

The Buzz: Links between policy uncertainty and equity volatility

Options Research

Uncertain times...

Many investors argue that recent equity volatility levels are as much about policy uncertainty as economics or corporate earnings. That may be even more true post last week's US election as investors re-focus on the impending fiscal cliff, capital gains and dividend taxes.

S&P 500 implied volatility shows a strong correlation to policy uncertainty

We explore the links between equity volatility and a new measure for economic policy uncertainty suggested by Nicholas Bloom from Stanford University and his coauthors. Our results show a strong positive correlation between policy uncertainty and the level of S&P 500 variance across maturities:

- Correlations to policy uncertainty range from 0.62 for 1m variance to 0.86 for 10y variance.
- One clear take-away is that the back-end of the S&P curve is about 40% more correlated to policy uncertainty than the front.

Bottom line: If policy uncertainty is reduced in the coming months, that could lead to a considerable drop in 1y+ implied volatility levels.

Policy uncertainty helps explain sticky levels of 1y+ variance

Our results show that policy uncertainty statistically explains a good deal of the stickiness at the back-end of the S&P 500 term structure. Regressions of 3m to 10y variance levels on the level of 1m variance underestimate current levels of implied volatility by 3-5 vol points. Adding policy uncertainty into the regression pushes predicted levels to within a vol point of actual levels across terms.

The policy uncertainty gap

Rolling regressions, show that policy uncertainty added little explanatory power for estimating the level of implied volatility from 2006-2009. Beginning in late-2009, early 2010, a large "policy gap" began to be priced. In 2012 the policy gap has been slowly closing. A resolution of the fiscal cliff could go a long way to closing the rest of the policy gap and reducing 1y+ S&P 500 variance levels.

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High levels of policy uncertainty have clouded the investment process post-crisis

Uncertain times...

Many investors argue that recent equity volatility levels are as much about policy as economics and corporate earnings. That may be even more true post last week's US election as investors re-focus on the impending fiscal cliff, capital gains and dividend taxes. Goldman Sachs Portfolio Strategist David Kostin stated in the November 9 *US Weekly Kickstart* that Corporate America has already adjusted its business activity to reflect heightened policy uncertainty. Revenue guidance for 4Q2012 has been cut sharply.

In our US Portfolio Strategy team's *S&P 500 Beige Book* report published last week, executives described that customers are postponing orders, tightly managing supply chains, introducing more spending scrutiny, extending deal cycles, and are generally less willing to spend given fiscal cliff uncertainty. Our Strategy team believes the S&P 500 index will slide further until the sources of uncertainty are addressed: fiscal cliff, capital gains taxes, and the debt ceiling. In this edition of *The Buzz* we explore the links between equity volatility and a new measure for economic policy uncertainty.

Economic policy uncertainty and the economy

In their recent paper, *Measuring Economic Policy Uncertainty*, Nicholas Bloom of Stanford University and his co-authors investigate the links between high levels of economic policy uncertainty and declines in economic activity. As they say in their paper¹:

"One intuition behind the depressing effect of uncertainty goes back to Bernanke (1983). As he points out, when investment projects are expensive to cancel or workers are costly to fire, higher uncertainty gives firms an incentive to delay investment and employment decisions.The claim is that businesses and households are [now] uncertain about future taxes, pending levels, regulations, health-care reform, and interest rates. In turn, this uncertainty leads them to postpone spending on investment and consumption goods and slow hiring, impeding the recovery."

Goldman Sachs US Economist Jan Hatzius argued in the October 19 *US Economics Analyst* that it makes sense that policy uncertainty is higher now than normal. We are currently in an environment of very large budget deficits, a high and rising government debt/GDP ratio, near-zero short-term interest rates, and an exceptionally large Fed balance sheet—in other words, macroeconomic policy settings that are unusually accommodative and will ultimately need to be normalized.

¹ For further details see Scott R. Baker, Nicholas Bloom, and Steven J. Davis, "Measuring Economic Policy Uncertainty," <http://www.policyuncertainty.com/media/BakerBloomDavis.pdf>.



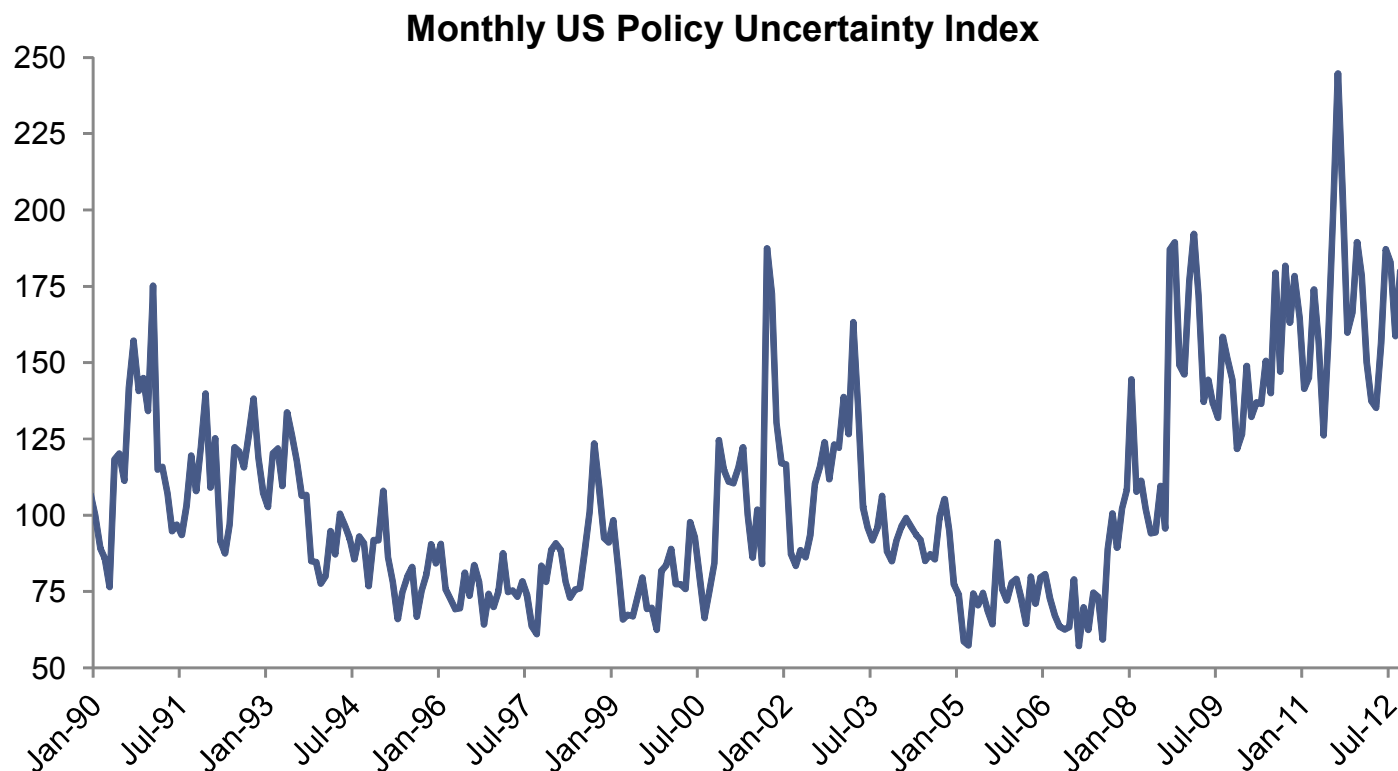
Measuring economic policy uncertainty

Bloom et al. measure policy uncertainty as a weighted average of three series: (i) the frequency of references to a combination of the terms “economic/economy,” “uncertain/uncertainty,” and one or more of the following terms: “policy,” “tax,” “spending,” “Federal Reserve,” “budget,” or “deficit”, from a set of 10 leading newspapers; (ii) the number of federal tax provisions facing expiration; (iii) the extent of disagreement between economic forecasters about inflation and government purchases. Their composite index is shown in Exhibit 1.

The index spikes around the Gulf Wars and 9/11 and more recently rose to highs post the Lehman bankruptcy, TARP legislation, the 2010 midterm elections, the Eurozone crisis and the US debt-ceiling dispute. In short, the index kicked into high gear in 2008 and has remained there. Our goal is to analyze the links between policy uncertainty and equity volatility.

Exhibit 1: US Economic Policy Uncertainty Index

Data from November 2002 to October 2012



Source: policyuncertainty.com

The link between policy uncertainty and equity volatility

Implied volatility levels show a strong correlation to policy uncertainty. Correlations increase with maturity.

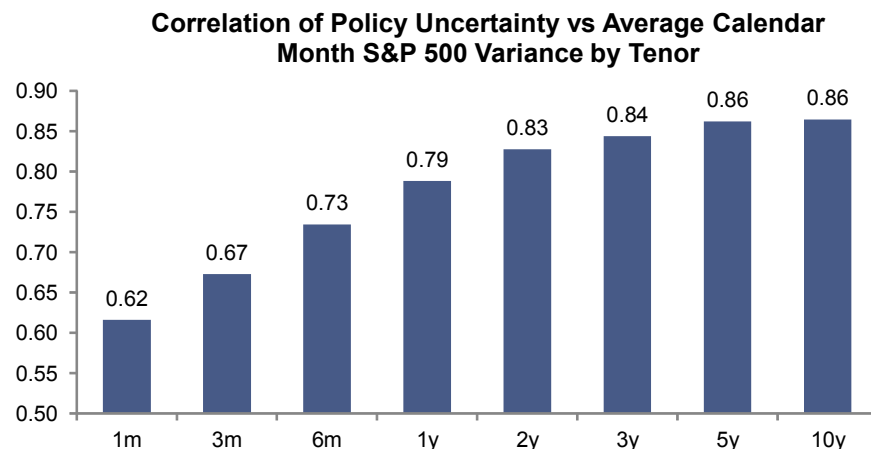
We analyze the correlation between a monthly time series of the policy uncertainty index and the average level of S&P 500 variance across tenors each calendar month from November 2002 through October 2012 (Exhibit 2). We make two key points with respect to the correlation analysis:

- 1. The correlation between policy uncertainty and S&P 500 variance is high.** Levels of S&P 500 variance show a strong correlation to policy uncertainty with correlation levels ranging from 0.62 for 1m variance to 0.86 for 10y variance.
- 2. Correlations increase with maturity: correlations to policy uncertainty are 40% higher for 10y vs 1m variance.** The correlation between policy uncertainty and different tenors of S&P variance increases by tenor for the listed 1m-2y maturities and then levels off from 2y to 10y variance.

