

Chapter 10

Market Volatility and Models for Forecasting Volatility

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ABSTRACT

This chapter delves into market volatility and its forecasting models in the dynamic financial landscape. It examines factors driving volatility, quantification approaches, and diverse models. From traditional to advanced models and deep learning techniques like RNNs, LSTMs, BiLSTMs, and GRUs, it enriches our understanding of market dynamics. These models are vital for risk management, strategic investment, and informed decisions, offering insights into volatile asset price fluctuations. By embracing data-driven solutions and predictive analytics, the authors navigate market unpredictability, led by models serving as custodians of comprehension and stability, guiding towards enlightened, strategic, and prosperous financial decisions.

INTRODUCTION

Innovative economic, political, social, and technological factors affect financial markets. These factors affect financial asset prices and returns over time. Investors, portfolio managers, and policymakers face significant risk from these fluctuations. Financial markets use volatility to measure, control, and reduce risk. Volatility measures the price or return fluctuation of a financial asset over time. Investor expectations and market sentiment affect financial market volatility. Volatility affects financial asset returns, pricing models, and derivatives. Thus, financial market analysis and prediction require volatility.

The various methods and models used to quantify and predict financial time series volatility are examined in this paper. Decision-making and financial market dynamics depend on volatility. This paper defines volatility, its causes, characteristics, and effects. Historical, conditional, stochastic, and implied volatility models are also evaluated. This study examines volatility analysis's pros and cons, uses, and limitations.

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1. THE CONCEPT OF VOLATILITY

Some academic studies use “volatility” precisely, others “fluctuation.” Financial instrument volatility is price or valuation changes. Ladokhin defined volatility in 2009 as the uncertainty surrounding high-risk asset returns over a predetermined time interval.

Volatility predicts financial asset valuation changes. Sevil (2001) defines asset value standard deviation. Financial asset volatility and stock return are measured by standard deviation. Hatipoğlu (2015) suggests that a wider standard deviation range indicates greater asset returns gains or losses.

Financial markets use “volatility” to describe financial instrument price fluctuations or uncertainty. Calculating asset value changes requires it. Typical volatility indicator is standard deviation. High standard deviations indicate volatile returns. Analyze financial market volatility methods.

Equation 1 calculates the standard deviation to determine asset return volatility in financial literature:

$$\text{Standard deviation: } \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n - 1}} \quad (1)$$

\bar{x} in the formula is the arithmetic mean; n is the number of elements.

The standard deviation formula can also be written as shown in Equation 2:

$$\sigma = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (x_i - \bar{x})^2} \quad (2)$$

σ in equation 2 is the standard deviation; N is the number of elements of the array; x_i is the x^{th} of the array. element; \bar{x} is the arithmetic mean of the numbers in the array.

More a financial instrument’s maximum and minimum values deviate from its mean, the higher its future returns and losses (Klenke, 2014).

Treasury bond and stock prices fluctuate. Financial assets with fluctuating prices or returns are riskier. Financial asset volatility includes price swings, so investments can profit or lose.

Although volatility is often used to measure risk, it does not necessarily indicate risk. Poon and Granger (2003) say data distribution around the mean is not always negative. Distributions can be positive or negative. While risk is usually negative, volatility includes both positive and negative asset extremes.

Not all financial asset volatility is bad. Financial asset volatility is key to price prediction. Knowing a financial asset’s extreme values helps investors predict price movements and maximize returns or minimize losses, say Kalotychou and Staikouras (2009). Investors seeking maximum returns or minimum losses must measure volatility. Investment risk is reduced by forecasting price and return deviations and developing alternative strategies. Financial market failures result from investors’ inability to assess risk and make critical decisions. Measured volatility matters. Observability is key for measurable variables. One cannot directly observe volatility. Figure 1. shows several empirical volatility measurement methods.

To accurately compute volatility, the best method must take into account variables like the data’s attributes, the analysis’s purpose, and whether the data is continuous or discrete. As shown in Figure 2., Huang (2011) suggests modeling volatility using historical volatility, Monte Carlo simulation, ARCH and GARCH models, quantile regression, and stochastic volatility.

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