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How Do Macroeconomic Variables Volatilities Affect Stock Markets Dynamics? Evidence From MENA Zone

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Abstract:
This research explores the impact of five macroeconomic variables volatilities on the fluctuations of stock markets returns, considering five countries from MENA zone. We contribute to the existing literature by introducing a new framework based on an EGARCH model that combine simultaneously five macroeconomic variables as explicative powers that has never been established before in such an issue. An economic examination in presented about the impact of several key macroeconomic variables prices and volatilities on different stock markets returns. Empirically, four GARCH models are tested and interpreted. The results are of great interest for portfolio managers and international investors since detecting the source of stock market volatility is an actual issue. According to the findings, we conclude that stock markets dynamics are not influenced by the same fluctuations of the same macroeconomic variables, depending on different factors that are revealed and explained.

JEL Classification: F31, F62, F65, G15
Keywords: financial market, stock market, foreign exchange market GARCH, EGARCH

I. INTRODUCTION

There are many circumstances where the exchange rate volatility comes in to play, including business between parties in different countries and international investments. Though, the volatility risk is very difficult to avoid in such circumstances. Volatility is something that affect any business undertaken involving at least two countries. In this world of uncertainty, it's very important to define macroeconomic variables that affect stock markets around the world and specially to explain the relationship between them, since the stock market is inextricably linked with the overall economy of a country. One of the main indicators is the stock market to demonstrate the financial sector's performance of an economy, just like the barometer is for weather condition. Indeed, finding out that if the volatility of one macroeconomic variable increase so the risk level of stock market increase as well is a real issue for the market players.

Under this context and in order to guide foreign investors in this world of uncertainty, several researches in the literature were able to give an overview based on different part of the world. Most of these works were interested by developed and Asian emerging markets. Their findings are mixed and contradictory which means that there is not a consensus in the literature about the relationship between key macroeconomic variables and stock markets returns, especially for the MENA region that has been neglected in the past. Actually, MENA zone is a region of diversified economics that are open to foreign investor's participation and also allow repatriation of dividends and capital. It's useful to mention that most MENA countries have no restrictions on foreign investors. Therefore, we find it interesting to do research on 5 countries belonging to this area and having gone through hard and challenging political but also economic periods. Indeed, understanding the interaction that may exist between macroeconomic variables volatility and stock market movements is an important issue for international investors and policy makers in equal measure, as it allows them to better manage their investments risks.

The present study aims at exploring the impact of five macroeconomic variables volatilities on the fluctuations of stock markets' return, considering five countries from MENA which are Tunisia, Egypt, Morocco, Turkey and Jordan.

Numerous authors in the literature made studies with the same target, in order to provide some insight to corporate managers, investors and policy makers. One of the first authors dealing with this subject, Mukherjee and Naka (1995), studied the dynamic relationship between six macroeconomic variables among exchange rate and consumer price index, and the Japanese stock market (TSE) by applying a VECM model. They came out to settle that a cointegration relation between these variables does exist and the sign of the long-term elasticity coefficients are generally consistent with the hypothesized equilibrium relations. Later on, based on these findings, several empirical studies were made, namely Gan et al. (2006) investigated the relationship between a set of seven macroeconomic variables and stock market in New Zealand. They employed the Johansen Maximum Likelihood and Granger-causality tests. Their findings show up that the interest rate, money supply and real GDP are the most relevant macroeconomic variables and they conclude that those variables affect the stock market dynamics.

While developed markets have received a lot of attention, research on emerging stock markets is relatively scant. For instance, Hamma et al. (2014) investigated the relationship and the link between oil price volatility and Tunisian stock market's dynamic

using a bivariate GARCH model. The authors found out that the stock market in Tunisia is highly affected by the volatility of the oil prices and they indicated that the majority of relationships are unidirectional from the oil market to Tunisian stock market.

Gay (2016) studied the interactions that may exist between macroeconomic variables and stock market index prices for the emerging counties considering the BRIC region (Brazil, Russia, India and China). For this purpose, the author used Box-Jenkins Autoregressive Integrated Moving Average (ARIMA) model and monthly data running from March 1996 to June 2006. The results of this paper showed a positive relationship between stock prices and exchange rates for all countries except India, and a negative relationship between oil prices and stock index prices.