Bottom line: The back end of the S&P 500 curve is more correlated to policy uncertainty than the front. That makes intuitive sense as the front end of the curve is driven more by short-term newsflow such as earnings, and economic releases, while policy initiatives are typically longer-term in nature.

Exhibit 2: S&P 500 implied volatility shows a strong correlation to policy uncertainty.

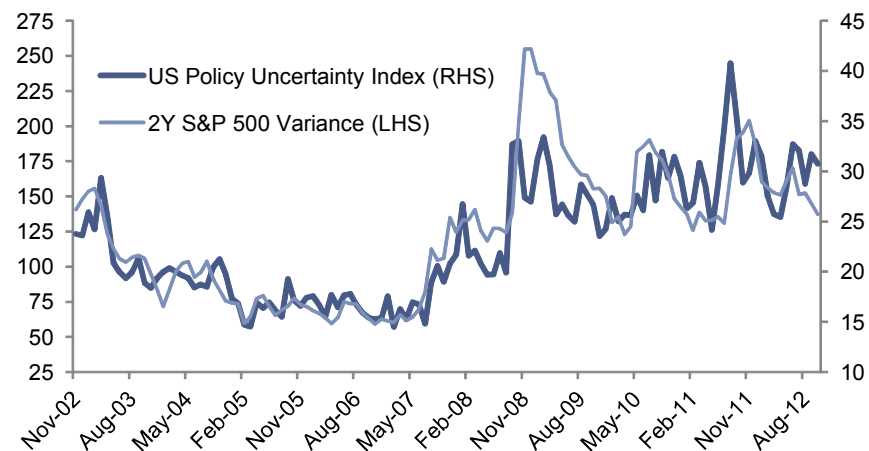
Correlation between US policy uncertainty index and the average level of S&P 500 variance each calendar month. Data from November 2002 to October 2012.



Source: policyuncertainty.com. Goldman Sachs Options Research

Exhibit 3: US Policy Uncertainty Index vs 2Y S&P 500 variance.

Data from November 2002 to October 31, 2012.



Source: policyuncertainty.com. Goldman Sachs Options Research

Policy uncertainty helps explain the “stickiness” at the back-end of the term structure

There has been a lot written post-crisis on the elevated levels of equity implied volatility at the back-end of the term structure. For perspective, the average VIX level in 2012 has been 18, or 3 points below its average level of 21 back to January 2003. Yet S&P 500 1y variance has been 2.6 pts above its long-run average so far in 2012 (25.9 vs 23.3) and 10y variance levels in 2012 have been 5.6 pts above their long-run average (32.5 vs 26.9). In short, the back-end of the S&P 500 curve has been sticky.

In order to estimate whether different parts of the volatility term structure are trading rich or cheap, traders often run simple regressions of the level of 3m to 10y vol on one-month variance levels. We run two sets of regressions in order to estimate levels of 3m to 10y S&P 500 variance. The first set of regressions predicts the level of 3m to 10y variance based upon one variable, the level of 1m variance. In a second set of regressions we estimate the level of 3m to 10y variance using two variables: (i) the level of one-month variance; and (ii) the level of policy uncertainty. Our results show that policy uncertainty statistically explains a good deal of the stickiness of the back-end of the S&P 500 term structure with predicted values much closer actual levels.

- **Short-dated vol underestimates current 1y to 10y variance levels by 3-5 vol points:** A regression of the average level of S&P 500 3m to 10y month variance versus the average level of 1m variance each calendar month provides an estimate for different maturities based off the level of short-dated volatility. Exhibit 4 shows a comparison of actual and predicted levels from October 2012. That simple model underestimates the current level of volatility across every term. It only underestimates 3m-6m variance by 0.6 to 1.5 vol pts; but it underestimates 1y to 10y variance levels by 3 to 5 vol points.
- **Policy uncertainty helps explain the gap:** If we add the level of policy uncertainty to our original regressions we find policy uncertainty is statistically significant for each term. In other words, it statistically helps predict levels of 3m to 10y variance. It also gets us to a better model for estimating current levels. For example, the average level of 5y variance was 28.7 in October. A simple model which predicts 5y off the level of 1m variance would have predicted 23.2 (5.5 vol pts low), adding policy uncertainty into the model gives us a predicted level of 28.9, right on top of the actual level.

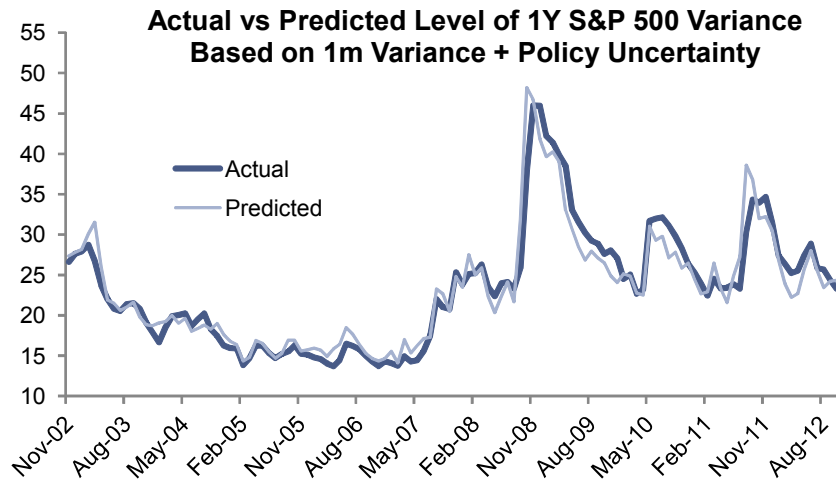
Exhibit 4: Policy uncertainty adds predictive power in explaining the stickiness of longer-dated S&P 500 implied volatility levels. Regressions use average monthly levels of S&P 500 variance from November 2002 through October 2012

S&P 500 Variance Tenor	Average Calendar Month S&P 500 Variance				
	Actual (Oct 12)	Predicted variance tenor based on		Actual - Predicted	
		1m variance	1m variance + policy uncertainty	1m variance	1m variance + policy uncertainty
3m	18.52	17.91	19.36	0.61	-0.84
6m	20.67	19.13	22.09	1.54	-1.42
1y	23.30	20.10	24.33	3.19	-1.04
2y	25.70	21.09	26.20	4.61	-0.50
3y	27.09	21.87	27.30	5.22	-0.21
5y	28.70	23.18	28.89	5.52	-0.19
10y	30.10	25.48	31.40	4.63	-1.30

Source: policyuncertainty.com. Goldman Sachs Options Research.

Exhibit 5: Predicted level of S&P 500 1y variance based off 1m variance and the level of policy uncertainty.

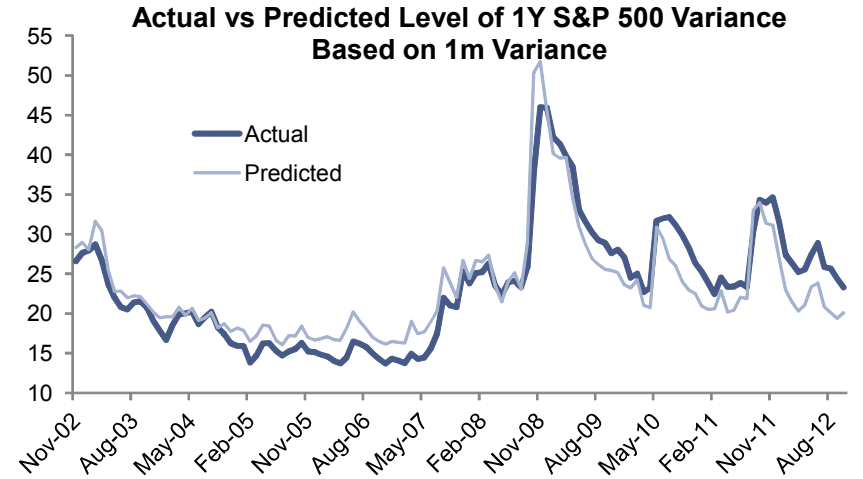
Data from November 1, 2002 to October 31, 2012.



Source: *policyuncertainty.com*. Goldman Sachs Options Research

Exhibit 6: Predicting the level of 1y S&P 500 variance with only the level of 1m variance underestimates the actual level by over 3 vol pts.

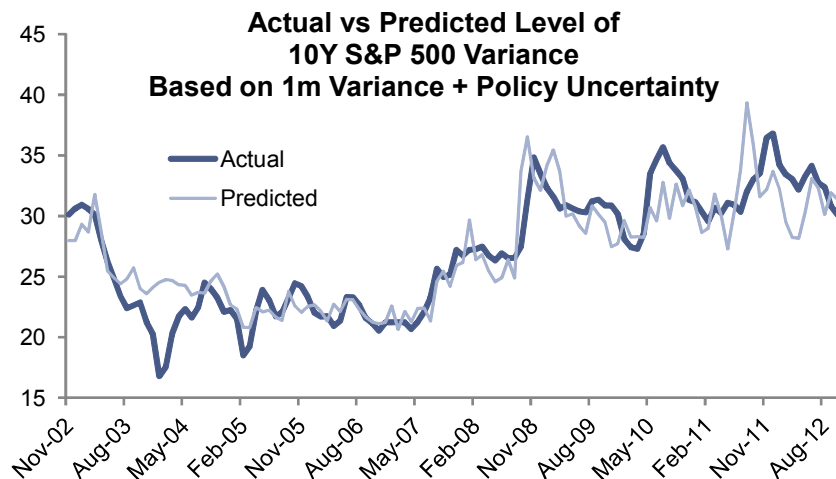
Data from November 1, 2002 to October 31, 2012.



