

The Informational Efficiency Hypothesis Of Markets: Theoretical Presentation And Empirical Test On The Moroccan Stock Market

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Abstract : *The present paper claims to test the informational efficiency hypothesis of moroccan stock market, by reviewing the main fundamentals of the efficient market hypothesis, the basis of all theoretical developments and empirical applications of classical financial theory. we tried to verify the existence of the weak form of financial market efficiency by using the Masi stock index series, In this regard, the tests used are the runs test, the autocorrelation test, the unit root test and the variance ratio test. The results of the tests used showed the absence of the weak form of stock market efficiency.*

Key words : *Informational efficiency hypothesis, runs test, autocorrelation test, the unit root test, the variance ratio test, moroccan stock market, masi stock index.*

I. Introduction

The informational efficiency of financial markets is an attempt to define and capture the most relevant aspects of financial markets. Adopted by the theory of classical finance, the hypothesis of the informational efficiency of financial markets refers to the ability of the financial market to perform a correct evaluation of stocks from the available information, assumed to be shared by all participants

The origins of the informational efficiency hypothesis of the financial markets are historical and the authors agree that the first works in this field were carried out at the end of the 19th century and the beginning of the 20th century. However, it is due to FAMA who identified, in his article of 1970, « Efficient capital markets: a review of theory and empirical work », the existence of several levels of informational efficiency, namely, the weak form, the semi-strong form and the strong form.

At the practical plane, this difference generated, since the end of the 1960s, the development of tests that are still used to date to evaluate each type of efficiency. As a result, financial theory has been enhanced by a series of tests, which have been modified or improved subsequently, and which tend to study the three forms of efficiency in the most important financial markets in the world.

Thus, this study tests the weak form of the efficiency of the Moroccan stock market. This article aims in its first section to carry out a review of the literature on the hypothesis of informational efficiency, following the theoretical reflections and empirical applications proposed by the financial literature. The second section aims to study, using different tests, the situation of the Moroccan stock market in terms of informational efficiency in the weak form.

II. Informational Financial Market Efficiency: A Review of the Literature

In finance, efficiency is a multidimensional concept that is used to define different aspects of financial markets: allocational efficiency, operational efficiency and informational efficiency. Generally, the term refers to the last aspect, which characterizes the relationship between information and stock prices (Dyckman and Morse, 1986).

The definition of the informational hypothesis was updated over time by several researchers to include three concepts. The first conception refers to a market in which financial assets are correctly evaluated, taking into account the information available at the time (Beaver, 1981). A second conception emphasizes the

unpredictability of returns (Ross, 2009). The third conception focuses on the unprofitability of arbitrage operations (Jensen, 1978).

In his 1970 article, « Efficient capital markets: a review of theory and empirical work », FAMA identified the existence of three levels of informational efficiency : weak efficiency, semi-strong efficiency and strong efficiency.

- **Weak form of efficiency**

According to the weak form of efficiency, stock prices reflect all information based on the historical series of prices and returns. Weak form tests are essentially random walk tests and attempt to determine whether future returns can be predicted based on past returns.

Weak form tests are the most widespread as they have been commonly associated with random walk tests. The underlying idea is to determine whether it is possible to predict future returns from past returns. Remember that the price P_t of a security follows a random walk if it verifies the following relationship: $\ln(P_t) = \phi \ln(P_{t-1}) + \epsilon_t$, where $\phi = 1$ and ϵ_t is white Gaussian noise.

- **Semi-strong form of efficiency**

The semi-strong form of efficiency assumes that all available information about a financial asset is incorporated into the price of that asset at the moment that this information is made public. This information can include any kind of information about the emitting company, such as annual reports, earnings announcements, bonus share distributions, information provided by the press, etc. The purpose is to test whether prices adjust quickly to this information, i.e. whether the market has correctly anticipated the announcement or publication of the results.

- **Strong form of efficiency**

The set of information includes, in addition to public information, all private information, i.e. all information possessed by initiates of the firm (privileged information) and which is not yet made public. The tests aim to determine whether individuals with monopolistic access to information are able to achieve higher profits than other agents.

Several empirical works have studied the different forms of efficiency in developed countries. We can name the works that have focused on the equity markets in Australia, Europe and the United States, which have shown that prices in these markets are efficient and follow a random walk (Kendall and Hill, 1953 ; Cootner, 1964 ; Fama, 1965 ; Jensen, 1978 ; French and Roll, 1986 ; Malkiel, 2003).