Recently, de Jesus (2020) were interested by the dynamic relationship between oil prices and stock prices for the oil-exporting and oil-importing countries. They investigated the cointegration and the asymmetry between oil market and the stock market for several developed and emerging countries during the period beginning from March, 13, 2001 till August, 25, 2017. Their findings revealed a positive long run relationship between oil and stock prices for all exporting-oil countries. However, for the importing-oil countries, the authors were able to find to different sign of the relationship between oil price and stock prices. Positive long term relationship was detected for emerging economies while a negative one was noticed to be exist for the developed countries such as France, Germany, U.S.A and Japan.

All these researches doesn't take into consideration more than two macroeconomic variables in order to explain the dynamic of the stock market prices. Adding to that, the authors used very short period of data and focused on the same countries.

Our study is of great interest for both portfolio managers and economic policymakers as it allow them to, not only, anticipate the risk while investing in stock markets, but also, anticipate public decisions (monetary or interest rate policy) for the sake of financial market stability. Therefore, it will be useful to empirically explore knowledge about the influence of the volatility of the selected macroeconomic variables on the dynamic of stock markets.

In this paper, we provide an analysis for the MENA region by using the data of five different countries, namely, Tunisia, Turkey, Egypt, Morocco and Jordan. Our main contribution is to assimilate five macroeconomic variables in the same framework thus we are able to better explain the volatility of stock markets prices. A large database of 17 years is employed for this study, running from January 2002 to May 2019 and based on monthly data so it will be easy to detect the change on movements. Empirically, we start by testing numerous GARCH models which are GARCH (1,1), TARCH, IGARCH and EGARCH to estimate the impact of the volatility of macroeconomic variables on the dynamic of stock markets indices. Then, we compare the results and define the most robust estimate according to information criteria. Finally, the results of the chosen model are presented and economically interpreted.

The findings and the evidences presented in this study should interested economic policy makers, researchers of related topics, and stock market participants. While, the existing literature offer a common evidence about the relationship between one macroeconomic variable's volatility and the fluctuations of the stock market prices, the current investigation gives on overview of the influence of five macroeconomic variables on five stock markets and highlights this debates on countries that were neglected by previous studies.

The present paper is organized as follows: Section 2 gives a brief review of the related literature on the impact of macroeconomic variables on stock market's dynamic; Section 3 illustrates data set, provides details about our adopted methodology. Section 4 presents and discusses the empirical results for every country, it also offers a detailed explanation of the empirical results. Finally, Section 5 provides some concluding remarks and highlights the perspectives of our future research.

II. LITERATURE REVIEW

Under this section, we provide a brief review of the most important theoretical and empirical researches dealing with the influence of macroeconomic variables on stock market's dynamics.

Regarding the high position that this topic occupies, the debate on explaining the dynamics of stock market indices based on macroeconomic variable's volatility has started a long time ago. Some authors were interested by detecting the causality relationship between these variables, while others made investigations about the effect of macroeconomic variable's fluctuation on the stock market movements.

Hatemi-J and Irandoust (2002) studied the causality relationship between the exchange rate and stock market in Sweden using a Granger test and a vector autoregression model (VAR). The authors tried to contribute to the existing works that considered the US market (e.g., Aggarwal 1981; Solnik, 1984; Soenen and Hennigar 1988; Bahmani Oskooee and Sohrabian 1992). In this article, they presented a new Granger non causality procedure and constructed a vector autoregression and used a monthly data covering a period of 5 years running from 1993 to 1998. They detected a unidirectional causality running from Swedish stock market prices to effective exchange rate.

Ozair (2006) investigated the direction of causality as well as short-run dynamics and long-run equilibrium relationship between stock prices and exchange rates using quarterly data for the period across 1960-2004 of USA. This study applied techniques of the unit root tests, cointegration modeling and Standard Granger causality tests to examine the relationship between these two financial variables. The empirical results revealed that there is no causal linkage and no cointegration between the stock prices and exchange rates as suggested under Traditional and Portfolio approaches.

