

Signals from Options Markets

2010 Risk Management Conference

Marko Kolanovic, PhD^{AC}

Head, Derivatives and Delta One Strategy

+1 (212) 272-1438

mkolanovic@jpmorgan.com

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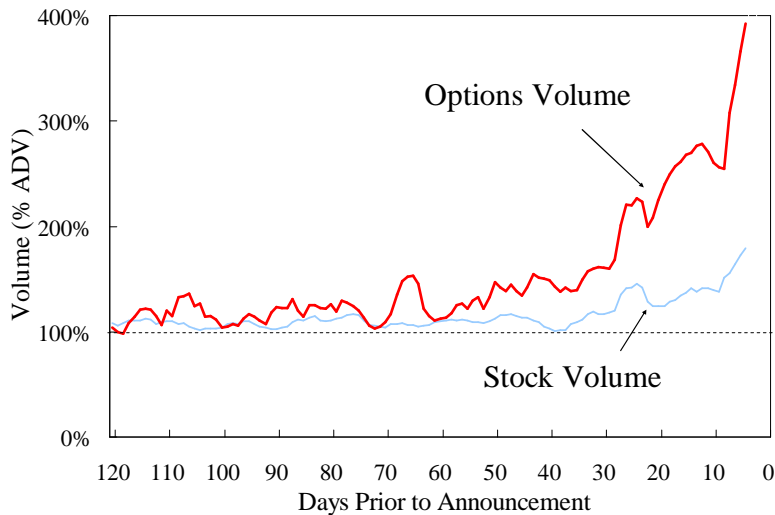
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Why Options Have Useful Trading Signals

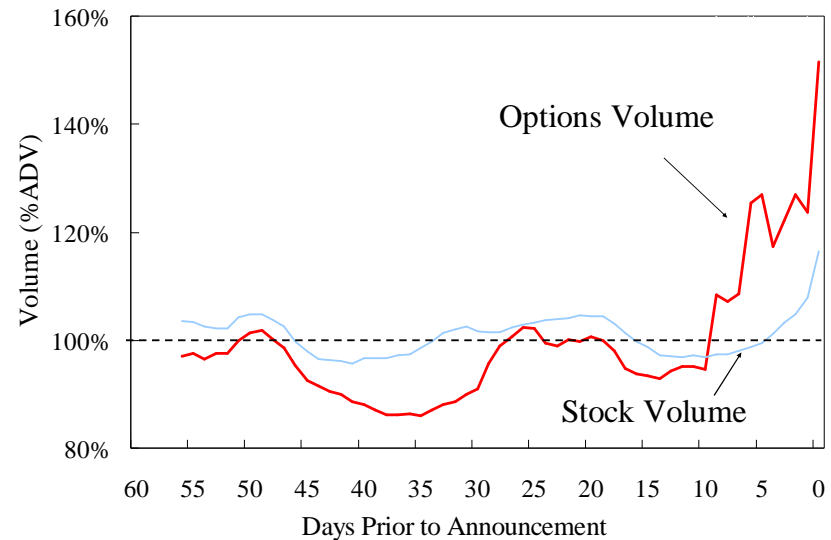
- **Is it possible to find signals that can accurately predict future performance of stocks?** If better-informed investors with high conviction first trade in one particular market (e.g., options or credit market), that market could lead and be used to anticipate future performance.
- In this presentation we **explore whether the equity options market leads the cash equity market** and how information from options can be used to improve returns, and reduce the risk of a portfolio.
- There are several reasons why **better-informed investors with high conviction might choose the options market over the cash market:**
 - 1) High conviction ideas are more likely to be implemented with leverage. **Options provide leverage** that is not always available in cash.
 - 2) High conviction ideas are more likely to be specific in terms of timing and price range. **Options provide the ability to implement specific views** that cannot be implemented with cash.
 - 3) Options can be used when there are short-sale restrictions, or uncertainty in the availability/cost of borrow. **Options can more effectively implement bearish views.**
 - 4) **Options provide better risk control.** For instance, a long stock position is exposed to 100% downside, and a short stock position to an unlimited downside. Option investors can express the same view with a pre-defined risk exposure.
 - 5) **Market impact and transaction cost of an option trade can be significantly lower than for an equivalent cash trade.** If an investor buys an OTM option, equivalent stock exposure will be accumulated by the option dealer over many days, and from many counterparties.
 - 6) Finally, essentially all option investors trade stocks, but not all stock investors trade options. It is more likely that an option investor will incorporate information from the stock market, but **stock investors may not incorporate all information from the options market.**