Source: Goldman Sachs Options Research

Exhibit 7: Predicted level of S&P 500 10y variance based off 1m variance and the level of policy uncertainty.

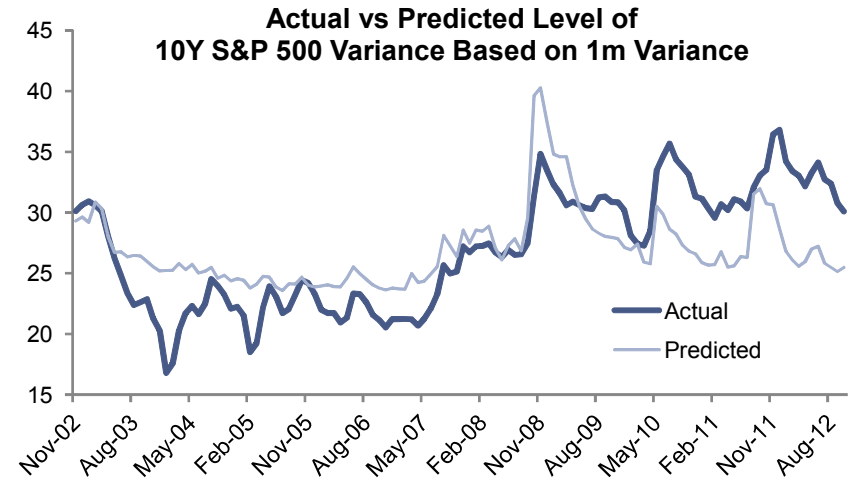
Data from November 1, 2002 to October 31, 2012.



Source: *policyuncertainty.com*. Goldman Sachs Options Research

Exhibit 8: Predicting the level of 10y S&P 500 variance with only the level of 1m variance underestimates the actual level by almost 5 vol pts.

Data from November 1, 2002 to October 31, 2012.



Source: Goldman Sachs Options Research

The uncertainty gap: the impact of policy uncertainty on equity vol has been higher post-crisis.

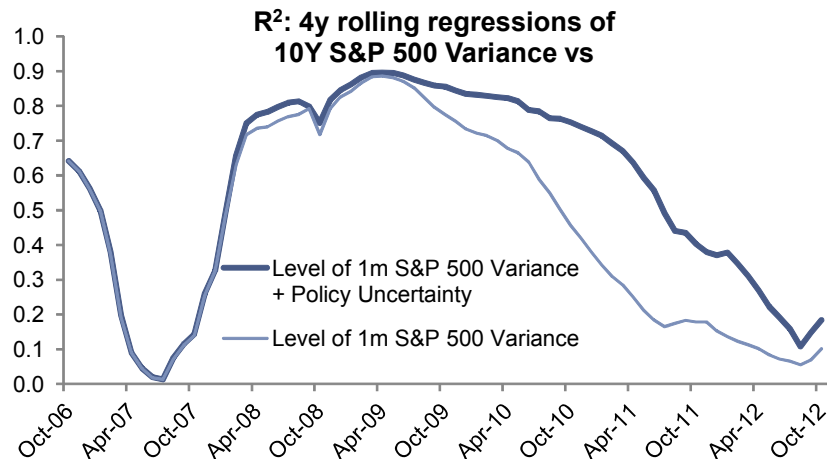
In this section we analyze how the impact of policy uncertainty on equity volatility has changed over time. We plot the R-squared values for both of the regression models mentioned above using 4y rolling windows over the last decade in exhibits 9 and 10. The difference in explanatory power between these two regressions gives us a simple measure of the “policy gap” or the added benefit of using policy to explain longer-dated variance levels.

- The impact of policy uncertainty on 10y variance is pronounced, with the highest impact appearing post crisis. The R²'s from the rolling 4y regressions of 10y variance versus (i) 1m variance and (ii) 1m variance plus the level of policy uncertainty, showed little difference from 2006-2009. In our view that tells us policy had little to no additive explanatory power pre-crisis. Beginning in late-2009, early 2010, a policy gap began to be priced, with the R²'s from regressions including our policy variable consistently above those from regressions based solely on the 1m variance. In 2012 the policy gap has been slowly closing.

Bottom line: In our view, as central banks have taken action the policy uncertainty gap is beginning to close. A resolution of the fiscal cliff could go a long way to closing the rest of the policy gap and reducing 1y+ S&P 500 variance levels.

Exhibit 9: The added explanatory power of policy uncertainty in predicting the level of S&P 500 10y variance has been higher post-crisis.

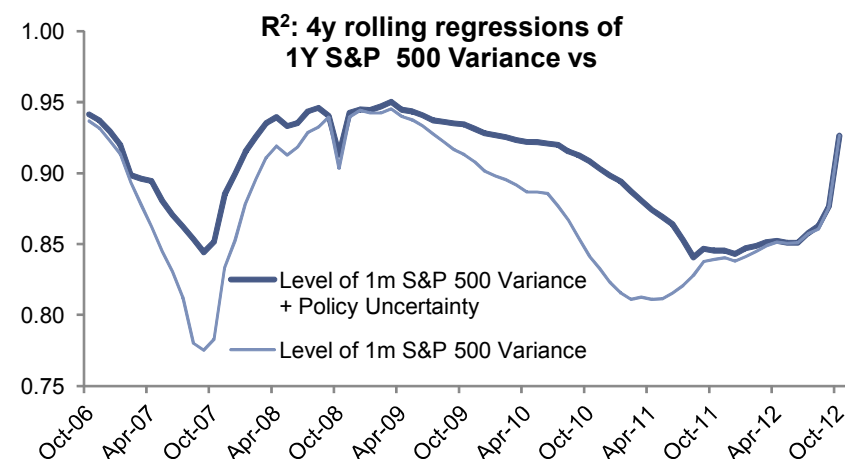
Data from November 1, 2002 to October 31, 2012.



Source: policyuncertainty.com. Goldman Sachs Options Research

Exhibit 10: For 1y variance policy uncertainty has shown additive explanatory power during pre-crisis and post-crisis periods.

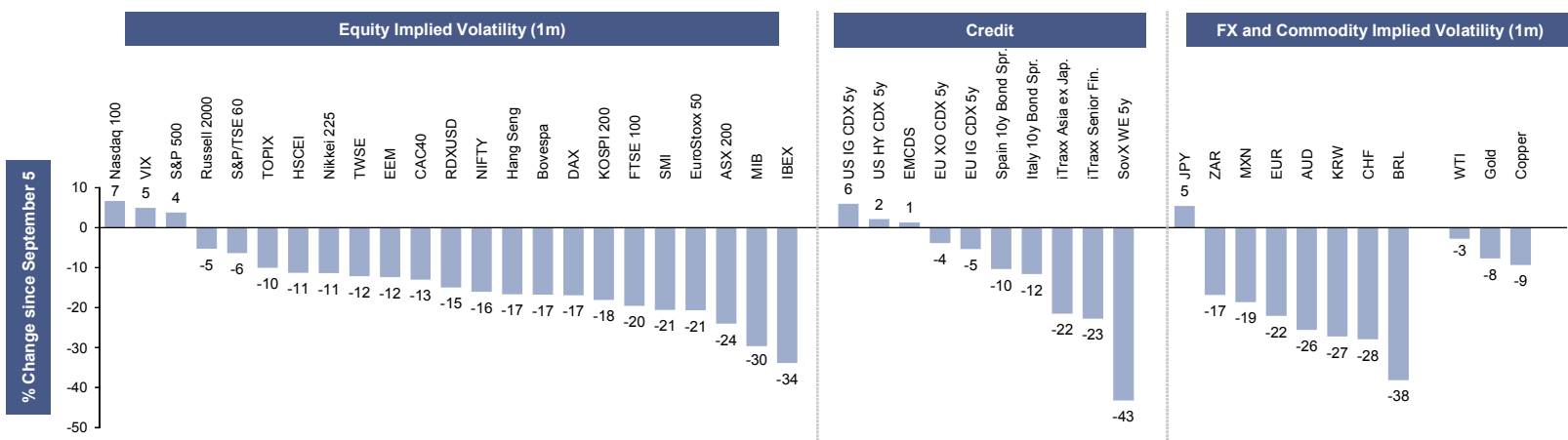
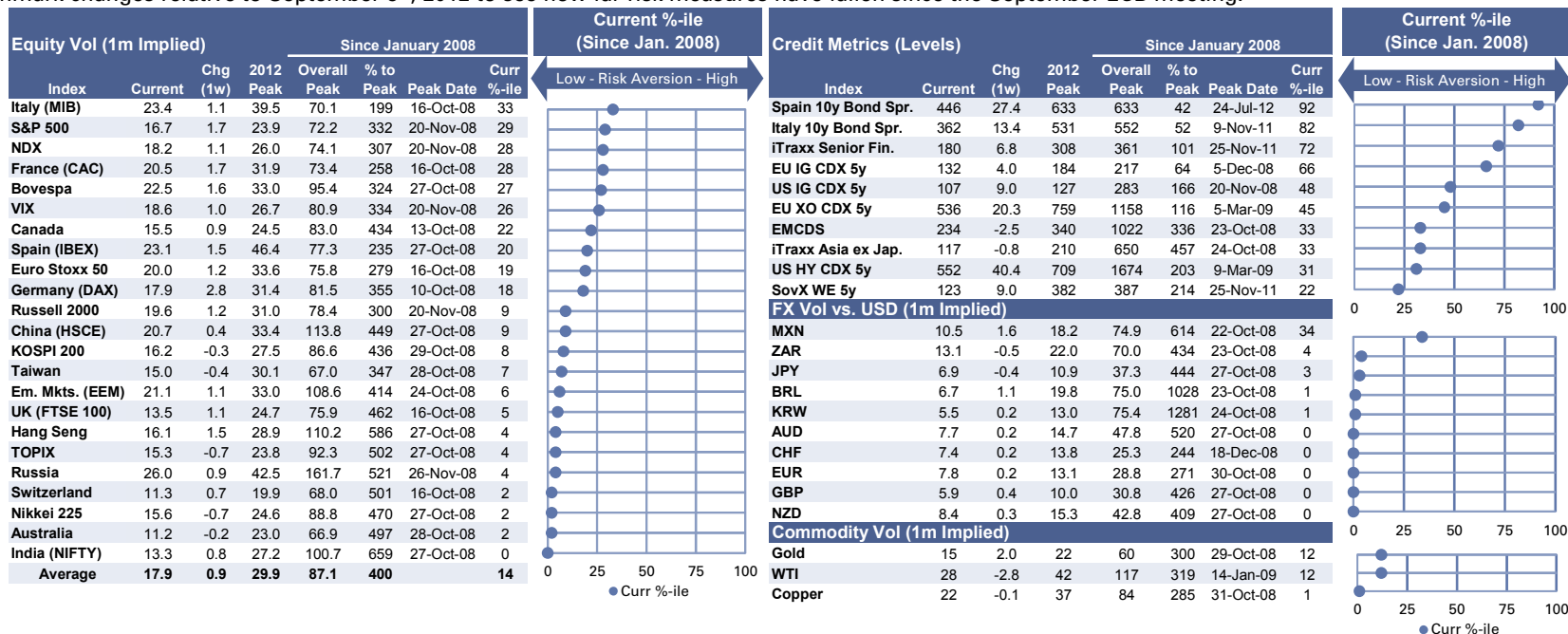
Data from November 1, 2002 to October 31, 2012..



