

Statistical Arbitrage Model for the S&P/ASX 200 VIX using Volatility of Volatility



Mike Zhang, CFA CMT
Analyst,
Perennial Value
Management

Introduction

Volatility of volatility (Vol of Vol) is defined as the volatility of the S&P/ASX 200 VIX Index (A-VIX), which by itself is a composite measurement of the implied volatility derived from the prices of S&P/ASX 200 index options. The Vol of Vol is measured as the 10-day standard deviation of the A-VIX index's daily log returns.

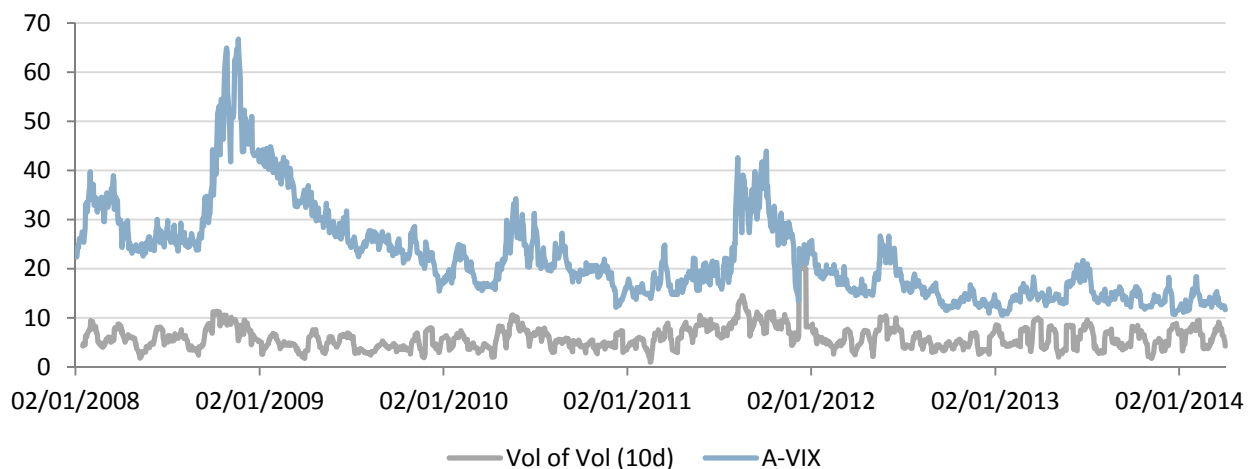
Previous studies by Bank of America Merrill Lynch (BofA) suggest the Vol of Vol itself can provide an early warning of instability in markets that tends to precede VIX spikes. Likewise Vol of Vol also tends to drop dramatically ahead of major volatility declines.*

BofA suggests a buy signal for volatility, when Vol of Vol is high and becoming more stressed. The specific rule is that the Vol of Vol buy signal is on, when the 10-day standard deviation of VIX changes exceeds the 80th percentile of its trailing 1-year distribution, and the 80th percentile of its trailing 3-month distribution.

This BofA study is based on the US based VIX Index, which could differ from the Australian based A-VIX Index that Perennial Value Wealth Defender focuses on. We will study Vol of Vol in more detail in this paper, construct a statistical arbitrage model and investigate the potential drawbacks.

Correlation between Vol of Vol and A-VIX

The A-VIX Index started in Jan 2008. As illustrated in the chart below, it is very clear the A-VIX and Vol of Vol are correlated.



Source: Perennial.

* Source: Timing volatility to generate alpha and hedge efficiently, Global Asset Allocation Paper #3, 10 Sep 2012, Bank of America Merrill Lynch.

The Vol of Vol has a distinctive characteristic in that it travels historically in a well-defined interval between 3% and 10%, making it a perfect mean-reverting countertrend technical signal by nature.

It is also clear that the A-VIX does not remain static, it is constantly moving up or down, unlike the equity market. It is a useful instrument for swing trading, offering higher gamma trading returns by holding A-VIX options (versus holding index options).

In regards to predicting future A-VIX movements, how reliable are the Vol of Vol overbought/oversold signals?

