88%	89%	88%	82%	64%	72%	85%	22%	-34%	-79%	86%	-68%	86%	93%
<b>DAX Vol</b>	-92%	-94%	96%	98%	96%	95%	97%	93%	96%	99%	--	96%	52%	97%	76%	91%	92%	92%	91%	87%	62%	67%	87%	17%	-38%	-78%	87%	-75%	88%	95%
<b>HSI Vol</b>	-89%	-91%	94%	95%	92%	91%	95%	93%	95%	95%	96%	--	56%	97%	71%	87%	88%	87%	87%	82%	66%	74%	83%	23%	-33%	-78%	86%	-73%	90%	92%
<b>NKY Vol</b>	-52%	-44%	58%	54%	47%	42%	52%	61%	45%	55%	52%	56%	--	52%	16%	33%	38%	30%	28%	25%	13%	40%	29%	70%	15%	-33%	59%	-20%	43%	46%
<b>KOSPI Vol</b>	-89%	-91%	94%	95%	92%	90%	95%	92%	94%	95%	97%	97%	52%	--	70%	87%	88%	88%	87%	83%	63%	68%	84%	22%	-32%	-78%	86%	-73%	90%	94%
<b>Correlation</b>	-68%	-75%	67%	74%	82%	87%	72%	63%	70%	72%	76%	71%	16%	70%	--	91%	89%	92%	91%	94%	66%	40%	73%	-33%	-63%	-48%	56%	-89%	61%	69%
<b>HY US</b>	-84%	-89%	84%	89%	94%	95%	87%	81%	88%	87%	91%	87%	33%	87%	91%	--	98%	98%	97%	97%	70%	53%	83%	-13%	-51%	-65%	73%	-88%	80%	85%
<b>IG US</b>	-85%	-88%	84%	91%	95%	96%	88%	82%	90%	88%	92%	88%	38%	88%	89%	98%	--	98%	96%	96%	69%	54%	84%	-7%	-47%	-64%	74%	-88%	81%	87%
<b>IG EU</b>	-84%	-89%	83%	90%	95%	96%	88%	80%	87%	89%	92%	87%	30%	88%	92%	98%	98%	--	99%	98%	73%	58%	84%	-15%	-58%	-66%	72%	-87%	76%	87%
<b>HY EU</b>	-84%	-90%	83%	90%	94%	96%	88%	79%	86%	88%	91%	87%	28%	87%	91%	97%	96%	99%	--	97%	74%	59%	81%	-16%	-62%	-67%	71%	-87%	77%	86%
<b>20y TSY</b>	-78%	-84%	77%	84%	90%	92%	82%	73%	81%	82%	87%	82%	25%	83%	94%	97%	96%	98%	97%	--	65%	46%	81%	-21%	-59%	-60%	68%	-92%	74%	81%
<b>1y IR Vol</b>	-61%	-65%	62%	67%	71%	73%	66%	61%	70%	64%	62%	66%	13%	63%	66%	70%	69%	73%	74%	65%	--	69%	62%	-20%	-56%	-52%	46%	-56%	56%	59%
<b>10y IR Vol</b>	-65%	-68%	73%	73%	68%	68%	76%	73%	82%	72%	67%	74%	40%	68%	40%	53%	54%	58%	59%	59%	26%	--	59%	26%	-32%	-67%	64%	-89%	61%	70%
<b>Eur Vol</b>	-76%	-80%	81%	82%	82%	83%	83%	78%	86%	85%	87%	83%	29%	84%	73%	83%	84%	84%	81%	81%	62%	59%	--	5%	-38%	-76%	69%	-75%	82%	85%
<b>Yen Vol</b>	-21%	-12%	30%	19%	7%	0%	21%	33%	17%	22%	17%	23%	70%	22%	-33%	-13%	-7%	-15%	-16%	-21%	-20%	26%	5%	--	45%	-17%	30%	26%	23%	21%
<b>Euro</b>	38%	48%	-28%	-38%	-48%	-52%	-38%	-26%	-53%	-34%	-38%	-33%	15%	-32%	-63%	-51%	-47%	-58%	-62%	-59%	-56%	-32%	-38%	45%	--	31%	-24%	61%	-46%	-34%
<b>Oil</b>	83%	83%	-80%	-78%	-71%	-67%	-80%	-80%	-81%	-79%	-78%	-78%	-33%	-78%	-48%	-65%	-64%	-66%	-67%	-60%	-52%	-67%	-76%	-17%	31%	--	-70%	52%	-81%	-79%
<b>Oil Vol</b>	-81%	-82%	89%	88%	83%	80%	89%	89%	91%	86%	87%	86%	59%	86%	56%	73%	74%	72%	71%	68%	46%	64%	69%	30%	-24%	-70%	--	-63%	91%	84%
<b>Copper</b>	65%	74%	-64%	-72%	-80%	-83%	-71%	-61%	-72%	-68%	-75%	-73%	-20%	-73%	-89%	-88%	-88%	-87%	-87%	-92%	-56%	-37%	-75%	26%	61%	52%	-63%	--	-72%	-72%
<b>GDX Vol</b>	-84%	-87%	90%	89%	85%	83%	92%	90%	93%	86%	88%	90%	43%	90%	61%	80%	81%	76%	77%	74%	56%	74%	82%	23%	-46%	-81%	91%	-72%	--	91%
<b>GLD Vol</b>	-88%	-90%	92%	95%	93%	91%	95%	90%	93%	93%	95%	92%	46%	94%	69%	85%	87%	87%	86%	81%	59%	70%	85%	21%	-34%	-79%	84%	-72%	91%	--

Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## Cross-Asset Hedging with VIX

- VIX futures currently have higher correlation to US and European Credit spreads than to the S&P 500 itself.
- To set up a cross-asset hedge, an investor needs to determine cross-asset ‘beta’ and matching notional exposures.
- For instance, the second-month VIX future increases ~3.2 points for every 10bps increase in credit spreads. This represents a beta of 0.32 (figure below, middle). To hedge US IG exposure of \$100K per bp, an investor would need to acquire ~\$300K per point exposure in VIX. \$300K per point exposure corresponds to 300 second-month VIX futures or 3,000 second-month VIX option contracts.
- The investor can then look at the levels and changes in cross-asset performance to determine whether the entry point is attractive and compare the cost of hedges

UX2 1Mret. vs. HY US 1Mret. (Past 12M)



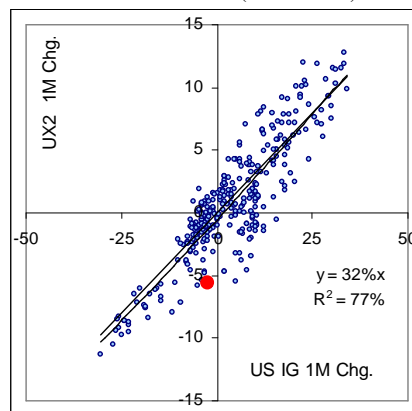
Current Levels

HY US	74.31
UX2	20.75

Regression

Beta 360d	0.0
Correlation	85%
Error	2.43
UX2 1M Chg	-5.55
HY US 1M C	-128.5
Z-Score	0.14

UX2 1Mret. vs. IG US 1Mret. (Past 12M/1M)



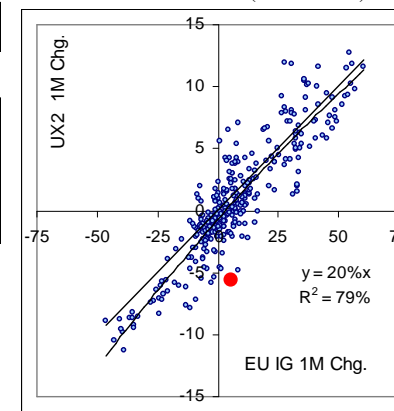
Current Levels

IG US	658.792
UX2	20.75

Regression

Beta 360d	0.3
Correlation	88%
Error	2.19
UX2 1M Chg.	-5.55
IG US 1M Ch.	-2.5
Z-Score	-2.16

UX2 1Mret. vs. IG EU 1Mret. (Past 12M/1M)



