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FULL LENGTH ARTICLE

Predictability of Stock Price Fluctuations with an Application of Agricultural Companies Data

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ABSTRACT

The research aimed to predict the fluctuations in closing Stock Price of four agricultural companies listed on the Iraq Stock Exchange using daily closing Stock Price data from 11/3/2015 to 15/3/2025. The symmetric and asymmetric ARCH model was applied to the research data. The results of the GARCH models showed that the closing price behavior of the companies (Al-Ahliyah for Agricultural Production, Middle East for Fish, Iraqi for Meat Production and Marketing) achieved a GARCH (1,1) rank, indicating that the effect of past error variance (ARCH) was of rank 1, in addition to the conditional variance element GARCH also being of rank 1. Meanwhile, the results showed that the closing prices for the Iraqi Seed Production Company were of rank GARCH (1,2). The results indicated that the first-order variance parameter was greater than one for all agricultural companies, suggesting that the fluctuations in stock closing prices exhibit a slight upward trend, which aligns with the logic of financial behavior in financial markets.

Keywords: Forecasting ▪ Agricultural companies ▪ ARCH model ▪ GARCH model ▪ Stock Price fluctuations

1. INTRODUCTION

Agricultural companies play a pivotal role in achieving food security and enhancing the national economy, especially amid global economic fluctuations. The closing stock prices of these companies in financial markets are an important indicator reflecting their performance and financial stability [1]. Therefore, measuring the volatility of closing prices is crucial for understanding market dynamics and assessing the risks associated with financial investment in this sector [2].

The changes in the closing prices of agricultural companies listed on the Iraq Stock Exchange are a source of concern for investors, leading them to hesitate in deploying their investments in these companies, which in turn affects the necessary financing for those projects [3]. Thus, it is essential to seek an appropriate method for measuring volatility in financial indicators to hedge against the financial risks that these companies may face [4]. Since the changes occurring in the indicators of companies listed on the stock exchange are daily changes, their impacts on traded companies appear to be immediate, prompting us to use a standard model that simulates the instantaneous changes in financial indicators, enabling investors to make decisions closer to reality [5].

The importance of this topic lies in its assistance to investors and decision-makers in the investment process when making appropriate financial decisions by referring to the results of the model used, which contributes to increasing profitability and reducing financial losses. Therefore, the research aims to measure the volatility occurring in the closing prices of agricultural companies listed on the Iraq Stock Exchange by using Generalized Autoregressive Conditional Heteroskedasticity models.

2. PREVIOUS LITERATURE

A study by Dum et al. [6] found that asymmetric GARCH models provided more accurate and suitable results than symmetric GARCH models in constructing an appropriate model for the fluctuations in Nigerian crude oil prices. This result aligns with the findings of Naik and Reddy, which indicated that GARCH models yield more accurate results in measuring the fluctuations in the Indian stock market index (VIX) compared to other standard models such as TGARCH and EGARCH for volatility [7]. Zakoian modified the classic ARCH model and developed it to be more effective and suitable for measuring the fluctuations in the French stock market index (CAC) [8]. Singh and Tripathi found that GARCH and PGARCH models proved effective in predicting future fluctuations in the Indian stock market index (S&P CNX Nifty) and that the response to shocks in volatility from good news was more pronounced than from bad news [9]. Samineni et al. found that bad news had a direct negative impact on the Nifty Bank index through the application of the EGARCH(1,1) model [10]. Amudha and Muthukamu concluded that asymmetric volatility models, namely EGARCH and TGARCH, are capable of measuring the fluctuations in stock prices, which showed that these prices react asymmetrically to good and bad news [11]. Kotishwar found that volatility had a significant effect on the Nifty index. The results of the ordinary least squares method indicated that one minute of high-frequency trading had a greater impact than other time intervals on the Bank Nifty index [12].

