Australian Implied Volatility Index

Volatility implied from option prices is widely regarded as the market’s estimate of future expected volatility of the underlying asset. We construct an implied volatility index for the S&P/ASX 200 Index, the AVX, which we find contains important information for predicting volatility of the ASX and significantly outperforms other predictors commonly used.

Predicting stock market volatility is of great importance to investors, corporations and financial institutions; it allows them to make better investment decisions, enables them to implement appropriate hedging policies, and assists them in setting accurate Value-at-Risk (VaR) levels. Many models have been proposed by both academics and practitioners, but among the most popular approaches to measure and forecast stock market volatility are the RiskMetrics approach introduced by J.P. Morgan in 1992 and the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) approach, first introduced by Robert Engle, a Nobel Laureate in Economics, in 1982. Both of these approaches rely on historical data to predict future stock market volatility.

Another approach to forecasting market volatility, that has become popular mostly in the United States, is based on the volatility that can be implied from option prices. Implied volatility is the only unobserved determinant in an option pricing model (such as the Black and Scholes model), and represents an estimate of the volatility implied by the option price. Moreover, since options are priced on the basis of future payoffs, implied volatility could be considered as a measure for future volatility.

The Chicago Board Options Exchange (CBOE) introduced an implied volatility index (the VIX) in 1993, and its usefulness was demonstrated by Whaley (1993), who suggested that besides being an index for market volatility, the VIX could be used for hedging purposes, by introducing options and futures on the VIX. Within a short timeframe the VIX became the main index for US stock market volatility and, since 2004, the VIX has become a tradable asset, with futures and options traded on the VIX.

Although Australia has a relatively active and long-established market in index options, to date the Australian Stock Exchange has not yet introduced or published an implied volatility index. In this study, we construct an implied volatility index, termed the AVX, for the Australian stock market, based on the index options traded on the S&P/ASX 200 Index. We observe that the AVX provides important information for predicting future volatility and outperforms the commonly used approaches, such as RiskMetrics and GARCH.

The Australian Implied Volatility index (AVX)

The approach we follow in constructing the volatility index for the Australian exchange is similar to the original procedure followed by the CBOE to compute the VIX. Specifically, we combine the implied volatilities of eight near-the-money options into a single at-the-money implied volatility index with a constant time to maturity (i.e. a forward-looking horizon) of three months. We construct the AVX for the S&P/ASX 200 using daily option prices for the period 1 January 2002 to 31 December 2008. The data is obtained from SIRCA, the Securities Industry Research Centre of Asia-Pacific, based in Sydney. These options are traded on the...
Australian Securities Exchange and are European-style options. The constructed AVX represents the market’s estimate of future S&P/ASX 200 return volatility over the subsequent three months.

Figure 1 presents a plot of the evolution of the AVX and absolute S&P/ASX 200 Index returns over time. From this plot we clearly notice a strong relationship between the AVX and absolute index returns, confirming the idea that the AVX essentially captures market volatility. Figure 1 also shows some interesting features of volatility over time. The 2002–07 period was one of relatively low volatility, with the AVX ranging between 10% and 20% (with some exceptions, such as during the Iraq War in 2003). With the sub-prime crisis starting in late 2007, implied volatility started to rise dramatically, reaching its highest value of 66.2% on 20 November 2008, during the peak of the global financial crisis. While the implied volatility averaged around 16% for the 2002–07 period, average volatility in 2008 amounted to 37%, underlining the severity of the crisis.

Figure 2 shows the relationship between the AVX and the (log) index level. We can observe a negative relationship between the level of the index and the AVX, i.e. when the AVX peaks the market index is at a trough and vice versa. In effect, the contemporaneous correlation between the AVX and index level is strongly negative at −0.76. This phenomenon is also observed in the US market and is one of the reasons why the US VIX is often referred to as the ‘investor fear gauge’, i.e. as investor fear increases they exit the stock market, depressing prices, while they increase their hedging positions in options thus increasing the implied volatility.

There could be two main explanations for the phenomenon observed in Figure 2. The first is the so-called leverage effect, which suggests that when stock prices decline, the debt-to-equity ratio increases, leading to an increase in leverage of the firm and hence an increase in the riskiness of the firm’s equity. As a consequence, stock market volatility increases. The second explanation for this phenomenon is the so-called time-varying risk premium effect. This effect states that when the market expects risk to increase (i.e. volatility to go up), investors would like to be compensated for this risk by receiving a higher risk premium and thus a higher expected return. This, in turn, causes current stock prices to decline.
AVX and future stock market volatility

Since option prices reflect market participants’ expectations of future movements of the underlying stock, the volatility implied from option prices may contain useful and perhaps better information about future stock market volatility than measures based on historical volatility. Indeed, several studies conducted in the United States (such as Blair et al. 2001; and Giot 2005) present evidence that implied volatility subsumes all information contained in past volatility and is a more efficient forecaster of future volatility.

In Figure 3 we present a time series plot of the AVX and the future realised volatility (annualised) over the next 22 trading days. It reveals that the implied volatility index appears to track the realised volatility quite well, admittedly with some time lag. There is a difference in the level of both volatility measures, the AVX overestimating the realised volatility. This phenomenon is also observed for the VIX in the United States and can be explained by the hedging demand for options and the so-called ‘volatility smile’.

Although the information observed from Figure 3 is promising regarding the forecasting performance of the AVX, we still need to conduct some formal tests to determine first, whether the AVX is indeed a good predictor of future volatility and second, whether it is a better predictor than alternative measures of volatility. To do this, we construct volatility forecasts at a one-month (22 trading days) horizon based on the AVX, and use the realised volatility (calculated as the sum of the squared daily returns of the past 22 trading days) as a benchmark to assess the AVX’s forecasting performance. The alternative measures we consider are the RiskMetrics and a GARCH model that can capture asymmetric impacts of shocks on volatility (see Glosten et al. 1993).