Why Options Have Useful Trading Signals

- We analyzed 10 years of options data to look for evidence that better-informed investors with high conviction about markets use the options market more than the cash market.
- The left figure below shows the average stock and options volume prior to cash takeover announcements in the US. One can notice that ~1 month before the announcement, excess option volumes was ~4 times larger than the excess cash volume. The excess option volume was largely in calls (average C/P volume ratio was ~2). Only after the announcement did the stock volume become dominant. This suggests that informed traders/investors are more likely to use options.
- The right figure below shows the average volume of stocks and options before earnings announcements. Options volumes surged two weeks before the earnings, with excess option volume ~5 times larger than excess cash volume. Earnings related stock moves are estimated to contribute ~15% of stocks' annual returns. Part of this earnings related move is usually anticipated by options prior to announcements (for instance, stocks with high C/P volume ratio prior to announcement had a smaller earnings related move).



Source: J.P. Morgan Derivatives and Delta One Strategy.

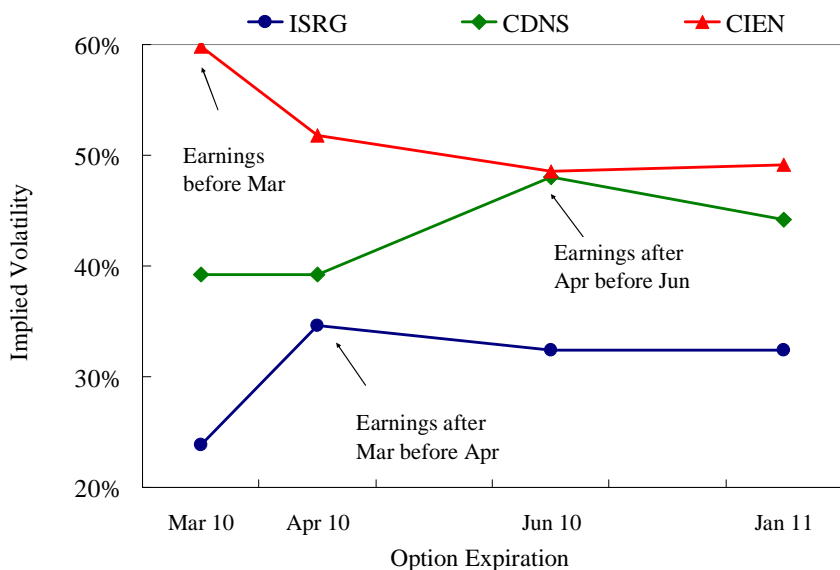


Signals from Options Markets

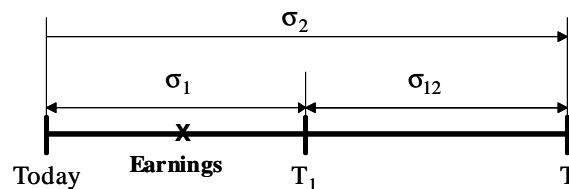
- Impact and Timing of Catalysts
- Directional Signals from Options
- Risk Management Signals from Options

Impact and Timing of Catalysts

- Options market usually contains information about timing and price impact of upcoming catalysts. Examples of price moving catalysts include: earnings announcements, court rulings, FDA approvals, mid-quarter updates, etc. For instance, if a catalyst is expected to happen in 3 months, 4 month options will likely have a higher implied volatility than 2 month options.
- The left figure below shows the term structure of options volatility for 3 stocks that are expected to have catalysts (earnings announcement) at different points in time. We can clearly notice that the term structure prices in both the timing, and volatility impact of the earnings moves.
- The right figure below shows a framework by which we can back out the expected size of a price move from the term structure of implied volatility. This framework can be used to estimate the size of the price impact (but not the direction of a move) for any catalyst.



Source: J.P. Morgan Derivatives and Delta One Strategy.