Statistical results of forecasting A-VIX return using Vol of Vol

As Vol of Vol is a mean-reverting time series within a well-defined trading range, the first step is to establish a level for buy/sell signals. We use the 10th percentile and 90th percentile (data period: 2008 Q1 to 2014 Q1) as the buy/sell signal which is generated by Vol of Vol to long/short the A-VIX Index.

Therefore, whenever Vol of Vol decreases below 3.37, we would be long A-VIX index. In comparison, whenever Vol of Vol increases above 8.86, we would short the A-VIX index.

Following the buy/sell signals, the A-VIX performances are as below:

1) Buy signal (Vol of Vol < 3.37)

Enter below 10th percentile				
2008 Q1 – 2014 Q1	0-10 days	10-20 days	20-30 days	Total
Total events	41	41	41	41
- Positive	26	19	20	23
- Negative	15	22	21	18
Avg positive A-VIX change	1.90	2.68	2.83	4.29
Avg negative A-VIX change	-1.44	-1.97	-2.01	-2.71
% positive events	63%	46%	49%	56%
% negative events	37%	54%	51%	44%
Average A-VIX change	0.68	0.18	0.35	1.22

There are 41 such events in the 2008-2014 period. In the following 10 days after a buy signal is generated, the A-VIX return was positive 63% of the time, generating an average change of 0.68. This is a good short-term (10 day) long A-VIX signal.

2) Sell signal (Vol of Vol > 8.86)

Enter above 90th percentile				
2008 Q1 – 2014 Q1	0-10 days	10-20 days	20-30 days	Total
Total events	28	27	27	27
- Positive	10	5	11	8
- Negative	18	22	16	19
Avg positive A-VIX change	7.48	7.77	2.66	6.10
Avg negative A-VIX change	-3.86	-3.98	-3.73	-5.79
% positive events	36%	19%	41%	30%
% negative events	64%	81%	59%	70%
Average A-VIX change	0.19	-1.80	-1.13	-2.27

Both 0 to 10 days and 10 to 20 days offer asymmetrical trading edges. The probabilities of negative returns are 64% and 81%, respectively. The average A-VIX change over the following 30 days is -2.27, suggesting this is a good medium term (30 days) short A-VIX signal.

Historical correlation between A-VIX and Vol of Vol

Having established the statistical arbitrage model of using Vol of Vol to predict the future movement in A-VIX, a review of the periods when the model doesn't work is required i.e. a turnaround in Vol of Vol doesn't necessarily lead to a turnaround in the A-VIX.

This is carried out by calculating the historical correlation using separate quarterly periods (Figure 1).

The correlation table covers the second quarter of 2008 to the first quarter of 2014 inclusive.

19 out of the 24 quarters (illustrated in Figure 1) show a positive correlation, indicating that the Vol of Vol moves in sync with the A-VIX. In these periods, a turnaround in Vol of Vol leads to a turnaround in the A-VIX.

Of the five quarters when Vol of Vol is not positively correlated with the A-VIX, our research shows the following commonalities (Figure 2):

- 1) **Fourth quarter in 2008, second quarter in 2009 and third quarter in 2009:** a big shift in average A-VIX levels occurred before or during these quarters. For example, average A-VIX increased from 27 to 50 during the fourth quarter in 2008, then dropped back to 29 and 25 in the second and third quarters in 2009, respectively. When the A-VIX shifts into a completely new range, Vol of Vol does not move in sync with the A-VIX.
- 2) **Fourth quarter in 2010:** the A-VIX dropped below 20 for the first time (actual value 18). This is a shift into a new low-volatility environment, which renders the Vol of Vol signal ineffective.
- 3) **Fourth quarter in 2011:** the average A-VIX level in the previous quarter (third quarter in 2011) increased 11 points from 18 to 29, a big shift once again, therefore rendering the Vol of Vol signal ineffective.

The above mentioned periods are during or right after a volatility regime switch, such as jumping from a sub-30 A-VIX regime to 30 to 50 regime in late 2008. While the Vol of Vol is suggesting an overbought signal, in fact, the A-VIX has switched to a higher regime and is likely to stay at a higher level for a while instead of mean reverting.