Current Levels

IG EU	119.5
UX2	20.75

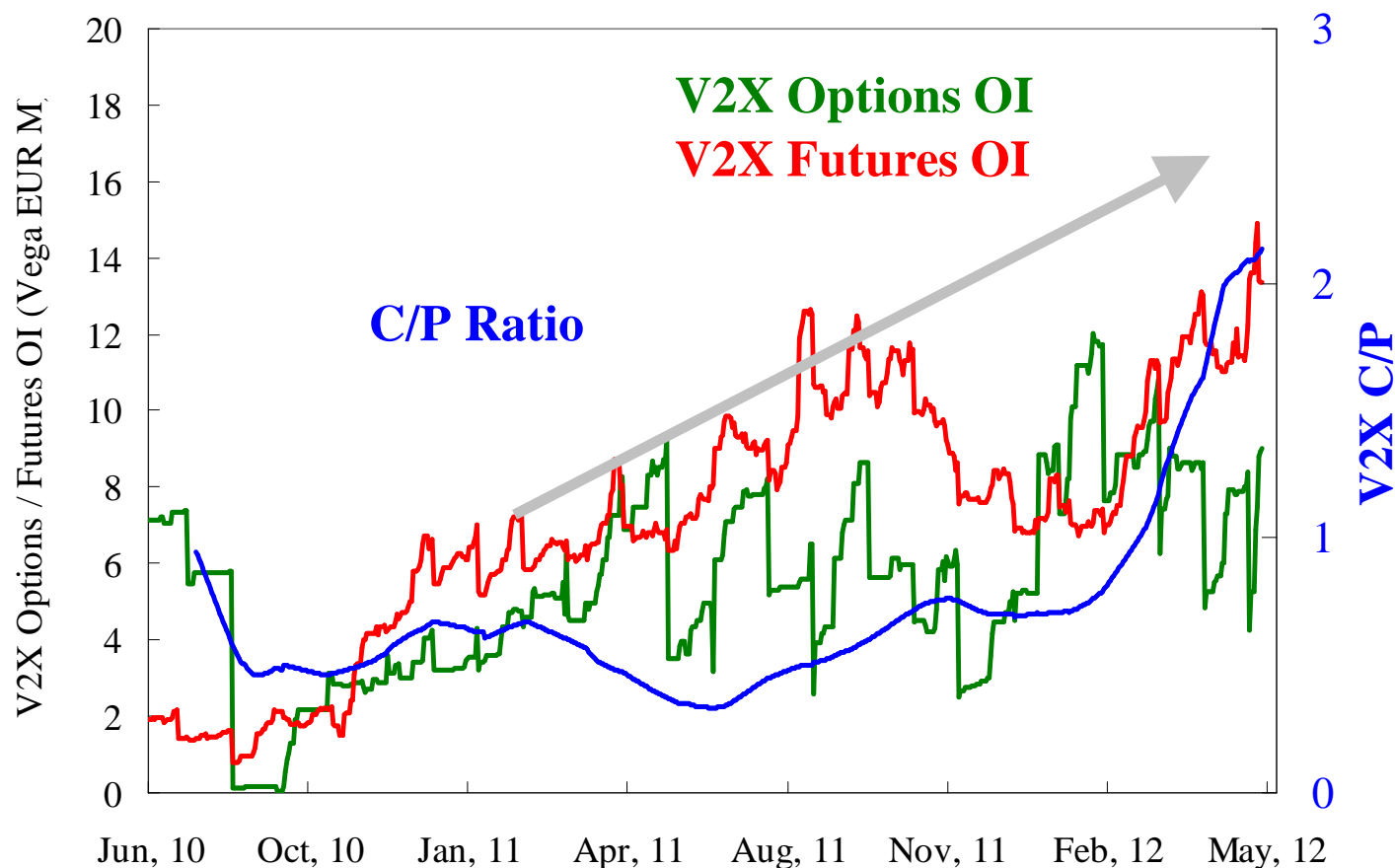
Regression

Beta 360d	0.2
Correlation	90%
Error	2.01
UX2 1M C	-5.55
IG EU 1M C	5.6
Z-Score	-3.35

Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## VIX in Europe: V2X

- In June 2009, Eurex launched the V2X futures\*. In March 2010 V2X Options started trading.
- Average daily volumes and open interest increased ~4 times since 2010. The market is still ~50 times smaller than VIX. Most of the trading takes place in first few futures (~85% in FVS1, FVS2 and FVS3). Call to Put ratio is currently ~2.



