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Analysis of the Determinants of Financial Market Efficiency in the Mena Region: An Empirical Approach

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Abstract:- This article presents an empirical study focusing on the daily returns of the main stock indices from eight countries included in the sample. Serial autocorrelation tests were conducted to evaluate the presence of temporal autocorrelations within these returns.

The results of these tests highlight that among the eight markets analyzed, only five were deemed efficient in terms of the absence of significant serial autocorrelations in the logarithmic returns of the major stock indices in our sample. Specifically, the markets of Egypt, Bahrain, Kuwait, the United Arab Emirates, and Jordan demonstrated a lack of significance in the autocorrelation coefficients up to the seventh lag, thus revealing a certain form of limited efficiency. On the other hand, the markets of Morocco, Tunisia, and Qatar exhibited significant autocorrelation coefficients, indicating inefficiency in terms of serial dependence.

To deepen the understanding of these results, a probit analysis was conducted to identify the determinants of financial market efficiency within the MENA region. Independent variables such as market age, the number of listed companies, market capitalization, and government efficiency were integrated into the model. The results revealed that some of these variables exert a significant influence on the efficiency of financial markets in the MENA region.

Keywords*: Markets efficiency, Autocorrelations test, probit model, MENA REGION, RANDOMWALK.*

1. Introduction

One of the most important roles of financial markets is to channel savings towards the most productive uses. In order to achieve this, prices in these markets should instantaneously and without delay incorporate all available information about these securities. This concept is referred to as the informational efficiency of the financial market, as defined by Fama (1965).

The hypothesis of informational efficiency in financial markets has been extensively addressed in modern financial literature. Efficiency tests have been conducted in various developed and frontier markets. It is also commonly used by practitioners and theorists, as many other theories, including approaches to financial asset valuation and the Capital Asset Pricing Model (CAPM), rely on its validity.

However, studies on the MENA markets are quite rare. Most of these studies have predominantly concluded in favor of the inefficiency of these markets, although they have generally not attempted to explain the causes of efficiency or inefficiency.

Concurrently, the regulatory authorities in the MENA region are undoubtedly aware of the importance of efficient financial markets for enhancing their attractiveness and competitiveness on the international stage. Several reforms have been initiated with the aim of achieving a level of efficiency that garners investor confidence.

In this article, we seek to fill the observed gap in financial literature on this subject. On one hand, we aim to update the efficiency status of these markets given the noticeable improvements in their conditions. On the other hand, we intend to identify the socio-economic factors that might explain the obtained results.

2. Literature Review

2.1. The Hypothesis of Informational Efficiency

The market allows for a confrontation of supply and demand, resulting in asset prices that are listed there. At its optimum, prices should incorporate all available information in their formation, making it qualified as an efficient market. Efficiency refers to the results of an action in relation to the resources mobilized. From a financial theory perspective, efficiency can take on several forms:

Operational efficiency: A market is operationally efficient if it facilitates the optimal connection between suppliers and demanders of capital at the lowest costs.

Allocational efficiency: This efficiency describes the major role entrusted to the financial market, which is channeling savings towards the most productive uses. Marginal returns would be equal at all times between lenders and borrowers in such a situation.

Informational efficiency: A market is informationally efficient if prices in this market fully, instantaneously, and without delay incorporate all available information. (Fama, 1965)

The definition provided by (Fama, 1965) regarding informational efficiency initially seemed too ambiguous to be subjected to empirical verification due to the imprecision of the concept of "available information." Therefore, in (Fama, 1970), he returned to provide a more precise definition by distinguishing three different levels of informational efficiency:

Weak form: This form of efficiency states that security prices reflect all historical price or return information. Under such conditions, it would be impossible to profitably anticipate stock prices using past information. Thus, the best way to predict future prices is through current information or future expectations. In other words, everything that happens between time t and time t+1 is random, and returns and prices between these periods are statistically independent. This means that predicting future fluctuations from methods based on historical information, such as technical analysis or chartism, would be impossible.

Semi-strong form: This form assumes that security prices instantaneously reflect all deducible information from historical information, as well as all public information. In other words, the price incorporates all public information, including data from issuing companies such as annual reports, profit announcements, stock dividends, and information published by the press. This type of efficiency renders fundamental analysis useless, as public information, which can help assess asset prices from the perspective of fundamental finance under the rational expectations hypothesis, becomes unusable.