Adjasi, Harvey and Agyapong (2008) made a research about the relationship between exchange rate volatility and Ghana stock market volatility employing EGARCH model. They included in their empirical model various macroeconomic variables namely, money supply in the market, Treasury bill rate, trade deficit and inflation measured by CPI. Their findings declared the existence of a negative relationship between exchange rate volatility and stock market return and a positive strong relationship between the consumer price and stock market volatility which means that a rise in the CPI increases the Ghanaian stock market volatility.

Ito (2013) used daily data running from March 31, 2003 to January 10, 2013 considering two periods: pre-crisis and post-crisis. The author investigated the influence of stock prices and interest rates on the Real Estate Investment Trust (REIT) considering Japanese market. He used ordinary least square (OLS) regression and he came out to settle that the impact of stock prices is positive while interest rate affect negatively the REIT in Japanese market.

Naifar and Al Dohaiman (2013) studied the impact of oil prices and stock markets returns of the Gulf Cooperation Council (GCC) countries using Markov regime-switching model. Then, they explored the relationship between oil price, interest rate and inflation rate before and during the subprime crisis by applying the EGARCH model. The authors find out that the relationship between GCC stock market returns and oil price volatility is regime dependent.

It's well mentioning that, while developed markets and Asian economics are getting all the attention of the researchers and documentations (Aggarwal et al., 1981; Soenen and Hennigar 1988; Jain and Biswal 2016; Jareno et al., 2019), studies on other emerging markets and especially those belonging to the MENA zone are relatively limited.

Ikoku and Okany (2014) studied the influence of the 2008th economic and financial crisis on the sensitivity of stock markets to macroeconomic risk factors namely exchange rate, inflation rate, interest rate, gold and oil prices. They made a comparative research between Nigerian stock market and the South African stock market behaviors. For this purpose, the authors used monthly data spread on 9 years running from January 2003 to December 2012 and they propose to apply multiple regression in order to detect the sensitivities of both stock markets with macroeconomic variables aforementioned. The findings of this work were mixed, but the most relevant in that Nigerian and South African stock markets become more sensitive to almost all the macroeconomic variables conducted in this study.

Raza et al (2016) were interested by the emerging countries. The monthly data they used is running from January 2008 till June 2015 and they employed the nonlinear ARDL approach. They proclaimed on the one hand, a positive impact of the gold price on stock market prices of BRICS economies. On the other hand, they identified a negative influence on the gold price on the stock markets of Mexico, Malaysia, Thailand, Chile and Indonesia. They asserted as a negative effect of the oil prices on emerging stock markets. The volatilities of these two macroeconomic variables seemed to have negative effect on all the emerging markets highlighted in this study. Then, Jamaludin et al (2017) elaborated a similar work to Raza et al (2016) but they integrated three different macroeconomic variables (inflation rate, money supply and exchange rate) and their monthly data cover a longer period of ten years running from January 2005 to December 2015. The ASEAN countries that were selected for the study are Singapore, Indonesia and Malaysia and the authors employed Panel Data Regression Analysis to investigate the relationship between chosen macroeconomic determinants and the stock returns. They find out that the exchange rate and the inflation rate highly impact the stock markets for these countries, however the money supply is found to be not significant. This study is considered to be limited compared to other researches that were interested by the ASEAN countries as it included only three countries and three fundamental macroeconomic variables.

Further, a number of recent studies were conducted on African and MENA countries namely, Tunisia, Morocco, Egypt, South Africa, Nigeria (Fowowe 2015; Boako and Alagidede, 2016; Adewuyi et al., 2019). Besides, Kassouri and Altıntaş (2019) made an investigation on the dynamic co-movements between exchange rate, money supply, interest rate and stock prices in Turkish market for the period covering January 2003 to December 2018. They used Threshold autoregressive model (TAR) and they found out

that an appreciation in the Turkish lira against USD leads to a depreciation in the stock prices in Turkey.