Few studies have focused on the Moroccan case. We can mention, for example, the work of El Khattab and Moudine (2014) who used two main tools to test the predictability of returns: the ARIMA process, and the Box and Jenkins method. The authors conclude to reject the weak form of informational efficiency for the Casablanca stock market for the period between 01/01/2004 and 15/03/2008. However, using the same methodology, Hassainate and Bachisse (2016) prove the existence of an informational efficiency in the weak form (random walk) over the period from 2000 to 2016.

III. Testing the weak form of efficiency of the Moroccan stock market

2.1. Data and methodology

The sample used in our study is composed of daily closing prices of the MASI index, for a period between 01/03/2002 and 21/03/2022. In order to test the weak form of the efficiency of the Moroccan financial market, we will implement the following 4 tests:

- **Run test**

A runs test is a statistic method for determining the randomness of data. A run can be defined as a sequence of positive (+) or negative (-) signs and each change of these signs constitutes a run. For the following sequence the change between the number 0 and the number 1, shows whether the frequency of the series occurs randomly.

0 0 0 1 1 1 0 0 0 1 1 0 1

This series has six runs that express the number of times the series changes sign or occurs randomly.

- **Autocorrelation test**

The autocorrelation test is used to determine whether the observations in a series are random and independent over time. The idea of this test is to measure the correlation between the current data and the data from previous periods. In this sense, if there is a correlation between the current data and the past data, then the market would not be efficient. For the autocorrelation test, we employ the Ljung-Box statistics by Ljung and George (1978).

- **Unit root test**

This is a statistic test to determine whether a time series is stationary, i.e. whether there is a unit root. Indeed, the existence of a form of market efficiency requires that the series is non-stationary; to do this we use the Augmented Dickey Fuller (ADF) test to test the unit root of the series. It consists to compare the calculated value to the Mackinnon critical value. The series is non-stationary if the calculated value is lower than the critical value

- **Variance ratio test**

The variance ratio test is used to test the hypothesis of the random walk of the data. It compares the predictability of the data over a sequence of observations by comparing the variances of a series over different intervals. For this purpose, if a series follows a random walk, then the period difference of the variance should be different from 1.

2.2. Results and discussions

- **Descriptive statistics of the data**

The descriptive statistics of the daily MASI data are presented in Table 1. The table shows the mean = 9595.338, minimum (2953.300) and maximum (14925.99) values, standard deviation = 3100.967. Skewness which represents the measure of asymmetry of the distribution around the mean is about -0.829105. On the other hand, the kurtosis which measures the flatness of the distribution of the variable is equal to 2.593588. Finally, the probability of the Jarque-Bera test shows that the MASI series is normally distributed.

Table 1: Descriptive statistics of the data

	MASI
<i>Mean</i>	9595.338
<i>Median</i>	10335.34
<i>Maximum</i>	14925.99
<i>Minimum</i>	2953.300
<i>Std. Dev.</i>	3100.967
<i>Skewness</i>	-0.829105
<i>Kurtosis</i>	2.593588
<i>Jarque-Bera</i>	607.2558
<i>Probability</i>	0.000000
<i>Sum</i>	47976692
<i>Sum Sq. Dev.</i>	4.81E+10
<i>Observations</i>	5000

Source: Author's calculation.

- Runs Test

To verify the existence of the weak form of the MASI efficiency we can use the runs test. Table 2 shows the results of the runs test for the period 01/03/2002 to 21/03/2022. The p-value clearly shows that it is less than 0.05 and therefore significant. This shows that the value of the z-statistic is not within ± 1.96 , which indicates that the MASI series is not random. Therefore, it can be concluded that the results of the runs test do not follow the weak form of the efficiency.

Table 2: Runs test

MASI runs test variables	Number of observations	P-value
Run	44	0.000
Above cutoff	3114	
Below cutoff	1886	
total	5000	

Source: Author's calculation.

- Autocorrelation

To detect whether the serie follows a random walk, it is possible to use a second method which is the autocorrelation test which is also known as a serial correlation test. To do this, we use the Ljung-Box statistic of Ljung and George (1978). The idea of autocorrelation measures the correlation between current MASI data and previous periods. Table 3 shows that the Moroccan stock market does not follow the weak efficiency form for the selected period. The results of the study are coherent with the findings of the runs test which indicate that there is no evidence that MASI follows a weak form of efficiency.