Strong form: In this form of efficiency, prices are assumed to reflect all information about the security, including historical, public, and private information. This includes information held by insiders of the company, such as executives and portfolio managers. In these conditions, exploiting any kind of information would be pointless.

Thus, the information integrated into prices includes all information regarding prices, including historical, public, and private information. This means that even insiders' information is included in the stock price. Consequently, insider trading would not be beneficial in this case.

In his article published in 1991, FAMA redefined the three forms of efficiency through three types of empirical tests to validate them. Thus, weak form efficiency becomes the study of predictability of returns. It is validated through tests that check whether it is possible to predict future stock prices based on historical information (prices, dividends, etc.). Furthermore, the semi-strong form encompasses event studies regarding public information. These tests verify whether the information in question is already incorporated into the stock price by analyzing price behavior before and after their disclosures. Moreover, tests of strong efficiency will assess whether company insiders with access to privileged information can achieve abnormal profits.

Validating one of the aforementioned forms directly impacts portfolio management methods, investment strategy selection, and security evaluation. For each form of efficiency, it is no longer possible for an investor to use desired information type to obtain excess returns. Additionally, it is impossible to generate profits or returns above average or the buy-and-hold strategy without incurring additional risk.

It should be noted that Fama's definition is not the only one in the literature. Other definitions have been formulated. In 1981, Beaver defined the concept of informational efficiency in relation to a set of signals given by the market. He considers a market efficient with respect to a signal if the configuration of security prices is identical to what it would have been in an economy where each agent receives the signal (information) at once. Latham (1986) argues that markets are efficient with respect to specific information if the revelation of this information to all operators would not impact stock prices. In 1992, Malkiel synthesized the various aforementioned definitions as follows:

"A financial market is efficient if it completely and correctly reflects all relevant and necessary information for price determination. Formally, the market is efficient with respect to a certain category of information... if prices are not affected by the revelation of this information to all agents. Efficiency with respect to this information... implies that it is not possible to achieve abnormal profits with respect to this information."

2.2. Empirical Tests of Informational Efficiency:

It is worth noting that tests of the hypothesis of informational efficiency in financial markets are abundant in financial literature. Our objective here is to review the works that seem most relevant.

As mentioned earlier, (Fama, 1965) demonstrated that the successive variations of the thirty stocks comprising the Dow Jones index during the period from 1957 to 1962 were independent. He thus confirmed the validity of the random walk hypothesis and found no significant autocorrelation regardless of the data frequency used (daily or even weekly).

(Bruno H. Solnik, 1973) conducted a similar study on eight markets in Europe: France, Italy, Great Britain, Germany, the Netherlands, Belgium, Switzerland, and Sweden. Solnik calculated autocorrelation coefficients for the main indices of each country for daily, weekly, biweekly, and monthly variations. The results indicated that the American market was more efficient than those in Europe.

(Fontaine, 1973) investigated the predictability of future stock prices based on past prices and dividends. His study covered the markets of Great Britain, the United States, Japan, and France. His results were as follows:

The random walk was validated by the portmanteau test (Box-Pierce) in all markets and for all lags.

The null hypothesis of the Dickey-Fuller test was accepted for all markets.

For the variance ratio test, he showed that for all lags and in all markets studied, except for the French market at the second lag, the hypothesis of random movement of stock prices was validated.

(Zadjenweber, 1994) conducted a study on the daily logarithmic returns of the CAC 40 index in the French market from 1982 to 1993 using run tests. He concluded that:

For the period between 1982 and 1987, the process of daily logarithmic return evolution of the CAC 40 index was non-stochastic and differed from random walk; prices exhibited positive dependence.

For the period between 1988 and 1993, the random walk hypothesis was accepted.

(French & Roll, 1986) calculated autocorrelation coefficients of daily returns for NYSE-listed stocks from 1963 to 1982. They calculated coefficients for 15 time lags to test the randomness of stock prices in this market. Their results were as follows:

First-order coefficients were, on average, all positive for most listed companies and negative for larger firms.

Coefficients from the second to 13th day were negative and turned positive beyond a 13-day lag.