During the same period, Ahmed (2019) focused on Egyptian stock market returns and used a nonlinear ARDL in order to identify the existence of short and long run asymmetries and determine the spillover effect of exchange rate fluctuations on stock returns over two regimes. They revealed that negative variations of the Egyptian exchange rate have a significant impact on stock returns, and the domestic currency appreciation have a positive effect on stock prices, however this influence is neglected comparing to the currency depreciation which has a stronger impact on stock returns. Junior and Tweneboah (2020) made a work in order to identify the link that may exist between exchange rate and stock market which is essential in the portfolio decision making. For this target, they employed the ensemble empirical mode decomposition (EEMP), the Quantile Regression Analysis (QRA) and Quantile-in-Quantile Regression (QQR) techniques and they used daily data. Among the results highlighted by the authors, there is a relationship between exchange rates and stock markets for both Morocco and Tunisia.

The debate over the influence of macroeconomic variables on the stock markets prices is still current as previous empirical works provide mixed evidence on this subject. Among all these studies, we notice discrepancies that result from different methodologies, data, and variables taking into account in every work. It is evident that the most complete research is the one that integrate all the most important macroeconomic variables that, according to the literature, are defined to be the major determinants of the stock market fluctuations. This is exactly, the main objective of our study.

To Sum up, Table 1 represents an overview of previous works in order to enhance the relationship of every key macroeconomic variable with stock market dynamic for different economic region considered back in time.

Table 1
Literature Overview

References (Previous works)	Variables concerned	Signs conducted with stock market dynamic	Periods of studies	Countries/ Economic zone
Hatemi-J and Irandoust (2002)	Exchange rate	Positive relationship	1993-1998	Sweden
Ozair (2006)	Exchange rate	No causal linkage	1960-2004	USA
Adjasi, Harvey and Agyapong (2008)	Exchange rate CPI	Negative link Positive link	1995-2005	Ghana
Naifar and Al Dohaiman (2013)	Oil price Interest rate Inflation rate	Positive linkage Negative linkage Positive linkage	2004-2011	GCC countries
Gay (2016)	Exchange rate Oil price	Positive relationship Negative relationship	1996-2006	BRIC countries
Raza et al (2016)	Gold price Oil price	Negative Negative	2008-2015	BRICS and emerging countries
Jamaludin et al (2017)	Inflation rate Exchange rate	Negative impact Positive impact	2005-2015	ASEAN countries
Kassouri and Altintaş (2019)	Exchange rate	Negative impact	2003-2018	Turkey
Ahmed (2019)	Exchange rate	Positive relationship	2014-2018	Egypt
Junior and Tweneboah (2020)	Exchange rate	Positive/negative Change over time	1995-2019	African countries

Based on the above discussion, we propose the following hypothesis:

H1: Macroeconomic variables, namely, the exchange rate, the inflation rate, the interest rate, the Gold and oil prices have no effect on stock market dynamic

H2: Macroeconomic variables, namely, the exchange rate, the inflation rate, the interest rate, the Gold and oil prices have the same influence (intensity and direction) on stock market dynamic

H3: The impact of macroeconomic variables (the exchange rate, the inflation rate, the interest rate, the Gold and oil prices) volatilities on stock market fluctuations depends on specific economic factors for each country or economic zone.

III. METHODOLOGICAL ISSUES

While most previous researches considered developed countries and Asian emerging markets, there are countries that have been neglected or conducted very few researches, namely markets that belong to MENA zone. Thus, in this study we focus on five countries from the MENA region. Adding to that, 4 models are tested in this research in order to choose to most accurate one and use it in our framework.

A. Data Sources and Variable Construction

Monthly data are used for this study in order to better detect the important evolution of the prices. A large sample of 207 observations per series is collected, running from January 2002 until May 2019 and include several macroeconomic variables other than stock market prices returns namely: exchange rates, inflation rates, interest rates, Gold prices and Oil prices for Tunisia, Turkey, Morocco, Egypt and Jordan.

The stock market indexes used for this research are the following. The most perform stock market index that reflect better the situation of the market by including most stocks is selected:

The TUNINDEX is considered to be an index of the yield type (dividends are reinvested), which measures the general trend of the market of the Tunis Stock Exchange.