![Figure 3: AVX and annualised future realised volatility (22 trading days)](image)

| TABLE 1: Correlations between future realised volatility and different forecasters |
|------------------|--------|
| AVX              | 0.81   |
| RiskMetrics      | 0.77   |
| GARCH            | 0.76   |

To determine whether the AVX is a good predictor of future volatility, we compute correlations between the future realised volatility and our various forecasts. The results are reported in Table 1, where we observe that the AVX has the highest correlation at 0.81, compared to 0.77 and 0.76 for the RiskMetrics and GARCH approaches, respectively. However, to examine the performance of each measure...
more accurately, we run the so-called performance regressions of realised volatility, $RV_t$, over the next month (22 trading days) against each specific forecaster, i.e.,

$$RV_t = \alpha + \beta X_t + \epsilon_t,$$

where $X_t$ is any of the forecasters discussed previously. In this regression we are interested in three things. First, the $\alpha$ of the regression will tell us whether the specific forecast does a good job at predicting the level of future volatility (with $\alpha = 0$ being most accurate). Second, the $\beta$ will tell us whether the forecaster does a good job at predicting the movements of future volatility (with $\beta = 1$ being most accurate in this respect). Finally, the $R^2$ of this regression will tell us the overall performance of the specific forecaster.

In Table 2 we report the results for the forecasting performance regressions. We note that all of the forecasters do a reasonable job at predicting volatility. All $\alpha$’s are close to zero and $\beta$’s are close to one. However, when we consider the overall performance of the forecaster, the $R^2$, the AVX produces the best overall performance, while the GARCH performs worst.

Having established that the AVX is indeed a good forecaster for future volatility, we now need to establish whether its performance is superior to that of the other approaches. To compare the different approaches we run so-called horse-race regressions or encompassing regressions, where we test the performance of the AVX against the other forecasting methods. These regressions take the following form,

$$RV_t = \alpha + \beta_1 AVX_t + \beta_2 X_t + \epsilon_t,$$

where $X_t$ is the forecast based on any of the alternative approaches. The significance of $\beta_1$ and $\beta_2$ will indicate whether one forecasting approach dominates the other. If $\beta_1$ is significant but $\beta_2$ is not, then the AVX is the better forecaster. If $\beta_2$ is significant and $\beta_1$ is not, then the alternative beats the AVX. If both $\beta_1$ and $\beta_2$ are significant, then the two forecasting approaches complement each other.

Table 3 further shows the results for the horse-race regressions. First, once the AVX is included in the regression, the addition of either the RiskMetrics or the GARCH volatility does not improve the regression ($R^2$) at all. Second, in all cases the coefficient on the AVX is highly significant. Thus, the results indicate that at the 22-day horizon the AVX is superior to the alternative forecasting approaches considered.

### Table 2: Forecasting performance regressions for 22 trading days

<table>
<thead>
<tr>
<th></th>
<th>$\alpha$</th>
<th>$\beta$</th>
<th>$R^2$ (adj)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVX</td>
<td>$-0.007^*$</td>
<td>$1.052^*$</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.096)</td>
<td></td>
</tr>
<tr>
<td>RiskMetrics</td>
<td>$0.008^*$</td>
<td>$0.818^*$</td>
<td>0.60</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.069)</td>
<td></td>
</tr>
<tr>
<td>GARCH</td>
<td>$0.005^*$</td>
<td>$0.948^*$</td>
<td>0.58</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.078)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance of the coefficients at the 5% level is indicated by $^*$.

### Table 3: Encompassing regressions for 22 trading days

<table>
<thead>
<tr>
<th></th>
<th>$\alpha$</th>
<th>$\beta_1$ (AVX)</th>
<th>$\beta_2$</th>
<th>$R^2$ (adj)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RiskMetrics</td>
<td>$-0.007$</td>
<td>$1.094^*$</td>
<td>$-0.036$</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.214)</td>
<td>(0.159)</td>
<td></td>
</tr>
<tr>
<td>GARCH</td>
<td>$-0.006$</td>
<td>$0.903^*$</td>
<td>$0.156$</td>
<td>0.66</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.165)</td>
<td>(0.116)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance of the coefficients at the 5% level is indicated by $^*$. 
Conclusions
Based on the S&P/ASX 200 Index options, we construct an implied volatility index for the Australian share market, the AVX. We provide empirical evidence that the AVX contains useful information about the volatility and index level of the stock market. Moreover, we show that the AVX is a superior forecaster of future stock market volatility. For stock market returns, we observe a negative contemporaneous relationship with the AVX. In terms of forecasting future volatility, the AVX has the highest forecasting power relative to alternative forecasters (RiskMetrics and GARCH). Overall, our findings demonstrate that the AVX has important information regarding the Australian stock market returns and that the publication of such an index could certainly provide valuable information to investors, corporations and financial institutions.

Notes
1 Dowling and Muthuswamy (2005) were the first to introduce an implied volatility index for the Australian market, but cover only a short time period from July 2001 to September 2002. Our study, however, considers a much longer period and extends their analyses considerably.
2 For full details regarding the construction of the AVX, see Frijns, Tallau and Tourani-Rad (2010).
3 We acknowledge the support for this study from SIRCA, the Securities Industry Resource Centre of Asia-Pacific.
4 The so-called ‘volatility smile’ refers to the phenomenon that implied volatility changes with the strike prices. At low and high strike prices, implied volatilities tend to be relatively high whereas, at intermediate strike prices, implied volatilities tend to be lower.
5 The regression coefficients and their respective robust standard errors in parentheses are presented.

References