(Andrew W. Lo & Craig Mackinlay, 1988) analyzed returns of NYSE-listed stocks grouped by size from 1962 to 1985. They demonstrated through variance ratio tests that weekly returns of listed companies did not follow a random process and that there was a positive linear dependence between these returns. They also noted that autocorrelations were more significant for smaller firms.

(Cowles, 1933) confirmed that series of returns in the American market evolved randomly and unpredictably.

(Kendall & Hill, 1953) working on twenty-two weekly series, showed that prices in the American market followed a random process.

Initial empirical tests on market efficiency were conducted in developed markets and generally supported weak efficiency in these markets due to the low autocorrelation of their returns and low transaction costs. There were numerous works in this direction, including studies conducted by (Working, 1934); (Kendall, 1943); (Kendall, 1953); (Cootner, 1964); (Fama, 1965), which covered stock markets in Australia, Europe, and the United States. These studies all support the idea that successive changes in asset prices in markets are random and not dependent on historical variations.

(Malkiel, 2003), (Jensen, 1978), (French & Roll, 1986) confirmed market efficiency for stocks, bonds, options, and commodities in developed countries like the United States, European countries, and Australia.

Over time, several studies confirmed the hypothesis of financial market efficiency, making it a paradigm of modern finance. However, this theory no longer enjoys unanimous conclusions. It has been critiqued by a new school of thought in the scientific community, the behaviorists, such as (Grossman and Stiglitz, 1980), (Case & Shiller, 1989), (Lo & MacKinlay, 2014), who argue that the market efficiency hypothesis lacks a solid foundation. (Vuillemey, 2013) even criticized the efficiency hypothesis epistemologically, suggesting it should be seen as a research program rather than a hypothesis in itself due to issues like the joint hypothesis problem, the diversity of valuation models, and the "general" definition of the term "relevant information," as well as the subjectivity of its judgment.

Efficiency Tests in the MENA Region:

(Elhami & Hefnaoui, 2018) conducted an empirical study on the efficiency hypothesis of financial markets in the MENA region, covering the period from May 2005 to April 2012, focusing on the stock indices of Bahrain, Egypt, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Tunisia, United Arab Emirates, as well as the GCC market group and the group of all Arab markets. They employed variance ratio tests developed by (Chow & Denning, 1993), in addition to unit root tests. Their findings suggest that the returns of MENA region markets are stationary, with the presence of structural breaks. They also concluded that these markets were close to a state of weak efficiency, which could be a positive outlook for these markets.

(Al-Khazali et al., 2007) studied the behavior of stock indices in eight countries in the MENA region, including Bahrain, Kuwait, Jordan, Morocco, Oman, Saudi Arabia, Tunisia, and Egypt, over the period from 1994 to 2004. They concluded that the evolution of none of these markets was random, attributing this to the youthfulness of these markets and the limited number of transactions within them.

(Ahmed Baghli, 2012) used the same battery of tests to examine the weak efficiency hypothesis of MENA markets, concluding their inefficiencies in the weak sense.

Harrison & Moore (2012) also analyzed the efficiency of MENA markets using the state space model and autocorrelation tests. They demonstrated that, except for the Jordanian and Dubai stock exchanges, the time series of returns in various MENA markets exhibited autocorrelation.

(Elhami & Hefnaoui, 2018) conducted an analysis of the weak efficiency hypothesis on a sample of MENA region countries consisting of emerging and frontier markets. They employed various tests, such as autocorrelation tests, runs tests, the multiple variance ratio test. The study covered a seven-year period, and the analysis concluded in favor of the inefficiency of these markets.

In light of the aforementioned studies, our objectives are to test the informational efficiency of financial markets in the MENA region and to determine the factors that may explain the obtained results. Therefore, our research questions are formulated as follows:

Are the markets in the MENA region efficient?

What are the determinants of weak efficiency in markets within the MENA region?

3. Methodology

3.1 Informational Efficiency Test

The purpose of this study is to analyze the informational efficiency of a representative sample from the MENA region, consisting of 8 countries (Morocco, Tunisia, Egypt, Qatar, Bahrain, Jordan, Kuwait, and the United Arab Emirates).

The study of return time series covers the period from 01.01.2000 to 31.12.2020, encompassing 10 years of daily data. The chosen efficiency test is the test of serial autocorrelation applied to the logarithmic return series of the main indices of the stock markets under investigation in our study.

