

VOLATILITY CLUSTERING IN FINANCIAL MARKETS: EVIDENCE FROM GARCH MODELS

MODELING TIME-VARYING VOLATILITY IN S&P 500 RETURNS

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1. RESEARCH QUESTION



Do financial returns exhibit volatility clustering, and can GARCH models capture the time-varying nature of market volatility?



2. OBJECTIVES

- ✓ Examine autocorrelation in returns and squared returns
- ✓ Test for ARCH effects and volatility clustering
- ✓ Estimate and interpret GARCH(1,1) model
- ✓ Analyze volatility persistence
- ✓ Compare actual vs forecast volatility
- ✓ Discuss implications for risk management



3. DATA & METHODOLOGY

Data: Daily S&P 500 Index (2010 – 2026)
Source: Yahoo Finance

Return Calculation (Log Returns)

$$r_t = 100 \times \ln\left(\frac{P_t}{P_{t-1}}\right)$$

Where P_t = closing price at time t

Methodology Flow

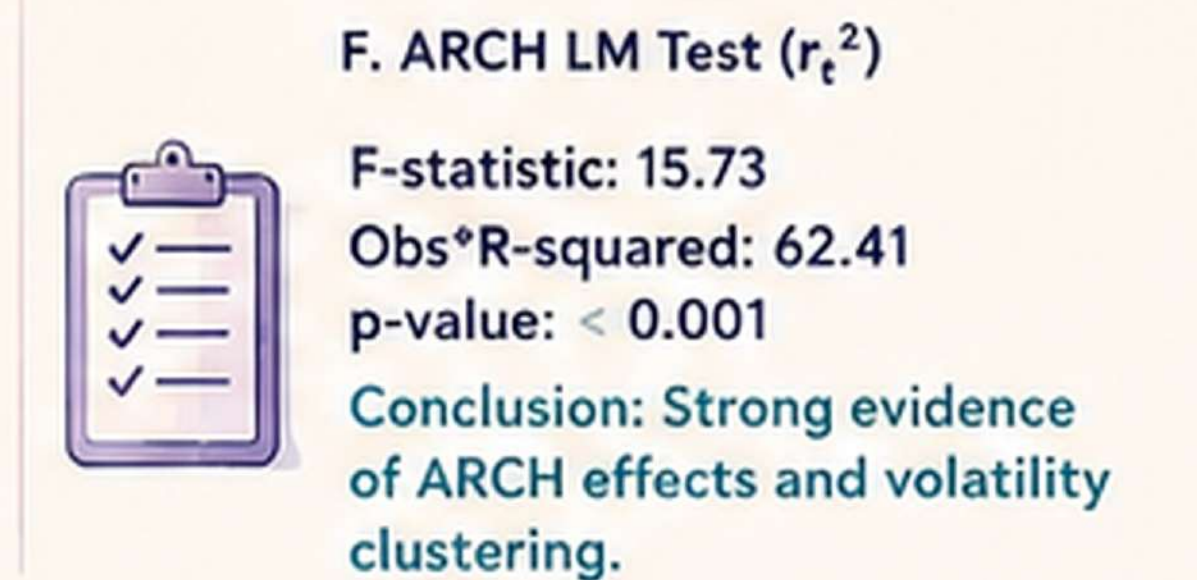
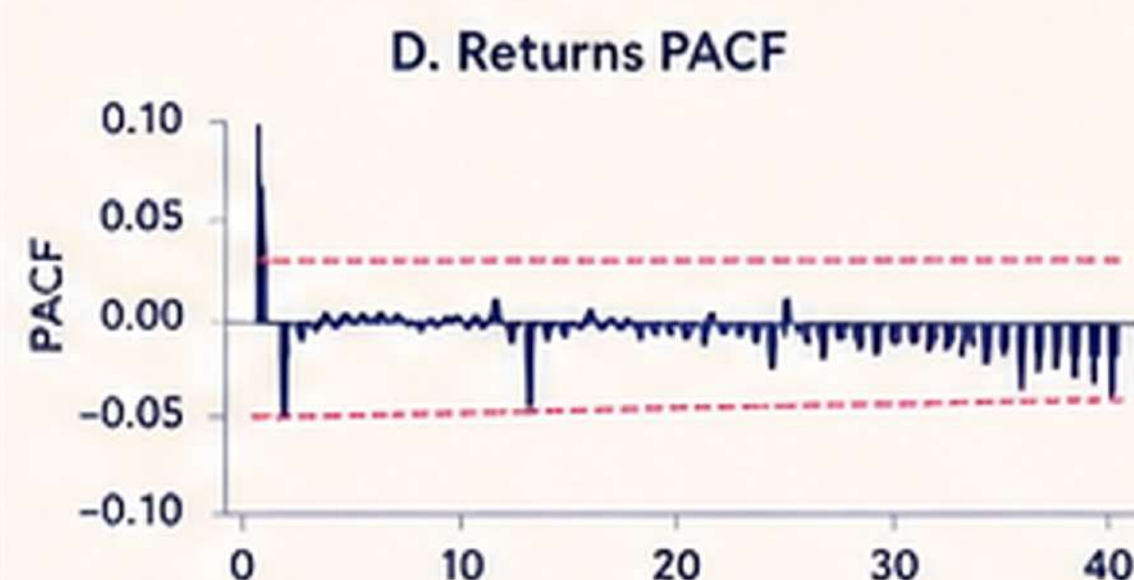
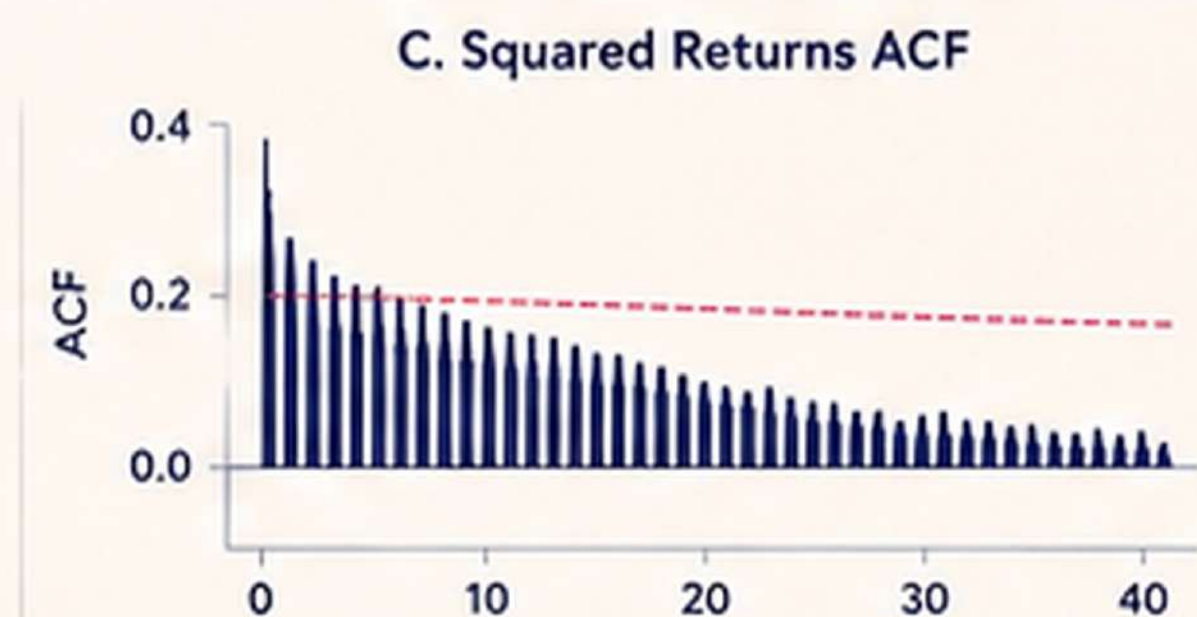
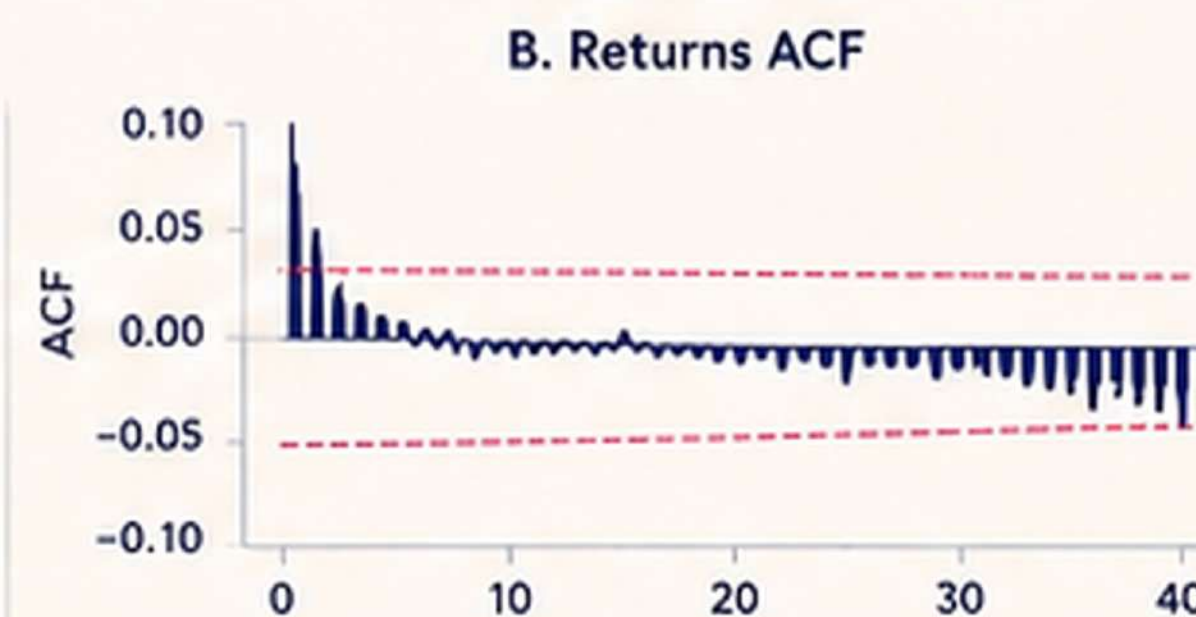