\*Re-launched by reducing multiplier to 100 from 1000. Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## VIX in Europe: V2X

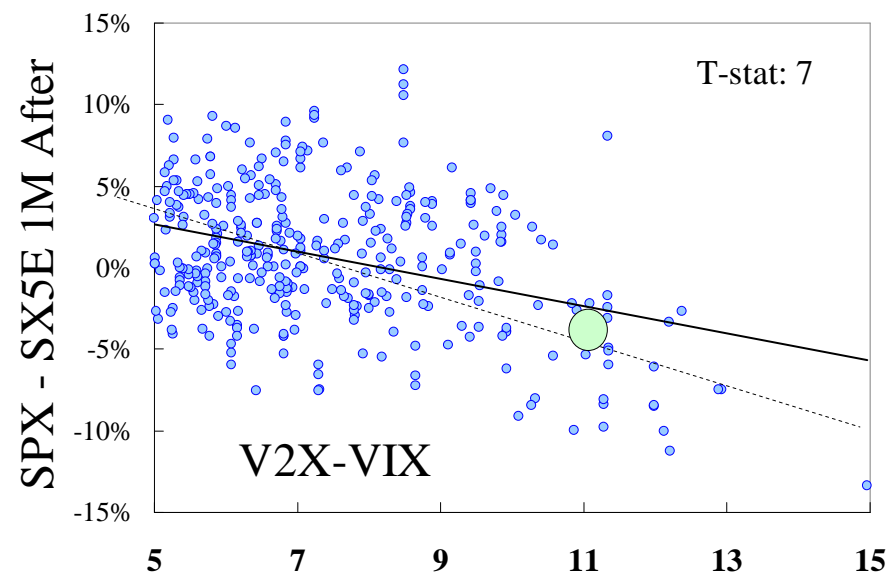
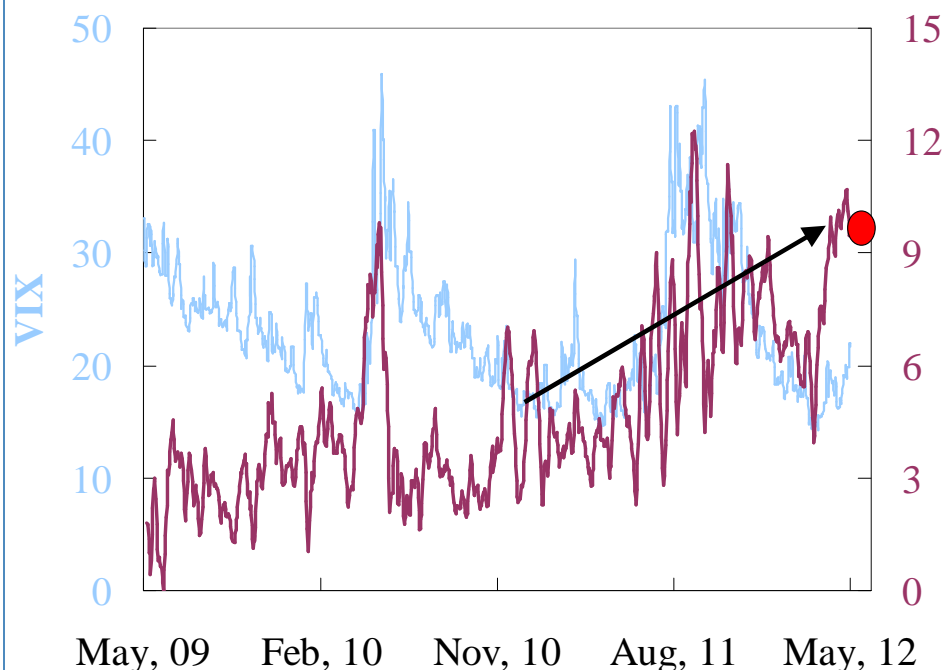
### CLIENT ACTIVITY

