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Modelling the Dynamics and Forecasting of Arable Food Prices in Nigeria: A Comparative ARIMA-GARCH Family Approach

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Arable food price volatility poses significant challenges to food security, inflation management, and economic stability in Nigeria, demanding robust quantitative forecasting of both price levels and inherent uncertainty. This study employs an econometric framework to model and forecast time-varying volatility in spot prices for two crucial Nigerian arable food commodities: Maize (White) and Rice. Initial analysis revealed strong trends and non-constant variance, leading to natural logarithmic transformation and first-order differencing $(d = 1)$ to achieve stationarity, confirmed by Augmented Dickey-Fuller (ADF) tests. An ARIMA(0,1,0) model, representing a Geometric Random Walk, captured mean dynamics, with residuals serving as market innovations. These residuals then underwent comparative volatility analysis using Symmetric GARCH(1,1), Asymmetric Exponential GARCH (EGARCH(1,1)), and Threshold GARCH (TGARCH(1,1)) models. Model selection leveraged Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), alongside parameter significance. For Maize (White), Symmetric GARCH(1,1) best fit, exhibiting significant ARCH(1) effects $(\alpha[1] p-value < 0.01)$, and implying volatility reacts to recent shocks, quickly reverting to a consistent level without asymmetric effects. For Rice, Symmetric GARCH(1,1) also provided the optimal fit, showing strong IGARCH(1,1) characteristics $(\alpha[1] + \beta[1] \approx 1.0)$ which denote highly persistent volatility shocks that do not decay, also without asymmetric effects. This research uniquely contributes by systematically modelling and forecasting these commodities'time-varying volatility, identifying distinct stochastic dynamics crucial for targeted interventions. It robustly demonstrates that symmetric GARCH models are appropriate, driven primarily by shock magnitude, revealing distinct volatility persistence profiles (ARCH for Maize, IGARCH for Rice). Understanding these precise dynamics empowers stakeholders to quantify future price uncertainty, informing effective stabilization mechanisms, risk mitigation, and agricultural investment for enhanced food security in Nigeria.

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