The Borsa Istanbul 100 index is a weighted capitalization index composed of companies from the Turkish national market (dividends are also reinvested).

Moroccan All Shares Index (MASI) is the most important stock index of the Casablanca Stock Exchange since January 2002. It is composed of 57 stocks. The downward trend since September 1998 has led to serious anomalies threatening the Moroccan stock market.

EGX-30 is the Egypt's stock market index which includes the 30 largest companies in terms of liquidity and activity, launched on February 1, 2003. This index is weighted by market capitalization and adjusted by free float.

ASIE (Jordan): The Amman Stock Index Exchange, is the stock market index of Jordan's private institution founded in 1999. ASIE is made up of developed and emerging countries whose main markets are among the top 10 in the ranking world.

Five macroeconomic variables are chosen for being the most variables conducted in other studies in the literature and they were considered as the source of the fluctuations generated in the stock markets for different countries.

The nominal effective exchange rate: in our study we are interested in analyzing nominal exchange rate volatility, which measures the relative price of two currencies, in order to take into account inflationary effects, since the real exchange rate policy consists in periodically adjusting the nominal exchange rate in order to keep the real effective exchange rate constant in order to preserve the competitiveness of the country. We consider exchange rate indexed to the dollar since it is the most widely used currency at the international level.

Inflation Rate (CPI): Reflects the costs of a basket of goods and services purchased by the average consumer. For our study we collected data on the consumer price index which measures inflation for each country. Numerous authors explored this variable in their paper regarding the importance it reveal for the determination of stock market dynamic (Hatemi.J and Irandoust 2002; Bahmani-Oskooee and Saha 2016)

The risk free interest rate: our data concerning the nominal interest rates with 3 months of maturity. These rates are presented by the central banks of each country. A lot of papers were concerned by this variable (Ahmad et al.,2010; Moumni and Benaissa 2014).

The gold price: Due to the lack of availability of this data for each country, we have taken into account in our research the world price index of USD / LINGOT gold.

The oil price index: We used the BRENT which serves as a global benchmark in the equity markets of Western Europe, Africa, the Mediterranean and the Middle East. Brent is considered as the Benchmark that fundamentalists and experts in the field use in order to index well-defined tariffs to oil from the North Sea countries exploiting northwestern Europe (Park and Ratti 2008, Haugom et al. 2014). It is usually traded at the Intercontinental Exchange (ICE) in London.

All these data are transformed by natural logarithm and they are collected from Data Stream.

$$R_{i,t} = \ln\left(\frac{P_{i,t}}{P_{i,t-1}}\right) \quad (1)$$

where:
$R_{i,t}$: the return of the price index.
$P_{i,t}$: the price index for the market (i) at time (t).

B. Empirical Models

Under this subsection, we are interested by illuminate the models used for this research, so first we induce the general form of a GARCH (1.1) model, which permits us to evaluate the conditional variances of each variable and to consider the persistence of the volatility's shocks However, the GARCH model does not consider the hypothesis of asymmetry, hence the need to develop extensions to this model. Then, we present the EGARCH model which, according to our tests, seems to be the most performing model in term of estimation. Indeed, during this research we have tested four univariate GARCH models and we find out that the EGARCH is the best model to use in this estimation. Unlike other GARCH models such as TGARCH or IGARCH, the EGARCH model doesn't have restrictions to ensure the non-negativity of conditional variances as it allow the use of the log form that guaranty the positivity of the variances.

As a reminder, the asymmetric volatility is an empirical phenomenon that results in a negative correlation between the return and the conditional variance of the next period's return. Means that, negative (positive) returns are generally associated with upward (downward) revisions of conditional volatility.