- Typical size: 100-200K Vega for both futures and options. 1M+ trades had been put in place.
- Type of investors: diversified investor base, but the flow is dominated by tail funds (~50% of flow)
- Bullish volatility trades: Buying outright calls (tails funds); Buying of call spreads (Asset Managers); Buy write: buying FVS3 or FVS4 to sell the 125% call of same maturity (Asset Managers)
- Bearish volatility trades: Buying short-dated ATM/ATM-2.5 or ATM-5 Put ratio (Hedge Funds)
- Relative Value: Spread V2X against VIX. Implemented either with options or futures

### IDB ACTIVITY

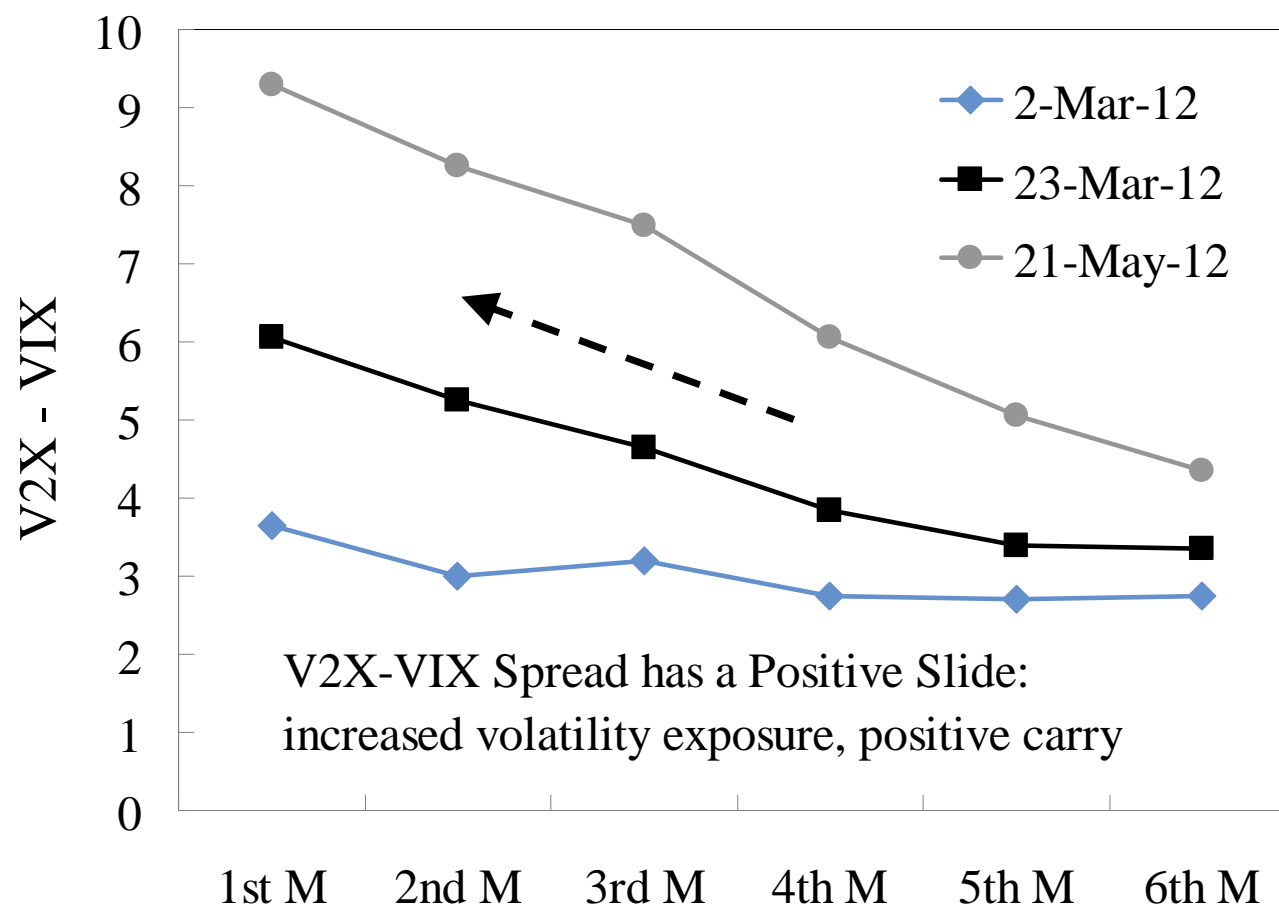
- Activity is limited due to: Low number of market participants, dealers having similar positions (so little risk recycling in the IDB). Relative value futures vs. vanilla and futures vs. variance swaps can be traded as a packaged in the IDB.