Why It Matters

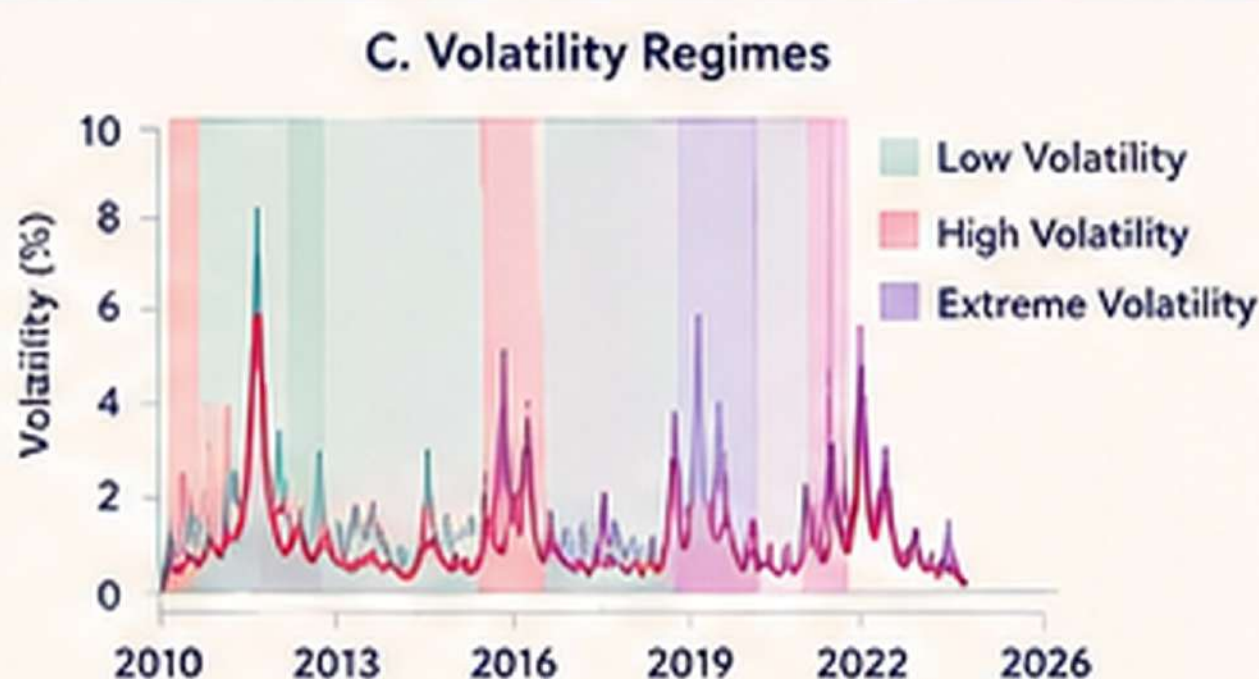
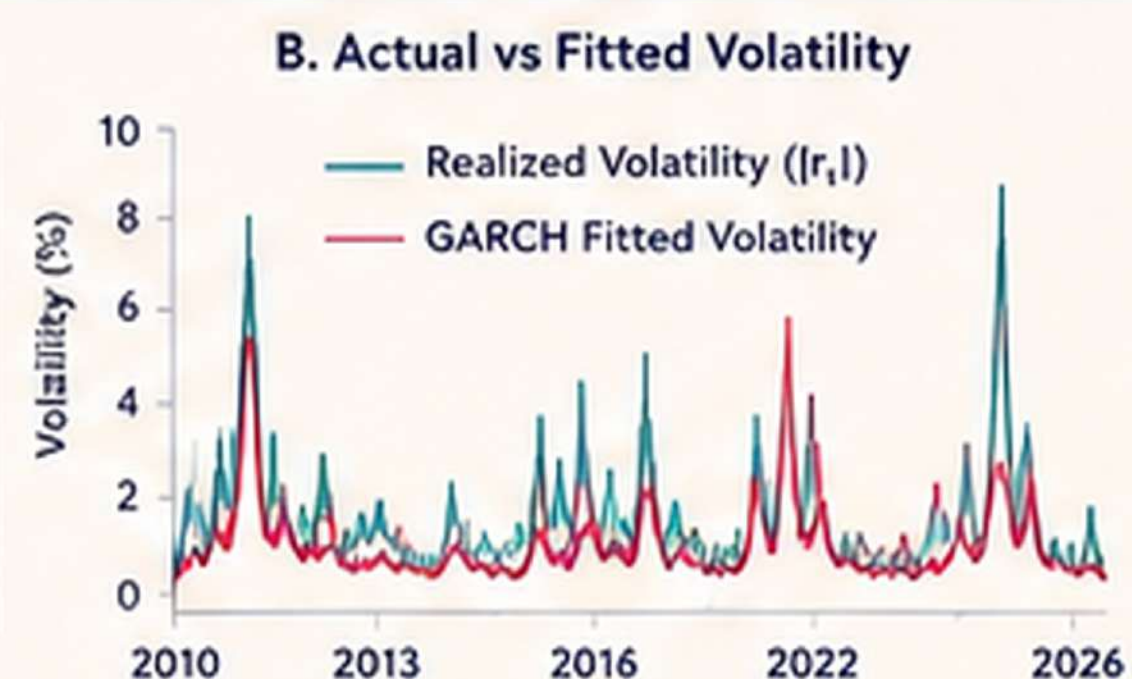
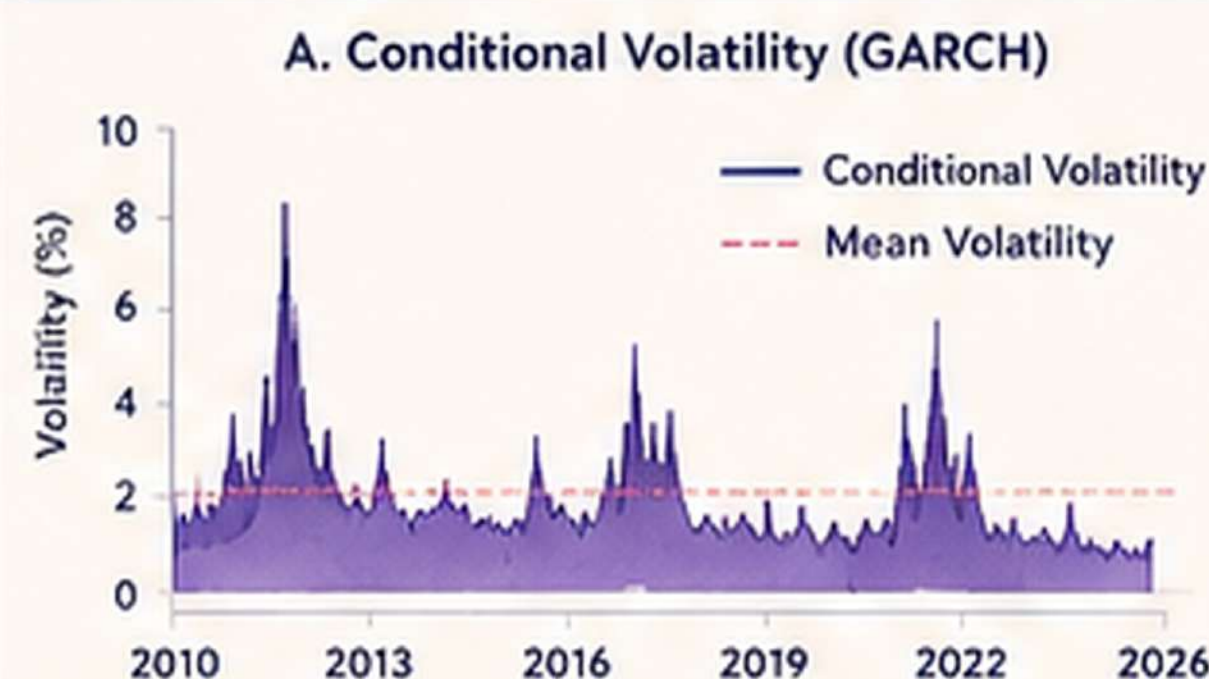
Accurate volatility modeling is crucial for Value-at-Risk, portfolio management, option pricing, and understanding market risk dynamics.