Figure 1.

	Correlation
2008 Q2	0.64
2008 Q3	0.58
2008 Q4	-0.02
2009 Q1	0.52
2009 Q2	-0.18
2009 Q3	-0.10
2009 Q4	0.23
2010 Q1	0.72
2010 Q2	0.69
2010 Q3	0.38
2010 Q4	-0.59
2011 Q1	0.53
2011 Q2	0.54
2011 Q3	0.58
2011 Q4	-0.11
2012 Q1	0.33
2012 Q2	0.65
2012 Q3	0.38
2012 Q4	0.41
2013 Q1	0.46
2013 Q2	0.36
2013 Q3	0.66
2013 Q4	0.13
2014 Q1	0.42

Figure 2.

	Correlation	S&P/ASX 200 return	A-VIX average
2008 Q2	0.64	-2.72%	25.48
2008 Q3	0.58	-10.48%	27.63
2008 Q4	-0.02	-22.36%	50.30
2009 Q1	0.52	-3.55%	39.10
2009 Q2	-0.18	10.48%	29.93
2009 Q3	-0.10	22.45%	25.21
2009 Q4	0.23	3.61%	22.46
2010 Q1	0.72	-0.02%	19.36
2010 Q2	0.69	-12.35%	24.03
2010 Q3	0.38	8.15%	21.68
2010 Q4	-0.59	3.63%	18.06
2011 Q1	0.53	2.01%	16.85
2011 Q2	0.54	-5.22%	18.16
2011 Q3	0.58	-12.69%	29.02
2011 Q4	-0.11	4.09%	26.57

Conclusion

Our research of the Vol of Vol for A-VIX index was reviewed over a six year period between January 2008 and March 2014. Due to the mean-reverting property of Vol of Vol, we constructed a statistical arbitrage model using Vol of Vol to generate buy/sell signals for the A-VIX.

Statistical back testing proved there's a positive edge using 10th percentile and 90th percentile of Vol of Vol as the oversold/overbought levels, and long/short the A-VIX index accordingly. This is an opposing view to the research conducted by Bank of America Merrill Lynch, which suggests a Vol of Vol spike leads to further advances in the VIX, and vice versa.

Potential drawbacks of this statistical arbitrage model were also reviewed. It is during or right after a volatility regime switch, such as jumping from a sub-30 A-VIX regime to 30 to 50 regime, that renders the Vol of Vol signal ineffective. While the Vol of Vol is suggesting an overbought signal, in fact, the A-VIX has switched to a higher regime and is likely to stay at such a level instead of coming back into the old regime.

In summary, when there's fundamental change that suggests the volatility regime has shifted (for example, GFC, credit crisis, earthquake etc.), we should temporarily ignore the signals generated by this statistical arbitrage model, and follow the trend in the A-VIX.

For all other enquiries please contact us on 1300 730 032
or visit www.perennial.net.au.

Signatory of:



Issued by: The Investment Manager, Perennial Investment Partners Limited ABN 59 087 901 620, AFSL: 238763 ("Perennial"). Sub Manager: Perennial Value Management Limited, ABN 22 090 879 904, AFSL: 247293. Responsible Entity: IOOF Investment Management Limited ABN 53 006 695 021, AFSL: 230524. This promotional statement is provided for information purposes only. Accordingly, reliance should not be placed on this promotional statement as the basis for making an investment, financial or other decision. This promotional statement does not take into account your investment objectives, particular needs or financial situation. While every effort has been made to ensure the information in this promotional statement is accurate; its accuracy, reliability or completeness is not guaranteed. Past performance is not a reliable indicator of future performance. Gross performance does not include any applicable management fees or expenses. Net performance is based on redemption price for the period and assumes that all distributions are reinvested. Fees indicated reflect the maximum applicable. Contractual arrangements, including any applicable management fee, may be negotiated with certain large investors. Investments in the Trusts must be accompanied by an application form. The current relevant product disclosure statements, reference guides and application forms can be found on Perennial's website www.perennial.net.au.