Forecasting Financial Markets Indicators
- DFM Index Case Study -

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Summary: This study aims to estimate the Dubai Financial Market index during the time period from 03 January 2022 to 31 January 2024 in order to predict the future values of the index, as the method of random time series conditional on the Heteroskedasticity of error variations was used. The results of the study showed that the index is predictable in the short term, and the best model that can represent observations is the model ARIMA (1,1,1) – GARCH (1,1).

Keywords: Estimate; Financial Market Index; Short Term.

Jel Classification Codes: C01; C13; C51; C53; C87.

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I- Introduction :

The Dubai Financial Market acts as a secondary market for the trading of securities issued by public joint stock companies, bonds issued by the Federal Government or any of the local governments and public institutions in the country, as well as investment fund units and any other financial instruments accepted by the market, whether local or foreign. The Dubai Financial Market (DFM) has commenced operations. On 26 March 2000 it became the first Sharia-compliant exchange globally since 2007 and following the launch of the stock exchange in November 2006 , when the DFM floated 1.6 billion shares, the DFM became a public shareholding company and its shares were listed on the stock exchange price list on 7 March 2007 , and following the initial public offering the Government of Dubai retained the remaining 80 per cent of the trading company the DFM.(The general index of the market Dubai Financial Rulebook 2018)

The Dubai Public Market Index (DFM) was officially launched on 3 December 2006 and aims to replicate the performance of DFM-listed companies. It is widely followed by the investor community and commercial media alike, so it was crucial to keep track of the future levels of this index. Therefore, the following problem can be raised:

Can the future values of the DFM Index be predicted?

To get acquainted with the aspects of the subject, the following questions can be raised:

- Is the movement of the DFM index a random walk?
- What is the best model that can track the movement of the DFM index?

Hypotheses of the study:

- DFM index movement does not follow random walk
- The stochastic time series method conditional on the Heteroskedasticity of error variations can track the movement of the DFM index

I. 1. Previous Studies:

I.1.1.Study of Derbal Amina, Lakhdar Abdelmalek, and Saidi Ammar, under the title Forecasting the Returns of Financial Market Indicators Using GARCH Symmetric and Asymmetric Models Case Study: Dubai Securities Exchange

This study aims to predict the index of the Dubai Financial Market by relying on .Daily database for the period 22/02/2006 to 30/01/2014. The study concluded that a self-regression model conditioned by garch(1,1) heterogeneity of errors has the best predictability.

I.1.2.The study of Abdullah Ayashi and Mohammed Al-Eid Tijani under the title of using hybrid models ARIMA-GARCH to predict the returns of the financial markets index The case study of the Saudi financial market during the period 2009-2019.

This study came to address the problem of the volatility of financial market indicators in light of economic variables and unstable financial crises, through forecasting With the future trends of the returns of the financial market indicators in Saudi Arabia, using the standard modeling of weekly data for the period from 04/01/2009 to 01/12/2019 , with 570 views. The study aims to know the optimal model of ARIMA-GARCH hybrid models to predict the returns of the Saudi stock market index during the aforementioned study period, and its ability to estimate and interpret the fluctuations of the returns of the Saudi stock market index.TADAWUL. The expected results indicated that the hybrid model Arima (1.1.1) -GARCH(1.1) , is able to predict the future trends of the volatility of the returns of the Saudi stock market index during the study periods, enabling it to face the volatility and potential risks of the financial markets.

I.1.3. study by Yahya Abdul Hamid Kamkhali and Hassan Radwan Katlou entitled Using Time Series Analysis Models to Predict the Emerging Financial Markets Index – DFM General Index Case Study.

This study aimed to build a model of random changes in the values of the DFM index using time series analysis models and then predict future changes. The researcher relied on the daily closing prices of the DFM general index during the period from 2010 to 2018 by 2464 views. The researcher found that the appropriate model for prediction is the arima 110 model. He also found that the general trend of the index is upward and therefore attractive and encouraging to invest, and that the DFM is not efficient at the weak level.

II- Methods and Materials:

1- Sample and limits of the study:

In order to achieve the objective of the study, we recorded 525 views of the daily closing prices of the Dubai Financial Market index in the period from 03 January 2022 to 31 January 2024 (holidays and holidays were excluded), all information was taken from the official website of the Dubai Financial Market

2-Study Tools:

In the first step, the chart of the daily observations series of the Dubai Financial Market Index (DFM_index) was used to take an initial look at the trends of the series, and then using the self and partial correlation function, and then we studied the unitary root tests of the series (DFM_index) using the ADF test, the Philips-Perron test, and the KPSS test. In these tests, we relied on EViews9.0 as one of the best programs specialized in time series.