Source: policyuncertainty.com. Goldman Sachs Options Research

Cross Asset Risk Barometer: Short-dated volatility remains near 5y lows

Exhibit 11: One-month equity implied volatility levels remain near 5y lows. Outside MXN, 1m FX implieds are also near 5y lows. Credit spreads are still mixed.
 Data: January 2, 2008 – November 9, 2012. Spanish and Italian 10y bond spreads in the table below refer to the spreads versus 10y German bunds. In the bar graph below we benchmark changes relative to September 5th, 2012 to see how far risk measures have fallen since the September ECB meeting.

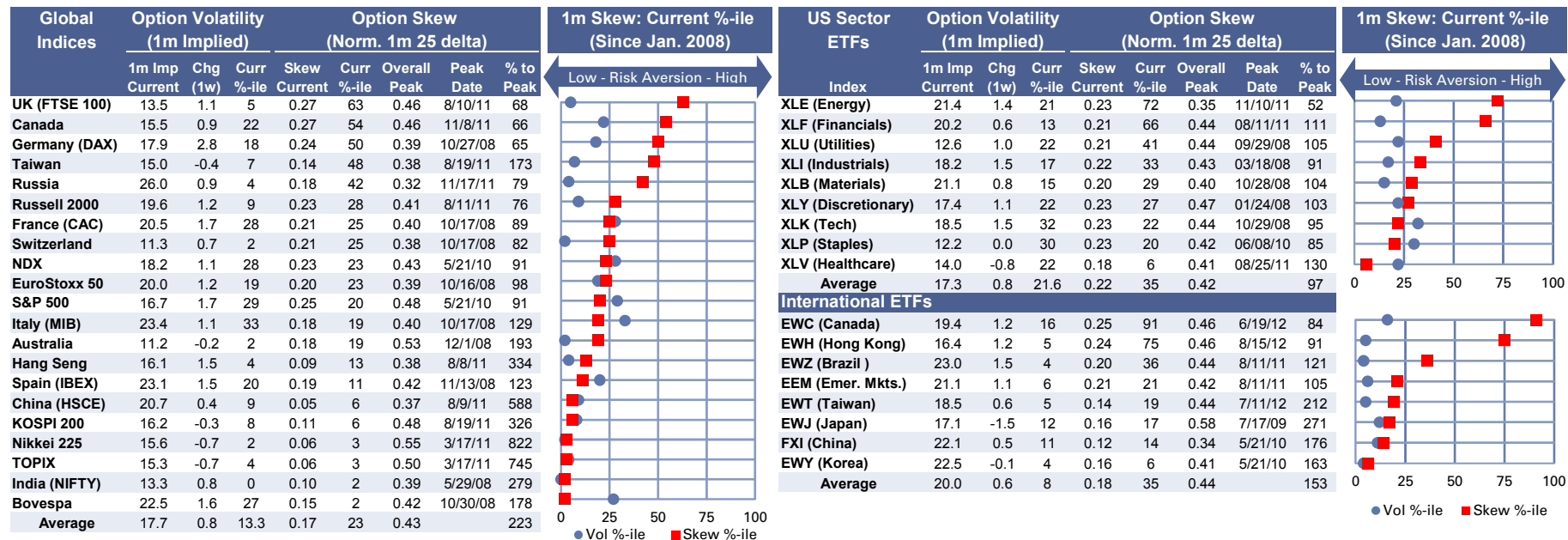


Source: Goldman Sachs Options Research.

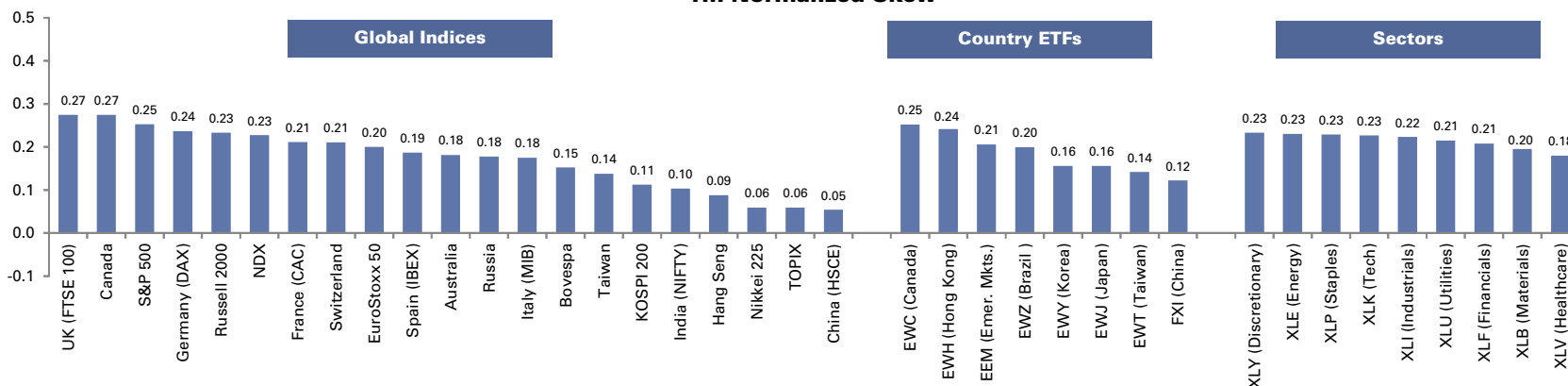
Skew View: Highest in UK, lowest in Asia and Brazil

Exhibit 12: One-month skew is highest in the UK and Canada on an absolute and percentile basis, lowest in Asia and Brazil.

Normalized skew: (25 delta put – 25 delta call) / 50 delta implied volatility. Percentiles are calculated using data from January 2, 2008 – November 9, 2012.



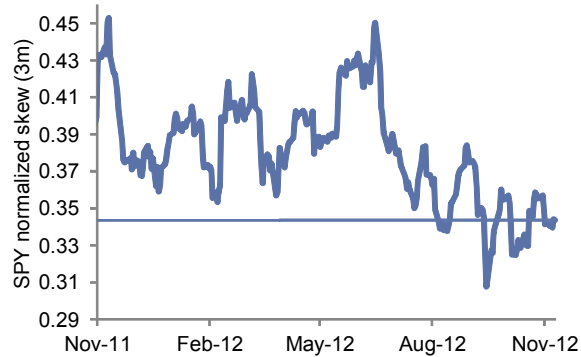
1m Normalized Skew



Source: Goldman Sachs Options Research.

Exhibit 13: SPY normalized skew (3m)

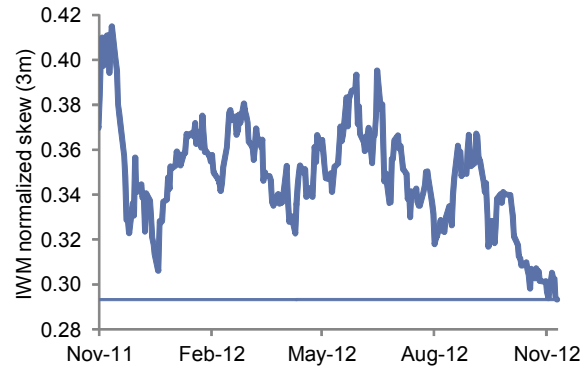
As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



Source: Goldman Sachs Options Research.

Exhibit 14: IWM normalized skew (3m)

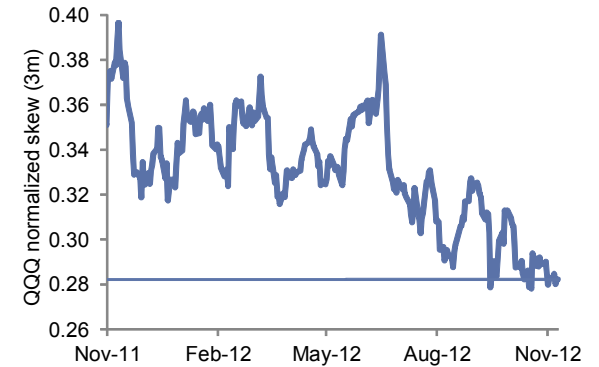
As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



Source: Goldman Sachs Options Research.