The logarithmic return is expressed as:

$R_t = \ln(p_t) - \ln(p_{t-1})$

p_t : price at time t.

p_{t-1}: price at time t-1.

The autocorrelation function measures the serial correlation between variable k at time t and the same variable delayed at time t-k, where k represents the lag:

$$\rho_k = \frac{cov(R_t, R_{t-k})}{\sigma_{R_t} . \sigma_{R_{t-k}}}$$

$$\rho_k = \frac{\sum_{t=1}^{t=n-k}(R_t - \bar{R})(R_{t-k} - \bar{R})}{\sqrt{\sum_{t=1}^{t=n-k}(R_t - \bar{R})^2} . \sqrt{\sum_{t=1}^{t=n-k}(R_{t-k} - \bar{R})^2}}$$

If the number of observations is large, as is the case in our study, the autocorrelation formula for sampling can be used (Régis Bourbonnais, n.d.2003). It is more practical, and we note:

$$\rho_k = \frac{\sum_{t=1}^{n-k}(R_t - \bar{R})(R_{t+k} - \bar{R})}{\sum_{t=1}^{n}(R_t - \bar{R})^2}$$

With:

N: the number of observations.

$\bar{y}$: the average of prices.

Since the coefficient of serial autocorrelation measures the degrees of dependence of a variable with respect to its lagged historical values, a zero ρ_k indicates that price variation is not autocorrelated. Conversely, a non-zero ρ_k indicates that price changes are correlated. A null autocorrelation is a sign of the weak-form efficiency hypothesis's validity, as it shows that past returns do not influence future prices, or in other words, historical information is already incorporated into prices (Fama, 1970).

In light of the literature review, to test whether serial autocorrelation is significantly different from zero at a 5% significance level, we formulate the following null and alternative hypotheses:

$H_0 : \rho_k = 0$

$$H_1 : \rho_k \neq 0$$

We can use a hypothesis test for the autocorrelation coefficient based on the comparison of an empirical t-test with a theoretical t-distribution. Indeed, (Quenouille, 1949) demonstrated that if the number of observations is greater than 30 (n > 30), the correlation coefficients follow a normal distribution with a mean of zero and a standard deviation of $= \frac{1}{\sqrt{n}}$, $\rho_k \sim N(0; \frac{1}{\sqrt{n}})$.

The confidence interval is then:

$$\rho_k = 0 \pm t^{\frac{\alpha}{2}}\left(\frac{1}{\sqrt{n}}\right)$$

With $t = \frac{\widehat{\rho_k}}{\sigma(\rho_k)}$ or :

$$\sigma(\rho_k) = \frac{1}{\sqrt{N}}\sqrt{1 + 2\sum_{1}^{n-k} {\rho_k}^2}$$

Insignificant autocorrelations for all lags would indicate market efficiency, suggesting that markets can follow a random walk. Conversely, significant autocorrelation at a certain lag different from zero would lead us to reject the weak-form market efficiency hypothesis.

3.2 Identification of Efficiency Factors in the MENA Markets

In this step, we aim to determine the factors explaining the efficiency and inefficiency of financial markets in the MENA region. To achieve this, we define the PROBIT model as follows:

$$Y_m = f(X_m)$$

Where $1 \leq m \leq 7$ represents the market in question, and Y_m represents a binary variable taking the value 1 in the case of an efficient market and 0 in the case of inefficiency. Xm represents the variables that could explain efficiency.

$$P(Y = 1) = G(\beta_1 + \beta_2 X_1 + \cdots + \beta_5 X_5)$$

In this context, the proposed variables are as follows:

The number of listed companies in the market: This variable accounts for the diversity of choices available to investors in the market.

Market capitalization as a % of GDP: The role of this variable is to measure the market's size relative to the economy in which it operates.

