Essays on Regime-Switching Volatility Models, Duration Models and Value-at-Risk

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My thesis aims to model and forecast volatility in both regularly spaced intervals and irregularly spaced intervals.

Essay 1: Regime-switching GARCH-Jump Models with Autoregressive Jump Intensity (Job Market Paper)

I present two types of regime-switching GARCH-jump models with autoregressive jump intensity to model the non-linearity in return series. Chan and Maheu (2002) present an autoregressive jump intensity model to explain the jump clustering phenomenon. However, the forecasts are inaccurate when the out-of-sample period differs from the in-sample period in the frequency of jumps. To solve this problem, I incorporate regime shifts in both the smooth changing GARCH term and infrequent jump term. The first model is a Markov regime-switching model which generalizes the GARCH model by distinguishing two regimes with different GARCH volatility and jump intensity levels. As the regimes are unknown to the econometrician in Markov regime-switching models, which leads to difficulty in forecasting, I also build a threshold GARCH-jump model with an exogenous threshold variable. The stationary conditions and moments of returns are derived for the threshold GARCH-jump model. Using Japanese YEN-US Dollar exchange rates, I show that both types of regime-switching models work much better than the traditional GARCH model for the in-sample period. Constructing realized volatility from 5-minute intraday data for evaluation, the threshold GARCH-jump model makes better forecasts than both the single regime autoregressive jump intensity model and the threshold GARCH (1,1) model.

Essay 2: Autoregressive Conditional Duration Models with Structural Changes

The rapid development in computer technology has led to the availability of ultra high frequency data, which arrive in irregular time intervals, making traditional econometric techniques inapplicable. Engle and Russell (1998) build a linear autoregressive conditional duration model to account for stochastic clustering of durations between two adjacent trades. In this essay, I find that the high persistence of trade durations noted in the literature, i.e., the sum of estimated autoregressive coefficients on lagged durations and conditional expected durations are close to one, may come from structural shifts in the data generating process. Monte Carlo experiments are conducted to show that even a temporary parameter change for a short time can lead to a big bias in the estimates of the autoregressive parameters, which converge to one quickly as sample size increases. Building on this fact, I use a threshold ACD model to account for parameter changes and find that multiple structural breaks are recognized in the transaction duration data of IBM.

Essay 3: Value-at-risk Estimation via Higher Moments Built on High Frequency Data

Many value-at-risk (VaR) models rely on the assumption of independence and/or normality of returns which leads to inaccurate VaR measurement in practice since returns are skewed and leptokurtic. In this essay, I incorporate higher moments to estimate VaR without any parametric specification of returns. Realized volatility, skewness and kurtosis constructed from high-frequency data are used in the Cornish-Fisher expansion (CFE) when the true distribution is unknown. In an empirical study, I compare the CFE approach to other models of time-varying higher moments which require a known distribution of returns.