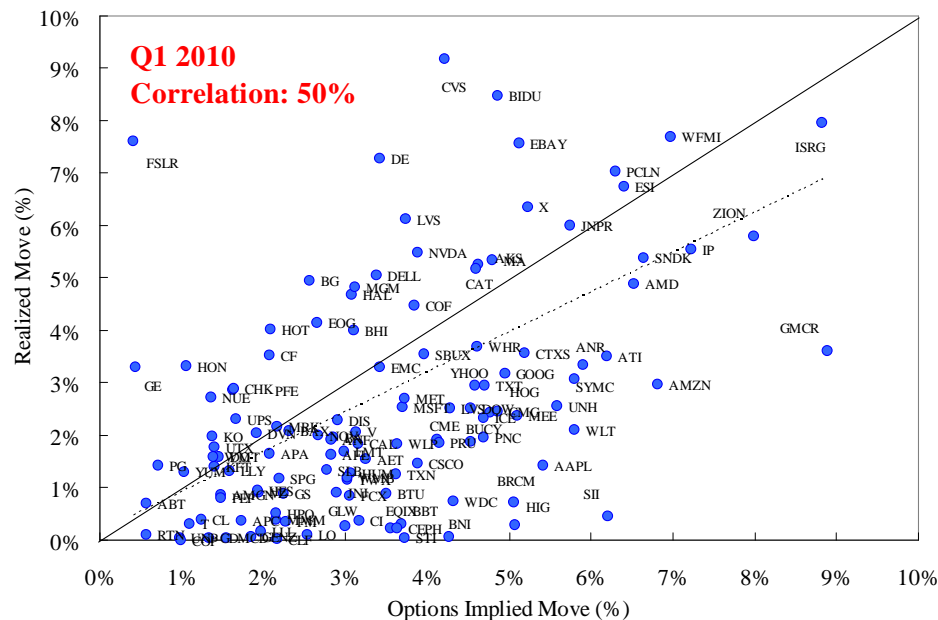


$$\sigma_{Earnings} = \sqrt{T_1(\sigma_1^2 - \sigma_{12}^2)} = \sqrt{(\sigma_1^2 - \sigma_{12}^2) \frac{T_2 T_1}{T_2 - T_1}}$$

$$\langle |r| \rangle \approx 0.8 \cdot \sigma_{Earnings}$$

Impact and Timing of Catalysts

▪ Applying our impact methodology to earnings of US companies shows that on average, **options correctly price the size of earnings related moves**. The figure below shows the option implied and subsequent realized earnings move for US stocks with liquid options announcing their 2009 Q4 results (during Q1 2010). The information coefficient of the option implied move relative to subsequently realized move was 50%, and is highly significant.

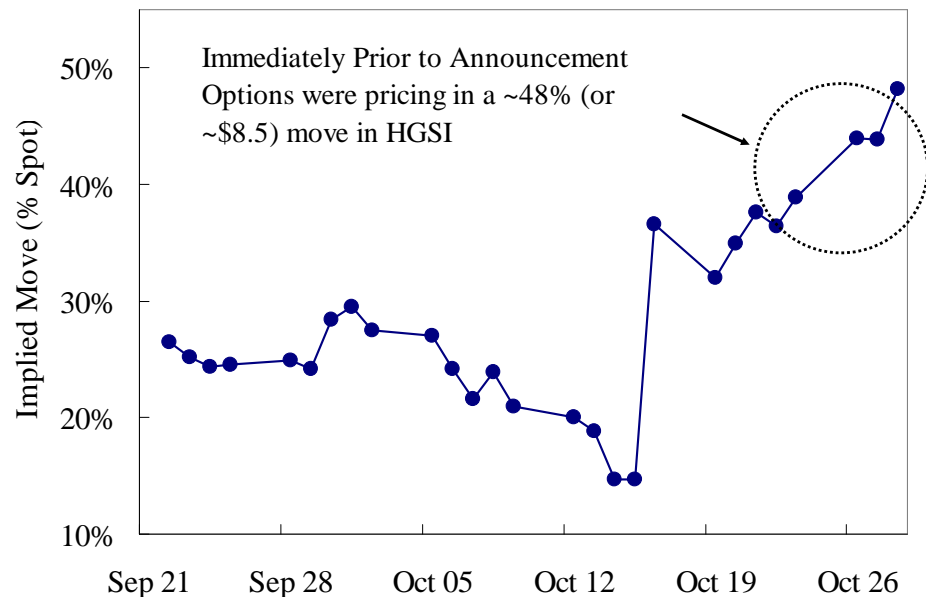


Source: J.P. Morgan Derivatives and Delta One Strategy.

- Over the past 5 years, the average predictive power (as measured by the information coefficient) was 40%. Option market predictions worked worst immediately following Lehman Brothers' collapse (IC of 22%), and best in Q3 2007 (IC of 70%).
- Information content of options is higher for stocks with liquid options. For instance, in the current quarter, the IC was 48% for all stocks in our sample, 49% for stocks with more than ~\$10M options notional volume, and 51% for stocks with more than ~\$20M options notional volume.

