The relationship between futures contracts and futures indicators according to the discrete wavelet transform method for maximum overlap in the Saudi financial market

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Abstract:

This study examined the impact of futures contract changes on the benchmark indicators of the same financial instrument for daily data for the period from March 2, 2025, to May 16, 2025. The nature of this relationship was revealed by relying on the time series cointegration and error correction model (ECM), the MODWT model, and the multivariate GARCH model. A long-term relationship was revealed between futures contract returns and the benchmark index. The ECM results show that all variables are endogenous, meaning they are quickly affected by external variables. As for the MODWT model, the results showed a strong relationship between futures contract returns and the benchmark index returns. This is an expected result in light of the economic and financial reforms witnessed by the Kingdom of Saudi Arabia in the context of its path to achieving "Vision 2030," which has provided a strong foundation for financial market dynamism.

Keywords: futures contracts; futures indicators; financial market.

Jel Classification Codes: G13, G15.

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1. Introduction :

The rapid developments and changes taking place globally, particularly in the investment and economic spheres, have led to the disappearance of many economic concepts and the emergence of new ones, whether at the individual or institutional level. This requires us to investigate the legitimacy and effectiveness of these tools, and what financial institutions should innovate to keep pace with this progress.

In this field, financial instruments are among the most important variables that have occupied a wide scope, due to their direct impact on all economic sectors. New instruments have emerged with new formulations that seek to create a suitable environment for the transacting parties and achieve their objectives. In this context, futures contracts, the focus of our research, are an investment tool in the form of a contract that is enforceable in the future and includes various real and financial assets for investment purposes. Their primary objective is to hedge against future risks and achieve the objectives of the contracting parties.

The Kingdom of Saudi Arabia is one of the most important and largest financial markets in the Arab region, possessing a large financial pool compared to its counterparts in the region, in addition to the large number of active investors in the market, and its reliance on indicative indicators, which are the primary guide and measuring tool for financial instruments within the market.

1.1. Study Problematic:

Through this research, we will attempt to examine the relationship between futures indicators and futures contracts, using the ARCH model for daily data from March 2025 to May of the same year.

Therefore, the main question of this research revolves around:

To what extent are futures indicators effective in achieving the highest returns for futures contracts in Saudi Arabia?

1.2. Study Aims

Assuming a relationship exists between benchmarks and futures contracts, this study will attempt to answer the following questions:

- How are futures contracts affected by the fluctuations in benchmarks?

- How quickly do futures contracts adapt to changes affecting the financial market in the long term?

We typically use a variety of statistical methods to answer these questions. In this study, we will attempt to answer the previous questions using the Autoregressive Conditional Heteroskedasticity (ARCH) model as a first step toward an in-depth study of the relationship between the Saudi Stock Exchange (TSE), represented by the benchmark, and futures contracts.

This study presents several important contributions, including: First, this research provides a comprehensive analysis of the nature of the relationship between the futures contracts of a group of financial institutions trading on the TSE and the latter, represented by the benchmarks. This provides a scientific addition and fills a gap in previous studies. Second, this study relies on a modern standard approach to address the nature of the correlations between variables. Third, it provides precise and clear contributions to financial policy and to stakeholders within and outside the financial market to address the challenges facing them in light of the current challenges.

To address the issues raised and achieve the expected results, this research paper is structured as follows: In the second section of this paper, we review the theoretical literature relevant to the research topic to accurately identify the research gap. We also summarize high-quality and noteworthy studies that examined the relationship between new financial instruments and the financial market. The third section of this study discusses the data and methods used in the analysis. The fourth section presents the estimation results of the "Autoregressive Heteroscedasticity (ARCH)" model to study the relationship between the selected variables and validate the methodology used, in addition to error correction tests. The fifth section presents a clear approach for stakeholders in financial policy, researchers, and experts in financial markets. The final section of this paper presents alternative channels for future research, in addition to the most important recommendations that contribute to the activation of the financial stock exchange.

1.3. Importance of the Topic:

The importance of our study stems from the importance of the topic, which addresses futures contracts as a modern and innovative financial instrument that contributes to finding practical solutions to address financing problems and bringing the viewpoints of contracting parties closer, on the one hand, and diversifying and expanding the financing base of financial markets, on the other.

2. Review of interpretive literature:

In light of the increasing complexity and rapid technological development at the international and regional levels, it is necessary to address one of the most important pillars of the world economy: the financial sector. In the same context, the interaction between financial assets and the financial stock market represents a challenge at the international economic level. This requires us to investigate the dynamic nature of these variables proposed in this paper, in addition to establishing methodological foundations in the form of controls to achieve financial continuity at the financial stock market level. In light of this, this section reviews the literature on the main research conducted in this context, with a focus on the experience of the Kingdom of Saudi Arabia.

We have many studies conducted on the financial sector, especially in what is related to the financial market and also links it to the internal and external environment, or what is called systematic risks and unsystematic

risks. The latter poses many complexities that require research to understand and limit the negative effects that are reflected in the relationship between variables. (Fatima M, Mustapha I, Baharom, & Hamisu S, 2020) This research aims to examine the relationship between crude oil price changes and selected African Islamic indices, using daily data from May 4, 2011, to January 25, 2018. Three main techniques were used: MODWT, CWT, and multivariate GARCH-DCC, to analyze whether these markets offer any diversification opportunities. The results revealed that the MODWT shows that the Egyptian Islamic Index outperforms all indices, while the CWT results indicate that investors would benefit from diversification in almost all markets (except South Africa) and enjoy the advantages that come with long-term investments. The results also showed a low correlation between the Egyptian and Tunisian Islamic indices, as oil price returns indicate the benefits of diversification in these markets. Among all Islamic stock markets, the Tunisian market records the lowest volatility relative to the crude oil index.. In another study by (De, 2017), which aims to analyze of the commodity futures market and the stock market, this paper proves the general correlation between the futures market and the stock market index for a total sample, using correlation tests, unit root tests, cointegration tests, and Granger causality tests for the period from January 2016 to January 2017. The empirical results of the two market prices demonstrate a correlation. However, China's stock market funds and futures did not demonstrate a clear correlation, and the trend of the Wenhua Commodity Futures Index did not keep pace with the index trend. This is because the Mandarin Commodity Futures Index did not represent the entire commodity futures market scientifically and reasonably, and there were some flaws in its design. Furthermore, with the development of the Chinese stock market, the futures market has become more mature, and equity investment has become more popular, although investors in this field are still new to the field. Recently, an increasing number of investors have been investing in the futures market. These investors tend to speculate on stocks, and they maintain their stock investment habits in futures. When stock indexes rise, futures contracts fall, and they then follow the futures index, resulting in a common phenomenon. (Algirdas Justinas & Česlovas , 2023) A research paper was presented. This paper examines futures contracts for selected agricultural commodities in the US market using GARCH models and Granger causality testing. The weekly realized returns on commodity futures contracts from the Chicago Board of Trade were used. The time series were found to be stationary and non-volatile, allowing for further modeling of exogenous variables using GARCH techniques. Furthermore, this study analyzed post-2020 data on the pandemic-induced disruptions in these markets. To measure speculation, the T-factor index of excessive speculation was used. The research concluded with three main findings. First, most commodities became more volatile in terms of return volatility during the post-2020 period. However, speculation increased only in the milk market. Overall, the milk market showed the highest average return volatility and speculation. Second, there is no evidence that speculation causes returns, nor is there a statistically significant inverse effect explaining dairy

futures returns through speculation. Finally, speculation, in all cases where it has a statistically significant effect on volatility, reduces volatility, making prices more stable.