3- Determining the inputs and outputs of the study sample:

The variables of the study are:

- Inputs: Daily DFM Index Views Series (DFM_index);
- Outputs: The optimal model for estimating this series and then predicting future values.

III- Results and Discussion:

1- Chart of the self and partial correlation function of the series (DFM_INDEX) and the series (DDFM_INDEX) :

Chart No. (1) shows that the series of daily observations of the Dubai Financial Market index (DFM_INDEX) is unstable. It does not fluctuate around a fixed medium, as we recorded a large discrepancy between the highest value of the index 4201.840 points on October 03, 2023 and the lowest value of 3325 points on December 09, 2022. When making first-class differences for the same series shown in Figure No. (2), it is clear that it fluctuates around a fixed medium.

2. Graphical representation of the self and partial correlation function of the series (DFM_INDEX) and the series: (DDFM_INDEX)

We note from Figure (03) that the self-connection coefficients calculated for the series **(DFM_INDEX)** for most of the gaps are morally different from zero at a significant rate of 0.05 , that is, outside the field of confidence, and $\left[\frac{-1.96}{\sqrt{n}}, \frac{+1.96}{\sqrt{n}}\right]$ this is evidence of instability. So we use tier one spreads. We note from Figure (04) that the self-connection coefficients calculated for the series **(DDFM_INDEX)** do not differ morally from zero at a significant rate of 0.05 , and this is evidence that the first differences of the series of daily observations of the Dubai Financial Market index are stable.

3- Unitary root tests (ADF test, Philips-Perron test, KPSS test) for series (DFM_index) and series (DDFM_INDEX):

- We note through Table (1) that the values of ADF and Philips-Perron in the three models are less than the critical values extracted from the Mackinnon table in absolute terms, and we also note through the same table that the KPSS values in the two models are greater than the critical values extracted from the Mackinnon table in absolute terms. Thus, the series (DFM_INDEX) under study contains a unitary root, which is unstable.

String stability (DFM_index) can be obtained by using first order spreads.

We note from Table (2) that the values of ADF and Philips-Perron in the three models are greater than the critical values extracted from the Mackinnon table in absolute terms. The KPSS values in both models are lower than the critical values extracted from the Mackinnon table in absolute terms. Thus, the series (DDFM_index) under study does not contain a unitary root and is stable.

4- Testing the ability to predict the future of the chain (DDFM_index) in the short term

A string (DDFM_index) has the ability to predict in the short term if it is not subject to the random walk hypothesis.

To test the random walk hypothesis of the series under study, two basic conditions should be met: independence between observations, and the distribution of these observations follows the normal distribution. If the results conclude that the chains are not subject to the random walk hypothesis, only then can the market index be predicted in the short term, so we will study this as follows:

4-1- Chain Normal Distribution Tests (DDFM_index):

- Through Figure (5), we note that the Skewness coefficient of torsion is equal to (0.817331SK=), which is a value that differs from zero, so the distribution shape is asymmetric. Since SK>0 means that the distribution is twisted to the right, Kurtosis is equal to (KU= 16.641) which is greater than 3, which indicates the presence of anomalies in the series.
- As for the Jarque-Bera statistic, which is equal to 8.843131, it is completely greater than the critical value of a distribution χ^2 with a degree of freedom of 2 at a significant level of 0.05, which is equal to 5,991. Therefore, we conclude that the series (DDFM_index) is not subject to the normal distribution hypothesis, and this is a characteristic characteristic of financial time series in general.

4-2- Testing the independence of series views (DDFM_index):

Through Table (2), which gives the results of the independent observation test for the series (DDFM_index), we note that the p-value values are less than 0.05 for all dimensions, and therefore we conclude that there is a correlation between the observations.

Through the two previous tests, a conclusion can be reached that the series (DDFM_index) is predictable in the short term.

5-Identifying and estimating the appropriate model:

After differentiating a set of models according to the values of Akaike and Schwarz, the selected model was selected to be the Arima model (1,1,1).