However, Battal and Hamad concluded that the best model for predicting closing price volatility in the Iraq Stock Exchange is the (3,1) EGARCH model, based on the statistical criteria used for model selection (Akaike Information Criterion and Schwarz Criterion), and that these models can provide information to investors to reduce the risks resulting from fluctuations in stock prices in the Iraqi financial market [13]. Xu et al. aimed to predict the closing prices of airline stocks to assist investors in making better financial decisions, using the LASSO (Least Absolute Shrinkage and Selection Operator) model. The results showed that the closing price of an airline's stock is influenced by its closing price on previous days and the closing prices of other types of airlines, and it is closely related to the Shanghai Composite Index from the previous day and the three days prior [14]. Sakamoto and Sengoku compared the effectiveness of predicting stock prices during normal periods versus the COVID-19 pandemic period and analyzed the extent to which business relationships between companies affect stock price volatility. Their results indicated that business relationships between companies are an effective indicator for predicting stock price volatility, especially during crises such as the COVID-19 pandemic [15]. Elshamy et al. addressed the challenge of accurately predicting stock prices by using an ensemble regression approach that combines multiple data sources. The approach proved effective in predicting Tesla's stock closing prices under various scenarios, handling volatility, anticipating sudden changes, and predicting both minor and radical changes [16].

3. METHODOLOGY AND WORKING METHODS

A group from the ARCH family has been employed as follows.

3.1 ARCH Model

It is one of the most important ARCH models and is called autoregressive conditional heteroskedasticity. Engle proposed this model in 1982 as follows [17]:

$$y_t = \phi + e_t, \tag{1}$$

$$e_t \mid I_{t-1} \sim N(0, h_t), \tag{2}$$

$$h_t = \alpha_0 + \alpha_1 e_{t-1}^2, \qquad \alpha_0 > 0, \quad 0 \le \alpha_1 < 1. \tag{3}$$

Here, ϕ represents the average closing price, while α_0 and α_1 represent the parameters of the variance equation of the closing-price fluctuations.

3.2 The General GARCH Model

It is one of the families of the ARCH model and is called the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model, referred to as conditional regression with non-constant general variance homogeneity [18], and is expressed in the following form [19]:

$$h_t = \delta + \alpha_1 e_{t-1}^2 + \beta_1 h_{t-1}. \tag{4}$$

The parameters $\alpha_1 + \beta_1$ are variance-fluctuation parameters. If their sum is less than one, it indicates stability in the fluctuations of closing prices. However, if the sum is greater than or equal to one, it is called the integrated GARCH process.

3.3 The Threshold ARCH Model

This is one of the ARCH family models and considers the effects of positive and negative news shocks, which may have asymmetric effects on stock-price volatility. The formula for this model is as follows [20]:

$$h_t = \delta + \alpha_1 e_{t-1}^2 + \gamma d_{t-1} e_{t-1}^2 + \beta_1 h_{t-1}, \tag{5}$$

where

$$d_t = \begin{cases} 1, & e_t < 0 \quad \text{(bad news)}, \\ 0, & e_t \ge 0 \quad \text{(good news)}. \end{cases} \tag{6}$$

The parameter γ represents the asymmetry or leverage parameter. If it equals zero, the model does not include asymmetry and approaches the general GARCH model [21]. If it is positive, it represents a positive shock (good news), and the effect on stock-price volatility is through the parameter α_1. If it is a negative shock (bad news), the effect on stock-price volatility is through $(\alpha_1 + \gamma)$. If the leverage parameter γ is positive, large, and significant, the negative-news shock is greater than the positive-news shock [21].

3.4 GARCH-in-Mean Model

This is one of the ARCH family models; however, it takes into account the risk premium for stock-price volatility and takes the following form [22]:

$$y_t = \beta_0 + \theta h_t + e_t, \tag{7}$$
$$e_t \mid I_{t-1} \sim N(0, h_t), \tag{8}$$
$$h_t = \delta + \alpha_1 e_{t-1}^2 + \beta_1 h_{t-1}, \tag{9}$$
$$\delta > 0, \qquad 0 \leq \alpha_1 < 1, \qquad 0 \leq \beta_1 < 1. \tag{10}$$

The parameter θ represents the risk premium in the estimated model and should be greater than zero, while the values of $\alpha_1 + \beta_1$ should range between zero and one [19].

