Financial Volatility Model Analysis
(MM2-12)

Costa, Miguel
Wang, Qingpeng
Mckay, Matthew
Batten, Jonathan A

Introduction

The project was, from the onset, a unique undertaking. The Final Year Projects of students in the ECE department tend to be centered on direct implementations of electronic and computer systems or application development. Such projects often rely on strong quantitative backgrounds and modeling techniques that are all used in similar applications. However, the language of mathematics is universal. A model employed in or intended for one field can just as easily see direct application in another.

Objectives

The objectives of the research were twofold: First, we aimed to significantly increase the scope and depth of our own financial knowledge, supplementing our core academic disciplines.

Second, we hoped to make the often daunting or elusive topics of financial modeling and portfolio analysis more interesting and accessible to technically and/or quantitatively skilled individuals without a background in finance.

Aim

We aimed to deliver meaningful insight into the real-world applications of the GARCH model, one of the most widely used financial volatility models. This was accomplished by using the model to perform rolling-window volatility forecasting on real-world historical bond data taken from the Australian bond market during the 1997 Asian Financial Crisis, then analyzing the results.

GARCH

We focused on the GARCH model for the final implementation of this project due to its widespread application and high industry use. After extensive study of the model, we employed the general form of the GARCH model, GARCH($p,q$):

$$\sigma_t^2 = \omega + \sum_{i=1}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2$$

where $\omega > 0, \alpha_i > 0, \beta_j > 0$, $\sum_{i=1}^{p} \alpha_i + \sum_{j=1}^{q} \beta_j < 1$

System Block Diagram

Implementation

To produce a rolling-window volatility forecast using the GARCH Model, we wrote a highly extensible EViews script to iteratively carry out GARCH estimation and store the retrieved parameters in individual series that together would constitute the coefficient matrix. This extended the limited out-of-the-box functionality of the toolkit by automating what would have otherwise been an extremely time-consuming process. We also made use of the toolkit’s statistical testing functions to ensure the validity of our results.

Results

After determining optimal window lengths and step sizes to obtain the most meaningful GARCH parameter series, we analyzed the behavior of bonds in an abnormal scenario by extracting and visualizing their regression coefficients under the GARCH (1,1) model. Statistical analysis was also performed on each series.

Key takeaways from our analysis of the results include compelling skewness of their residuals.

Government Bond Residuals

The objectives of the research were twofold: First, we aimed to allowed us a captivating glimpse into the world of financial modeling.

It served to both supplement our limited backgrounds and allowed us to make the often daunting or elusive topics of financial modeling and portfolio analysis more interesting and accessible to technically and/or quantitatively skilled individuals without a background in finance.

We aimed to deliver meaningful insight into the real-world applications of the GARCH model, one of the most widely used financial volatility models. This was accomplished by using the model to perform rolling-window volatility forecasting on real-world historical bond data taken from the Australian bond market during the 1997 Asian Financial Crisis, then analyzing the results.