Through the estimation results shown in Table (3), we note that the teacher has statistical significance at ϕ the significance level of 0.05, as the value of T Student, which is equal to the absolute value of 3.836946, is completely greater than the critical value of the normal distribution of 1.96. Also, through the same table, we note that the teacher θ_1 has statistical significance at the significance level of 0.05, as the values of T Student2.789873 are completely greater than the critical value of the normal distribution of 1.96. Accordingly, the form is statistically acceptable

6- Arch impact test for errors in the Arima model(1,1,1) :

In Arima self-regression models, variation is constant over time, but in fact, we find that the stability of variation over time cannot always be achieved. When dealing with a financial time series, the idea of equal variation is rarely true because one of the most important advantages of financial time series is that they give accurate predictions of both common variations and variations in the returns of financial assets. These accurate predictions are made through the ability to model time-varying variations. We call the process of time-variance variation the term Heteroskedasticity, and this term is the basis in arch models. The change in variance is related to previous data, which means that this variance is conditional on the verification of previous data in the sense that the variance is conditional.

Through Table No. (5), it is found that the value of Prob Chi-Square(1), which is equal to 0,0000, is less than 0.05. Accordingly, the zero hypothesis is rejected and the alternative hypothesis is H_0 accepted, that is H_1, the variation of errors is not fixed over time, that is, the remainders are subject to the arch model.

7-The impact of estimating errors through symmetrical arch models:

By experimenting with many models through the development of many expanded formulas for symmetrical arch models by increasing the number of transactions, deleting non-significant transactions, and determining the best model for which the Akaike and Schwarz standards are the least possible. This method leads us to choose the GARCH model (1,1) to describe the conditional variation behavior of the Dubai market index, which is given by the following relationship: $\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \delta_1 \sigma_{t-1}^2$

Through Table (7), which shows the values of the variables forming the GARCH model (1,1), we derive the following equation of conditional variation behavior: $\sigma_t^2 = 38.52533 + 0.147124\,\varepsilon_{t-1}^2 + 0.807042\,\sigma_{t-1}^2$

Through the results obtained from Table (5), the proposed model can be accepted for the following considerations:

- All milestones are statistically significant, that is, they differ morally from zero by a significant percentage of 0.05. Reject H_0 (Student values are completely greater than the critical value of the normal distribution 1.96),
- The two coefficients of the GARCH model δ_1 are positive α_1 and positive, that $\alpha_1 + \delta_1 = 0.147124 + 0.807042 = 0.954166 < 1$ is, the stability condition is met.
- The Drebin-Watson statistic of1.992473 indicates that there is independence among the rest of the estimate.

Through Table (6), it is clear that the value of Prob Chi-Square(1), which is equal to 0.3519, is greater than 0.05. Therefore, the zero hypothesis is accepted and the alternative hypothesis is rejected H_1 H_0, that is, the variation of errors is fixed across time, that is, the residues of the model Arima (1,1,1) -GARCH(1,1) are not subject to the arch model.

8- Forecasting the future values of the DFM Index:

After confirming the validity of the model Arima (1,1,1) -GARCH(1,1) , and after testing the ability of observations to predict the short term, we predicted 30 observations outside the study sample, (see Figure (6))

IV- Conclusion:

By estimating the DFM Index, we have reached many results, including:

- The daily series of observations of the DFM index is not subject to the random walk hypothesis and therefore has the ability to predict the short term.
- After using several arch models, we found by differentiating between these models by several criteria that the best model that can represent the time series of stock prices is the Arima model(1,1,1) with the GARCH error (1,1).
- A significant decline in the Dubai Financial Market index at the end of the study period compared to its beginning due to the impact of financial markets in the region on rising geopolitical risks after the conflict between Israel and Hamas cast a shadow over morale, as well as the headwinds due to monetary policy and geopolitical turmoil.
- The predicted values of the Dubai Financial Index also gave low levels, although they did not take into account geopolitical turmoil, which obliges the authorities in the UAE to remedy the matter.

- Appendices:

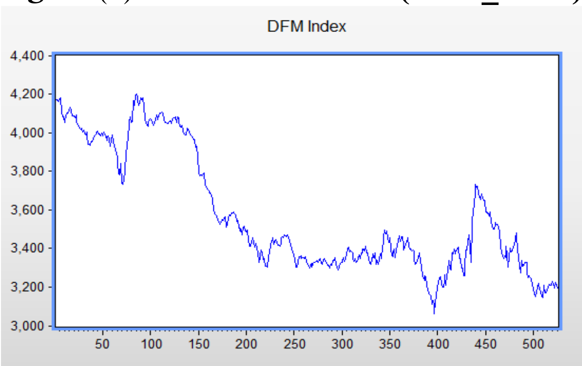
Table (1) : Unitary root tests (ADF test, Philips-Perron test, KPSS test) for series (DFM_index) and series (DDFM_INDEX):