4. RESULTS AND DISCUSSION

The agricultural sector accounts for 7.8% of the total number of companies listed on the Iraq Stock Exchange, which has a total of 135 companies as of 2024. The number of agricultural companies listed in the market is 8, with the number of shares traded in 2023 reaching approximately 43,590,657 shares and a trading value of 463,665,817 dinars. Investing in this sector is considered a successful investment, as it provides a fertile environment for the growth of agricultural investment due to its investment components that contribute to achieving long-term economic development [23].

Figure 1 represents the time-series data of daily closing prices for a group of agricultural companies listed on the Iraq Stock Exchange for the period 2015–2024. There were 346 observations for Al-Ahliyah Agricultural Production Company, 1,464 observations for the Iraqi Company for Meat Production and Marketing, 1,133 observations for the Iraqi Seed Production Company, and 439 observations for the Middle East Fish Company. The closing prices of the agricultural companies listed on the Iraq Stock Exchange do not follow a normal distribution (they are asymmetrical), a characteristic that most financial indicators of financial markets exhibit.

4.1 Descriptive Statistics Indicators

The results of the descriptive statistics in Table 1 for the agricultural companies in the sample study show that the number of observations varies from one company to another based on the available official data issued by the official website of the Securities Commission in Iraq. The highest mean closing price was for the Middle East Fish Company (AMEF), with a mean of 8.472 dinars, while the lowest mean closing price was for the Al-Ahliyah Agricultural Production Company (AAHP), at 1.11 dinars. At the company level, the highest closing price for AMEF was approximately 12.50000 dinars, while the lowest closing price recorded was 6.680000 dinars. The highest closing price for AAHP reached 1.470000 dinars, while the lowest closing price for the shares of this company was 0.163254 dinars.

The skewness coefficients for Al-Ahliyah Agricultural Production Company and the Iraqi Company for Meat Production and Marketing were −0.090878 and −0.293278, respectively, indicating negative skewness: the series of closing-price fluctuations is skewed to the left and closing prices are more affected by negative shocks than by positive shocks. In contrast, the skewness coefficients for the Iraqi Seed Production Company and the Middle East Fish Company were 0.215380 and 1.037251, respectively, indicating that the series is skewed to the right and closing prices are more affected by positive shocks than by negative shocks.

It is also evident that the time series of stock closing prices were non-stationary, meaning the t-statistic was not significant with the constant and trend at level. This indicates significant fluctuations in those prices and necessitates the construction of a standard model to measure those fluctuations.

4.2 Estimation of ARCH Models

Table 2 shows the estimation of ARCH models for agricultural companies.

The results for AAHP indicate that the average daily closing price of the company's stock during the research period was 1.22 dinars. The variance equation shows a positive fluctuation in the company's stock price at a rate of 0.001 daily. The first-order variance parameter was 1.025, indicating a continuous fluctuation in the closing prices of AAHP shares. All these parameters were significant at the 1% level. It is worth noting that the variance-estimator parameters α_0 and α_1 had values greater than zero. As for AIPM, the average closing price reached 4.61 dinars, and the stability of the fluctuation rate was 0.001, similar to AAHP, in addition to the first-order variance parameter reaching 1.038, indicating continuous and increasing fluctuations in the closing prices of AIPM shares. Regarding AISP and AMEF, the estimation results indicated that the average daily closing prices were 5.58 and 8.07 dinars, respectively, along with positive closing-price fluctuations of 0.013 and 0.001. The first-order variance parameter was 1.009 for AISP and 1.07 for AMEF.

It is evident from the above that the highest fluctuations in closing stock prices were in AMEF at 1.07, while the company with the lowest fluctuations in closing stock prices was AISP at 1.009.

