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The optimal corridor for implied volatility: From periods of calm to turmoil

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ABSTRACT

Corridor implied volatility is obtained from model-free implied volatility by truncating the integration domain between two barriers. Empirical evidence on volatility forecasting in various markets points to the utility of trimming the risk-neutral distribution of the underlying stock price, in order to obtain unbiased measures of future realized volatility. The aim of this paper is to investigate the optimal corridor of strike prices for volatility forecasting in the Italian market, by analyzing numerous symmetric and asymmetric corridors in a dataset for the years 2005–2010 spanning both a relatively calm period and a period of turmoil. The results indicate that put prices, providing information on the probability of a downturn of the underlying asset, provide the best indication of future realized volatility, particularly in a period of turmoil.

1. Introduction

Volatility estimation and forecasting has attracted the attention of many authors in recent years. Volatility can be estimated and forecast by using either historical information (e.g. methods based on past standard deviation, moving averages, ARCH, GARCH models, see Poon and Granger (2003) for a literature review) or option prices. Option-based (implied) volatility is a natural forecast of subsequently realized volatility, since option prices embed the expected volatility from the present time until the expiration date of the option. Among option-based volatility forecasts we have the model-based Black–Scholes implied volatility that relies on the Black and Scholes option pricing model,

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model-free implied volatility, derived from Britten-Jones and Neuberger (2000) that does not rely on any particular option pricing model, and corridor implied volatility (CIV), proposed by Carr and Madan (1998), obtained from model-free implied volatility by truncating the integration domain between two barriers. The barriers can be set by choosing directly a given interval of strike prices or by examining a given portion of the risk-neutral distribution, which in turn determines the corresponding interval of strike prices. Corridor implied volatility can be useful in at least two cases. First it can be used to deal with the problem of estimating the tails of risk-neutral distribution, due to the lack of liquid options for very high and very low strikes (see e.g. the computation of market volatility indexes, such as the VIX index at CBOE). Second, it can be used in order to obtain a measure of volatility focusing either on a particular part of the risk-neutral distribution of the underlying asset, or on a given option class (e.g. call versus put), thus incorporating the expectations of a hypothetical investor who may be more or less bullish or bearish.

Volatility forecasting is important both for investors and policy-makers. For investors, an accurate estimate of volatility is useful for derivative pricing, risk management and portfolio allocation. Kostakis, Panigirtzoglou, and Skiadopoulos (2011) use implied volatility and higher order moments to design optimal portfolios via direct and indirect maximization of expected utility; De Miguel, Plyakha, Uppal, and Vilkov (2013) calculate mean-variance optimal portfolios by using implied volatility correlations. Moreover, volatility estimation is important for the accurate estimation of the beta coefficient: among others, Buss and Vilkov (2012) have shown how to combine historical and implied volatility in beta estimation. An accurate estimation of volatility is also essential for the assessment of Value-at-Risk (VaR). Among others, Giot (2005) uses the old VIX index (VXO) to calculate the VaR for the S&P 100 portfolio; Alentorn and Markose (2008) report that the VaR calculated by option implied volatility outperforms the VaR calculated by means of historical simulation, and the option implied VaR is able to respond quickly to market shocks, even in some cases anticipating such shocks. Volatility forecasts play a major role in portfolio strategies (see e.g. Dumas, Kurshev, & Uppal, 2009) and volatility trading strategies, as in the work of Cremers and Weinbaum (2010), who exploit deviations of implied volatility from put-call parity. Volatility is used for stock selection by Bali and Hovakimian (2009) who find that stock selection based on the magnitude of the volatility risk premium (the difference between the realized and implied volatility of a stock) generates positive portfolio returns. Moreover, volatility can be considered as an asset class in itself, and in Daigler and Rossi (2006) it is shown that the introduction of an instrument based on volatility in a portfolio substantially reduces the overall volatility of the portfolio.

For policy-makers, accurate volatility forecasting plays a key role in financial stability analysis and as an early warning signal in monetary policy interventions. In the macroeconomic literature, the real effects of volatility are gaining more and more importance (see e.g. Christiano, Motto, & Rostagno, 2014 who show that a risk shock is one of the most important variables driving the business cycle). Bekaert, Hoerova, and Lo Duca (2013) show that the VIX index (the US implied volatility index, which is considered to be an indicator of "investor fear", since it measures both uncertainty about future volatility and investor risk aversion) is strongly correlated to monetary policy measures. In particular, it is argued that a lax monetary policy decreases both risk aversion and uncertainty; conversely, high uncertainty and high risk aversion lead to laxer monetary policy in the short term. Bruno and Shin (2013) point to bank leverage as the channel for monetary policy to affect market conditions: lax monetary policy leads to a decrease in VIX and high leverage in banks, whereas increases in VIX are followed by deleveraging by banks.

Many of the above-mentioned papers are based on either Black–Scholes implied volatility or on model-free implied volatility (truncated by using only a liquid corridor of strike prices, as in the formula for the VIX index traded in the US market and used also, with some adaptation, for the volatility indexes traded in some European and Asian markets, see e.g. Muzzioli (2010) for the German market). There is limited evidence of the forecasting power of other corridors of implied volatility and the small number of papers, analyzing mainly the US market, point to the utility of trimming the risk-neutral distribution of the underlying stock price, in order to obtain an unbiased measure of future realized volatility. In the German (DAX-index options) and US market (SPX options), Barunik and Barunikova (2012), analyzing a period (July 2006–October 2010) covering the recent financial crisis, find that corridor implied volatilities that cut a portion equal to 2.5% and 5% in each tail of the