ENHANCING PORTFOLIO PERFORMANCE WITH
the implied volatility index

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Implied volatility has become a popular asset class as investors seek more effective diversifiers for investment portfolios after the recent global financial crisis. This paper provides a close examination of the relationship between the Australian Implied Volatility Index (A-VIX) and its underlying asset, the S&P/ASX 200 Index. It also highlights the limitations of A-VIX futures, which were introduced in October 2013, as a diversifier for investment portfolios.

Financial markets around the world suffered dramatic declines in market values as a result of the 2007 global financial crisis (GFC). The S&P 500 Index dropped by approximately 50 per cent from its peak in 2008, while the S&P/ASX 200 Index fell from 6700 points to the 3100 points one year after the crisis, according to the Chicago Board of Options Exchange and the Australian Securities Exchange (2012). Many investment funds which were well-diversified and protected still experienced severe losses during the GFC.

Prior to the crisis, assets which had low correlations were considered to be effective diversifiers. However, these correlations rose dramatically during and after the crisis. This resonates with previous findings that suggest correlations between asset classes tend to tighten up during market shocks (Szado 2009). Benefits from diversification declined when they were needed the most. Interestingly, implied volatility is one of the few asset classes that displayed negative or low correlations with equities, bonds and commodities and increased in value during market downturns (DeLisle et al. 2010; Luo and Dash 2011). While the S&P 500 lost approximately 50 per cent, its implied volatility index realised a gain of about 125 per cent during the 2008–09 period. This negative correlation has led many investors to explore the implied volatility index as a possible way to provide portfolio protection. As a result, interest in exchange-traded volatility derivatives has increased significantly, as volatility has been considered to be an efficient diversifier for equity portfolios (Szado 2009; and Briere et al. 2010).

These observations raise an important question: ‘Does having exposure to an implied volatility index ensure the effectiveness of portfolio diversification, thus improving portfolio performance for Australian investors?’ This study focuses on the relationship between the A-VIX and the S&P/ASX 200 Index.

The inverse relationship between price and volatility

Before examining the effects of including implied volatility in a portfolio, it is important to understand the relationship between price and volatility. The strong, negative relationship between prices and volatility is well documented in the literature (Black 1976; French et al. 1987). Numerous researchers have examined the relationship between different asset classes and equity volatility. Several causes are present, yet there are two major empirical and theoretical explanations for this inverse relationship.

The first theory is the ‘leverage effect’, originally documented by Black (1976). He believes that the most obvious causal relationship runs from changes in the value of the firm to its stock returns which then flow on to volatility changes. This suggests that a fall in a company’s value will cause a negative return on its stock and the company’s leverage level then becomes higher resulting in higher return-volatility for the stock. There are many studies that support Black’s philosophy, such as Christie (1982), Turner et al. (1989) and Bollerslew et al. (2012).
The second explanation is the ‘volatility feedback effect’ developed by French et al. (1987) who argue that the trade-off between return and risk (where volatility is an indicator of risk) is weakly explained by leverage. They claim that the causal relationship runs from investors’ perception of the risk that they must bear to changes in stock prices. For that reason, if there is a rise in uncertainty about future payoffs of a company, investors require a higher rate of return to compensate for the extra risk (uncertainty) that they take. Thus, a change in the business or economic conditions leads to a change in the volatility of stocks and results in lower stock prices. In this framework, an increase in implied volatility is the cause of a reduction in equity prices (Harvey 1989; Nelson 1991; Ozdenoren and Yuan 2008).

Regardless of the underlying causality, a strong asymmetric relationship between price and volatility exists. Drops in stock prices are associated with increases in volatility. However, the magnitude of price and volatility movements is not always symmetric. Haugen et al. (1991) study the reactions of stock prices and the expected returns to changes in volatility. In addition to finding that equity prices and returns are heavily affected by variations in volatility, the authors find an interesting dissimilarity in the volatility reaction to a fall in price, in contrast with an increase in price. Evidently, the market reacts more aggressively to a price drop as opposed to a price rise. Their findings are further supported by Whaley (2009). For that reason, volatility appears to be an effective diversifier of equities as its negative correlation increases in absolute value when it is needed the most.

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The Australian Volatility Index (A-VIX)
The Australian Securities Exchange (ASX) introduced the S&P/ASX 200 Implied Volatility Index (A-VIX) in 2008 after the success of the S&P 500 Volatility Index (VIX). The Chicago Board of Options Exchange (CBOE) launched the VIX in 1993. The VIX is an index that measures the 30-day implied volatility of the S&P 500 Index options. Similarly, the A-VIX measures the level of market volatility that investors expect over a 30-day period. The A-VIX is computed based on the mid-point of the bid-ask spread of both S&P/ASX 200 in-the-money and out-of-the-money call and puts options. Near-term and next-term call and puts options with more than 23 days and less than 37 days to expiration are utilised to compute the A-VIX. These options are rolled over to new contract maturities weekly. The reason for the exclusion of expiring options is to eliminate potential price anomalies driven by maturing options (Whaley 2009).