4.3 Estimation of GARCH Models

Table 3 shows the results of estimating GARCH models for the research-sample companies.

The results for AAHP indicate that the first-order error-variance parameter ($\alpha_1 = 0.96$) means that previous fluctuations in stock closing prices affect current closing prices in the short term, while the GARCH-effect coefficient ($\beta_1 = 0.260$) indicates the persistence of closing-price fluctuations in the long term. These parameters are significant at the 1% level, confirming the presence of a volatility-clustering feature. It is noteworthy that the sum of the previous error-variance coefficient and the GARCH effect for the model ($\alpha_1 + \beta_1 = 1.22$) is greater than one, indicating the persistence of shocks and previous fluctuations on current fluctuations, increasing over time.

For AIPM, the first-order error-variance parameter for the past period was $\alpha_1 = 0.774$, indicating that previous fluctuations in closing prices affect current closing prices in the short term, while the GARCH-effect coefficient $\beta_1 = 0.258$ indicates persistence in the long term. All parameters were significant at the 1% level. The sum $\alpha_1 + \beta_1 = 1.032$ is greater than one, indicating the persistence of previous shocks and fluctuations for AIPM on current fluctuations, increasing over time. This result is consistent with Dum et al. [6].

For AISP, the parameter of the previous error variance of

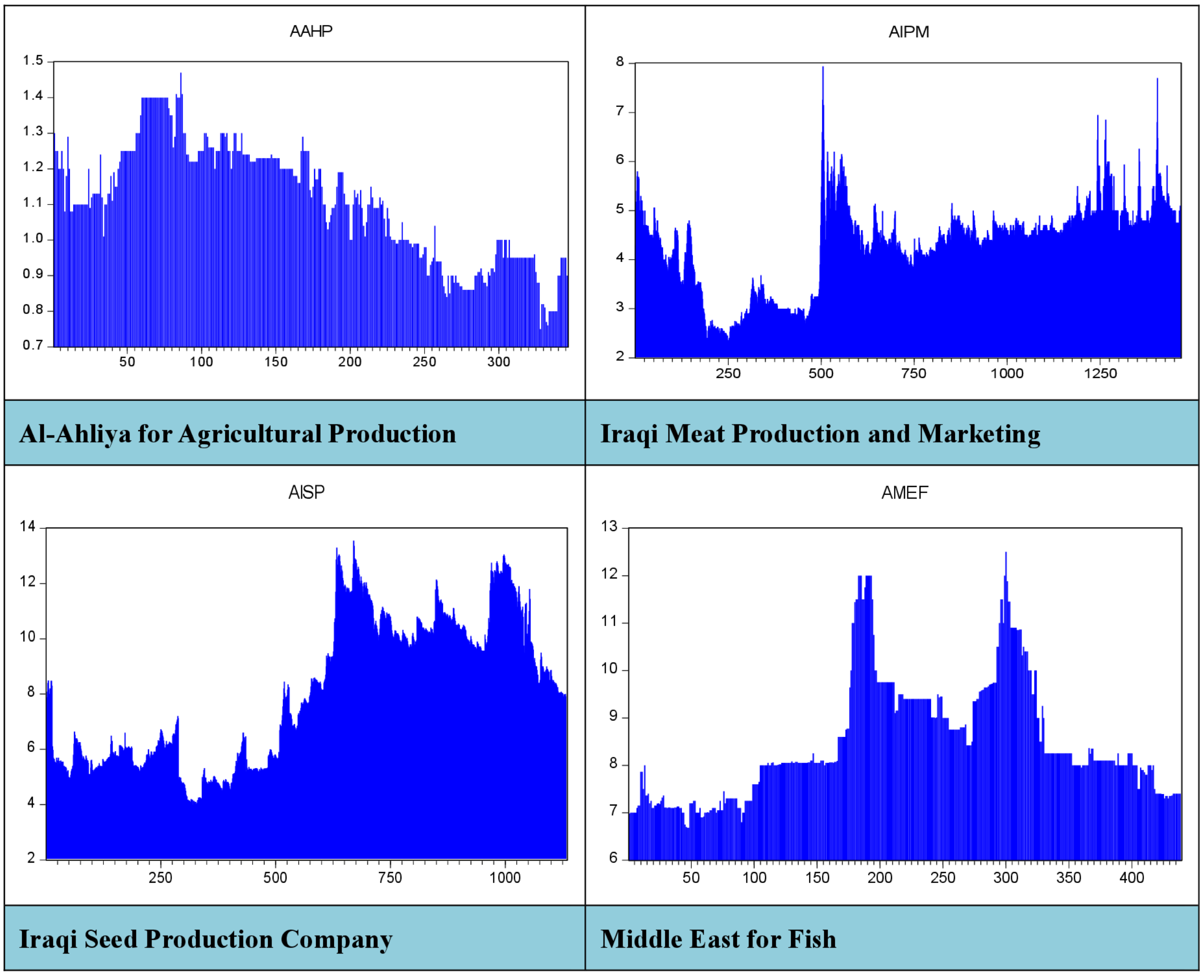


Figure 1. Closing price series of agricultural companies listed in the Iraqi financial market.

Table 1. Results of the descriptive statistics for the closing prices of agricultural companies.

Statistical indicator	AAHP	AIPM	AISP	AMEF
Mean	1.110376	4.302459	8.080071	8.472073
Median	1.120000	4.500000	8.000000	8.080000
Maximum	1.470000	7.940000	13.55000	12.50000
Minimum	0.750000	2.310000	4.000000	6.680000
Std. Dev.	0.163254	0.885951	2.623314	1.252940