Regarding the nature of the relationship between the financial market and futures contracts in Saudi Arabia, many experts have conducted their studies in this field. (Shawkat & Eisa , 2008)conducted a study on the dynamic relationship between oil futures prices and the stock markets of the Gulf Cooperation Council countries. The study showed that, with the exception of the State of Qatar, there was an equilibrium relationship with different predictive power, while Saudi Arabia is considered the only country capable of providing good results in predicting oil futures prices on the New York Mercantile Exchange (Timex). There is another study presented by (Mao, Bing, Yu-chuan , & Jian-Hsin , 2011) on "The main factors affecting the success of futures contracts traded in the futures markets." The results demonstrated the necessity of a large, immediate market for the success of futures contracts. Furthermore, the trading volume of futures contracts is positively affected the smaller the size of the futures contract. The small size of the contract positively affects the trading volume of futures contracts, which contributes to their success. Meanwhile, the relative size of the stock exchange and the trading platform is considered one of the most important factors in the success of a futures contract. In another context, (AL-SAATI, 2002) A theoretical study was presented examining the possibility of modifying conventional futures contracts to comply with the provisions of Islamic Sharia, taking into account the objectives of conventional futures contracts. The study concluded that economic efficiency is the primary objective of Sharia-compliant futures contracts. Therefore, futures contracts could be beneficial for Islamic finance if modified to become Sharia-compliant, allowing them to distribute risks among investors, collect information about the future path of prices in the spot market, and contribute to the stability of future money prices.

This study aims to establish procedures to limit behaviors that contravene the principles of Islamic law in all its manifestations. Numerous studies have examined the relationship between the stock exchange, represented by the stock market, and various financial instruments, both traditional and emerging, to mitigate potential risks. In this context, our research supports this hypothesis by selecting a new or emerging financial instrument capable of reducing and hedging risks and in line with investor desires.

3. The theoretical model of the study:

3.1. Markowitz's investment portfolio theory:

Markowitz (1952) is considered the first to establish the legal framework for the modern theory of securities, which consists of a set of risky securities, which also contributes to the optimal selection of financial instruments. The theory assumes that to select the components of a financial portfolio, the return and risk of each financial asset must be calculated. The sum of the expected risk and return on the portfolio, measured based on the proportion of each asset within the portfolio, are the basic criteria for determining the optimal

portfolio that matches the desires and objectives of investors.

Furthermore, the risk of a financial asset, which depends on the change in the returns of financial assets, is not the only component of portfolio selection. Rather, it depends on the covariance between each pair of assets to form a well-diversified portfolio. Under Markowitz's theory, a negative or low correlation between each pair of assets is a good indicator of the presence of the assets within the portfolio, which makes the financial portfolio a good choice for an investor. The expected risk of a portfolio can be calculated using the covariance as follows:

$$\delta_{Pij}^2 = \sum W_i^2 \delta_i^2 + \sum_{i=0} \sum_{j=0} 2W_i W_j COV_{ij}$$

where δ_i^2 is the variance of the expected return on financial asset i; W_i is the proportion of each financial asset within the portfolio such that $\sum W_i = 1$; and COV_{ij} is the covariance between each two assets.

3.2. Methodology used in the study

3.2.1. Using the autoregressive distributed lag (ADRL) methodology

The unit root decomposition, error correction methodology (VECM), and co-integration, which are time series analysis techniques, along with long-run structural modeling (LRSM), aim to study the relationship between the selected study variables in the research paper. Since these techniques, which were mentioned earlier, are unable to determine the exact relationship between lag and lead, in addition to their inability to analyze large samples, therefore, to determine and analyze the lag and lead relationship, a more advanced method is used to determine the most effective variable for further analysis. Among the most commonly used techniques for analyzing the lead and lag relationship between variables, the modular maximum overlap discrete wavelet transform (MODWT) is one of the best techniques that serves our study.

3.2.2. Multivariate GARCH-DCC Model

To study the volatility and correlation of futures price changes and futures benchmarks, this research paper uses the dynamic conditional correlation (DCC) method. This model identifies correlations between changes in financial instrument variables over time (Luc & Yongdeng , 2023). By defining linear equations, this model illustrates the reversal of average volatility. The equations can be written as follows:

$$r_t = \beta_0 + \sum \beta_i r_{t-i} + U_t + G_t + Z_t$$

$$U_t = E[r_t / \Omega_{t-1}]$$

$$G_t = diag\left[\sqrt{h_{ii,t}}\right]$$

$$Z_t = U_t G_{i-t}$$

Where:

- Gt: the conditional standard deviation of the diagonal matrix;

- hii,t: the expected conditional variance of the univariate GARCH model;

- zt: the standardized residual vector with a single variance and a mean value of zero;

- Rt: the time-varying conditional correlation matrix of returns.

The DCC model for the dynamic correlation matrix (Christian M & Linqi , 2023) by following this form as follows:

$$Q_{ij,t} = \beta(q_{ij,t-1} - P_{ij}) + \alpha(Z_{i,t} - P_{ij}) + P_{ij}$$

$$(diagQ_t)^{1/2} = diag\left(\frac{1}{\sqrt{q_{11}}}, t, \frac{1}{\sqrt{q_{nn}}}\right)$$

$$R_T = (diagQ_t)^{-1/2}(diagQ_t)^{-1/2}$$

Where:

- P_ij is both the time-varying conditional correlation coefficient and the positive correlation coefficient (Q_(ij,t),√(q_ii),t,√(q_nn)) = P_ij.

The assumptions of the standard normal distribution may not apply to the analysis, as financial instruments are based on a skewed return distribution. Therefore, it is necessary to rely on a model that can take the actual nature of the change in volatility. Among the solutions presented is adopting the Student-t distribution, where U_(t-1) |Ω_(t-1)~F_Student~T(U_t,V) is used (where V is the degree of freedom) versus the conditional distribution U_(t-1) |Ω_(t-1)~N(0,H_T).

