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The asymmetric response of volatility to market changes and the volatility smile: Evidence from Australian options

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ABSTRACT

We document that in Australian markets, the impact on stock market volatility is higher following negative market shocks than following positive shocks of the same magnitude. We find that the implied volatility responses of in-the-money (ITM) options are consistent with the observed pattern. However, the implied volatilities of out-of-the-money (OTM) options are largely unresponsive to such shocks. We conclude that ITM options create different prospects for gains and losses compared with OTM options, and that the differences may be understood in relation to loss aversion behaviour. These different preferences and expectations explain the trend of the volatility smile as increasing implied volatility with in-the-moneyness.

1. Introduction

It is well established that changes in US stock market volatility are much higher following negative return shocks than following positive return shocks of the same magnitude. More specifically, estimations suggest a "reverse-J" shape in which future volatility tends to: (1) rise weakly following positive

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return shocks, (2) decline following periods in which surprise returns are close to zero, and (3) rise strongly following negative return shocks.[1]

Although a similar asymmetry has also been found in the behaviour of implied volatility, the extent of this asymmetry remains unclear. Thus, while researchers report that implied volatility increases sharply following large negative returns, its behaviour following positive and near-zero returns is less clear. By comparison, estimations of asymmetric EGARCH-type models predict an increase in volatility following large positive return shocks (albeit much less than following a negative return shock of the same magnitude) that contradicts the findings of many studies that implied volatility declines following a positive return shock. Ederington and Guan (2010) report that although their (1) EGARCH, (2) implied, and (3) actual volatilities rise sharply following large negative returns, the measures provide contradictory outcomes following positive and near-zero returns. Specifically, they find that while the EGARCH models predict a small increase in volatility following large positive returns, both implied and realised volatilities decline substantially with rising markets. Thus, they conclude that the behaviour of realised volatility basically corresponds to that predicted by implied volatility, rather than to that predicted by the asymmetric EGARCH models.[2] For the US, VIX, Montier (2002) reports a continuously decreasing percentage change in the implied volatility with increasing positive return in the underlying S&P 100. Thus, the prospect of downside losses appears to count for more than the equivalent upward gains. Montier observes that the observations are "just what prospect theory would forecast" (p. 26).[3]

In response, the present paper explores these issues in the context of the Australian stock exchange. Our findings are briefly as follows. To begin, we confirm that as in US markets, stock market volatility in Australian markets is higher following negative return shocks than following positive return shocks of the same magnitude. Unlike Ederington and Guan (2010), our paper makes a distinction across options as in-the-money (ITM), out-of-the-money (OTM) and at-the-money (ATM). Thus, we find that the reverse-J curve response of option implied volatility to returns as reported by Ederington and Guan (2010) for US markets, is preserved in Australian markets for ITM options, but not for OTM options, for which latter options the volatility response to returns is symmetric (positive and negative returns leading to equally high volatility). Thus, we are led to infer that OTM options create different prospects for gains and losses as compared with ITM options, and that these differences are weighted in accordance with the investor's base position as predicted by prospect theory. Furthermore, the differences provide a basis for explaining the volatility smile of increasing implied volatility with moneyness that is observed for equity options.

2. Data and methodology

Our research data for call options on the SPI 200 futures are taken from the TAQTIC database which is compiled from the Reuters and SIRCA databases. The TAQTIC data includes the time of transaction (in milliseconds), expiration date, strike price, bid and ask prices for each quote record, and trade price and size for each trade record. Implied volatilities are reported for the quarterly expiring call options

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[1] For example Schewrt (1989), French et al. (1987), Christie (1982). The same pattern has been observed for non-US markets, although the asymmetry is not always statistically significant (Ederington and Guan 2010).

[2] Papers that study the relation between predictable volatility (ARIMA, ARCH and GARCH) models and returns include French et al. (1987), Wu and Xiao (2002), Bekaert and Wu (2000) and Ederington and Guan (2010). Koulakiotis et al. (2006) link the EGARCH models introduced by Nelson (1991) to asymmetry between market risk and expected returns. Hatemi-J and Irandoust (2011) report that in the US market, volatility causes returns negatively while returns cause volatility positively. In more recent work, Aboura and Chevallier (2015) emphasise that forecasting volatility constitutes a formidable challenge as well as offering a fundamental instrument to manage risks, and find evidence that return and volatility are related across commodity and financial markets. In related work, Bagliano and Morana (2014) show that global and domestic shocks to the economy impact on financial outcomes; while Smales (2015), in the context of Australia, shows how political shocks impact on option implied volatility.

[3] A 5% monthly drop in the S&P 100 is associated with a 30% increase in implied volatility, whereas a 5% monthly rise in the S&P 100 is associated with an 8% decline in implied volatility. The slope for negative returns is therefore approximately −6% per percentage change in the S&P 100, whereas the slope for positive returns is approximately −1.6% per percentage change in the S&P 100.