Skewness	−0.090878	−0.293278	0.215380	1.037251
Kurtosis	2.073901	3.036625	1.643772	3.579791
Jarque–Bera	12.84086	21.06880	95.59262	84.86813
Probability	0.001628	0.000027	0.000000	0.000000
Heteroskedasticity Test: ARCH				
F-statistic	1894.031	6374.493	25680.74	4756.793
Probability	0.0000	0.0000	0.0000	0.0000
Unit Root Test Results (ADF), without constant and trend at level				
t-Statistic	0.4820	−0.7176	−0.5185	−0.3288
Probability	**0.8187**	**0.4059**	**0.4921**	**0.5666**

Table 2. Results of agricultural companies listed in the Iraq Stock Exchange: ARCH model estimates.

Model component	AAHP	AIPM	AISP	AMEF
$\widehat{r}_t = \widehat{\beta}_0$	1.22***	4.61***	5.58***	8.07**
$\widehat{h}_t = \widehat{\alpha}_0 + \widehat{\alpha}_1 e_{t-1}^2$	0.001***+1.025***	0.001***+1.038***	0.013***+1.009**	0.001***+1.07**

(*) Significant at 10%; (**) significant at 5%; (***) significant at 1%; (no) not significant.

the first degree reached $\alpha_1 = 0.911$, which means that previous fluctuations in stock closing prices affect current closing prices in the short term. The GARCH-effect coefficient $\beta_1 = 0.121$ indicates the continuity of fluctuations in the long term. All parameters were significant at the 1% level, confirming variance persistence. The sum $\alpha_1 + \beta_1 = 1.031$ indicates the continued impact of previous shocks and fluctuations on current fluctuations, increasing over time.

For AMEF, the previous error-variance parameter reached

Table 3. GARCH models for agricultural companies listed in the Iraq Stock Exchange.

Company	$\widehat{r}_t = \widehat{\beta}_0$	$\widehat{h}_t = \delta + \alpha_1 e_{t-1}^2 + \beta_1 h_{t-1}$	GARCH(p,q)
AAHP	1.22***	6.54E-05**+0.96***+0.260***	GARCH(1,1)
AIPM	4.62***	0.004***+0.774***+0.258***	GARCH(1,1)
AISP	5.58***	0.012***+0.911***+0.121***−0.030***	GARCH(1,2)
AMEF	8.07***	0.005***+0.807***+0.235***	GARCH(1,1)

(*) Significant at 10%; (**) significant at 5%; (***) significant at 1%; (no) not significant.