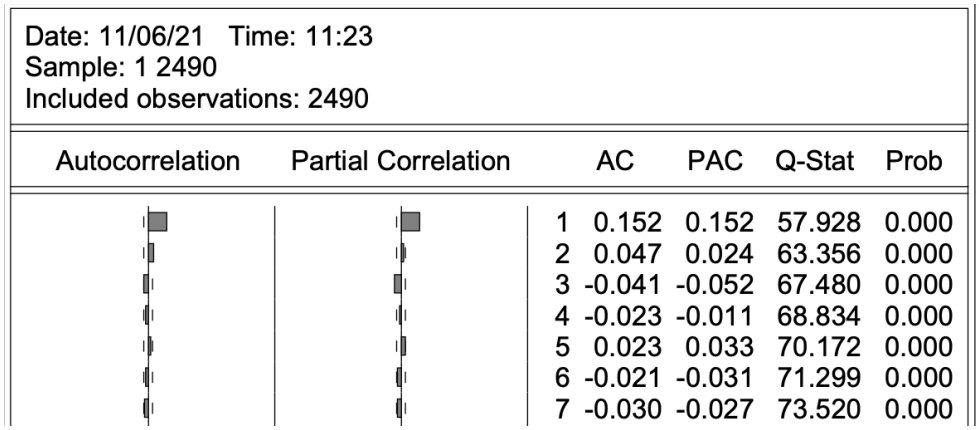
Market age: It measures the market's age, which is the difference between the market's creation date and the current year (2022).

Governement efficiency variable: Developed by (Kaufmann et al; 2011), these ratios describe the legal environment in the studied countries. They are collected from the website: www.govindicators.org

3. Results and Discussion

3.1 Results of Weak Efficiency Tests (Serial Autocorrelation Tests) :

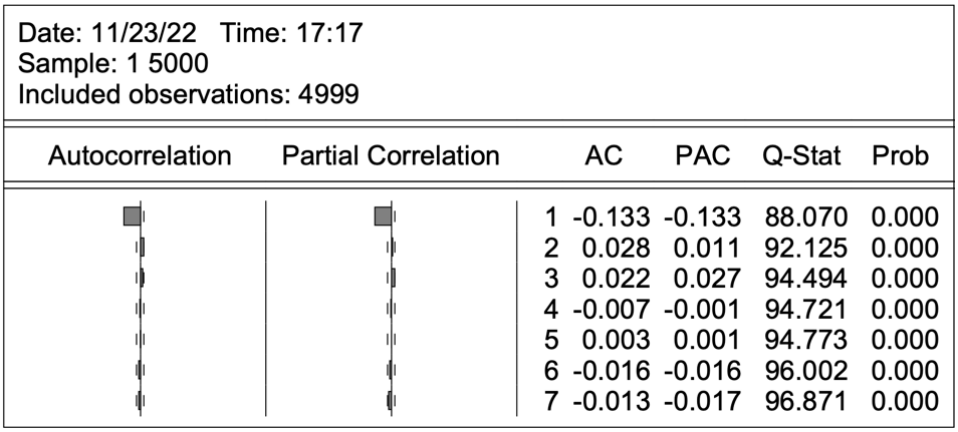
MADEX :



	AC	PAC	Q-Stat	Prob
1	0.152	0.152	57.928	0.000
2	0.047	0.024	63.356	0.000
3	-0.041	-0.052	67.480	0.000
4	-0.023	-0.011	68.834	0.000
5	0.023	0.033	70.172	0.000
6	-0.021	-0.031	71.299	0.000
7	-0.030	-0.027	73.520	0.000

Figure 1 MADEX CORRELOGRAM

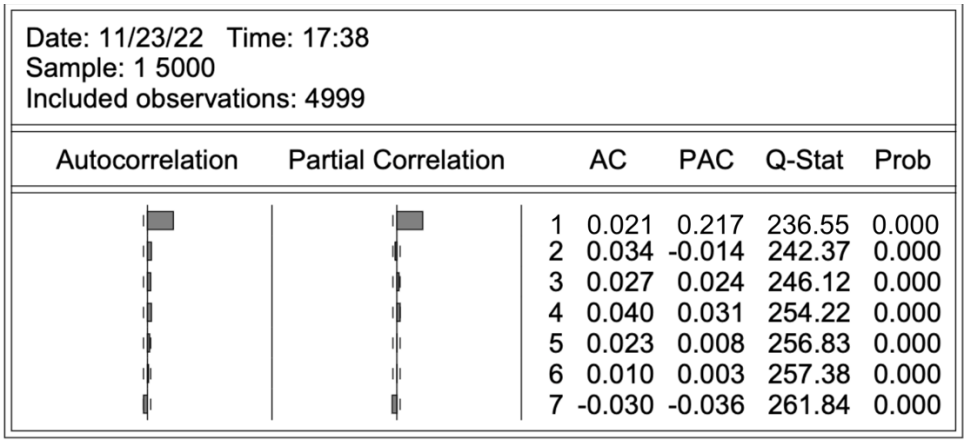
TUNINDEX :