1. GARCH (1,1) Model

Since its development by Bollerslev and Taylor (1986), the GARCH (1.1) specification has proved to be an adequate representation for most financial time series.
By definition, the GARCH (1.1) model is presented in two equations:
The mean equation: which provide the log returns of the stock market indices:

$$R_t = \mu + \varepsilon_t$$
$$\varepsilon_t | \, I(t-1) \sim D(0, \sigma_t^2) \quad (2)$$

where:
R_t: are the stock market indices log-returns at the time t
μ: is the average value of returns
ε_t: are the error terms.
I(t-1): is the information set up to time t-1,
σ_t^2: is the conditional variance of the error terms.
D: is the distribution of the residuals that can be Gaussian, Student or GED.
The variance equation: that depends not only on the volatility of returns but also on past volatilities:

$$\sigma_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 + \sum_{i=1}^{5} \delta_i X_{i,t-1} + \sum_{j=1}^{5} \theta_j X_{j,t-1}^2 \quad (3)$$

where:
ω : Constant term parameter; $\omega >= 0$;
α and β are parameters >= 0;
σ_{t-1}^2 : The passed conditional variance.
δ_i and θ_j are coefficients to estimate.
i, j=1,2,3,4,5 referring respectively to explanatory variables (Exchange rate, inflation rate, interest rate, gold price and oil price)

2. EGARCH

The Exponential Generalized Autoregressive Conditional Heteroscedasticity is defined by Nelson (1991) in order to fix the GARCH gaps and detect the asymmetric volatility.

The EGARCH model specifies the conditional variance in logarithmic form, which means that it is not necessary to impose an estimation constraint in order to avoid having a negative variance. In *such* a model, negative shocks are likely to introduce a higher level of volatility than positive shocks of the same magnitude and in all cases the volatility is always positive.
EGARCH (1,1) is defined by:
The mean equation:

$$r_t = a_0 + a_1 r_{t-1} + \mu_t \quad (4)$$

$$\mu_t = \sigma_t \varepsilon_t \quad (5)$$

$$(\varepsilon_t)_t \sim \text{i.i.d } D(0,1) \quad (6)$$

The conditional variance:

$$\text{Log}\,\sigma_t^2 = \omega + \beta \text{Log}\sigma_{t-1}^2 + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} \quad (7)$$

where:
α, β, γ, ω are parameters to estimate.
β: represents the autoregressive term. It measures the volatility persistence.
α: is the choc effect of the return.
γ: the effect of asymmetry corresponding to the impact and complementary or specific of a negative shock (it is assumed that the good news is when $\frac{\varepsilon_t}{\sigma_t} > 0$, otherwise it is bad news). Both news have different effects on the conditional variance. Thus, the impact of the news on the volatility is asymmetric when $\gamma \neq 0$.
D: the residuals distribution (Gaussian, Student or GED).

For this study, exogenous variables are included in the conditional variance. However, in some cases, the GARCH parameter (σ_{t-1}^2) tends to capture all the explanatory power of the explanatory variables, since if they impact σ_t^2 they may also impact σ_{t-1}^2. Consequently, it is required to remove this parameter in order to allow the other explanatory variables to be relevant.

$$\text{Log}\,\sigma_t^2 = \omega + \beta \text{Log}\sigma_{t-1}^2 + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \sum_{i=1}^{5} \delta_i X_{i,t-1} + \sum_{j=1}^{5} \theta_j X_{j,t-1}^2 \quad (8)$$

where
δ_i and θ_j are coefficients to estimate.
i, j=1,2,3,4,5 referring respectively to explanatory variables (Exchange rate, inflation rate, interest rate, gold price and oil price)

IV. EMPIRICAL RESULTS AND DISCUSSION

In this section, the principal findings of this paper are explored and the results that are obtained will be discussed.

First of all, the descriptive statistics are presents in order to describe our sample and to highlight its specificities.

Then, the EGARCH model is employed. After testing four GARCH models, namely TARCH, IGARCH, GARCH (1.1) and EGARCH (Appendix1: Table 5) we notice that according to the information criteria (AIC, SIC) the EGARCH is the most perform model, adding to that the fact that a significant body of evidence in the literature and specially summarized by Hamilton (1994) agree that EGARCH should be used in such issues. Nevertheless, EGARCH allow the use of logarithmic data, so it is guaranteed that the variance is positive and we won't have to transform the data in order to ensure the non-negativity of conditional variances.

