Structural Analysis of Inter-Stock Dynamics in the Indian IT Sector

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INTRODUCTION

Financial markets are increasingly characterized by complexity, volatility, and interdependence among assets. In such an environment, understanding how stocks behave individually and in relation to one another is critical for investors, analysts, and risk managers. Particularly in emerging economies like India, the rapid growth of sectors such as information technology (IT) has created both opportunities and challenges in stock market analysis. The Indian IT sector has become a cornerstone of the country's economic growth and global competitiveness. Among the leading firms in this space, Infosys and Tata Consultancy Services (TCS) stand out as dominant players with significant market capitalization, global client bases, and investor interest. Their stocks are frequently perceived to move in parallel due to similar business models, industry influences, and macroeconomic exposure. However, this apparent similarity may obscure meaningful differences in their long-term relationship and market risk behavior, which are critical factors for informed financial decision-making. This study addresses the problem of relying on surface-level correlations without thoroughly analyzing the deeper financial interactions between Infosys and TCS. The core focus is to assess whether these companies truly share a long-term relationship and how their volatility dynamics compare over time. The document proceeds to explore this problem using a structured approach: it begins with data exploration, followed by an investigation of long-run relationships, and concludes with a comparative analysis of their volatility behavior. The aim is to deliver actionable insights into their co-movement and risk characteristics, supporting better trading and investment decisions.

PROBLEM STATEMENT

In financial markets, especially within sectorally aligned companies, apparent similarities in stock movements can obscure critical differences in underlying behavior. This is particularly true for Infosys and TCS, two of India's leading IT firms, whose stock prices often appear to move in tandem. However, such surface-level co-movement can be misleading. Without a deeper understanding of their actual long-term relationship and how each stock uniquely responds to market fluctuations, investors risk basing strategies on assumptions rather than evidence. The central problem lies in the uncertainty over whether these two stocks are truly bound by a consistent, long-term equilibrium or whether their apparent synchronicity is coincidental or short-lived. Furthermore, there is a lack of clarity on how their individual risk profiles evolve, particularly in response to market shocks and volatility. This ambiguity complicates the development of robust strategies for trading, which rely on a stable relationship between assets. Without granular insight into both their connectedness and volatility behavior, efforts to manage portfolio risk or exploit inter-stock dynamics may fall short of their potential.

OBJECTIVE OF THE STUDY

The primary objective of this study is to gain a deeper understanding of the financial relationship and risk behavior between Infosys and Tata Consultancy Services (TCS)—two major players in the Indian IT sector. While these companies are often perceived to move similarly in the market, this study aims to explore whether such assumptions hold under detailed statistical and volatility-based scrutiny.

Specific objectives:

- To investigate the presence of a long-term equilibrium relationship between the stock prices of Infosys and TCS using appropriate time series techniques.
- To analyze and compare the volatility dynamics of Infosys and TCS, identifying differences in how each stock responds to market fluctuations.
- To assess the implications of co-movement and volatility behavior for investment strategies, portfolio diversification, and market risk forecasting.
- To challenge the assumption of stock similarity within sectorally aligned firms by revealing deeper insights into their distinct financial characteristics.

DATA DESCRIPTION

The study utilizes daily closing prices of two major Indian IT companies, Infosys (INFY.NS) and Tata Consultancy Services (TCS.NS), sourced from Yahoo Finance. Covering the period from January 2020 to early 2025—a span marked by significant market events including the global pandemic—this dataset provides a relevant window to examine inter-stock dynamics in the Indian IT sector. To ensure consistency and comparability, only daily closing prices were used, which were then converted into daily returns for statistical analysis and volatility modeling.

METHODOLOGY

Volatility Modeling using ARCH and GARCH

To capture the time-varying volatility of stock returns, ARCH and GARCH models were applied. The steps included:

- **Data Preprocessing**: Returns were calculated using logarithmic differences of closing prices.
- **Model Estimation**: Multiple models were tested including ARCH(1), GARCH(1,1), and GARCH(2,2).
- **Model Evaluation**: Models were evaluated based on Log-Likelihood, AIC, BIC, and parameter significance.

Key Findings:

- **Infosys**: Best modeled by GARCH(1,1). It exhibited strong volatility persistence (alpha + beta ≈ 0.9), indicating that shocks to volatility have long-lasting effects.
- **TCS**: Best modeled by GARCH(2,2), showing moderate persistence (alpha + beta ≈ 0.45). This implies quicker mean reversion and relative stability.
- **Unconditional Variance**: Infosys had a higher long-run variance, identifying it as the more volatile stock.

Implications:

- Infosys is more suited for short-term strategies due to its higher and more persistent volatility.
- TCS may be preferred for long-term, risk-averse portfolios.

Cointegration and Error Correction Modeling

A detailed Engle-Granger Two-Step Test was conducted to examine the long-term relationship between Infosys and TCS.

- **Static Engle-Granger Test**: Initial regression revealed non-stationary residuals, suggesting no cointegration.
- **Dynamic Lagged Regression**: Inclusion of lagged terms rendered residuals stationary, confirming cointegration.
- **ECM Construction**:

  $$\Delta INFY_t = \beta_0 + \gamma\, \Delta TCS_t + \alpha\, ECT_{t-1} + \eta_t$$

  - α (error correction coefficient) ≈ -0.0109: Indicates that about 1.09% of deviation from equilibrium is corrected each period.
  - $\gamma \approx 0.393$: Shows a significant short-run relationship where changes in TCS influence INFY.
  - $R^2 \approx 0.40$: 40% of variation in ΔINFY is explained.

Implications:

- TCS and Infosys maintain a long-term equilibrium, despite short-run fluctuations.
- The ECM provides a robust framework for pairs trading and forecasting.
- Market mispricings are temporary and self-correcting.

CONCLUSION

The findings of this project offer valuable real-world applications for traders, investors, and portfolio managers. The GARCH analysis revealed that Infosys is significantly more volatile and exhibits high volatility persistence. This characteristic suggests that Infosys may be more suitable for short-term trading strategies where traders can capitalize on frequent price swings. However, this also means higher risk, making it less ideal for long-term investors with lower risk tolerance.

In contrast, TCS showed moderate and less persistent volatility, making it more stable over time. Such behavior is favorable for long-term holding and suits risk-averse investors looking for consistent growth with lower exposure to market shocks. A prudent investment strategy would be to balance the two stocks in a portfolio, using TCS for stability and Infosys for growth-oriented, tactical allocations.

Cointegration analysis further uncovered a statistically significant long-run equilibrium relationship between the two stocks. This means that despite short-term divergence, the prices of Infosys and TCS tend to move together over time due to shared economic and sectoral factors. The Error Correction Model (ECM) quantified this relationship, showing that INFY adjusts around 1.09% of any disequilibrium per period. This presents a clear opportunity for **pairs trading strategies**, where traders can monitor deviations from the long-run equilibrium to enter long/short positions accordingly. For instance, if INFY deviates significantly above the expected level based on TCS, it may be a signal to short INFY and go long on TCS.

In practical terms, the study equips market participants with:

- A basis to **design pairs trading strategies** exploiting temporary mispricings.
- A data-driven framework to **optimize portfolio diversification** using distinct volatility behavior.
- Forecasting tools using ECM for **anticipating price corrections and managing risk exposure**.

Ultimately, understanding the structural dynamics and volatility patterns of sector-aligned stocks like Infosys and TCS can empower better decision-making, enhancing both risk-adjusted returns and strategy robustness in India's evolving financial markets.