	AC	PAC	Q-Stat	Prob
1	-0.133	-0.133	88.070	0.000
2	0.028	0.011	92.125	0.000
3	0.022	0.027	94.494	0.000
4	-0.007	-0.001	94.721	0.000
5	0.003	0.001	94.773	0.000
6	-0.016	-0.016	96.002	0.000
7	-0.013	-0.017	96.871	0.000

Figure 2 TUNINDEX CORRELOGRAM

EGX :

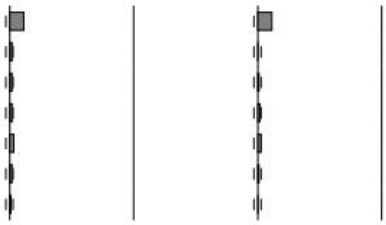


	AC	PAC	Q-Stat	Prob
1	0.021	0.217	236.55	0.000
2	0.034	-0.014	242.37	0.000
3	0.027	0.024	246.12	0.000
4	0.040	0.031	254.22	0.000
5	0.023	0.008	256.83	0.000
6	0.010	0.003	257.38	0.000
7	-0.030	-0.036	261.84	0.000

Figure 3 EGX CORRELOGRAM

QSI :

Date: 08/04/23 Time: 11:55
Sample: 1/03/2000 1/01/2020
Included observations: 4132

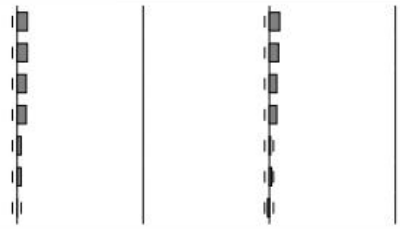


	AC	PAC	Q-Stat	Prob
1	0.121	0.121	60.139	0.000
2	0.017	0.002	61.325	0.000
3	0.017	0.015	62.508	0.000
4	0.023	0.020	64.771	0.000
5	0.037	0.032	70.457	0.000
6	0.023	0.015	72.716	0.000
7	0.012	0.006	73.284	0.000

Figure 4 QSI CORRELOGRAM

BAX :

Date: 08/04/23 Time: 10:49
Sample: 1/03/2000 1/01/2020
Included observations: 2627



	AC	PAC	Q-Stat	Prob
1	0.083	0.083	17.932	0.000
2	0.088	0.081	38.129	0.000
3	0.075	0.062	52.795	0.000
4	0.079	0.063	69.379	0.000
5	0.036	0.015	72.749	0.000
6	0.040	0.021	76.938	0.000
7	0.003	-0.014	76.970	0.000

Figure 5 BAX CORRELOGRAM

AMMAN ALLSHARES :

Date: 08/04/23 Time: 12:00
Sample: 1/03/2000 1/01/2020
Included observations: 4699

	AC	PAC	Q-Stat	Prob
1	-0.078	-0.078	28.836	0.000
2	-0.063	-0.069	47.391	0.000
3	-0.009	-0.019	47.732	0.000
4	0.007	0.000	47.972	0.000
5	0.023	0.022	50.487	0.000
6	0.001	0.006	50.496	0.000
7	0.014	0.018	51.360	0.000

Figure 6 AMMANALLSHARES CORRELOGRAM

BKA :