Impact and Timing of Catalysts

- The earnings price impact methodology can be applied to any significant catalyst. In the example below we analyze the price impact of phase 3 trial results. On Oct. 15th 2009, HGSI announced that they would release phase 3 trial results for their lupus drug BENLYSTA on Nov 2nd. As there is a multi-billion dollar market for this drug, the trial results were expected to have a significant impact on the stock price.
- Option volumes surged with notional open interest reaching ~20% of HGSI shares outstanding. The term structure of implied volatility adjusted to incorporate views on the size of the announcement impact. Immediately prior to the announcement, options were pricing a 48% move in either direction (Figure below left)
- On November 3rd, following the announcement, the stock closed at \$28.07, or 50% higher than the pre-announcement price of \$18.69 (figure below right). Options predicted the size of this move with great accuracy.

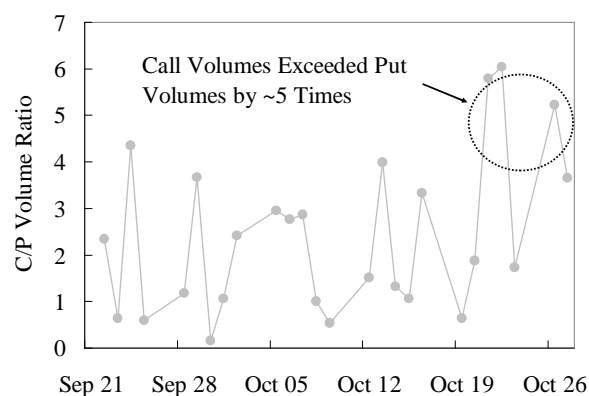


Source: J.P. Morgan Derivatives and Delta One Strategy.

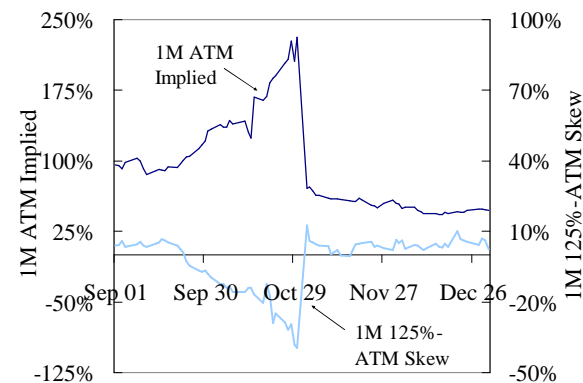
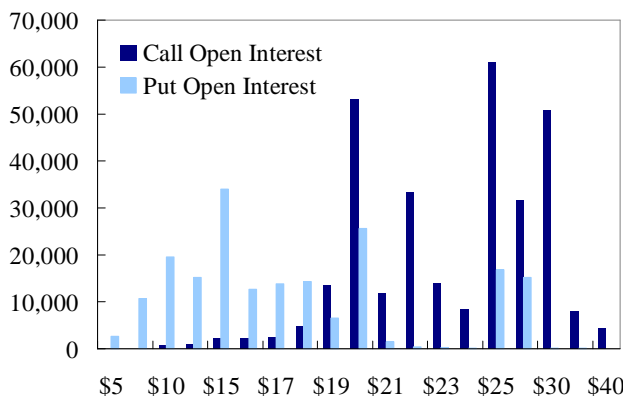


Directional Signals from Options

- We saw that options can accurately predict the size of the price impact from a significant catalyst. The question is: **Can options predict the direction of stock moves?**
- One would expect that better-informed investors **buy calls if they are bullish and buy puts if they are bearish**. Naively, a **high C/P volume**, and a **high C/P open interest** would be bullish signals as investors are buying calls. However, high volume in calls could also be a result of call selling activity that is bearish, and high put volume may result in put-selling activity that is bullish.
- **Perhaps a better option sentiment signal is the skew** (the difference between OTM put and call implied volatility). High skew would be a bearish signal as it would imply a predominance of buyers of OTM puts and sellers of OTM calls. Low skew would be a bullish signal as it would imply more buyers of OTM calls and sellers of OTM puts.
- The figures below show the behavior of C/P volume, open interest, and skew in our HGSI example. Prior to the announcement, the C/P volume ratio was 5, C/P open interest was 1.6, and the skew declined. **C/P volume and open interest pointed in the right direction (bullish). However, the skew did not**, as the price of OTM calls declined relative to the price of ATM calls. The reason for this was a call spread strategy (e.g. call spreads were also recommended by J.P. Morgan Derivatives Strategy).
- These considerations illustrate that interpreting directional option signals can be more involved and **requires a more detailed study**.



Source: J.P. Morgan Derivatives and Delta One Strategy.