4. VOLATILITY CLUSTERING EVIDENCE



6. CONDITIONAL VOLATILITY ANALYSIS



5. GARCH(1,1) MODEL

Model Specification

$$r_t = \mu + \varepsilon_t, \quad \varepsilon_t | \mathcal{F}_{t-1} \sim N(0, \sigma_t^2)$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$$

Parameter Estimates

Parameter	Estimate	Std. Error	p-value
μ	0.046%	0.013%	0.001
ω	0.0000010	0.0000003	0.003
α (ARCH)	0.089	0.015	< 0.001
β (GARCH)	0.888	0.018	< 0.001

Volatility Persistence

$$\alpha + \beta = 0.977$$

High persistence – shocks to volatility take a long time to fade away.



7. KEY IMPLICATIONS

- Financial returns exhibit volatility clustering.
- GARCH(1,1) captures time-varying volatility effectively.
- Volatility persistence is very high ($\alpha + \beta \approx 1$).
- Shocks to volatility have long-lasting effects.
- Accurate volatility models improve risk measurement (VaR, ES) and derivative pricing.
- Understanding volatility dynamics supports better investment and risk management decisions.

9. THE BIG TAKEAWAY

“Markets are calm, then stormy, then calm again.
Volatility comes in clusters –
and GARCH helps us capture the storm.”
Measure it well. Model it right. Manage risk better.



10. REFERENCES

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