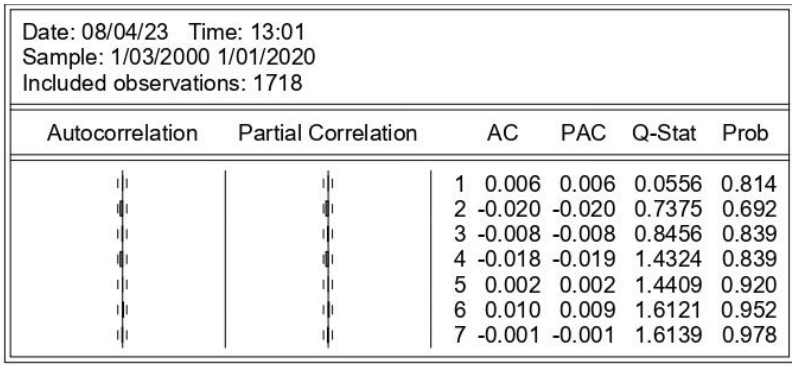


Figure 7 BKA CORRELOGRAM

DFMGI :

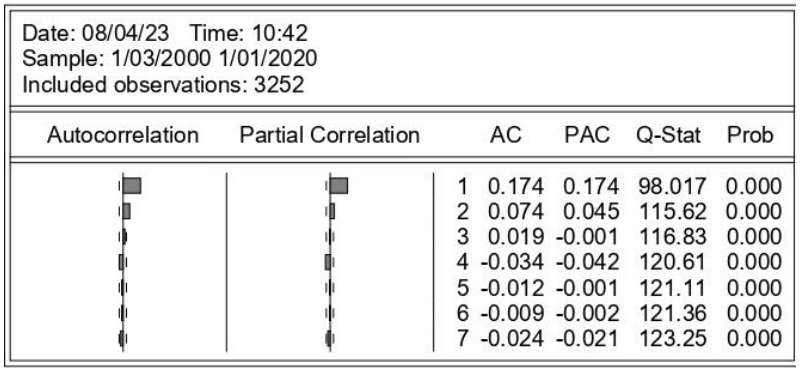


Figure 8 DFMGEN CORRELOGRAM

The results of weak efficiency tests for the chosen sample markets are summarized in the table below. We calculated serial autocorrelation coefficients up to the 7th lag, using a significance level of 5%. The results indicate that 5 markets in the sample exhibit weak efficiency due to the non-significance of their autocorrelation coefficients up to the 7th lag. These markets include Egypt, Bahrain, Jordan, Kuwait, and the United Arab Emirates. Meanwhile, the Moroccan and Tunisian markets, as well as Qatar, are considered inefficient due to the significance of their autocorrelation coefficients, particularly at the first lag. This signifies that today's prices are significantly dependent on yesterday's prices, which contradicts the assumption of market efficiency that prices should follow a random walk process.

The table below summarizes the results obtained for the different markets:

countries	**Index**	**PAC LAG**						
		1	**2**	**3**	**4**	**5**	**6**	**7**
Morocco	*MADEX*	0,152**	0,024	-0,052	-0,011	0,033	-0,031	-0,027
TUNISIA	*TUNINDEX*	-0,13**	0,028	0,022	-0,07	0,003	-0,016	-0,013
EGYPTE	*EGX 30*	0,027	0,034	0,027	0,04	0,023	0,01	-0,003
Qatar	*QSI*	*0,121***	*0,0017*	*0,0017*	*0,0023*	*0,0037*	*0,0023*	*0,0012*
BAHRAIN	*BAX*	*0,083*	*0,088*	*0,075*	*0,079*	*0,036*	*0,04*	*-0,014*
Jordan	*AMGNRLX*	*-0,078*	*-0,063*	*-0,009*	*0,007*	*0,023*	*0,001*	*0,014*
Koweït	*BKA*	0,008	-0,019	-0,006	-0,019	0,005	0,012	-0,004
U.A.E.	*DFMGI*	0,066	0,031	0,008	0,038	0,060	0,003	0,027

3.2. Analysis of explanatory factors for the results:

By examining these factors, we aim to understand the determinants of market efficiency and to identify significant variables that can predict whether a market is efficient or not.

To accomplish this, we employ a statistical modeling approach, specifically binary logistic regression. This method will enable us to analyze the relationship between the binary variable "efficient or not" and the selected explanatory variables: market age, number of listed companies, market capitalization, and government efficiency.

Using this approach, we can estimate the coefficients associated with each explanatory variable and determine their impact on the probability of market efficiency. We will also seek to evaluate the statistical significance of these variables to ascertain their importance in predicting market efficiency.

This modeling will thus allow us to deepen our understanding of the factors influencing financial market efficiency. The obtained results will contribute to the existing literature on this subject and could have significant implications for investors, regulators, and policymakers in making informed decisions regarding financial markets.