3.2.3. Maximum Overlap Discrete Wavelet Transform (MODWT)

The basic formula for the MODWT is based on the analysis of time series into different components by studying the lead-lag relationship between the independent and dependent variables (Paulo , Arthur , & Paulo , 2023). The wavelet variance is defined as follows:

$$\sigma^2(X_i) = VAR(Y_{ij}^2)$$

The covariance equation, which can be represented by the jth wavelet scale, indicates the relationship between the two processes Y and X and can be written as follows:

$$\gamma_{xy}(\lambda_j) = cov\left(\omega_{ij}^y \omega_{ij}^x\right)$$

Accordingly, the wave correlation between two time series can be defined as the percentage ratio between the square root of the wave variance and the variance of their respective waves. The relationship between the two processes can also be measured by the wave correlation coefficient, as follows:

$$Pyx_{\lambda i} = \frac{\gamma yx_{\lambda i}}{\alpha_{(bar)}x.y_{\lambda i}}$$

where (Pyx)_λi represents the correlation coefficient between two random variables such that |(Pyx)_λi |≤1, α_((bar)) x.y_λi represents the unbiased estimator of the wavelet variances, and (Pyx)_λi represents the

common variance.

3.2.4. Continuous Wavelet Transform (CWT) Methodology

The continuous wavelet transform (CWT) is a function of one variable, time, which aims to relate the original single-variable time series to a function of two different variables: frequency and time. Furthermore, it is not necessary to specify the number of time scales for the wavelet to automatically generate the data length. According to this methodology, it appears as a two-dimensional serial correlation. Therefore, the correlation between two variables (wavelets) according to the CWT model reveals the degree of coherence of the wavelets.

According to the least squares method, an asymmetric wavelet filter with length L = 8 (i.e., taking eight non-zero coefficients) is used, symbolized by LA (8). Thus, the studied time series data, with the formula x(t)EL^2 (R), is projected onto the original wavelet as follows:

$$W_i(u,s) = \int_{-\infty}^{\infty} x\,(t)\,\frac{1}{\sqrt{s}}\,\omega\left(\frac{T-U}{s}\right)DT$$

Where s represents the frequency and time domain, thus, the use of wavelet transforms is a function of two variables u and s that is created from the original time series. In addition, the image that appears as a result of applying this technique is the result of the interaction between the two variables, as the wavelet coherence is a two-variable framework, and the wavelet coherence formula for the two time series can be written as follows:

$$R_n^2(s) = \frac{\left|s\left(S^{-1}w_n^{xy}(s)\right)\right|^{\,2}}{\left(S(S^{-1}|w_n^x(S)|^{\,2})\;S\left(\,S^{-1}\left|w_n^y(s)\right|^{\,2}\right)\right)}$$

Where:

- s: represents the wavenumber,
- S : is the smoothing factor,
- w_n^xy: is the cross-wavenumber transform of the time series X,Y,
- w_n^y and w_n^x : are the continuous wavenumber transform of the time series X,Y, respectively.

4. Applied study of the model:

4.1. Study Data:

Through this study, we will attempt to highlight the role of futures contracts as one of the new financial instruments in the financial markets by comparing it with the leading indicators called the Futures Index. To highlight the importance of this tool in the field of finance, we chose the Kingdom of Saudi Arabia because it is considered one of the most important financial markets globally active in the field of financing with financial engineering tools, especially Islamic ones, in addition to being the largest financial market in terms of financing capacity in the Arab region. In order to obtain the best results, we selected a sample of futures contracts active in

the Saudi financial market that were able to achieve the highest return during the study period, which extended from the date of the start of futures contract activity on March 2, 2025, to May 16 of the same year.

This study relied on daily data from March 2, 2025, to May 16, 2025, for the study variables, namely the MT30 Futures Index expiring in June 2025 as the dependent variable, in addition to the independent variables of a selected sample of the best futures contracts on the Saudi Stock Exchange, which were selected based on the settlement price factor.

Table N°1: Classification of study variables

Type	Definition	Label	Unit
Dependent variable	Indicative indicator for the Futures contracts	MT30	**%**
Independent veriable	Al Ahli stock futures June 25	AFC	
	STC Stock Futures June 25	STCFC	
	SABIC Stock Futures June 25	SFC	
	Almarai Stock Futures June 25	MRFC	
	June 25 Maaden Stock Futures	MFC	
	Al Rajhi Stock Futures June 25	RFC	

Source: Prepared by the researcher.

This table represents the study variables. The data were obtained from the Tadawul platform database for the Saudi financial market. The returns for both the dependent variable and the independent variables were calculated as follows:

$$R_I = \frac{P_t}{P_{t-1}}$$

where R_I represent the required return, P_(t-1) represents the value of the security at the beginning of the day, and P_t represents the price of the security at the end of the day.

Table N°2: - Descriptive analysis of study variables

g	STCFC	SFC	RFC	MT30	MRFC	MFC	AFC
Mean	-0.134	-0.10509	-0.11345	-0.10291	-0.16018	0.244909	0.03
Median	-0.11	-0.17	-0.05	-0.1	-0.09	0.44	0.14
Maximum	2.27	3.05	3.19	3.78	3.69	6.43	5.58
Minimum	-4.52	-3.85	-6.03	-6.56	-5.41	-9.65	-6.88
Std. Dev.	1.190535	1.157174	1.394476	1.289177	1.460097	2.925155	1.736018
Skewness	-0.71624	-0.36084	-0.92799	-1.7534	-0.61896	-0.622	-0.3686
Kurtosis	4.865398	4.505535	7.893857	13.89892	5.068138	4.320638	7.745568
Jarque-Bera	12.67685	6.387957	62.77901	300.4011	13.31372	7.543334	52.85472
Probability	0.001767	0.041008	2.33E-14	5.87E-66	0.001285	0.023014	3.33E-12
Sum	-7.37	-5.78	-6.24	-5.66	-8.81	13.47	1.65
Sum Sq. Dev	76.53812	72.30877	105.0064	89.74673	115.1217	462.0526	162.743

Source: Prepared by the researcher based on the program eviews 13.

This table shows the summary statistics for the futures returns data and the futures benchmark. The results

show that all the variables under study have a negative mean except for the futures contracts (for Al Ahli Bank and Maaden Company), which have a positive mean. The results also show that the highest standard deviation was recorded for the futures contracts of Al Ahli Bank (2.92%), which makes it the most volatile indicator. In contrast, the SABIC futures index achieved the lowest standard deviation, which makes it less vulnerable to fluctuations in the stock exchange. Regarding the deviation results, it is also noticeable that all values are positive, which indicates that all values are concentrated on the right side of the mean.