Finally, the final results are illuminated and economically interpreted.

A. Descriptive statistics

Applied to a sample composed of 207 observations for every country. Monthly data are used going from January 2002 to May 2019. The analysis of descriptive statistics proposes to offer an objective representation on the evolution and the risk level of the data used in our empirical study.

Table 2 shows the descriptive statistics of data. The presented values are calculated on logarithmic data.

Table 2
Descriptive Statistics

Variables	Countries	Mean	Median	Skewness	Kurtosis	Jarque-Bera
Stock markets Log-returns	Morocco	0.005	0.002	0.174	5.54	56.98
	Egypt	-0.016	-0.017	0.293	5.10	41.12
	Jordan	0.003	-0.002	0.311	5.43	54.39
	Turkey	0.009	0.013	-0.237	4.12	12.838
	Tunisia	0.008	0.006	-0.175	4.91	32.80
Exchange Rate Log-returns	Morocco	-0.001	-0.002	0.374	5.05	41.329
	Egypt	-0.006	0.000	-10.42	135.99	153290.1
	Jordan	1.36E-06	0.000	0.351	10.08	437.21
	Turkey	0.007	0.001	1.458	9.76	469.37
	Tunisia	0.003	0.002	0.263	3.31	3.23
Inflation Rate Log-returns	Morocco	-0.000	-0.001	-0.367	4.32	19.85
	Egypt	0.009	0.007	-0.353	5.11	42.55
	Jordan	0.003	0.003	1.308	15.63	1436.97
	Turkey	0.008	0.007	1.202	7.79	249.29
	Tunisia	0.003	0.004	0.004	2.91	0.66
Interest Rate Log-returns	Morocco	-0.003	0.000	-3.194	23.85	4120.45
	Egypt	-0.002	-0.000	-2.393	17.20	1937.86
	Jordan	0.0006	0.000	-3.186	26.21	4998.07
	Turkey	-0.006	-0.004	6.308	73.57	44545.41
	Tunisia	0.001	0.000	0.449	18.34	2046.23
Gold Log-returns	Global	-0.0006	-0.002	0.0061	3.87	6.54
Oil Log-returns	Global	-0.006	0.02	0.978	4.473	51.73

Before the estimation of the EGARCH model, it is mandatory to check the stationarity of every variable for each country. For this purpose the Augmented Dickey–Fuller (1979) as well as the Im, Pesaran and Shin (IPS 1997) tests are adopted. The results are presented in Appendix 2 (Table 6 and Table 7).

B. Results from EGARCH model

Employing the Exponential GARCH model, the empirical study aims to examine the relationship between stock market dynamics and macroeconomic variables introduced in this research. The specification of applying EGARCH model is to examine whether the volatility of stock returns is affected by the macroeconomic variables. Hence, we can affirm that the model considers both price and volatility between stock market and all the

other macroeconomic variables.

Table 3 reports the estimates of the EGARCH model using maximum likelihood method as well as the diagnostic tests in order to check the performance of our estimation.