Exhibit 15: QQQ normalized skew (3m)

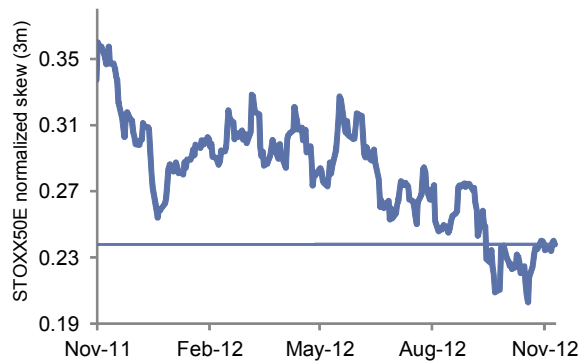
As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



Source: Goldman Sachs Options Research.

Exhibit 16: Euro Stoxx 50 normalized skew (3m)

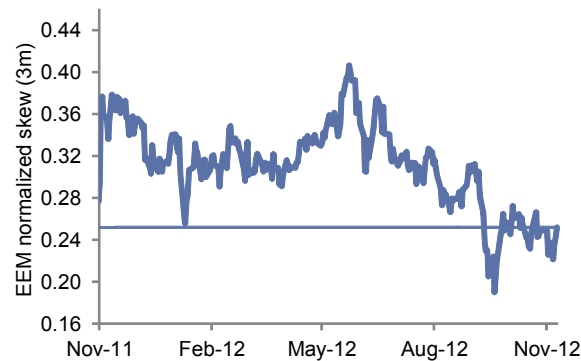
As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



Source: Goldman Sachs Options Research.

Exhibit 17: EEM normalized skew (3m)

As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



Source: Goldman Sachs Options Research.

Exhibit 18: HSCEI normalized skew (3m)

As of November 9, 2012 market close. Normalized skew: $(25 \text{ delta put} - 25 \text{ delta call}) / 50 \text{ delta implied vol.}$



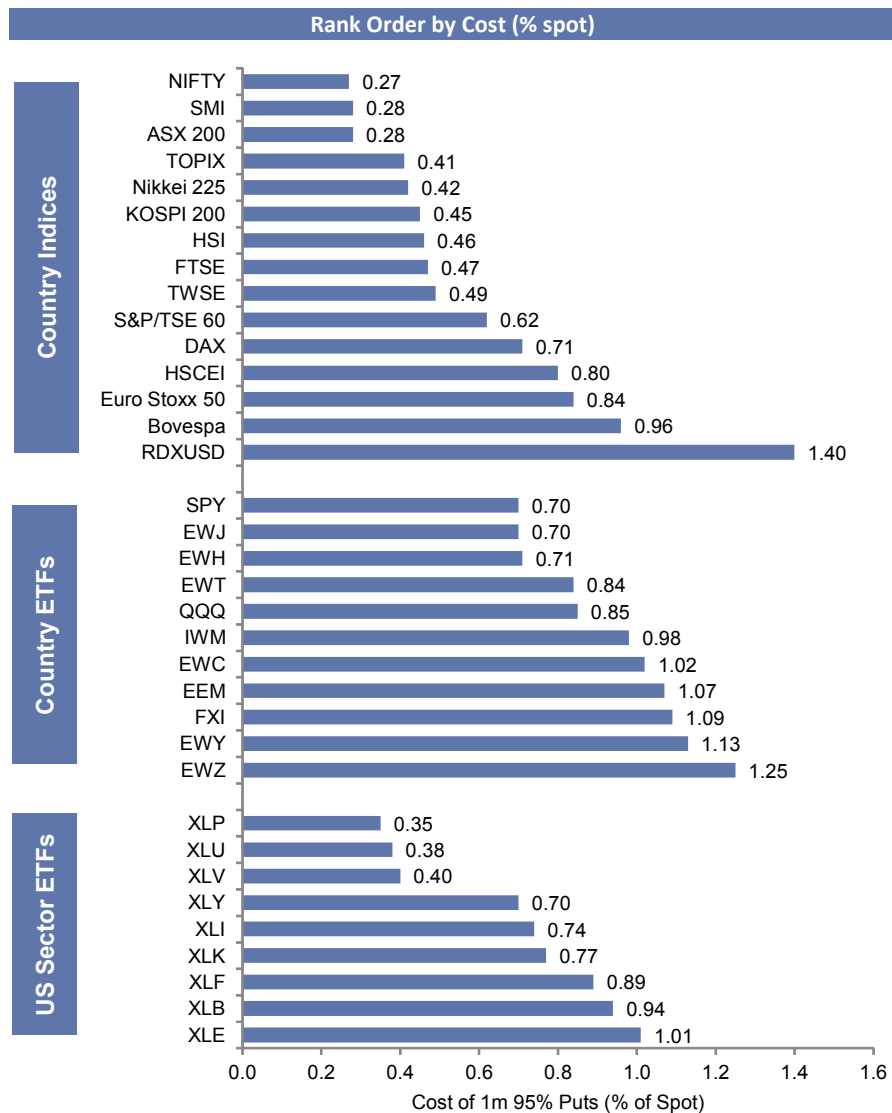
Source: Goldman Sachs Options Research.



Hedging Landscape (95% Put Pricing): NIFTY and ASX 200 puts lowest cost globally

Exhibit 19: 1m 95% put pricing: NIFTY the lowest globally.

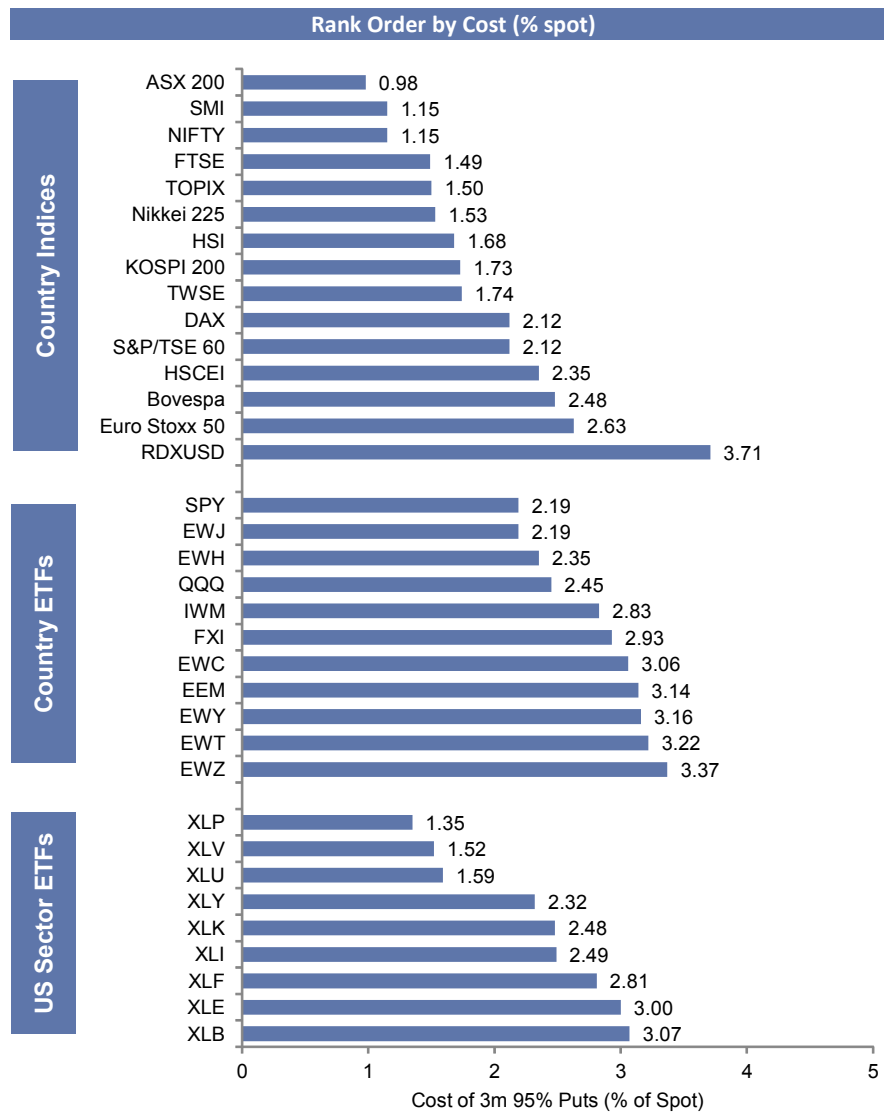
Indicative pricing as of November 9, 2012. Pricing (% spot). **Risk:** the maximum loss from buying a put is the upfront premium paid.



Source: Goldman Sachs Options Research.

Exhibit 20: 3m 95% put pricing: ASX 200 the lowest globally.

Indicative pricing as of November 9, 2012. Pricing (% spot). **Risk:** the maximum loss from buying a put is the upfront premium paid.



Source: Goldman Sachs Options Research.