5. Discussion of experimental results

5.1. Time series and their analysis

Table N°3: Test results (P-Perron test and ADF test)

UNIT ROOT TEST TABLE (PP)								
At Level								
		MT30	MFC	MRFC	AFC	RFC	SFC	STCFC
With Constant	t-Statistic	-7.60937	-8.38867	-17.4212	-7.25344	-8.20082	-7.02237	-9.2042
	Prob.	2.02E-08	2.05E-09	5.80E-08	6.21E-08	3.48E-09	1.31E-07	2.58E-10
With Constant & Trend	t-Statistic	-7.52661	-8.39296	-18.3706	-7.22118	-8.10162	-6.95989	-9.1591
	Prob.	2.26E-07	1.68E-08	2.00E-06	5.98E-07	3.91E-08	1.39E-06	2.20E-09
Without Constant & Trenc	t-Statistic	-7.60324	-8.40733	-10.3944	-7.33522	-8.01202	-6.93452	-9.14079
	Prob.	3.43E-15	4.42E-21	2.52E-51	1.07E-13	6.87E-18	8.41E-12	5.60E-29
At First Difference								
		d(MT30)	d(MFC)	d(MRFC)	d(AFC)	d(RFC)	d(SFC)	d(STCFC)
With Constant	t-Statistic	-25.0913	-27.1237	-31.328	-48.6689	-40.0429	-33.7236	-31.1511
	Prob.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
		***	***	***	***	***	***	***
With Constant & Trend	t-Statistic	-25.619	-27.4812	-30.958	-48.0735	-45.7202	-33.264	-31.858
	Prob.	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
		***	***	***	***	***	***	***
Without Constant & Trenc	t-Statistic	-25.4212	-27.408	-31.7361	-49.1514	-36.7167	-34.3521	-31.5333
	Prob.	6.39E-58	6.39E-58	6.39E-58	6.39E-58	6.39E-58	6.39E-58	6.39E-58
		***	***	***	***	***	***	***
UNIT ROOT TEST TABLE (ADF)								
At Level								
		MT30	MFC	MRFC	AFC	RFC	SFC	STCFC
With Constant	t-Statistic	-7.51543	-8.38867	-7.66499	-7.16884	-7.90781	-6.955	-9.10632
	Prob.	2.71E-08	2.05E-09	1.88E-08	8.16E-08	8.16E-09	1.64E-07	3.25E-10
With Constant & Trend	t-Statistic	-7.44311	-8.37072	-7.59095	-7.12607	-7.83171	-6.89952	-9.12075
	Prob.	2.94E-07	1.79E-08	2.02E-07	8.12E-07	8.80E-08	1.70E-06	2.42E-09
Without Constant & Trenc	t-Statistic	-7.5217	-8.38865	-7.51617	-7.23765	-7.88146	-6.93586	-9.06282
	Prob.	1.02E-14	6.47E-21	1.43E-14	3.35E-13	5.75E-17	8.30E-12	5.40E-28
At First Difference								
		d(MT30)	d(MFC)	d(MRFC)	d(AFC)	d(RFC)	d(SFC)	d(STCFC)
With Constant	t-Statistic	-8.83656	-8.16235	-9.83156	-11.5981	-12.9642	-11.4905	-7.97028
	Prob.	8.45E-10	5.60E-09	1.23E-10	9.61E-12	9.52E-12	1.02E-11	9.57E-09
		***	***	***	***	***	***	***
With Constant & Trend	t-Statistic	-8.75954	-8.07724	-9.72666	-11.4838	-12.8418	-11.3766	-7.90193

Source: Prepared by the researcher based on the program eviews 13.

Table (03) shows the results of the Phillips-Perron (PP) test and the Extended Dickey-Fuller (ADF) test, which are often used to verify the stationarity of variables based on the unit root test. Looking at the obtained results, it is clear that at the (At) level and at the first difference, almost all variables have negative t-statistic values. This means that most of the series are stationary at the level according to the PP and ADF tests, which enables us to use these series in time-sequence regression models (VECM) and test the presence of cointegration between them to determine the long-run relationship.

Table N°4: Johansen cointegration vector for study variables

H_1	H_0	Statistics	Critical Value 90%	Critical Value 95%
Maximum Eigenvalue Values				
$r = 1$	$r = 0$	75.95	46.29	**43.23**
$r = 2$	$1 \geq r$	71.79	82.14	**86.16**
Trace Statistics				
$r \geq 1$	$0 = r$	174.31	120.36	**125.61**
$r \geq 2$	$1 \geq r$	109.67	110.74	**114.51**
$r \geq 3$	$0 \geq r$	102.38	103.19	**107.59**
$r \geq 4$	$1 \geq r$	96.03	97.91	**101.03**

Source: Prepared by the researcher based on the program eviews 13.

The results obtained in Table (4) for Johansen's cointegration analysis show that the variables move in the long run in the same direction, as they contain a single cointegration vector (r=1) at the 95% significance level, as shown by the results of cointegration using trace statistics and maximum eigenvalue statistics. The maximum eigenvalue statistics indicate that at (r=1) the calculated value = 75.95 is greater than the critical value at the 95% level (43.23), and therefore we reject the null hypothesis r=0. At (r=2) the calculated value = 71.79 is less than the critical value at the 95% level (89.16), and therefore we do not reject the null hypothesis 1≥r. When using trace statistics, when (r≥1), the calculated value = 174.31 is greater than the critical value at the 95% level (125.61), so we reject the null hypothesis r = 0. When (r≥2), the calculated value = 109.67 is less than the critical value at the 95% level (114.51), so we do not reject the null hypothesis r≥1. Therefore, both tests agree on the existence of a single cointegrating vector (r = 1), which means that the variables are linked in a long-run equilibrium relationship, which makes it possible to use the error correction model (VECM).

Table N°5: Vector error correction for futures and leading indicators for future contract