Table 3: Autocorrelation test

Number of lags	AC	PAC	Q-Stat	Prob
1 Lag	0.999	0.999	4995.0	0.000
2 Lags	0.998	-0.088	9981.7	0.000
3 Lags	0.997	-0.013	14960.	0.000
4 Lags	0.996	0.019	19929.	0.000
5 Lags	0.995	0.009	24891.	0.000
6 Lags	0.995	-0.001	29844.	0.000
7 Lags	0.994	0.010	34789.	0.000
8 Lags	0.993	-0.004	39726.	0.000
9 Lags	0.992	-0.008	44655.	0.000
10 Lags	0.991	0.004	49576.	0.000

Source: Author's calculation.

- Unit root test

The third method we will use consists of examining the weak form of the efficiency by the unit root test. To do this, we use the Augmented Dickey-Fuller (ADF) test which consists of testing the unit root in the series. For this purpose, we compare the calculated value to the critical value (Mackinnon's tabulated value); if the calculated value is less than the critical value, we reject the null hypothesis, which indicates that the series is not stationary. Table 4 shows that the ADF test statistic is -56.62702, which is lower than the MacKinnon tabulated

value at 1% and 5%. It can be concluded that MASI does not follow the weak form of efficiency at the selected period, which was coherent with the results of the runs test and the autocorrelation test.

Table 4: Unit root test

		t-Statistic	Prob. *
Augmented Dickey-Fuller test statistic		-56.62702	0.0001
Test critical values :	1% level	-3.431477	
	5% level	-2.861923	
	10% level	-2.567016	

Source: Author's calculation.

- Variance test ratio

The final method used to test the random walk of the data is the variance ratio test (VRT). This test investigates the predictability of the data by comparing the variances of the differences in the data calculated over different ranges. This test uses two specifications; the first under the assumption of homoscedastic using an asymptotic distribution. The second test specification was used under the assumption of an asymptotic heteroscedastic distribution. The results of table 5 shows that the joint probability value is less than 5%, therefore, the study reveals that the variance ratio test is consistent with the previous results that the MASI series does not follow the weak form of the efficiency.

Table 5: Variance ratio test

Variance ratio test	Under Homoscedastic	Under heteroscedastic
Joint z statistic value	17.68994	326.5177
Joint probability value	0.000	0.000

Source: Author's calculation.

- Results discussion

Our study examined the existence of the weak form of efficiency in the Moroccan stock market. This form of efficiency is based on the idea that future changes in stock prices can be predicted on the basis of historical series and therefore the analysis of current or past prices provide an indication for the future.

Our results show that MASI does not follow a random walk. This is in accordance with the findings of El Khattab & Moudine (2014) who used two main tools to test the predictability of returns: the ARIMA process, and the Box and Jenkins method. Using these two econometric tools, the authors conclude that the weak form of informational efficiency is rejected for the Casablanca stock market.

Indeed, it was revealed that MASI does not follow a random walk, which was consistent with the different tests used, indicating that the Moroccan stock market does not follow the weak form of efficiency. On the contrary, Hassainate and Bachisse (2016) showed that the Moroccan stock market would have a memory, therefore it is not possible to reject the existence of the weak form of informational efficiency for the Casablanca stock market. In this regard, adopting another methodology, by using a set of tests our results showed that the Moroccan stock market, approximated by the MASI index does not follow a random walk and therefore we reject the weak form of efficiency.

IV. Conclusion

From our theoretical and practical research, we can draw the following conclusions:

- The hypothesis of informational efficiency of financial markets is a hypothesis that has been widely discussed in the financial literature, and is of great importance to both theoreticians and practitioners.

- The review of the empirical literature shows that the hypothesis has been tested in different markets, both developed and emerging, and has been concluded mostly in favour of efficiency in developed markets, however, developed markets are less efficient.
- Our study examined the existence of the weak form of efficiency in the Moroccan stock market based on the runs test, autocorrelation test, unit root test, variance ratio test. It concludes the inefficiency in the weak sense of the Moroccan stock market.
- The inefficiency of the financial markets of the emerging countries, like Morocco, can be justified by the organizational imperfection of their markets and by the high transaction costs weighed down by the tax system and by the low liquidity of these markets.

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