Global Put Spreads: ASX 200 and SMI screen as the highest payout ratio

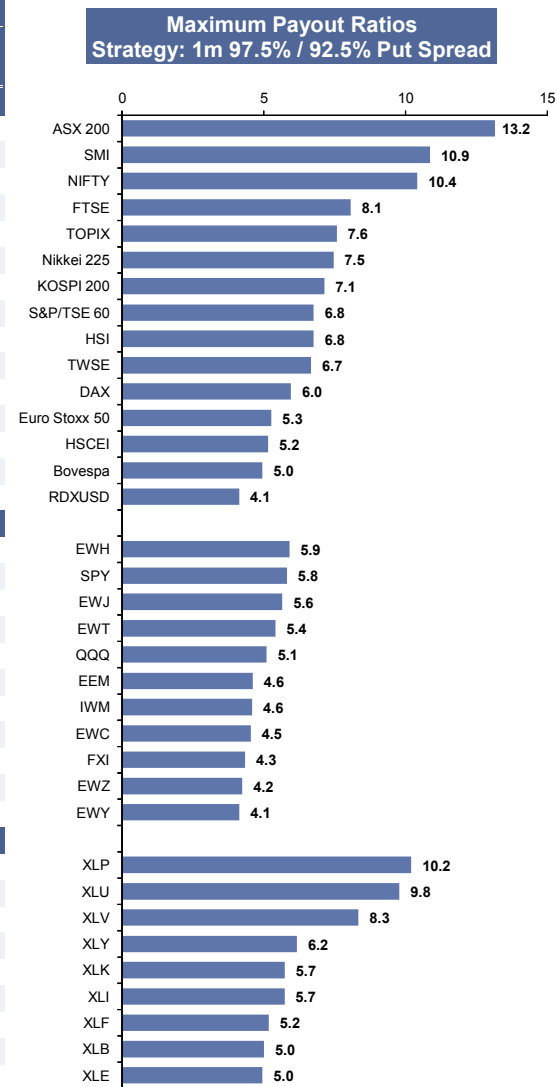
To screen for hedging candidates we rank order the maximum payout ratios (maximum gain/entry cost) of 1m 97.5% / 92.5% put spreads, assuming each underlier settles below the lower put strike at expiration.

Risks: The maximum loss from buying a put spread option is the upfront premium paid.

Exhibit 21: Maximum payout ratios for 1m and 3m 97.5% / 92.5% put spreads.

Payout ratios: maximum gain / entry price assuming each underlier settles below the lower put strike at expiration. Indicative pricing as of November 9, 2012.

Country Indices	97.5% / 92.5% Put Spreads					
	Put Strikes		Pricing by Term			
	Put Spread Strikes (% of spot)	Index Level Strikes	Premium (% of spot)		Max Payout Ratios	
			1m	3m	1m	3m
ASX 200	97.5 / 92.5	4350.5 / 4127.4	0.38	0.84	13.2	6.0
SMI	97.5 / 92.5	6547.3 / 6211.6	0.46	1.04	10.9	4.8
NIFTY	97.5 / 92.5	5544.1 / 5259.8	0.48	0.98	10.4	5.1
FTSE 100	97.5 / 92.5	5625.4 / 5337	0.62	1.13	8.1	4.4
TOPIX	97.5 / 92.5	712.5 / 675.9	0.66	1.34	7.6	3.7
Nikkei 225	97.5 / 92.5	8538.7 / 8100.8	0.67	1.34	7.5	3.7
KOSPI 200	97.5 / 92.5	242.5 / 230	0.70	1.45	7.1	3.4
S&P TSE 60	97.5 / 92.5	680.3 / 645.4	0.74	1.34	6.8	3.7
Hang Seng	97.5 / 92.5	20849.8 / 19780.5	0.74	1.34	6.8	3.7
TWSE	97.5 / 92.5	7110.9 / 6746.2	0.75	1.45	6.7	3.4
DAX	97.5 / 92.5	6984.4 / 6626.2	0.84	1.35	6.0	3.7
Euro Stoxx 50	97.5 / 92.5	2417.8 / 2293.8	0.95	1.55	5.3	3.2
HSCEI	97.5 / 92.5	10193.5 / 9670.7	0.97	1.60	5.2	3.1
Bovespa	97.5 / 92.5	55923.8 / 53055.9	1.01	1.42	5.0	3.5
RDXUSD	97.5 / 92.5	1532.9 / 1454.2	1.21	1.75	4.1	2.9
Country ETFs						
EWJ (MSCI Japan)	97.5 / 92.5	8.7 / 8.3	0.89	1.59	5.6	3.2
EWT (MSCI Taiwan)	97.5 / 92.5	12.6 / 12	0.93	2.11	5.4	2.4
QQQ (PowerShares QQQ Trust Series)	97.5 / 92.5	61.8 / 58.7	0.98	1.51	5.1	3.3
EEM (MSCI Emerging Markets)	97.5 / 92.5	40 / 37.9	1.09	1.72	4.6	2.9
IWM (iShares Trust Russell 2000 Index)	97.5 / 92.5	77.4 / 73.4	1.09	1.62	4.6	3.1
EWC (MSCI Canada)	97.5 / 92.5	27.2 / 25.8	1.10	1.74	4.5	2.9
FXI (iShares FTSE China 25 Index)	97.5 / 92.5	35.6 / 33.7	1.15	1.77	4.3	2.8
EWZ (MSCI Brazil)	97.5 / 92.5	51.5 / 48.8	1.18	1.71	4.2	2.9
EWY (MSCI Korea)	97.5 / 92.5	55.9 / 53	1.21	1.76	4.1	2.8
US Sector ETFs						
XLU (Utilities)	97.5 / 92.5	33.8 / 32.1	0.51	1.27	9.8	3.9
XLV (Healthcare)	97.5 / 92.5	38.2 / 36.2	0.60	1.25	8.3	4.0
XLK (Tech)	97.5 / 92.5	27.5 / 26.1	0.87	1.47	5.7	3.4
XLI (Industrials)	97.5 / 92.5	35.4 / 33.6	0.87	1.52	5.7	3.3
XLF (Financials)	97.5 / 92.5	15.1 / 14.3	0.96	1.61	5.2	3.1
XLB (Materials)	97.5 / 92.5	34.7 / 32.9	1.00	1.70	5.0	2.9
XLE (Energy)	97.5 / 92.5	67.8 / 64.3	1.01	1.64	5.0	3.1

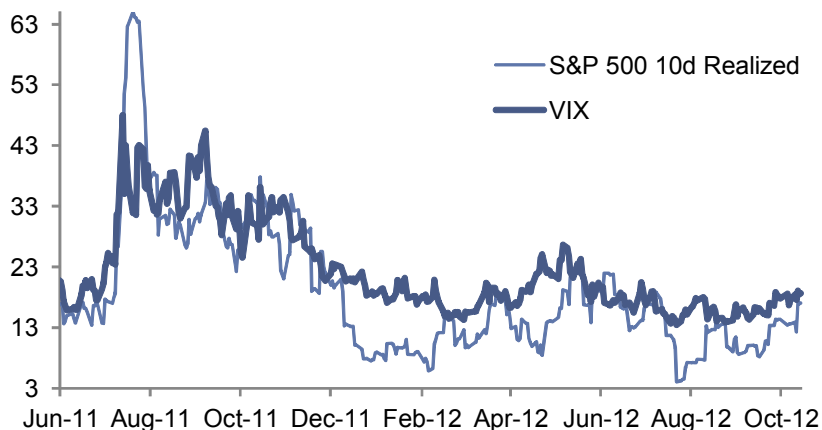


Source: Goldman Sachs Options Research.

VIX Quicks: VIX @ 18.6 Nov-12 to Apr-13 VIX futures - shift up ~0.4-1 vol pts.

Exhibit 22: The VIX is currently trading on par with 10d realized.

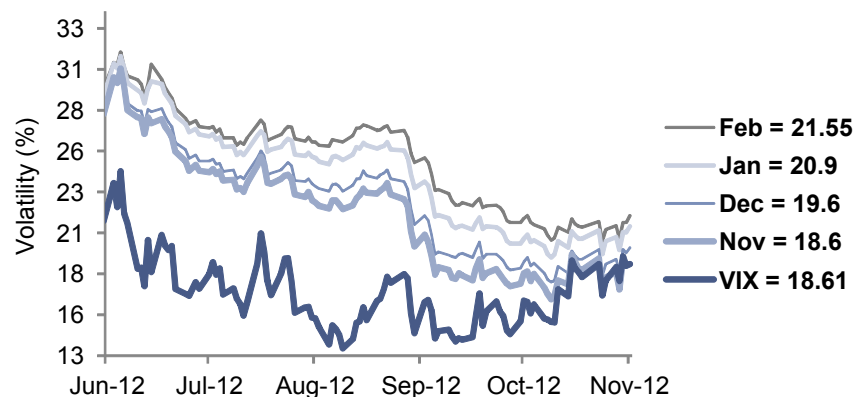
Data as of November 9, 2012.



Source: Goldman Sachs Options Research.

Exhibit 24: VIX futures increased 0.4-1 vol pts across maturities last week.

Data as of November 9, 2012.



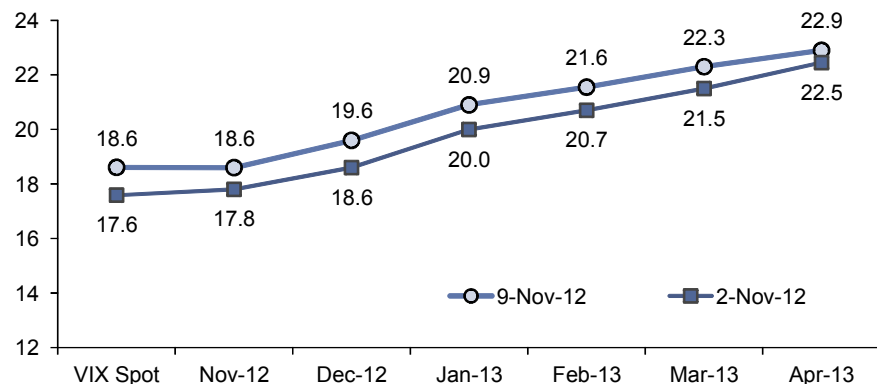
Source: Goldman Sachs Options Research.

Exhibit 23: The VIX term structure shifted up during the last week.

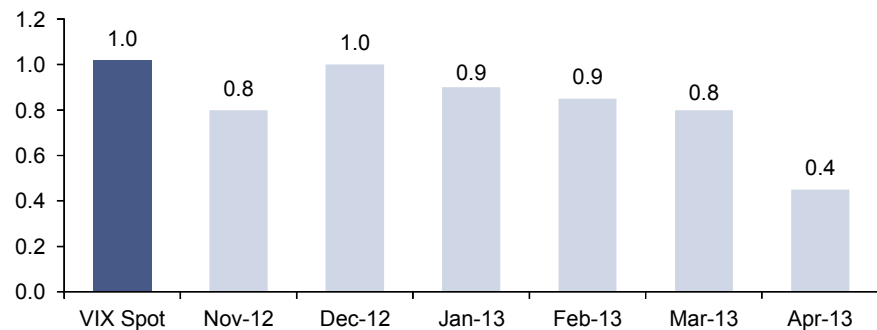
Data as of November 9, 2012.