Error Correction:	D(MT30)	D(STCFC)	D(SFC)	D(RFC)	D(MRFC)	D(MFC)	D(AFC)
COINTEQ1	-0.618378 (0.41378) [-1.49445]	0.421460 (0.39044) [1.07946]	-0.087030 (0.36216) [-0.24031]	-0.511171 (0.41301) [-1.23767]	-2.106081 (0.42845) [-4.91563]	-1.410252 (1.00219) [-1.40718]	0.588148 (0.57110) [1.02984]
D(MT30(-1))	-0.211773 (0.44254) [-0.47854]	-0.216964 (0.41757) [-0.51959]	0.429080 (0.38733) [1.10779]	0.520762 (0.44171) [1.17897]	0.748927 (0.45822) [1.63443]	-0.780794 (1.07183) [-0.72847]	0.125381 (0.61079) [0.20528]
D(STCFC(-1))	-0.364580 (0.18264) [-1.99613]	-0.607664 (0.17234) [-3.52599]	0.024062 (0.15986) [0.15052]	-0.282519 (0.18230) [-1.54973]	-0.663186 (0.18912) [-3.50677]	-0.695443 (0.44236) [-1.57211]	-0.252013 (0.25208) [-0.99971]
D(SFC(-1))	-0.298494 (0.20508) [-1.45551]	-0.296496 (0.19351) [-1.53222]	-0.620829 (0.17949) [-3.45876]	-0.176607 (0.20469) [-0.86278]	-0.286943 (0.21235) [-1.35130]	-0.315012 (0.49670) [-0.63421]	-0.321935 (0.28305) [-1.13738]
D(RFC(-1))	0.010875 (0.24599) [0.04421]	0.122011 (0.23211) [0.52567]	-0.278129 (0.21530) [-1.29182]	-0.564704 (0.24553) [-2.29997]	0.306756 (0.25470) [1.20437]	0.830663 (0.59578) [1.39424]	-0.184229 (0.33951) [-0.54263]
D(MRFC(-1))	0.254567 (0.17552) [1.45039]	-0.052696 (0.16561) [-0.31819]	0.134415 (0.15362) [0.87499]	0.330220 (0.17519) [1.88496]	0.155773 (0.18174) [0.85714]	0.681966 (0.42510) [1.60425]	-0.248296 (0.24225) [-1.02497]
D(MFC(-1))	0.106098 (0.08848) [1.19915]	0.151018 (0.08349) [1.80892]	-0.008752 (0.07744) [-0.11302]	0.049363 (0.08831) [0.55896]	-0.028318 (0.09161) [-0.30910]	-0.297150 (0.21429) [-1.38666]	0.133998 (0.12212) [1.09730]
D(AFC(-1))	-0.032340 (0.24091) [-0.13424]	0.079356 (0.22732) [0.34910]	0.040213 (0.21086) [0.19071]	-0.201821 (0.24046) [-0.83932]	-0.462376 (0.24945) [-1.85361]	-0.002154 (0.58348) [-0.00369]	-0.182632 (0.33250) [-0.54926]

Source: Prepared by the researcher based on the program eviews 13.

The results of the analysis in Table (05) for the error correction model (VECM) to determine the trends of the external and internal variables show that all the variables that were relied upon within this research paper are internal variables and therefore have varying sensitivity towards the external variables, as the results indicate that there is a long-term equilibrium relationship represented by COINTEQ1 and the variable MRFC is the most responsive to the correction of the imbalance, and in the short term, STCFC has a strong effect on itself and on MRFC, while MFC strongly affects MRFC, while the rest of the variables have less influence.

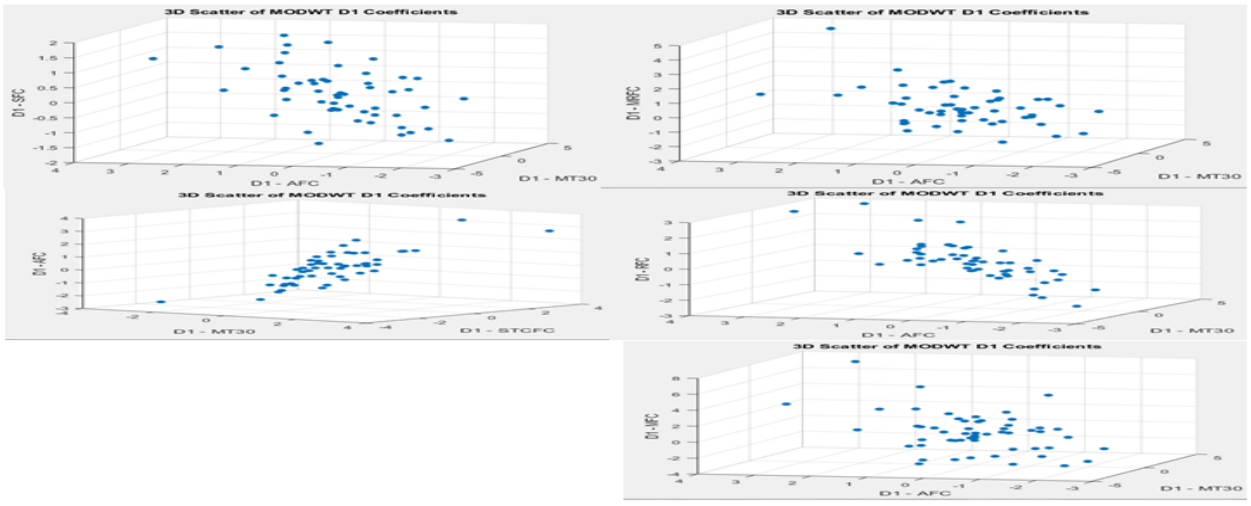
5.2. Analysis of Maximum Overlap Discrete Wavelet Transform (MODWT) Results

In a three-dimensional MODWT analysis, the cross-correlation points between variables must match the scales of the downstream, sideways, and upstream waves, which, as previously noted, are bounded between positive and negative [0.8]. Although the statistical results we previously obtained show that all variables in this

paper are endogenous, it is essential to understand the nature of the dynamic relationship between the variables, which provides us with a clearer view of building more accurate prediction models.

Figures 1 to 5 illustrate the MODWT cross-correlation results between the futures benchmarks and the selected sample futures contracts for the lag and lead periods of each measure within the corresponding confidence interval. Figure 1 shows the waveform cross-correlation between the futures benchmarks, the National Bank of Egypt futures contract, and the remaining variables (STCFC, RFC, SFC, RMFC, MFC). The figure indicates that almost all combinations of the triple correlation are close, which means there is a strong relationship between the variables, especially the combination of (MT30, AFC, s), which indicates a very strong correlation between the variables. Looking at Figure 2, which represents the relationship between (MT30, STCFC) and the remaining variables, the figure also shows a strong relationship between all combinations except for the combination (MT30, STCFC, SFC). It is noticeable that there is a clear correlation between (MT30, STCFC) more than the triple combination.

Figure 1: MODWT between (MT30 with AFC) and other variables



Source: Prepared by the researcher based on the program MTLAP.13.

