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The predictive power of implied volatility: Evidence from 35 futures markets

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Abstract

Using data from 35 futures options markets from eight separate exchanges, we test how well the implied volatilities (IVs) embedded in option prices predict subsequently realized volatility (RV) in the underlying futures. We find that for this broad array of futures options, IV performs well in a relative sense. For a large majority of the commodities studied, the implieds outperform historical volatility (HV) as a predictor of the subsequently RV in the underlying futures prices over the remaining life of the option. Indeed, in most markets examined, regardless of whether it is modeled as a simple moving average or in a GARCH framework, HV contains no economically significant predictive information beyond what is already incorporated in IV. These findings add to previous research that has focused on currency and crude oil futures by extending the analysis into a very broad array of contracts and exchanges. Our results are consistent with the hypothesis that futures options markets in general, with their minimal trading frictions, are efficient.

JEL classification: G13; G14
Keywords: Volatility forecasts; Futures options; Option market efficiency; GARCH models; Implied volatility

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1. Introduction

How well does implied volatility (IV) predict future realized volatility (RV)? Research so far has failed to provide a definitive answer as results on this empirical question have been mixed. The purpose of this study is to re-examine the predictive power of IVs, relative to historical and GARCH-based volatility estimates. We accomplish this using a battery of tests with extensive data on 35 futures options covering a wide variety of asset classes and exchanges.

Solving an option pricing model backwards using an observed option price provides an estimate of the IV of returns on the underlying asset. The expected value of future RV should be equal to IV if (1) options are priced correctly and (2) the option pricing formula is correct. We find some support for this joint-hypothesis: Implieds are biased yet better predictors of RV than alternative historical volatility (HV) estimates.

Early research on the predictive content of IV found that IV explains variation in future volatilities better than HV. Latané and Rendleman (1976), Chiras and Manaster (1978), Schmalensee and Trippi (1978), and Beckers (1981) utilized stock options and the basic Black and Scholes (1973) option pricing model without considering dividends, the possibility of early exercise, different closing times in stock and option markets, and the various options' terms to maturity, to arrive at this conclusion.

In subsequent research, Kumar and Shastri (1990), Randolph et al. (1990), Day and Lewis (1992), Lamoureux and Lastrapes (1993), and Canina and Figlewski (1993), all of which examine either options on individual stocks or options on the cash S&P 100 index, use more sophisticated methodologies with more careful treatment of the data. They generally find that IV is a poor forecast of the subsequently RV over the remaining life of the option. For example, Canina and Figlewski (1993) use a regression approach to examine the predictive content of S&P 100 index options and find virtually *no* relation between the implied and subsequently RV over the remaining life of the option, despite the fact that the HVs and future RVs are related. Some of these studies also find that IV has little power to predict short-run changes in the volatility of the underlying asset, e.g. over a one-week horizon, compared to predictions that could be derived from time-series models. Specifically, Day and Lewis (1992) and Lamoureux and Lastrapes (1993) analyze the predictive power of IV within the context of GARCH-type models. They find that IV has some predictive power, but that GARCH and/or HV improve this predictive power.

In contrast to this later stream of research, Christensen and Prabhala (1988), using a monthly sampling frequency with non-overlapping data, find that IV is a good predictor for RV. Their results also demonstrate that the predictive ability of IV improved after the structural pricing shift in the OEX market that followed the 1987 stock market crash. Given the equivocal results and conclusions in stock market options alone, it is clear that further research on the predictive power of IV is warranted.

Only two studies of which we are aware have examined the performance of IV as a predictor outside of equity markets (Day and Lewis, 1993; Jorion, 1995). Both stud-