Date	S&P 500	VIX Spot	VIX Futures					
			Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
2-Nov-12	1,414.2	17.6	17.8	18.6	20.0	20.7	21.5	22.5
9-Nov-12	1,379.9	18.6	18.6	19.6	20.9	21.6	22.3	22.9
1 wk Chg	-34.4	1.0	0.8	1.0	0.9	0.9	0.8	0.4
1 wk % Chg	-2.4%	5.8%	4.5%	5.4%	4.5%	4.1%	3.7%	2.0%

Term Structure of VIX Spot and VIX Futures over Time



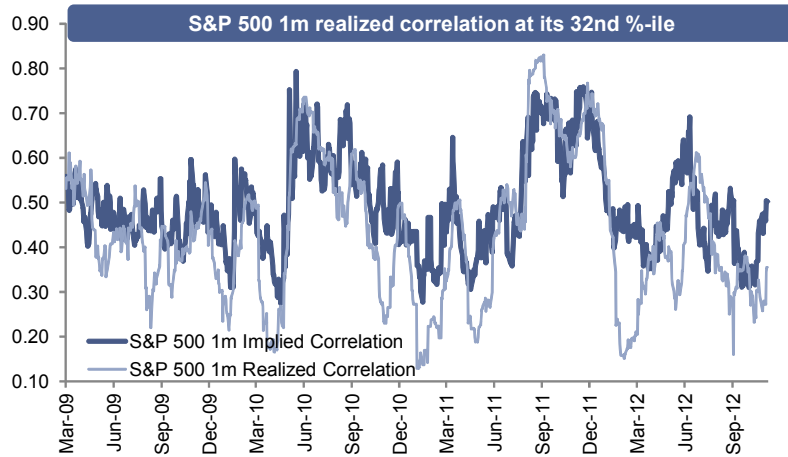
Changes in VIX spot and futures (November 2 to November 9)



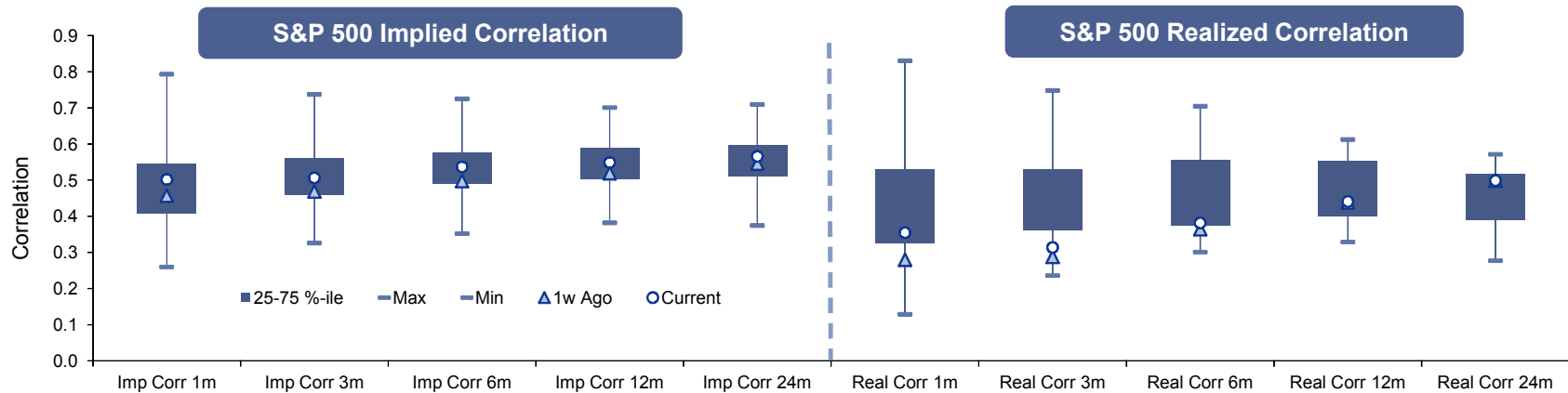
Source: Goldman Sachs Options Research.

The Correlation Connection: SPX 1m realized correlation, 32nd %-ile vs a 5-year history

Exhibit 25: S&P 500 implied and realized correlation across maturities.
5y history through November 9, 2012 market close.

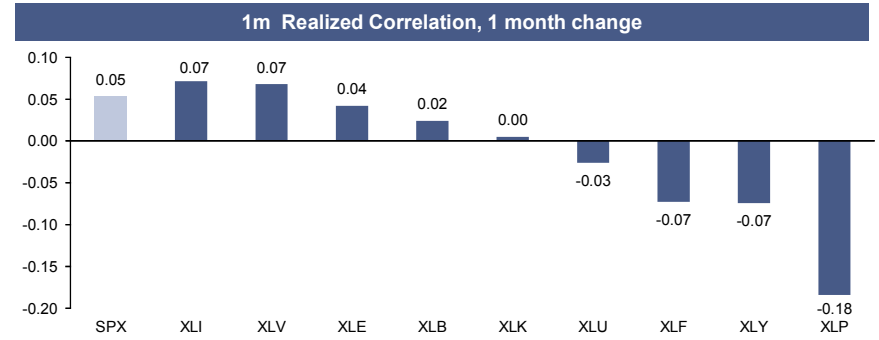
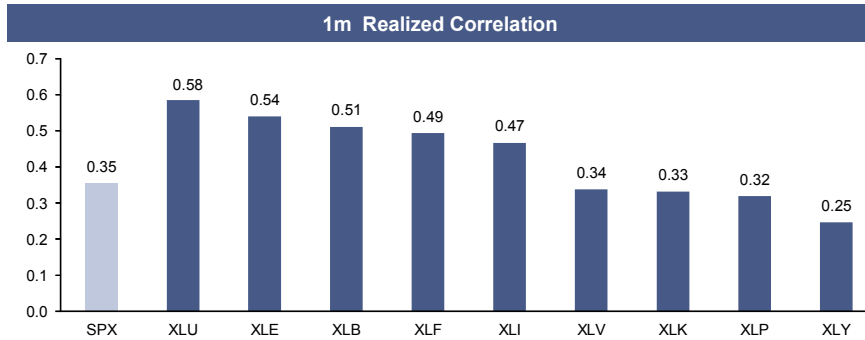


	Implied					Realized				
	1m	3m	6m	12m	24m	1m	3m	6m	12m	24m
Current	0.50	0.51	0.54	0.55	0.57	0.35	0.31	0.38	0.44	0.50
5y %-ile	0.62	0.54	0.55	0.57	0.62	0.32	0.12	0.32	0.34	0.68
1m ago	0.35	0.46	0.49	0.53	0.57	0.30	0.31	0.38	0.47	0.50
1m Chg	0.15	0.05	0.04	0.02	-0.01	0.05	0.00	0.00	-0.03	-0.01
Min	0.26	0.33	0.35	0.38	0.37	0.13	0.24	0.30	0.33	0.28
25 %-ile	0.41	0.46	0.49	0.51	0.51	0.33	0.36	0.37	0.40	0.39
Median	0.47	0.50	0.53	0.54	0.55	0.43	0.41	0.42	0.47	0.47
75 %-ile	0.55	0.56	0.58	0.59	0.60	0.53	0.53	0.56	0.55	0.52
Max	0.79	0.74	0.72	0.70	0.71	0.83	0.75	0.70	0.61	0.57

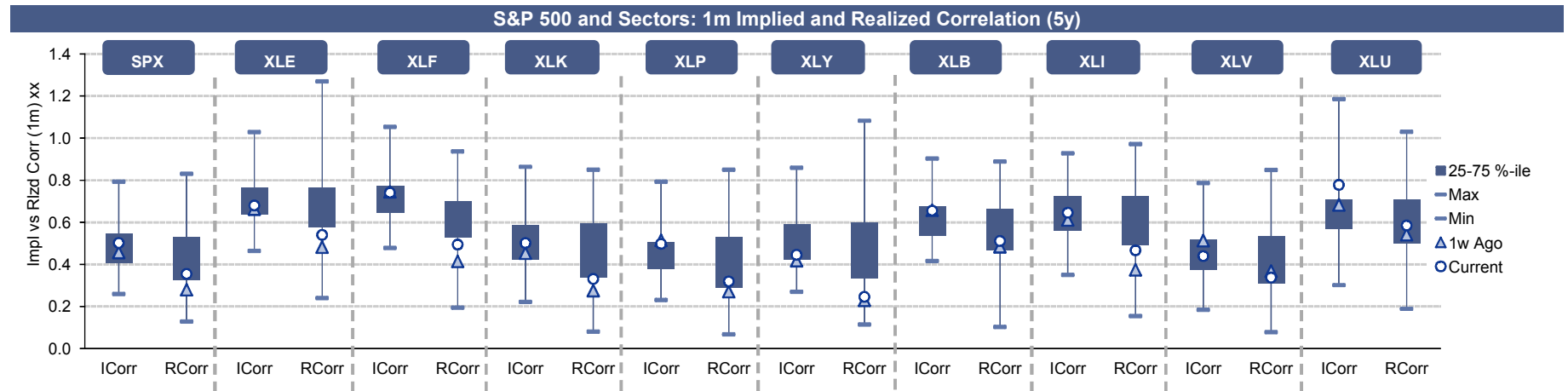


Source: Goldman Sachs Options Research.

Exhibit 26: One-month implied and realized correlation metrics across the S&P 500 and sector ETFs
 5y history through November 9, 2012 market close.