Figure 2: MODWT between (MT30,STCFC) and the rest of the variables

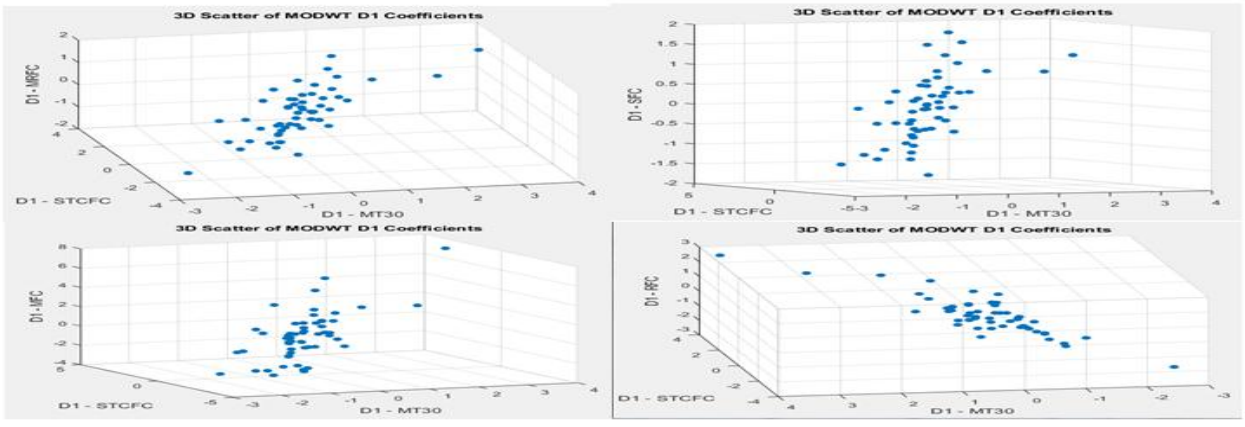
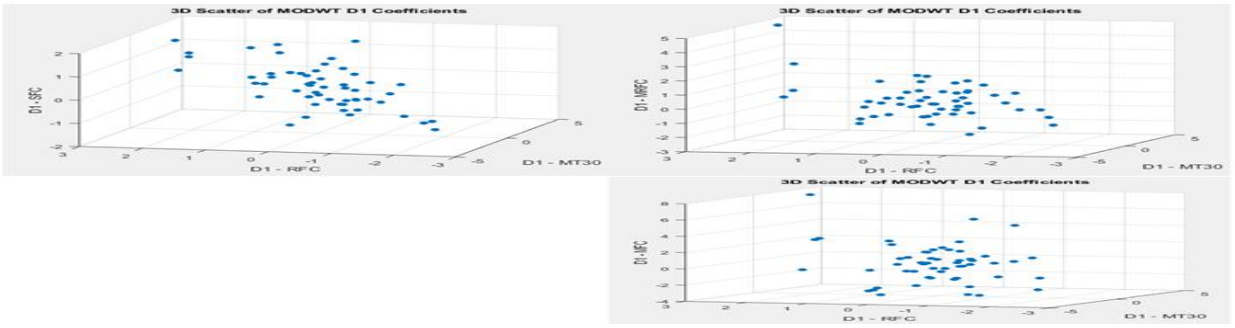
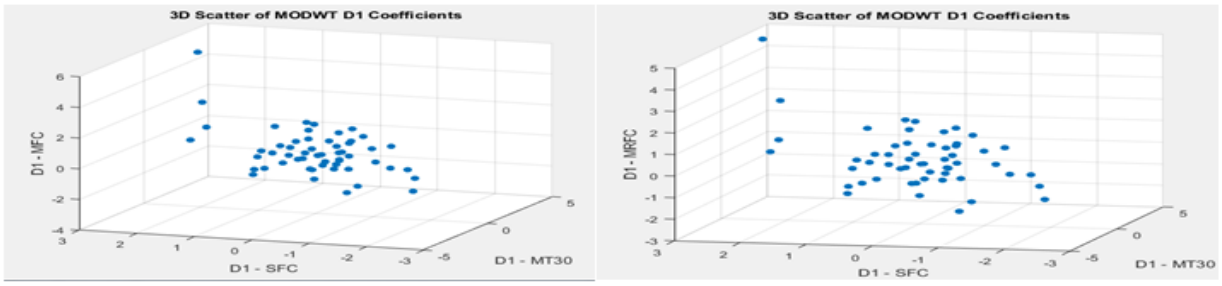


Figure 3: MODWT between (MT30,RFC) and the rest of the variables



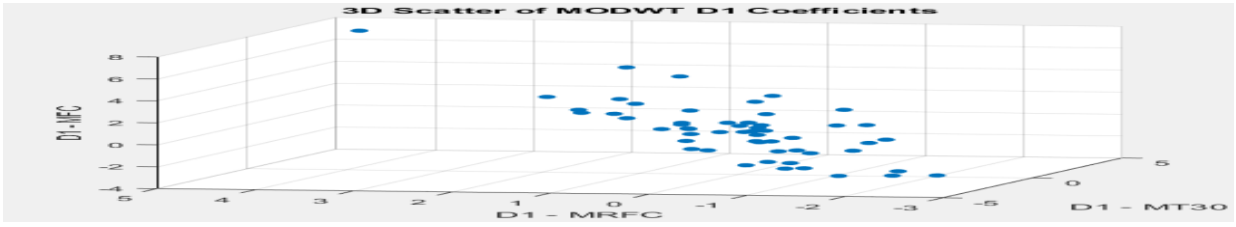
Source: Prepared by the researcher based on the program MTLAP13.

Figure 4: MODWT between (MT30,SFC) and the rest of the variables



Source: Prepared by the researcher based on the program MTLAP13.

Figure 5: MODWT between (MT30,MRFC) and MFC



Source: Prepared by the researcher based on the program MTLAP13.

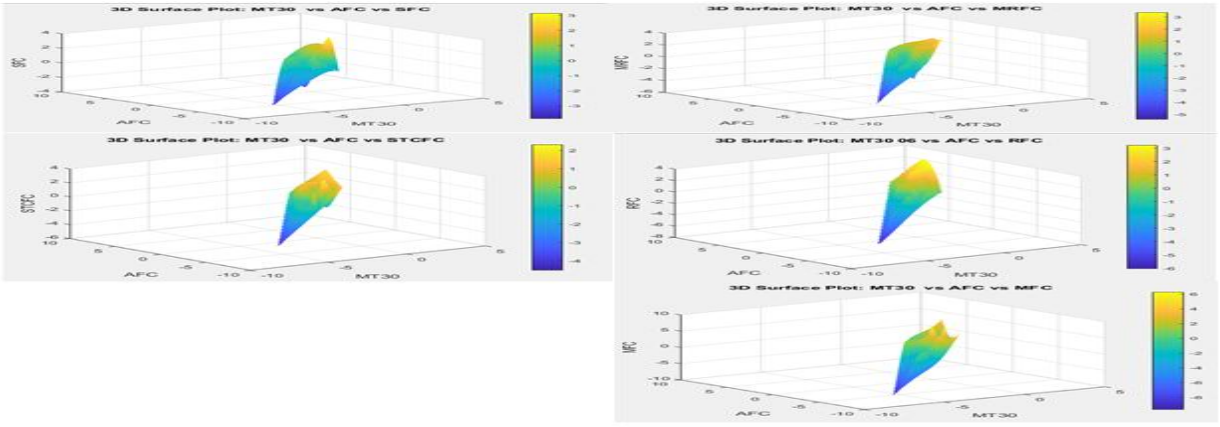
As for Figure 03, which represents the relationship between (MT30, MFC) and the rest of the variables, and Figure 04, the relationship between (MT30, SFC) and the rest of the variables, and the last figure, which represents the combination (MT30, MFC, MRFC), it is also noticeable that there is a strong correlation between all the variables, which explains the ability of futures contracts to move in the same direction with the indicative indicators of futures contracts.