0.807, which means that previous fluctuations in stock closing prices have a clear impact on current closing prices in the short term. The GARCH-effect coefficient $\beta_1 = 0.235$ indicates continuity in the long term. The sum $\alpha_1 + \beta_1 = 1.042$ is greater than one, indicating that the impact of previous shocks and fluctuations on current fluctuations continues and increases over time.

Regarding the threshold GARCH models, the results confirmed asymmetry in the impact of positive and negative news. Positive news often leads to greater volatility than its negative counterpart, except for AMEF, which was more affected by negative news, reflecting the sensitive nature of some agricultural activities to political and economic stability. This result supports the "reverse leverage effect" hypothesis, as discussed by Glosten et al., which indicates variation in response to shocks based on their type [24].

4.4 Estimation of the Threshold GARCH Model

Table 4 shows the results of the threshold model for agricultural companies listed on the Iraq Stock Exchange.

For AAHP, the impact of positive-news shocks was $\alpha_1 = 1.162$, while the impact of negative-news shocks was $\alpha_1 + \gamma = 0.91$. Thus, the impact of negative shocks was less than that of positive shocks on the volatility of AAHP closing prices. All parameters were significant at the 1% level, and the financial-leverage parameter $\gamma = -0.243$ was significant and negative, indicating that the effect of positive shocks was more significant than that of negative shocks.

For AIPM, the impact of positive-news shocks was $\alpha_1 = 0.785$, while the impact of bad-news shocks was $\alpha_1 + \gamma = 0.768$, suggesting that positive-news shocks had a greater impact than negative-news shocks. All parameters were significant at the 1% level, and the financial-leverage value $\gamma = -0.0161$ was significant and negative.

For AISP, the effect of positive-news shocks was $\alpha_1 = 0.811$, which is consistent with Singh and Tripathi [9]. The effect of negative-news shocks was $\alpha_1 + \gamma = 0.753$, meaning that negative-news shocks had less impact than positive-news shocks. All parameters were significant at the 1% level, and the leverage parameter $\gamma = -0.058$ was significant and negative.

For AMEF, the effect of positive-news shocks was $\alpha_1 = 0.788$, while the effect of negative-news shocks was $\alpha_1 + \gamma = 0.856$. The leverage value $\gamma = 0.068$ was significant and positive, indicating that the impact of negative shocks was more significant than that of positive shocks, which is consistent with Dritsaki [25]. These results are illustrated in Figure 2.

Figure 2 shows that positive shocks are more significant than negative shocks for the Iraqi Seed Production Company (AISP), Iraqi Meat Production and Marketing Company (AIPM), and Al-Ahliyah Agricultural Production Company (AAHP), while negative shocks were more significant than positive shocks for the Middle East Fish Company (AMEF).

4.5 Estimation of GARCH-M Models with the Mean

Table 5 shows the GARCH-M model results for agricultural companies.

The results indicate that the risk premiums ($\theta = -0.107, -0.107, -0.186, -0.007$) for AAHP, AIPM, AISP, and AMEF, respectively, are negative and significant at the 5% level. This is because the closing prices for most agricultural companies are trending downwards, including AAHP, which had a closing price of 1.3 dinars on 17/3/2015 and became approximately 0.9 dinars by the end of the period on 30/5/2024 due to weak trading in the Iraq Stock Exchange. The decline in closing prices leads to a decrease in the risk premium, which aligns with financial analysis.

The GARCH-M model results demonstrated a negative relationship between the level of risk and expected return (Risk Premium), showing that increased volatility leads to a decrease in expected stock returns. This is consistent with the reality of the Iraqi market, characterized by low liquidity levels and modest trading volume. This behavior contradicts classical theory, which posits a link between higher risk and higher return, while simultaneously confirming the findings of previous studies conducted on emerging markets suffering from weak financial-market infrastructure.

