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Market risk and the concept of fundamental volatility: Measuring volatility across asset and derivative markets and testing for the impact of derivatives markets on financial markets

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Abstract

This paper proposes an unobserved fundamental component of volatility as a measure of risk. This concept of fundamental volatility may be more meaningful than the usual measures of volatility for market regulators. Fundamental volatility can be obtained using a stochastic volatility model, which allows us to 'filter' out the signal in the volatility information. We decompose four FTSE100 stock index related volatilities into transitory noise and unobserved fundamental volatility. Our analysis is applied to the question as to whether derivative markets destabilise asset markets. We find that introducing European options reduces fundamental volatility, while transitory noise in the underlying and futures markets does not show significant changes. We conclude that, for the FTSE100 index, introducing a new options market has stabilised both the underlying market and existing derivative markets.

JEL classification: C32; G18

Keywords: Fundamental volatility; Kalman filter; Stochastic volatility model; Implied volatility

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1. Introduction

Traditionally, the efficient market hypothesis views price volatility as a result of the random arrival of new information which changes returns. However, empirical studies such as Shiller (1981), Schwert (1989), and French and Roll (1986) suggest that volatility cannot be explained only by changes in fundamentals. Significant amounts of volatility in asset prices come from 'noise trading' of irrational traders. From this point of view, volatility may be defined as the sum of transitory volatility caused by noise trading and unobserved fundamental volatility caused by stochastic information arrival. Our modelling of fundamental volatility in this paper assumes that the fundamental volatility is an unobserved random variable; it changes through time.

There are many volatilities related to only one underlying asset which are measurable at a given time point: the return volatility of the underlying asset, futures return volatility on the asset, and call and put option implied volatilities over various maturities and exercise prices, etc. However, it is natural to assume that there is only one fundamental volatility defined over the underlying asset and all its derivatives. This is because information which affects the fundamentals of the underlying asset is the same across all derivatives of the asset and, thus, results in the same fundamental volatility. Other factors will also influence this single fundamental volatility as well as information arrival: the structure of related markets, the distribution of assets held by investors, transaction costs and numerous other factors in the global economy, including all the macroeconomic information available at the time. This study does not address these other factors which may be important. Our decision to not include them was driven by unavailability of data and the difficulties of specifying a plausible model that covers all these points.

Our study proceeds by decomposing the FTSE100 stock index related volatilities into transitory noise and fundamental volatility and utilises the decomposition to investigate the effect of the introduction of derivatives on the volatility. Using the stochastic volatility model (SVM) developed by Harvey and Shephard (1993, 1996) and Harvey et al. (1994), we calculate the portion of transitory noise in the observed volatility (i.e., signal-to-noise ratio), and are able to infer the fundamental volatility process and also the relationship between transitory noises of different volatilities. Our analysis reveals the following results. Noise in the options market is not correlated with noise in the underlying and/or futures markets. However, the different noises associated with different options contracts are correlated with each other, and noise in the underlying market is correlated with that of the futures market. In addition, fundamental volatility has a high degree of persistence, a feature often observed in high frequency financial data; see Engle and Bollerslev (1986).

An interesting area of study for volatility is to investigate the effect of the introduction of derivatives on the underlying asset volatility. In a frictionless