The dotted pattern of figures (1, 2, 3, 4, 5) indicates the presence of a non-linear yet strong relationship. This is due to the ability of the futures department of the sample under study to analyze the data and information available to it to obtain a clear vision and execute orders based on that, in addition to the pivotal role played by

economic policy at the level of the Kingdom of Saudi Arabia in implementing the "Vision 2030" plan on the one hand, and the success of financial instruments, especially Islamic ones, in overcoming the challenges that affected the global economy during the "Covid 19" period on the other hand.

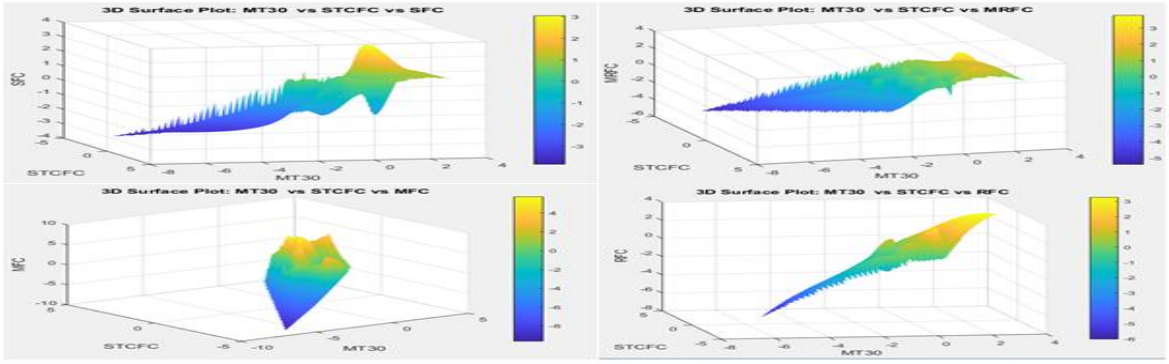
Figures (5, 6, 7, 8, 9, 10) illustrate the development of the wave transformations of the study variables, where the scales represent a three-dimensional graph of the correlation relationship between the variables relative to the dependent variable (MT30), and the side scale indicates the degree of correlation between the variables, where the blue color represents low correlation and the yellow to red color represents strong correlation.

Figure 6: Wavelet coherence between (MT30,AFC) and the rest of the variables



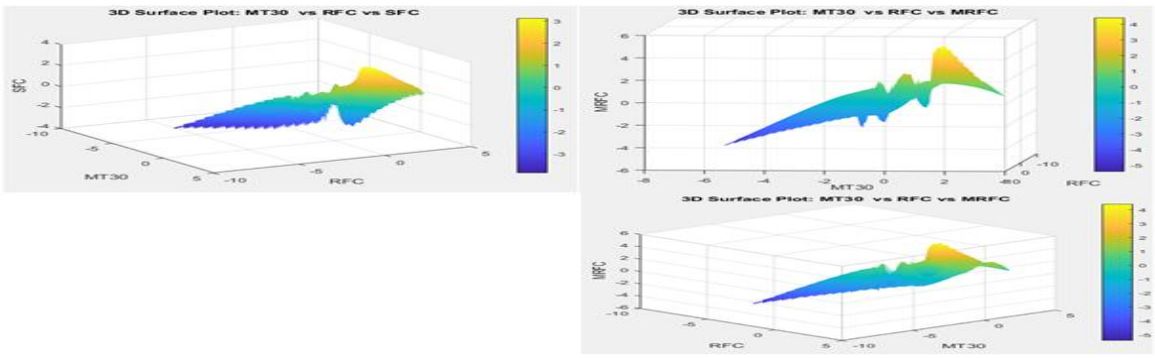
Source: Prepared by the researcher based on the program MTLAP13.

Figure 7: Wavelet coherence between (MT30,STCFC) and the rest of the variables



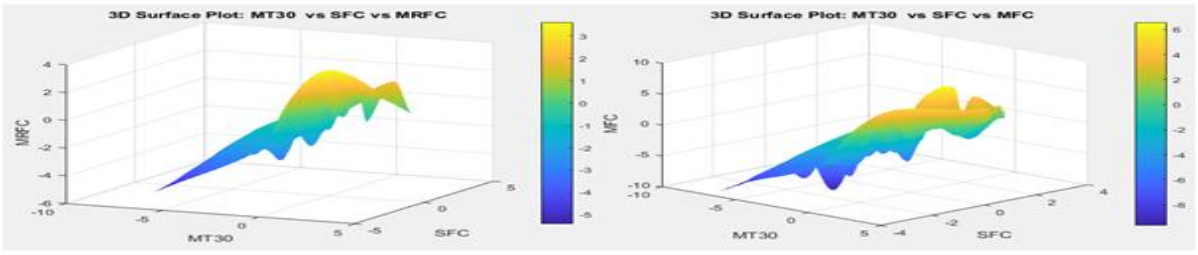
Source: Prepared by the researcher based on the program MTLAP13.

Figure 8: Wavelet coherence between (MT30,RFC) and the rest of the variables



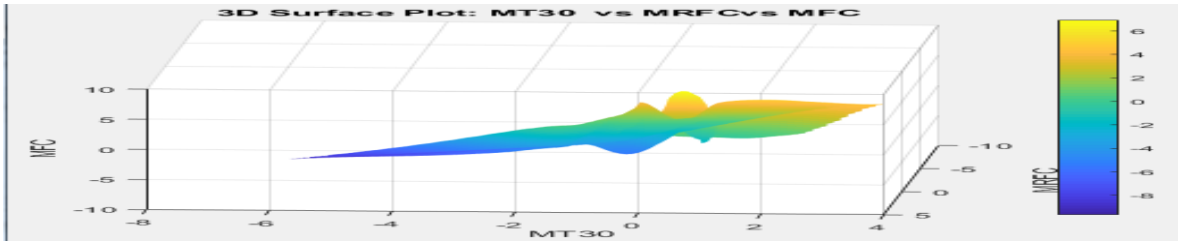
Source: Prepared by the researcher based on the program MTLAP13.

Figure 9: Wavelet coherence between (MT30,SFC) and the rest of the variables



Source: Prepared by the researcher based on the program MTLAP13.

Figure 10: Wavelet coherence between (MT30,MRFC) and MFC



Source: Prepared by the researcher based on the program MTLAP13.

Looking at the details of the figures that depend on linking two variables to a third variable each time, we notice that the values are concentrated on a narrow surface, which indicates the presence of a strong correlation between the two basic variables. As for the (Z) axis, which represents the third variable, all the figures show a shift in color from blue to yellow. This indicates that these variables are rising rapidly in certain areas, represented by the yellow color, after they were rising slowly in the early stages, represented by the blue color.