السلسلة (DFM_INDEX)			
بدون ثابتة واتجاه	بوجود ثابتة فقط	بوجود ثابتة واتجاه	النموذج
0.0951 (– 1.94)	0.5086 (-2.86)	0.6617 (-3.41)	**ADF**
0.1242 (-1.94)	0.4748 (-2.86)	0.5468 (-3.41)	**Philips-Perron**
	2.2366 (0.463)	0.4468 (0.146)	، **KPSS**
السلسلة (DDFM_INDEX)			
بدون ثابتة واتجاه	بوجود ثابتة فقط	بوجود ثابتة واتجاه	النموذج
0.000 0	0.000 0	0.000 0	**ADF**

(− 1.94)	(−2.86)	(−3.41)	
0.000 0 (−1.94)	0.000 0 (−2.86)	0.000 0 (−3.41)	**Philips-Perron**
	0.086 (0.463)	0.049 (0.146)	**KPSS**

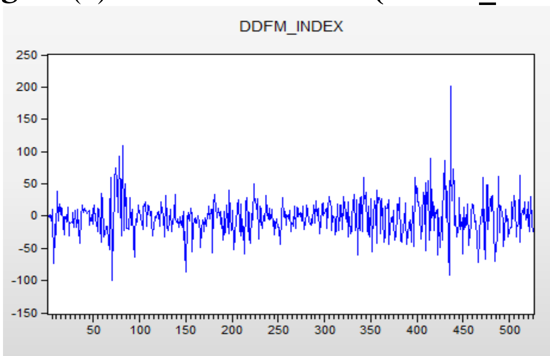
The source : Prepared by the researcher based on EViews9.0

Figure (1): the chart of series (DFM_index)



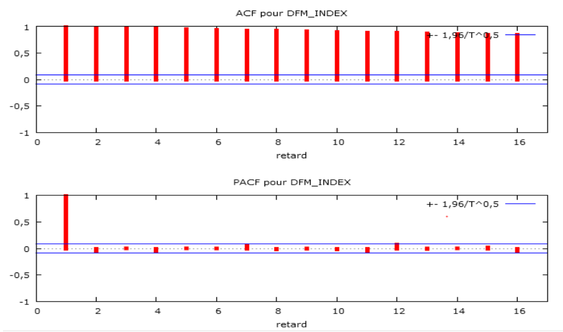
The source : Prepared by the researcher based on EViews9.0

Figure (2): the chart of series (DDFM_index)



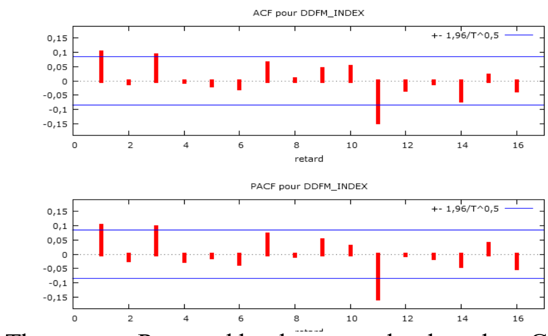
The source : Prepared by the researcher based on EViews9.0

Figure (3): Graphical representation of the self and partial correlation function of the series (DFM_INDEX)



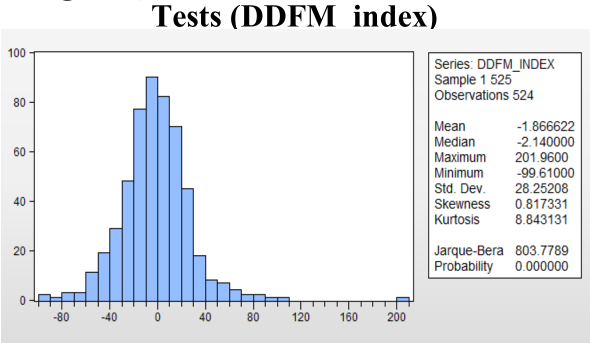
The source : Prepared by the researcher based on Gretl

Figure (4): Graphical representation of the self and partial correlation function of the series (DFM_INDEX)



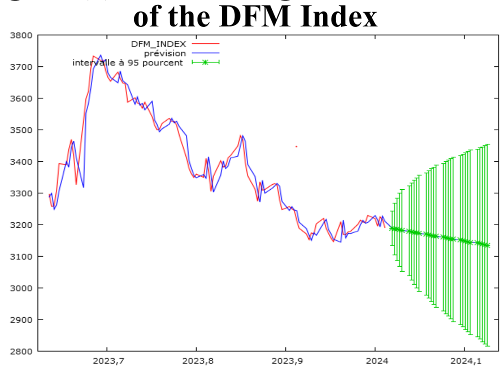
The source: Prepared by the researcher based on Gretl