Directional Signals from Options

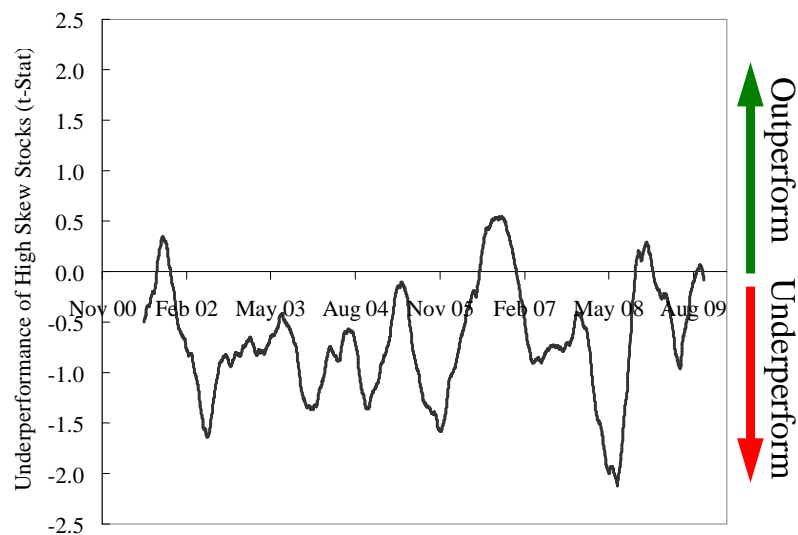
- The figure below summarizes backtests of various sentiment signals from option markets. By using a 10 year history of options for S&P 100 companies, we tested the performance of a long-short basket constructed based on: **Put/Call Open Interest, Put/Call Volume, Skew, and Change in Skew** (skew signals are colored green, P/C OI and volume signals in blue, and change in skew in yellow; the table is sorted by descending performance of the long-short baskets).
- We can notice that **3M and 6M skew were relatively strong sentiment signals** that predicted stock performance with a 60-80% success rate. Stocks with low skews tended to outperform stocks with high skews by 10-20% per annum.
- **P/C Open interest signal was less stable, and P/C volume was both an unstable and weak sentiment signal.** Stocks with low P/C open interest (and P/C volume) tended to outperform stocks with high P/C metrics.
- Interestingly, **short term change in skew was a (weak) contrarian signal**, indicating that an increase in skew leads to outperformance, and decrease in skew leads to underperformance. The reason for this is a common strategy of buying put spreads and call spreads to capture short term catalysts.

Performance of Various Sentiment Signals	Low-High 5			Low-High 10			Low-High 20		
	Perf.	IR	Hit Rate	Perf.	IR	Hit Rate	Perf.	IR	Hit Rate
3M 90-110 Skew (perf. next 3M)	18%	0.64	63%	15%	0.72	67%	14%	0.83	71%
6M 90-110 Skew (perf. next 6M)	17%	0.62	70%	13%	0.65	74%	12%	0.76	78%
3M 75-125 Skew (perf. next 3M)	11%	0.40	57%	7%	0.33	57%	6%	0.36	60%
6M 75-125 Skew (perf. next 6M)	11%	0.40	62%	8%	0.39	65%	8%	0.54	71%
1M 90-110 Skew (perf. next 1M)	10%	0.36	53%	9%	0.41	54%	8%	0.54	57%
3M P/C Open Interest (perf. next 3M)	15%	0.28	48%	14%	0.42	53%	7%	0.37	53%
1M P/C Open Interest (perf. next 1M)	10%	0.27	47%	12%	0.48	50%	8%	0.48	49%
6M P/C Open Interest (perf. next 6M)	25%	0.26	50%	19%	0.35	62%	10%	0.35	61%
1M P/C Volume (perf. next 1M)	5%	0.16	50%	4%	0.21	52%	4%	0.30	53%
3M P/C Volume (perf. next 3M)	6%	0.15	54%	5%	0.20	53%	4%	0.24	53%
1M 75-125 Skew (performance next 1M)	3%	0.11	48%	1%	0.05	50%	0%	0.00	48%
6M P/C Volume (perf. next 6M)	6%	0.09	55%	5%	0.14	58%	4%	0.20	56%
1M 90-110 Skew 1M Change (perf. next 1M)	-1%	-0.02	49%	0%	-0.03	50%	-1%	-0.07	49%
3M 90-110 Skew 1M Change (perf. next 1M)	-1%	-0.05	49%	-2%	-0.13	48%	0%	-0.03	50%
6M 90-110 Skew 1M Change (perf. next 1M)	-5%	-0.15	48%	-4%	-0.21	48%	-3%	-0.20	48%

Source: J.P. Morgan Derivatives and Delta One Strategy.