	SPX		XLE		XLF		XLK		XLP		XLY		XLB		XLI		XLV		XLU	
	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr	Icorr	Rcorr
Current	0.50	0.35	0.68	0.54	0.74	0.49	0.50	0.33	0.50	0.32	0.45	0.25	0.66	0.51	0.65	0.47	0.44	0.34	0.78	0.58
1 month ago	0.35	0.30	0.53	0.50	0.57	0.57	0.32	0.33	0.42	0.50	0.33	0.32	0.51	0.49	0.49	0.40	0.41	0.27	0.60	0.61
High (5y)	0.79	0.83	1.03	1.27	1.05	0.94	0.86	0.85	0.79	0.85	1.08	0.86	0.90	0.89	0.93	0.97	0.79	0.85	1.19	1.03
Median (5y)	0.47	0.43	0.70	0.67	0.70	0.62	0.50	0.47	0.44	0.39	0.51	0.47	0.60	0.55	0.64	0.61	0.44	0.41	0.64	0.60
Low (5y)	0.26	0.13	0.46	0.24	0.48	0.19	0.22	0.08	0.23	0.07	0.27	0.11	0.42	0.10	0.35	0.16	0.18	0.08	0.30	0.19

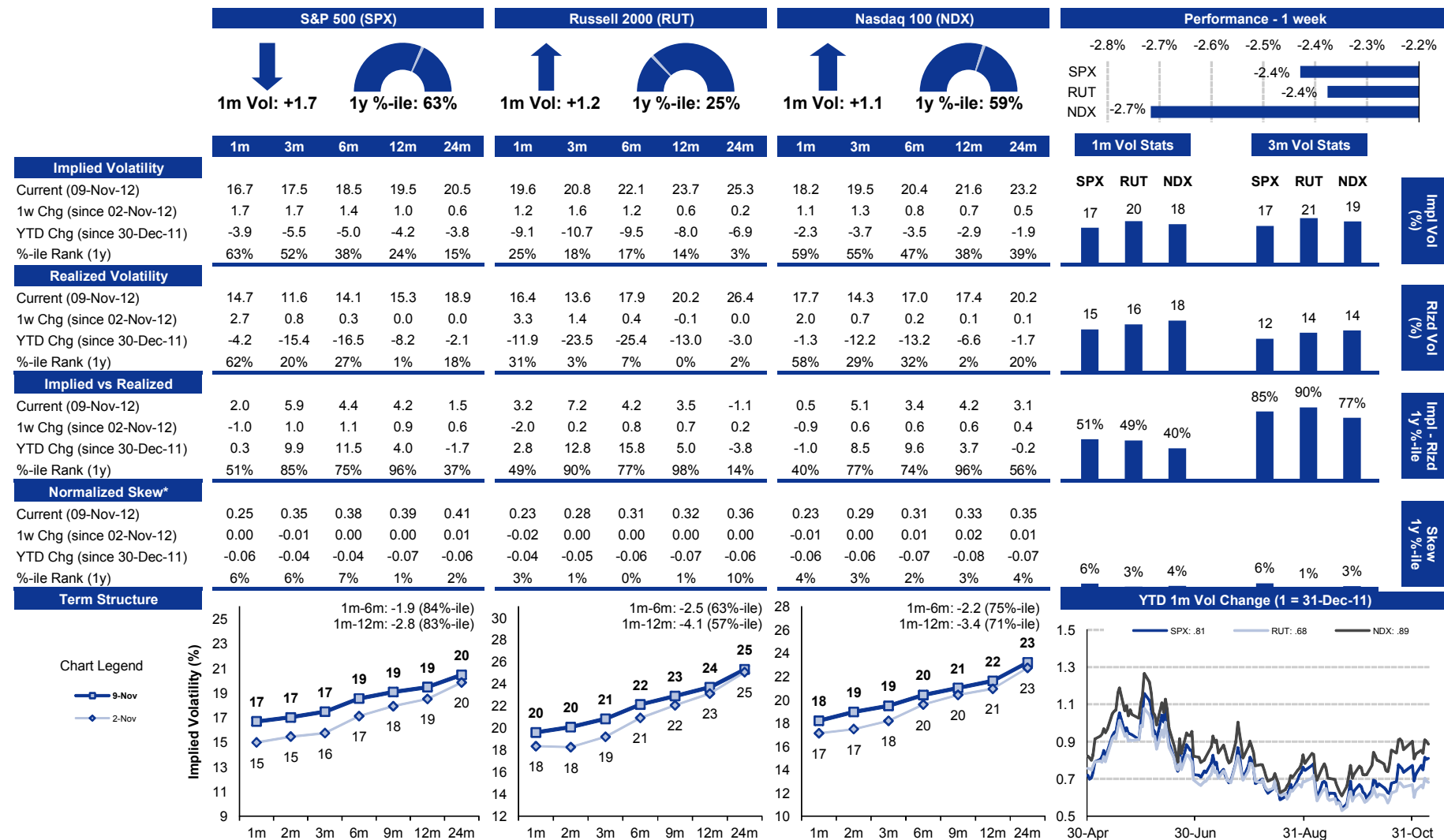


Source: Goldman Sachs Options Research.

US Volatility Landscape

Exhibit 27: 50-delta implied volatility comparison across US indices

Data as of November 9, 2012 market close.



1m Vol Stats

SPX: 17, RUT: 20, NDX: 18

3m Vol Stats

SPX: 17, RUT: 21, NDX: 19

1y %-ile

SPX: 51%, RUT: 49%, NDX: 40%

1m-6m

SPX: -1.9 (84%-ile), RUT: -2.5 (63%-ile), NDX: -2.2 (75%-ile)

1m-12m

SPX: -2.8 (83%-ile), RUT: -4.1 (57%-ile), NDX: -3.4 (71%-ile)

YTD 1m Vol Change (1 = 31-Dec-11)

SPX: .81, RUT: .68, NDX: .89

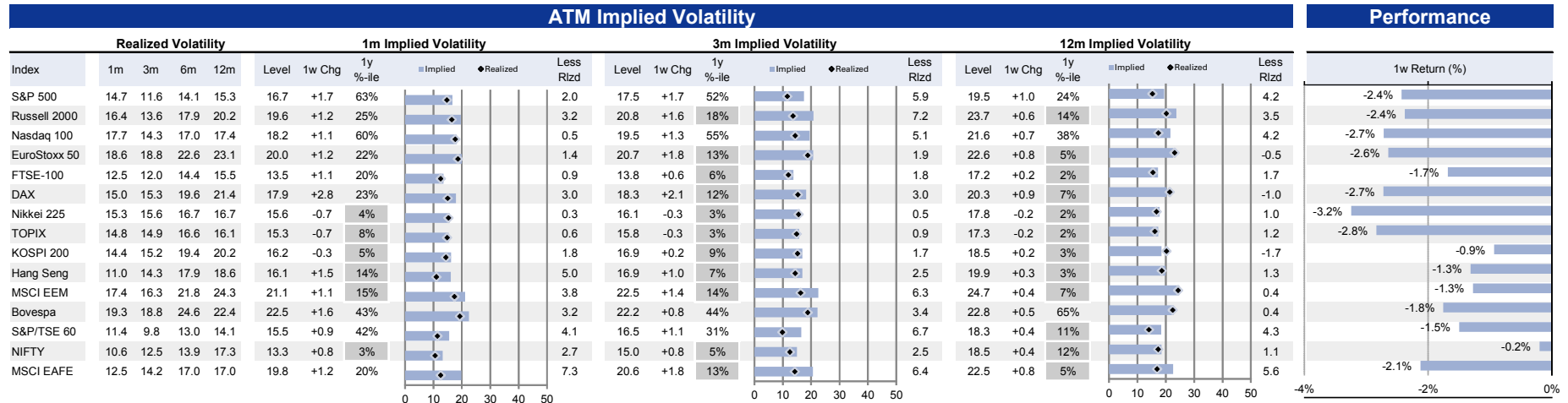
* Normalized skew: (25 delta put - 25 delta call) / 50 delta

Source: Goldman Sachs Options Research.

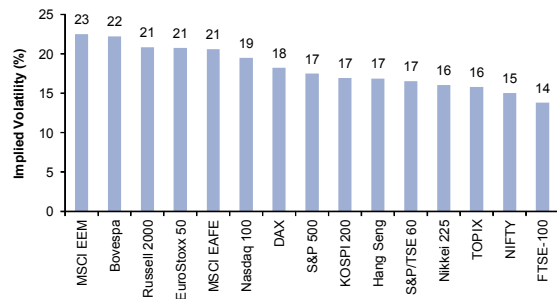
Global Volatility Landscape

Exhibit 28: 50-delta implied volatility comparison across global indices.

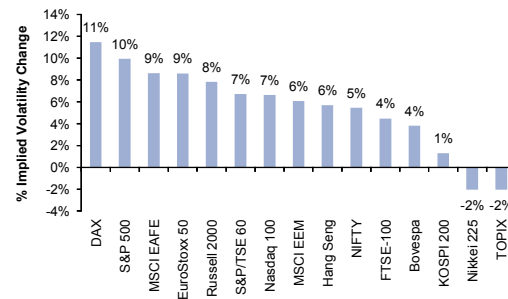
Data as of November 9, 2012 market close.



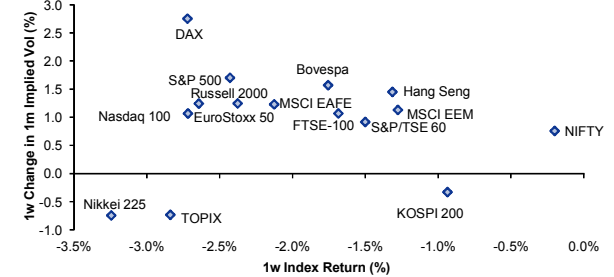
3m Implied Volatility Level



1w % Change in 3m Implied Volatility



1m Implied Vol Change vs. Performance



Source: Goldman Sachs Options Research.

Disclosure Appendix

Reg AC

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