## VIX - V2X spread



- The chart (above left) shows the average spread between the VIX and V2X over the past 3 years. The spread widened with every escalation of EU crisis. Recently, this spread roughly doubled to ~10 points (from an average level of 5).
- Trading of V2X-VIX spread has increased the liquidity and demand for V2X products
- Over the past 3 years, this spread was also a good predictor of relative performance of European and US equities: widening of the spread resulted in a subsequent underperformance of S&P 500 relative to EuroStoxx 50 (S&P 500 often lagged EuroStoxx 50, figure above right).

## VIX - V2X spread



- Over the last 2 years, the term structure of the spread displayed a flat or inverted term structure.
- The reason was higher realized volatility of EuroStoxx 50 (sovereign debt crisis in Europe), and steep upward sloping term structure of S&P 500 volatility.
- Term structure of the spread allows investors to place a longer-dated futures trade at a better entry point and benefit from positive “carry” (slide).



## Other 'VIX' Indices

- 'VIX' Indices are calculated on a broad range of underlyings
- 7 'VIX' indices started trading recently: VHSI, VNKY, VXN, VXEEM, VXEV, OVX, GVZ
- 'VIX' indices on stocks, and even 'VIX' of 'VIX'

'VIX'	Underlying Index	Futures Trading
VIX	CBOE S&P 500	Mar, 26, 2004
V2X	Eurostoxx 50	Jun, 02, 2009
RVX	CBOE R2000	No
VXD	CBOE Dow Jones	No
VXO	CBOE S&P 100	No
VXN	CBOE NDX	May, 17, 2012
VXEEM	CBOE EEM ETF	Jan, 09, 2012
VXEV	CBOE Brazil ETF	Feb, 21, 2012
VXFXI	CBOE China ETF	No
VXXLE	CBOE Energy ETF	No
VXGDX	CBOE Gold Miners ETF	No
VXSLV	CBOE Silver ETF	No
EVZ	CBOE EURO Currency	No
OVX	CBOE Oil ETF	Mar, 27, 2012
GVZ	CBOE Gold ETF	Apr, 20, 2011
VDAX	DAX	No
VHSI	Hang Seng	Feb, 20, 2012
VNKY	NIKKEI	Feb, 27, 2012
VKOSPI	KOSPI200	No

'VIX'	Underlying	Futures Trading
VXAZN	CBOE VIX on Amazon	No
VXAPL	CBOE VIX on Apple	No
VXGS	CBOE VIX on GS	No
VXGOG	CBOE VIX on Google	No
VXIBM	CBOE VIX on IBM	No
VVIX	CBOE VIX on VIX	No

Source: J.P. Morgan Equity Derivatives Strategy, Bloomberg

## Outlook for Volatility Markets ...

- Demand for volatility products is likely to stay strong
- Investors should understand mechanics of new products and risks related to investing in volatility

### How well did the traditional risk management work in the crisis:

**Not at all (76%)**  
Adequate (21%)  
Very well (3%)

### What is the biggest concern for investors:

**Managing Volatility (51%)**  
Stable Income (26%)  
Capital Appreciation (12%)  
Other (11%)

### Cost of Volatility/Tail Risk Hedges is:

**Some Cheap/Some Rich (52%)**  
**Expensive but necessary (23%)**  
**Prohibitively expensive (19%)**  
**Fairly Priced (6%)**

Based on a survey of CIOs from February 2012.

Source: J.P. Morgan Equity Derivatives Strategy, US Institute

# Disclosures

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