Directional Signals from Options

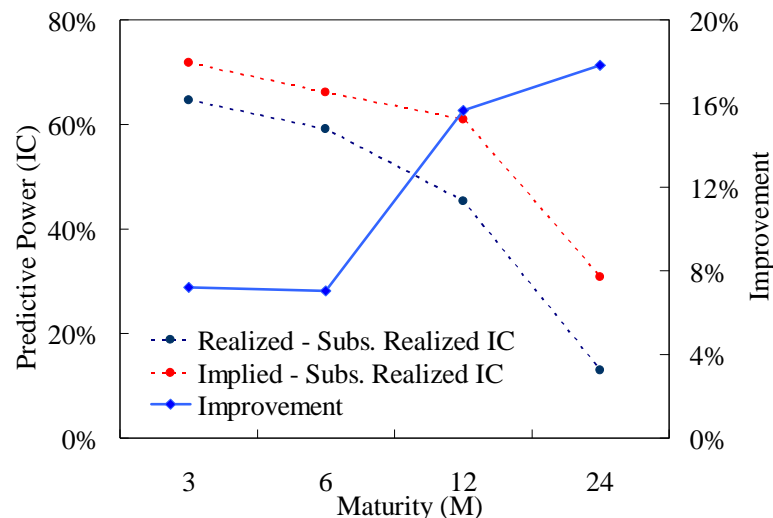
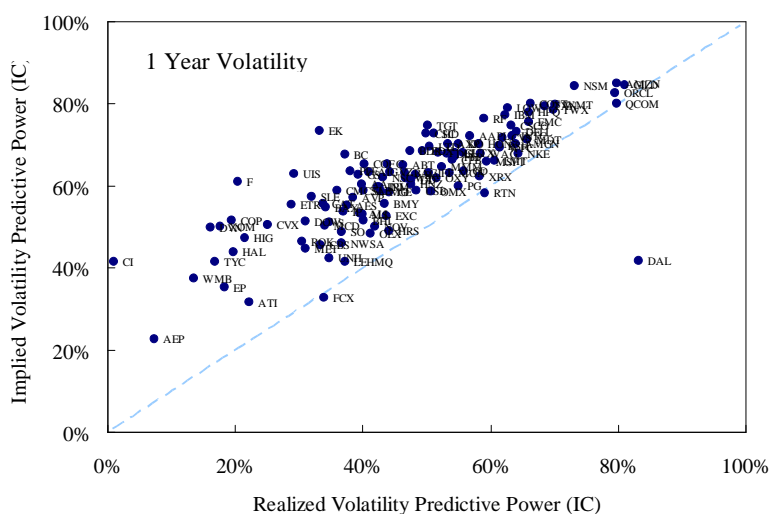
- In the previous slide, we showed that **3M and 6M skews** are meaningful sentiment indicators. The figure below shows the strength of underperformance of high skew stocks over the past 10 years (the figure shows t-statistics of beta adjusted stock returns, relative to the benchmark index; high skew stocks almost always underperformed low skew stocks).
- Further we want to investigate if the skew effect was a result of option activity around earnings announcements. We studied the relationship of skew and change in skew and performance over the earnings window and found that **underperformance of high skew stocks was not related to performance over the short earnings announcement window**. Rather, the underperformance of high skew stocks was a result of anticipated poor performance over more extended time periods.



- **Short term change in skew is not a reliable signal as it is influenced by put spread and call spread trading.** The change in skew is still a useful metric, but it needs to be analyzed alongside changes in levels of volatility, P/C open interest and volume (as we did in the HGSI example).
- While P/C volume does not have a significant predictive power, academic literature suggests that P/C volume related to the opening of new option positions is a strong sentiment indicator (J. Pan and A. Poteshman, “The Information in Option Volume for Future Stock Prices”).