5. CONCLUSION

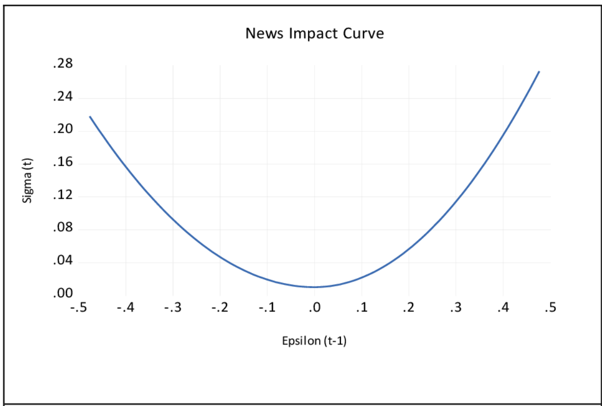
This study aimed to explore the dynamics of closing-price fluctuations for agricultural-company stocks listed on the Iraq Stock Exchange by applying ARCH, GARCH, T-GARCH, and GARCH-M models. This was part of an effort to understand the financial-risk characteristics associated with this vital sector in the context of an emerging economy characterized by unstable market features. Daily closing-price data for four agricultural companies were analyzed over a period extending several years, relying on the outputs of the EViews 12 statistical program.

The results of the ARCH models highlighted significant volatility in all companies, reflecting the sensitivity of closing prices to daily events and their instability. The models also revealed that these fluctuations are characterized by persistence, indicating a weak market capacity to absorb short-term shocks, which reflects the characteristics of emerging markets that lack depth and transparency. Using GARCH models, the results showed a complex behavior of variance, where the sum of the ARCH and GARCH coefficients $(\alpha + \beta)$ exceeded one in most companies, indicating a long-term cumulative effect of shocks on price volatility, which aligns with modern financial literature regarding developing markets.

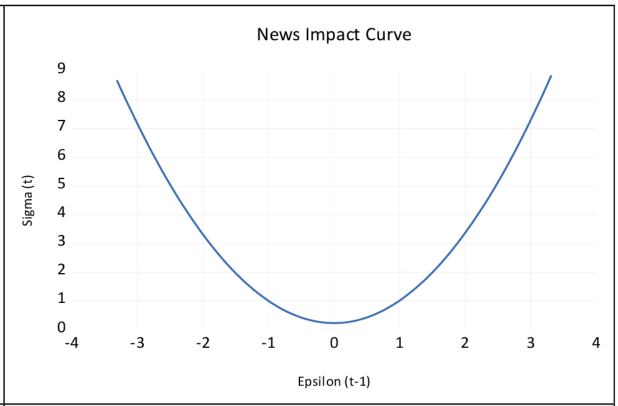
Table 4. Results of the threshold GARCH model.

Company	$\widehat{r}_t = \widehat{\beta}_0$	$\widehat{h}_t = \delta + \alpha_1 e_{t-1}^2 + \gamma d_{t-1} e_{t-1}^2 + \beta_1 h_{t-1}$	GARCH(p,q)
AAHP	1.226***	5.00E-05**+1.162***−0.243+0.249**	GARCH(1,1)
AIPM	4.627***	0.0048*+0.785***−0.0161+0.257***	GARCH(1,1)
AISP	7.962**	0.0902**+0.811***−0.058−0.026+0.281**	GARCH(1,2)
AMEF	8.068**	0.005***+0.788***+0.068+0.230**	GARCH(1,1)

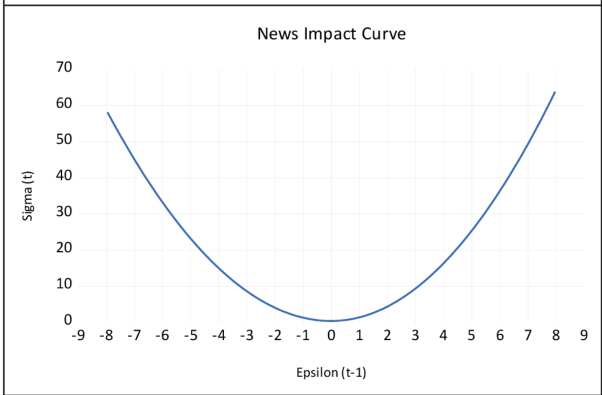
(*) Significant at 10%; (**) significant at 5%; (***) significant at 1%; (no) not significant.