Figure (5): Chain Normal Distribution Tests (DDFM_index)



The source : Prepared by the researcher based on EViews9.0

Figure (6): Forecasting the future values of the DFM Index



The source: Prepared by the researcher based on Gretl

Table (2) : Testing the independence of series views (DDFM_index)

BDS Test for DDFM_INDEX
Date: 02/05/24 Time: 17:22
Sample: 1 525
Included observations: 525

Dimension	BDS Statistic	Std. Error	z-Statistic	Prob.
2	0.021852	0.003643	5.999004	0.0000
3	0.041493	0.005775	7.184940	0.0000
4	0.052134	0.006860	7.599307	0.0000
5	0.057177	0.007133	8.015715	0.0000
6	0.057644	0.006862	8.399972	0.0000
7	0.057358	0.006273	9.143506	0.0000
8	0.055284	0.005531	9.995806	0.0000
9	0.051467	0.004746	10.84347	0.0000
10	0.046978	0.003989	11.77677	0.0000
11	0.042141	0.003297	12.78070	0.0000
12	0.037975	0.002689	14.12422	0.0000

The source : Prepared by the researcher based on EViews9.0

Table (3) : Identifying and estimating the appropriate model

Dependent Variable: DDFM_INDEX
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 02/05/24 Time: 07:19
Sample: 2 525
Included observations: 524
Estimation settings: tol= 1.0e-05, derivs=analytic (linear)
MA derivatives use numeric methods
Initial Values: C(1)=0.11000, C(2)=0.08774, C(3)=796.577
Convergence achieved after 27 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AR(1)	0.108097	0.031916	3.386946	0.0008
MA(3)	0.105295	0.037742	2.789873	0.0055
SIGMASQ	783.2039	27.97510	27.99647	0.0000

R-squared	0.016887	Mean dependent var	-1.866622
Adjusted R-squared	0.013113	S.D. dependent var	28.25208
S.E. of regression	28.06624	Akaike info criterion	9.512807
Sum squared resid	410398.8	Schwarz criterion	9.537205
Log likelihood	-2489.356	Hannan-Quinn criter.	9.522362
Durbin-Watson stat	1.992473		

Inverted AR Roots	.11		
Inverted MA Roots	.24+.41i	.24-.41i	-.47

The source : Prepared by the researcher based on EViews9.0

Table (4) : test ARCH

Heteroskedasticity Test: ARCH

F-statistic	19.81162	Prob. F(1,521)	0.0000
Obs*R-squared	19.15913	Prob. Chi-Square(1)	0.0000

The source : Prepared by the researcher based on EViews9.0

Table (5): Estimating the Dubai Financial Market Index using models

Dependent Variable: DDFM_INDEX
Method: ML ARCH - Normal distribution (OPG - BHHH / Marquardt steps)
Date: 02/05/24 Time: 07:24
Sample (adjusted): 2 525
Included observations: 524 after adjustments
Estimation settings: tol= 1.0e-05, derivs=numeric (linear)
MA derivatives use numeric methods
Initial Values: C(1)=0.00500, C(2)=0.00500, C(3)=520.092, C(4)=0.15000, C(5)=0.60000
Convergence achieved after 29 iterations
Coefficient covariance computed using outer product of gradients
Presample variance: backcast (parameter = 0.7)
GARCH = C(3) + C(4)*RESID(-1)^2 + C(5)*GARCH(-1)

Variable	Coefficient	Std. Error	z-Statistic	Prob.
AR(1)	0.084397	0.044341	1.903358	0.0570
MA(3)	0.062924	0.050206	1.253335	0.2101
Variance Equation				
C	38.52533	13.50813	2.852010	0.0043
RESID(-1)^2	0.147124	0.027148	5.419248	0.0000
GARCH(-1)	0.807042	0.038633	20.89018	0.0000

R-squared	0.014711	Mean dependent var	-1.866622
Adjusted R-squared	0.012823	S.D. dependent var	28.25208
S.E. of regression	28.07036	Akaike info criterion	9.338780
Sum squared resid	411307.2	Schwarz criterion	9.379443
Log likelihood	-2441.760	Hannan-Quinn criter.	9.354704
Durbin-Watson stat	1.949679		

The source : Prepared by the researcher based on EViews9.0

Table (6) : test arch

Heteroskedasticity Test: ARCH

F-statistic	0.864560	Prob. F(1,521)	0.3529
Obs*R-squared	0.866441	Prob. Chi-Square(1)	0.3519

The source : Prepared by the researcher based on EViews9.0

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