Risk Management Signals from Options

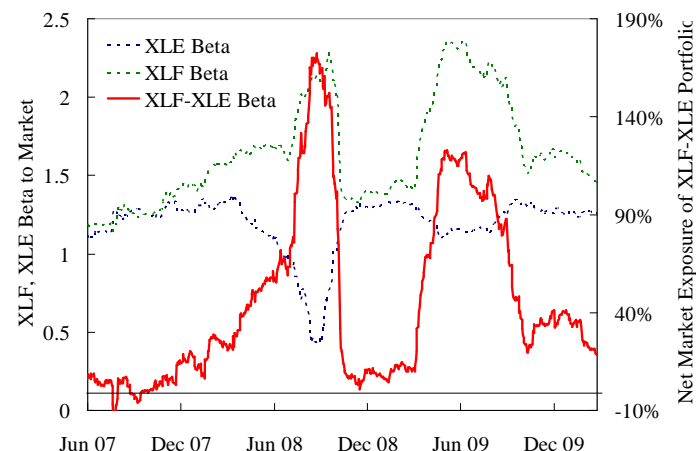
- Signals from options can also be used to **improve management of portfolio risk**.
- Option implied volatility is a good predictor of future realized volatility. The figure below (left) shows the predictive power (Information Coefficient) of 1-year implied volatility against predictive power of 1-year realized volatility for S&P 100 companies over the past 10 years. We note that the **implied volatility is a better predictor of future volatility for virtually all stocks in the sample** (we excluded takeover names).
- The figure below (right) compares the predictive power of option implied and historically realized volatility. **Options give a better estimate of future volatility across all maturities**, however the larger improvement is for longer maturities (12 months and beyond).



- Options can be used to predict the level of correlation between stocks. However, **option implied correlation has roughly the same predictive power as historical realized correlation**.
- Because of its strong predictive power, **option implied volatility can be used to create improved estimates of portfolio beta, and optimal mean variance portfolios**.

Risk Management Signals from Options

- **Beta is used to determine a portfolio's market exposure, risk, and a proper hedge ratio.** Beta is calculated as the product of the correlation between the portfolio and the benchmark, and the ratio of the portfolio volatility to benchmark volatility: $\beta_{Pt.} = \rho \cdot (\sigma_{Pt.} / \sigma_{spx})$
- Using the historical beta relies on the stability of correlations and volatilities of the portfolio and the benchmark. In highly volatile markets, both correlation and volatilities are unstable and hence **historical beta estimates are unstable**. For example the XLF-XLE sector relative value trade that started as market neutral, quickly turned into a losing trade with a large market exposure (Figure right).



- We saw that option implied volatility is a better predictor of future volatility as compared to historical realized volatility. Hence, **one can use option implied volatility to calculate option implied betas.**
- However, the forward looking information contained in option volatilities may be lost when calculating implied betas. Option implied beta calculation needs to address the following potential issues:

Beta is proportional to a ratio of stock to index volatility, and even if both measures are improved (by using option volatility), the ratio may not be significantly improved.

S&P 500 index volatility is known to trade at a persistent premium. This will introduce downward bias to option implied betas.

As implied correlation between stocks and their benchmark is not available, implied beta estimates usually have to rely on historical correlation data.

- These issues can be addressed in different ways, and hence there are different ways to calculate option implied beta.

Risk Management Signals from Options

- We tested the predictive power of implied betas constructed with:

- 1) Realized correlation and implied volatility for stocks and index (**Implied**)
- 2) Realized correlation and implied volatility for stocks only (**Implied Stock**)
- 3) Realized correlation and implied volatility for stocks and index, adjusted for the volatility premium (**Implied Adjusted**)
- 4) Long term realized correlation, and implied volatility for stocks and index (**Combination**)

- Results are shown in the tables to the right. There was no single method of estimating betas that was the best in all cases. **However, using implied betas led to significant improvement in some cases.**

% of Stocks whose beta is best predicted (by beta method)					
Mat.\Beta Method	Realized	Comb.	Impl. Stk.	Implied	Impl. Adj.
3M	20.2%	39.4%	17.4%	8.3%	6.4%
6M	11.9%	31.2%	26.6%	12.8%	10.1%
12M	13.8%	21.1%	38.5%	14.7%	10.1%
24M	16.5%	16.5%	22.0%	34.9%	4.6%