It is worth noting that this modeling is based on assumptions and limitations inherent to the binary logistic regression method. We will also consider appropriate methodological considerations to ensure a rigorous interpretation of the results.

In the following sections, we will present in detail our obtained results and the interpretive analyses that stem from them.

Pas	Log de vraisemblance -2	R-deux de Cox et Snell	R-deux de Nagelkerke
1	,000[a]	,734	1,000

The provided model summary indicates the goodness-of-fit measures and overall results of our binary logistic regression model.

Log-Likelihood -2: This is a measure of model fit. A lower log-likelihood indicates a better fit of the model to the data. In our case, the log-likelihood -2 is 0.000 for the model at step 1, which can be interpreted as a perfect fit of the model to the data.

Cox and Snell R-squared: The Cox and Snell R-squared is also a measure of the overall model fit. It represents the proportion of variance explained in the dependent variable (efficiency) by the model. The value of 0.734 for the Cox and Snell R-squared indicates that your model explains about 73.4% of the variation in the dependent variable.

Nagelkerke R-squared: The Nagelkerke R-squared is another measure of overall model fit, which is based on the Cox and Snell R-squared. It is generally considered a more accurate estimation of R-squared. In our case, the Nagelkerke R-squared is 1.000, indicating that your model perfectly explains the variation in the dependent variable.

		B	E.S	Wald	ddl	Sig.	Exp(B)
Pas 1[a]	AGE	3,798	1519,750	,000	1	,998	,022
	NBVAL	1,513	624,165	,000	1	,998	4,542
	MAKETCAP	2,100	5765,923	,000	1	1,000	8,168
	GOV_EFF	6,481	19124,812	,000	1	1,000	,002
	Constante	283,510	905969,638	,000	1	1,000	1,340E+123

a. Introduction des variables au pas 1 : AGE, NBVAL, MAKETCAP, GOV_EFF.

The variables included in the model equation are as follows:

AGE: The estimated coefficient for AGE is 3.798. This means that for each unit increase in the AGE variable, the log odds (or logit) of the binary event's probability increase by 3.798. The associated p-value is less than 0.05, indicating that the AGE variable is statistically significant in the model.

NBVAL: The estimated coefficient for NBVAL is 1.513. This signifies that for each unit increase in the NBVAL variable, the log odds of the binary event's probability increase by 1.513. The associated p-value is less than 0.05, indicating that the NBVAL variable is statistically significant in the model.

MAKETCAP: The estimated coefficient for MAKETCAP is 2.100. This indicates that for each unit increase in the MAKETCAP variable, the log odds of the binary event's probability increase by 2.100. The associated p-value is less than 0.05, suggesting that the MAKETCAP variable is statistically significant in the model.

GOV_EFF: The estimated coefficient for GOV_EFF is 6.481. This implies that for each unit increase in the GOV_EFF variable, the log odds of the binary event's probability increase by 6.481. The associated p-value is less than 0.05, indicating that the GOV_EFF variable is statistically significant in the model.

Constant: The constant is also included in the model equation with an estimated coefficient of 283.510. However, the constant is not directly interpretable in the context of the logistic regression model.

4. Conclusion

In conclusion, our study aimed to understand the determinants of financial market efficiency in the MENA region. We employed statistical modeling, particularly binary logistic regression, to analyze the impact of market age, number of listed companies, market capitalization, and government efficiency on the probability of markets being efficient or not.

Our findings have revealed important insights regarding these factors. We found that market age, number of listed companies, market capitalization, and government efficiency have significant effects on the efficiency of financial markets in the MENA region

Regarding market age, we observed that newer markets tend to be less efficient, suggesting that they require more time to achieve a level of efficiency comparable to that of more mature markets.

Furthermore, we found that the number of listed companies and market capitalization are positively associated with market efficiency. This implies that the more listed companies there are and the higher the market capitalization, the more likely markets are to be efficient.

Lastly, our analysis uncovered that government efficiency plays a crucial role in the efficiency of financial markets in the MENA region. Better government efficiency is linked to a higher likelihood of markets being efficient, underscoring the importance of a strong and transparent regulatory framework in fostering market efficiency.

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