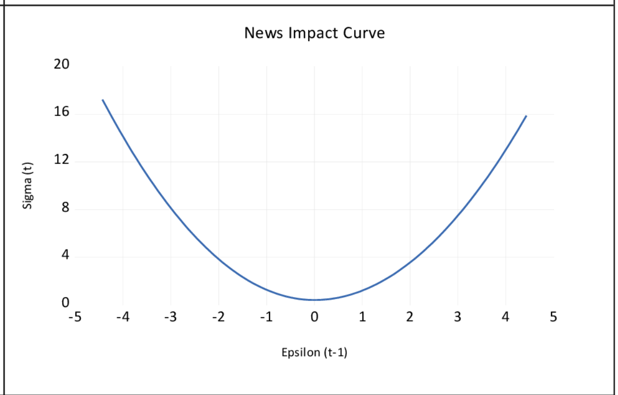
AAHP asymmetry news shocks for the company



AIPM Similarity news shocks for the company.



AISP Similarity news shocks.



AMEF Similarity news shocks for the company

Figure 2. Symmetry of positive and negative news shocks for agricultural companies listed on the Iraq Stock Exchange.

Table 5. Results of GARCH-M models.

Company	Mean equation / Risk premium	Estimated variance equation	GARCH(p,q)
AAHP	0.002**−0.107**	0.0001***+0.0011***−0.0001+0.523***	GARCH(1,1)
AIPM	0.015**−0.107*	0.0003*+0.165***−0.139+0.888***	GARCH(1,1)
AISP	0.020**−0.186***	0.004**+0.620***−0.599**+0.685***	GARCH(1,1)
AMEF	0.0006***−0.007***	0.003***+0.197***−0.196***+0.411***	GARCH(1,1)

(*) Significant at 10%; (**) significant at 5%; (***) significant at 1%; (no) not significant.

All time series of agricultural companies listed on the Iraq Stock Exchange in the study sample exhibit strong short-term fluctuations according to the ARCH test for heteroskedasticity. The rate of fluctuation in closing prices for these companies assists investors who wish to buy and sell shares in determining the upper and lower limits for buying and selling. Positive-news shocks have a stronger impact than negative-news shocks on the closing prices of agricultural-company shares. However, the results for the Middle East Fish Company indicated that the negative-news shock had a stronger effect than the positive-news shock on the company's closing stock prices. Additionally, the first-order variance parameters were greater than one for all agricultural companies, indicating that fluctuations in closing stock prices have taken a slight upward trend, which aligns with the logic of financial behavior in financial markets. Finally, the study concluded that the closing prices of agricultural companies are trending downwards, as confirmed by the risk-premium results, which were negative for all companies, indicating that investing in these companies' shares carries high risks.

The entry of agricultural companies, such as dairy-manufacturing companies, into the financial market in Iraq aims to enhance competition, increase trading volume, reduce financial-investment risks, achieve investment profits, and promote transparency and disclosure in the Iraqi financial market. It also encourages companies to adhere to international financial-reporting standards and supports the development of laws and regulations for trading. Additionally, there is a focus on expanding the use of hedging tools and risk management, especially in sensitive agricultural sectors, along with the importance of encouraging applied research that links macroeconomics and market behavior.

Future research should focus on using more advanced models, such as EGARCH and APARCH, which may provide greater capacity to describe the asymmetric distribution characteristics of volatility. It is also advisable to include macroeconomic variables in predictive models to provide a broader and more accurate perspective for both decision-makers and investors.

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