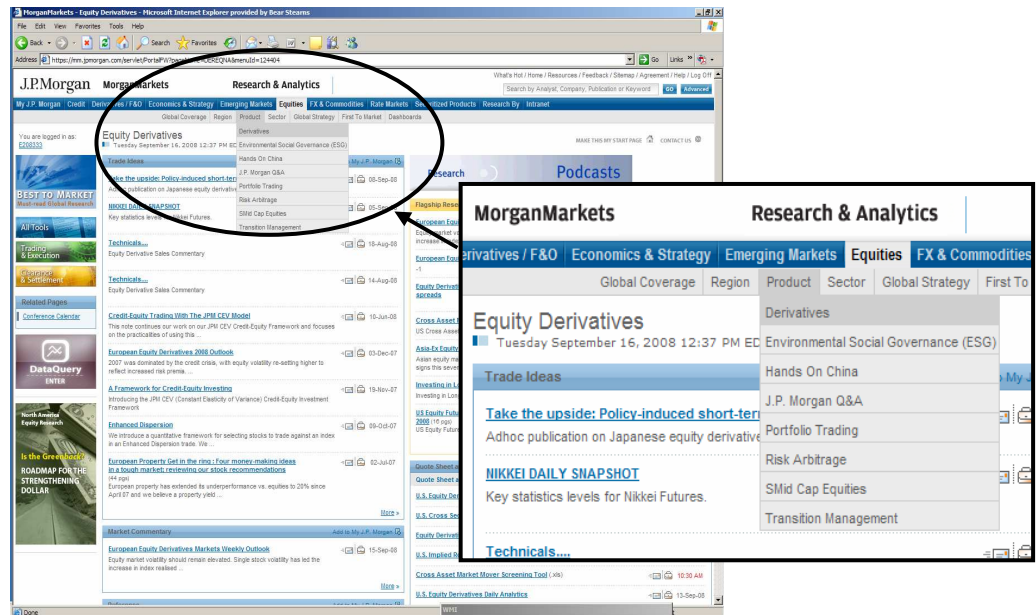
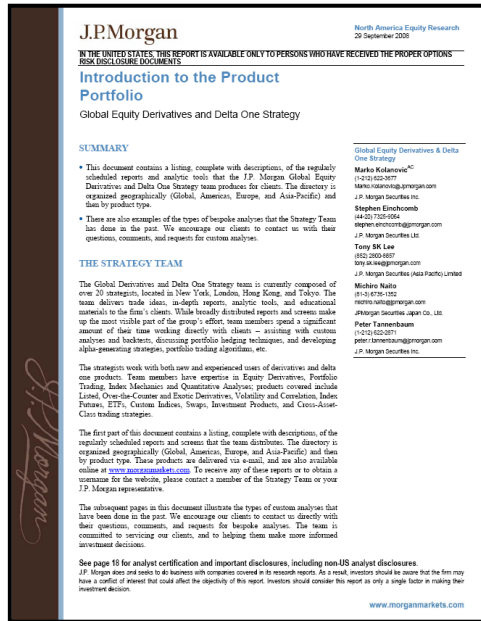
Beta method that has the highest predictive power				
Sector\Maturity	3M	6M	12M	24M
Materials	Realized	Comb.	Realized	Realized
Utilities	Comb.	Realized	Comb.	Comb.
Health C.	Realized	Impl. Stk.	Realized	Implied
Industrials	Comb.	Comb.	Realized	Implied
Energy	Comb.	Comb.	Impl. Stk.	Comb.
Financials	Comb.	Comb.	Impl. Stk.	Impl. Stk.
C. Discretion	Comb.	Implied	Impl. Stk.	Impl. Stk.
C. Stables	Impl. Stk.	Impl. Stk.	Impl. Stk.	Implied
Technology	Impl. Adj.	Impl. Adj.	Impl. Adj.	Implied

- Across all sectors, **realized and combination beta tend to be the better predictor for short maturities** (larger part of improvement of combination beta comes from using long term realized correlation). **Implied beta works better for longer maturities.** This was an expected result, as implied volatility has a better predictive power for longer maturities.
- Across various sectors, implied beta methodology worked better for **Technology, Staples, Consumer Discretionary and Financials.** Realized (and combination) beta worked better for **H. Care, Utilities, Materials, Industrials and Energy.**
- The implied beta methodology tends to work better in a **high volatility environment**, as implied volatility more quickly adjusts to levels of volatility (realized volatility tends to lag).
- Preliminary analysis of using implied volatility in mean variance optimizations shows that implied volatilities can lead to instability and high turnover. More work is needed to establish the appropriate method of incorporating implied volatility levels in mean variance optimizations.

Appendix: JPM Strategy Team Snapshot

Global Equity Derivatives and Delta One Strategy

- Analysts in New York, London, Hong Kong, Tokyo, and Mumbai
- Regular strategy publications: reports, screens, product notes, and commentaries
- Provides customized analyses and bespoke research for clients and trading desks
- Available at www.morganmarkets.com (Derivatives, Delta One - Portfolio Trading)



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	Overweight (buy)	Neutral (hold)	Underweight (sell)
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IB clients*	58%	57%	42%
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IB clients*	78%	73%	57%

*Percentage of investment banking clients in each rating category.

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