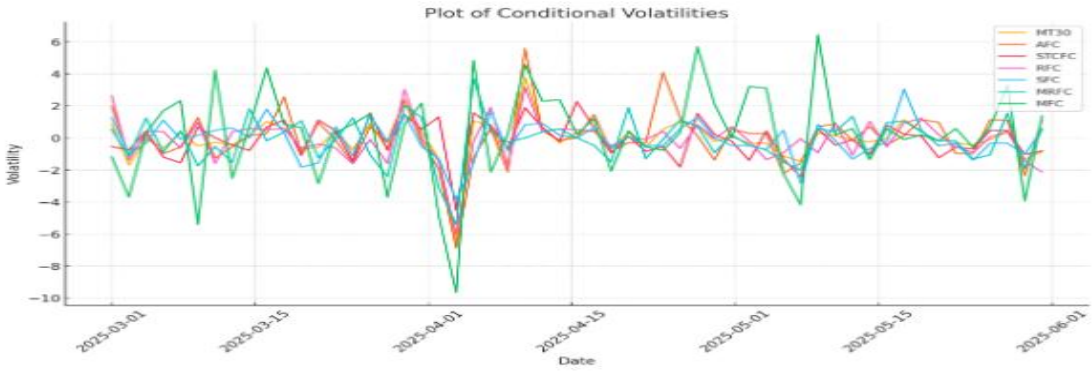
It is clear that all the results obtained through the three-dimensional plot of the MODWTD1 coefficients for the three variables, showing clusters and highlighting the local changes in the wavelet transform field, do not follow clear linear distributions, which can be explained by the presence of unclear interactions in short-term changes, which indicates the presence of deeper relationships dependent on the signal or on time, which enables the construction of anomaly detection systems based on wavelet features and the construction of predictive models.

5.3. Analysis of the results of a multivariate GARCH DCC model

5.3.1. Results of Estimating Conditional Volatility in Futures Contracts and the Futures Benchmark

Figure 11 illustrates the time-varying relationship between the futures contracts of the selected sample for the study and the MT30 benchmark. The results show that the Almarai Company (MRFC) futures contracts and the Al Rajhi Company (RFC) futures contracts are the least volatile over the period. In contrast, we observe extreme volatility in both Ma'aden Company (Minister) futures contracts, followed by STC Company (STC) futures contracts with the least intensity.

Figure 11: Conditional fluctuations of variables



Source: Prepared by the researcher based on the program MTLAP13.

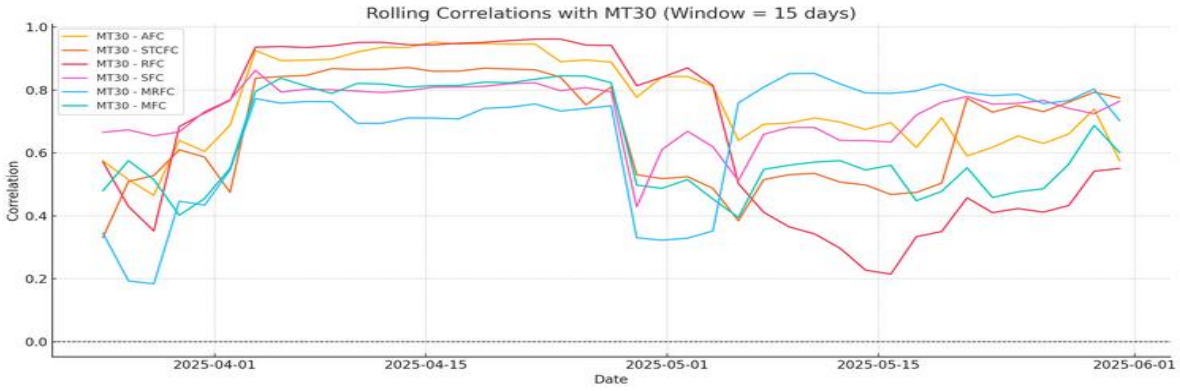
What distinguishes the relationship between the variables is that they roughly follow the same pattern, with varying degrees of influence. This indicates that the futures contracts of the selected sample, which represent the highest-earning companies, follow the same pattern as the benchmarks. This also means that the benchmarks play a leading role in guiding all financial instruments in the same direction.

5.3.2. Analysis of the results of the estimated conditional correlations between futures contracts and the MT30 benchmark index.

Figure 12 shows the conditional correlations for a selected sample of futures contracts in the Saudi financial market and the leading index for the same category of financial instruments. The figure shows two clear periods. In the first period, we observe a strong correlation between the MT30 leading index and futures contracts for Al Rajhi Financial Group (RFC) shares and Al Ahli Financial Group (AFC) shares. In the second period, we observe a slight correlation between the leading index and futures contracts for Almarai Financial Group (MRFC). In the second period of the study, we observe a significant change in the degree of correlation between the benchmark index and the remaining variables. We observe a slight correlation between the MT30 leading index and RFC, after a strong correlation in the first period. Conversely, there is also a strong correlation between the MT30 and MRFC, after a slight correlation in the first period. This indicates some differences in the prediction of futures

prices between the companies listed on the financial market and selected for the study, and between the leading index. The value of the achieved profits, however, remains on the same trajectory. This is primarily due to the overall system of the financial sector in the Kingdom of Saudi Arabia, which has helped create the appropriate environment by developing a well-thought-out economic plan through which it seeks to achieve its financial and economic goals, represented by "Vision 2030."

Figure 12: Error correction for conditional fluctuations of variables



Source: Prepared by the researcher based on the program MTLAP13.

6. Conclusion:

Through this study, we sought to clarify the nature of the relationship between the benchmark futures index and futures returns for a selected sample of companies operating in the Saudi stock market by using the autoregressive conditional heteroskedasticity (ARCH) model as a first step, which showed the presence of a single cointegration vector, which means that the variables are linked by a long-term equilibrium relationship, which means the possibility of using the error correction model (VECM). The results of the analysis of the error correction model (VECM) to determine the trends of external and internal variables show that they have varying sensitivity towards external variables, as the results indicate that in the short run there is a very strong effect of STCFC on itself and MRFC, while MFC has a very strong effect on MRFC, while the rest of the variables have less influence. Regarding the long-run equilibrium relationship represented by COINTEQ1, the MRFC variable is the most responsive to imbalance correction. The most important findings we have reached in this paper can be summarized as follows:

- There is a long-run relationship between (AFC, STCFC, SFC, MFC, MRFC) and (MT30), and this relationship is highly significant between (MRFC, STCFC) and (MRFC, MFC);
- The results show that all variables are endogenous, meaning they are highly sensitive to external variables (the indicative index);
- Revealing the extent of the technical and technological skills possessed by executives within the

financial market by working to achieve the highest returns and reduce the amount of risk;

- This research paper is an ideal model for all employees, including managers, traders, investors, and supervisors, to understand the investment environment within the financial market;
- The existence of a favorable investment environment as a result of the efforts made by the Saudi government to develop its economy based on a well-thought-out future plan that enables it to occupy the top positions in the global economy.

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