Asymmetry in correlations

FIGURE 1: Averse movements between the A-VIX and the S&P/ASX 200 Total Return Index

Source: Datastream Database.
Figure 1 demonstrates the inverse relationship between the S&P/ASX 200 Total Return Index and the A-VIX since the implied volatility index was first introduced in Australia. The two indices virtually mirror each other.

The adverse movements, supported by a negative correlation of -0.65 between the S&P/ASX 200 Index and the A-VIX returns, exhibit diversification benefits when the two indices are combined in a portfolio. The behaviour of the implied volatility index is very unique. The index rises aggressively when the S&P/ASX 200 Index drops and only decreases slightly when the S&P/ASX 200 Index rises. This characteristic suggests that the A-VIX appears to be the natural diversifier/protection for portfolios that hold or replicate the S&P/ASX 200 Index.

We used econometric models to test this proposition. The following represents the results of these statistical models. Accordingly,

\[ r_{A-VIX} = \alpha + \beta_1 r_{ASX 200} + \varepsilon \]  
\[ r_{A-VIX} = \alpha + \beta_1 r_{ASX 200} + \beta_2 D r_{ASX 200} + \varepsilon \]  

Where:

\( r_{A-VIX} \) : daily return of the A-VIX
\( r_{ASX 200} \) : daily return of the S&P/ASX 200 Index
\( D \) : a dummy variable which equals 1 if the ASX return is negative.

Equation (1) measures the relationship between the S&P/ASX 200 Index returns and their implied volatility index return. However, since the two indices exhibit an asymmetric relationship, equation (2) is designed to test the diversification benefit of the A-VIX. To support our hypothesis, the coefficient \( \beta_2 \) of equation (2) should be statistically, significantly negative. The regression results are presented below. The negative coefficients are statistically significant at a 1 per cent confidence level. This indicates that our hypothesis on the negative relationship between the A-VIX and the S&P/ASX 200 Index cannot be rejected.

**TABLE 1: Regression models**

<table>
<thead>
<tr>
<th>Model (1)</th>
<th>coefficient</th>
<th>( \beta_1 )</th>
<th>( \beta_2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_{A-VIX} = \alpha + \beta_1 r_{ASX 200} )</td>
<td>0.00**</td>
<td>-3.52***</td>
<td></td>
</tr>
<tr>
<td>t-stat</td>
<td>2.19</td>
<td>-37.79</td>
<td></td>
</tr>
<tr>
<td>Model (2)</td>
<td>coefficient</td>
<td>( \beta_1 )</td>
<td>( \beta_2 )</td>
</tr>
<tr>
<td>( r_{A-VIX} = \alpha + \beta_1 r_{ASX 200} + \beta_2 D r_{ASX 200} )</td>
<td>-0.00***</td>
<td>-2.60***</td>
<td>-1.79***</td>
</tr>
<tr>
<td>t-stat</td>
<td>-3.27</td>
<td>-16.14</td>
<td>-6.99</td>
</tr>
</tbody>
</table>

Notes: This table reports the results of performing regression model 1 and 2. \( r_{A-VIX} \) is the daily return of the A-VIX Index. \( r_{ASX 200} \) is the daily return of the S&P/ASX 200 Index. \( D \) is a dummy variable which equals 1 if the ASX return is negative. ** and *** denote 95% and 99% confidence intervals, respectively.

It is clear that there is an inverse relationship between the A-VIX and its underlying index. Results from the two regressions illustrate that during days when the ASX return is negative, the return of the A-VIX will be positive, and vice versa. On average, if the S&P/ASX 200 Index level decreases by 1 per cent, the A-VIX will gain 4.39 per cent in value but when the S&P/ASX 200 Index grows by 1 per cent, the A-VIX only loses 2.6 per cent. In other words, the rate of change of the A-VIX is greater when the market is experiencing a fall. This clearly reflects not only an inverse relationship but also reveals the asymmetry of movements between the implied volatility index and the underlying asset. This interesting characteristic provides implied volatility diversification benefits over traditional diversification tools such as futures and options contracts.
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One possible explanation for this attractive feature is the usage of options for risk management purposes. Many participants in the options market are portfolio insurers who use put options to protect their portfolios. A drop in the S&P/ASX 200 Index level will cause higher demand for put options which leads to a higher price for the options. Consequently, the value of the implied volatility index will increase. This is also the reason why the volatility index is considered to be more of a barometer of investors’ fear rather than a barometer of investors’ greed, Whaley (2009).

