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The economics of data: Using simple model-free volatility in a high-frequency world☆

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ABSTRACT

This paper examines the practical implications of using high-frequency data in a fast and frugal manner. It recognises the continued widespread application of model free approaches within many trading and risk management functions. Our analysis of the relative characteristics of four model-free volatility estimates is framed around their relative long memory effects as measured by the feasible exact local Whittle estimator. For a cross-section of sixteen FTSE-100 stocks, for the period 1997–2007, we show that 5-min realized volatility exhibits a higher level of volatility persistence than approaches that use data in a sparse way (close-to-close volatility, high-low volatility and Yang & Zhang volatility). This observation is a useful decision-tool for a trading and risk management decisions that are undertaken in a time-constrained task environment. It recommends that the use of sparse data (open, high, low and closing price observations) requires trader intuition and judgement to build long-memory effects into their pricing.

1. Introduction

Asset price volatility is a core input in trading and risk management activities in the financial markets. The increased capacity of exchanges to accurately record and make available high frequency trade data presents academics and practitioners with a set of choices around the use of data in volatility estimation. This increased availability of data has coincided with a period where task

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complexity in the financial services has increased and this has been associated with increasingly well educated, highly compensated employees (Philippon & Reshef, 2010). Glode, Green, and Lowery (2012) describe this radical development of financial expertise as an 'arms race' and theoretically show how it can contribute to instability to the financial system. Complexity has become particularly problematic for regulatory and 'lay' investors who require greater transparency from financial institutions in the reporting of risk positions and describing the profile of individual financial products. While informative, many arcane models that attempt to capture the historical parameters of financial asset volatility at daily and intraday frequencies have only limited applicability in financial institutions.

While the availability of high frequency data provides an opportunity to more closely approximate the true nature of asset price volatility, more sophisticated approaches that use complete or almost complete data are not necessarily optimal in a number of practical settings. This paper sets out to re-examine relatively simple model-free volatility estimates that utilise data in a sparse and transparent manner. We recognise that decision-making build on information-frugal models reduce computational effort but are still applying a relevant subset of the available information. Our commentary focuses on four estimation procedures, linking their distinct use of available price data to important volatility characteristics. In particular, we focus our attention on the relative long-memory effects or persistence reflected in each of these measures. Long-memory effects are an important component if volatility estimates are a decision input in long term forecasting, optimal consumption and savings decisions, portfolio optimisation and the pricing of derivatives.

Brownlees and Gallo (2006) observe that high frequency data require significant adjustment as they are converted into usable time series. This process requires decisions – particularly on the construction of data filters – that materially affect the resultant series and the output from analysis of these series. Furthermore, in practical applications, the choice of volatility estimator is very often dependent on its relative complexity and the extent to which it contributes to decision-making in a task environment that may be time constrained (trading) or require clear communication (risk reporting). These practical applications very often require a relatively simple measure of price volatility that sets aside elements of market microstructure that affect prices over short periods. The important research into the influence of microstructure effects include, tick size, discrete observation and bid-ask spread contribute significantly to our knowledge and have important implications for the field of finance (Lee & Mykland, 2012).

The development of the ARCH model by Engle (1982) marked the emergence of a sizeable literature that developed and refined groups of parametric ARCH and stochastic volatility models.[1] Ongoing refinements to the family of ARCH/GARCH models are generally directed towards capturing heavy-tailed distributions as well as long-memory effects in volatility. This is exampled by Engle and Patton's (2001) recommendation of the inclusion of volatility characteristics such as mean-reversion, asymmetric effects and persistence if a volatility forecast is to be used effectively in portfolio and risk management applications. Attempts to capture long-memory effects are evident in fractionally integrated variants of the autoregressive integrated moving average (ARIMA) (Granger, 1981; Granger & Joyeux, 1980) and GARCH class of models (Baillie, 1996). These models allow the persistence parameter, d to assume values between 0 and 1, thus producing forecasts that allow the effect of shocks to dissipate hyperbolically over time. However, the existence of competing model variants suggests that a neat, parameterised model cannot consistently capture the behaviour of a complex real-world phenomenon such as financial returns in an efficient market. Furthermore, while marginal gains in predictive accuracy may be achieved by sophisticated statistical approaches over short horizons, equivalent or superior predictive information is often available from model free approaches estimated using conventional techniques (Garvey & Gallagher, 2012).

Within the class of model free volatility estimates there are a range of estimation procedures that can be distinguished by their utilisation of intra-day price observations. With the potential availability of all trade information, the estimation choices range from the application of virtually all price observations (Zhang, 2006; Zhang, Mykland, & Aït-Sahalia, 2005), to sparse approaches such as realised

[1] See Andersen, Bollerslev, Diebold, and Ebens (2001) for a list of studies.