**A-VIX exposure in an investment portfolio**

The inverse relationship between the A-VIX and the underlying S&P/ASX 200 Index appears to be strong. While the implied volatility index is often used as an indicator of stock price movements, it is, however, unclear whether an increase in implied volatility causes stock prices to drop or if a drop in stock prices leads investors to panic and hence increases their perception of volatility.

The strong inverse relationship between the A-VIX and the S&P/ASX 200 Index could create a new measure for investors to diversify an equity investment portfolio if investments in the former index can be made directly. The only exposure to the implied volatility index is via its futures. In Australia, the capital requirement to initiate a volatility futures trading account is not expensive, not to mention that investors can collateralise their investment portfolio. However, the behaviours of A-VIX futures are not identical to the A-VIX and could potentially remove the diversification benefits. There are two reasons for this.

First, the implied volatility index is mean-reversed with an average value of 16 to 20 points (Dash and Moran 2005). After periods of high volatility in the market, the index will revert to its average level. In other words, if an investor could invest $100 directly into the A-VIX and follow a buy-and-hold strategy, they would end up with $100. In order to make a profit, an investor needs to have the ability to predict crashes and speculate on the short-term sentiments reflected in the A-VIX. Second, the only exposure to the A-VIX is through its futures contracts which have a forward-looking property. Investors who trade these futures are betting on the level of implied volatility at a later point in time. An investor who is certain about a price shock that would cause the A-VIX value to increase in the near future can enter into a long position. However, as futures market participants are aware that this shock will not last long and the VIX index will steadily revert back to its average value, the VIX futures price would not change as much as the underlying index. As a result, the diversification benefit would not be much compared to that of the A-VIX.
Figure 2 illustrates that during periods of high A-VIX value, the price of the A-VIX futures did not increase by the same amount. Moreover, implied volatility futures contracts suffer from the so-called contango trap where their prices are ‘systematically drawn downward toward the level of the A-VIX’. Hence, a buy-and-hold approach with A-VIX futures almost certainly results in a loss (Whaley 2013). For these reasons, A-VIX futures prices will not increase as much as the index, minimising the diversification benefits arising from the asymmetric negative correlation between the A-VIX and the S&P/ASX 200 Index.

**Replicating the A-VIX**

The A-VIX futures are currently the only direct exposure to the implied volatility index. Unfortunately, the diversification benefit is not effectively utilised via the A-VIX futures. Some raised the question of whether there are other ways to take advantage of the inverse (and asymmetric) relationship between stock prices and implied volatility, perhaps replicating the A-VIX index using options positions.

This is possible since the A-VIX value is computed using the prices of several near- and next-term stock index call and put options. Therefore, one must take long or short positions in all of these options and constantly rollover weekly to replicate the A-VIX index. Unfortunately, we suspect this strategy would entail high transaction costs and potentially wipe out the diversification benefits derived.
Conclusion

Australia's implied volatility index (A-VIX) reflects investors' expectations of future volatility. Our study has shown that the inverse relationship between the Australian equity market and its implied volatility exhibits diversification benefits. Furthermore, the negative relationship becomes stronger when the market experiences downturns. This asymmetric correlation suggests a performance-enhancing feature of the index.

We argue that A-VIX futures do not offer the same diversification benefit as their underlying index, and could potentially weaken investment performance if included. The A-VIX can be replicated using put and call options on the S&P/ASX 200 Index but the costs can be high which eliminates the potential benefit. Nonetheless, as it was recently introduced, the volume and liquidity of A-VIX futures have not yet reached levels comparable to those of other actively traded derivatives. This suggests that there is potential for developing more tradeable instruments based on the A-VIX similar to the exchange-traded products on volatility indices that are available in the US and Europe markets.

The availability of A-VIX futures has opened the door for investors who want to explore the index as a possible way to provide portfolio protection. We argue that A-VIX futures do not offer the same diversification benefit as their underlying index, and could potentially weaken investment performance if included. The A-VIX can be replicated using put and call options on the S&P/ASX 200 Index but the costs can be high which eliminates the potential benefit. Nonetheless, as it was recently introduced, the volume and liquidity of A-VIX futures have not yet reached levels comparable to those of other actively traded derivatives. This suggests that there is potential for developing more tradeable instruments based on the A-VIX similar to the exchange-traded products on volatility indices that are available in the US and Europe markets.

Notes

1. Diversification principally means risk-reduction through a wide range of assets.
2. A comprehensive analysis on the VIX pricing algorithms that provide an in-depth knowledge of the VIX calculation was carried out by Hancock (2012).
3. These econometric models were developed in line with the Whaley (2009) research.
4. 2.6+1.79.
5. See ASX for the list of acceptable assets for collateral. Investors are required to meet variation margins after each trading day.
6. These are the periods in which the A-VIX’s diversification benefit is most desired.
References