Table 3
Estimation Results of The EGARCH Model

Panel A: Parameter estimates					
Parameters	**Tunisia**	**Morocco**	**Egypt**	**Turkey**	**Jordan**
ω	0.4365***	-8.7978***	5.7607***	39.4633***	1.2783**
	(0.0000)	(0.0075)	(0.0008)	(0.0000)	(0.0104)
β	0.9879***	0.9677***	0.8007***		0.9479***
	(0.0068)	(0.0000)	(0.0000)		(0.0000)
γ	0.1984	0.0694	0.1875	0.1576	0.2128
	(0.8371)	(0.2668)	(0.9385)	(0.6860)	(0.5606)
α	0.0842***	0.1945*	0.9688***	0. 9690***	0.3176**
	(0.0022)	(0.0736)	(0.0000)	(0.0000)	(0.0207)
Xlr	-3.1590	1.9408**	-3.4547	-2.79E+09	-7.36E+08***
	(0.6563)	(0.0225)	(0.4536)	(0.1273)	(0.0000)
Inf	-6.3818***	5.2298	4.9398	-1.24E-09	-9.0613
	(0.0004)	(0.3781)	(0.5671)	(0.7900)	(0.6490)
Int	8.3627	3.1175	5.2654**	1.29E-08	1.0244
	(0.9782)	(0.5710)	(0.0470)	(0.9524)	(0.5846)
Gold	-5.6730	-5.8796	8.1179	2.20E+09	1.0276**
	(0.4819)	(0.4441)	(0.1960)	(0.9375)	(0.0193)
Oil	1.1535	2.3168	2.6150**	8.1929	5.8020
	(0.9738)	(0.4662)	(0.0351)	(0.8292)	(0.9179)
Xlr^2	-6.4461	-3.3535***	3.0438	-0.5196	1.3708
	(0.2393)	(0.0000)	(0.5781)	(0.5201)	(0.1951)
Inf^2	0.0128	1.8431**	1.2093***	1.0461***	29.8591
	(0.5417)	(0.0308)	(0.0000)	(0.0047)	(0.4580)
Int^2	2.6959	-3.8143	-3.2164***	-2.7609***	-4.6460
	(0.5782)	(0.6555)	(0.0054)	(0.0001)	(0.1709)
$Gold^2$	0.0002	0.1776***	-0.0409***	0.0451	-0.0003
	(0.3692)	(0.0000)	(0.0000)	(0.8669)	(0.5846)
Oil^2	-5.1665	3.4559	-1.1767***	-1.0912	2.8979***
	(0.7993)	(0.4734)	(0.0000)	(0.3131)	(0.0000)
Panel B: Diagnostic checks of the model					
LM(1) test	1.4403	0.0520	1.5768	0.0017	0.5821
	(0.2315)	(0.8198)	(0.2107)	(0.9672)	(0.4464)
Q-Stat (36)	39.310	45.702	40.368	55.119	48.302
	(0.324)	(0.129)	(0.283)	(0.132)	(0.832)
DW stat	1.5974	1.8448	1.7567	1.7845	1.6990
GED parameter	Normal distribution	3.3732*** (0.0000)	5.0106*** (0.0007)	Normal distribution	Normal distribution

*Notes: statistically significant at: *10%, **5%, ***1% levels. MacKinnon (1996) P-values are reported in (.) Rt: the price log return. LM test: the ARCH test. Q-Stat (36): Ljung-Box S-statistics for 36 lags. DW stat: the Durbin Watson test (1950-1951) to check the serial correlation.*

Table 4
Parameters References

Parameters	Referring to
ω	Constant
β	Volatility persistence (σ^2_{t-1})
γ	The asymmetric effect
α	The choc effect on the return
Xlr	Exchange rate log-return
Inf	Inflation rate log-return
Int	Interest rate log-return
Gold	Gold price log-return
Oil	Oil price log-return
Xlr^2	Exchange rate squared log-return
Inf^2	Inflation rate squared log-return
Int^2	Interest rate squared log-return
$Gold^2$	Gold price squared log-return
Oil^2	Oil price squared log-return

From the results presented in Table 3, we can notice that the term β is significant for almost all the countries except Turkey where we had to remove the GARCH term because it involved all the explicative power. This term measures the volatility persistence, it is positive and close to 1 for all countries implying that shocks have permanent effect on stock prices volatilities.

However, the parameter **γ** is not significant for all countries, so we can consider that shocks on macroeconomic variables does not have an asymmetric effect on stock markets prices dynamics.

According to these findings, it is noticed that the exchange rate and its volatility are statistically significant only for Morocco and Jordan. This positive relationship between the exchange rate and the Morocco stock market returns dynamic means that a depreciation in the local currency in Morocco leads to a decrease in the stock market returns. In other words, a rise in the importation of goods will be automatically followed by a fall in the stock market return in Morocco. These results are relevant since the MASI is used in this study as the proxy of Casa Stock market which represents the performance of all companies' shares. Same interpretation could be done for Jordan, its stock market dynamic is influenced the exchange rate negatively. Already the exchange rate JOD/USD is very volatile during all our pretend period and it affect the ASIE [1] due to its geographical position, in fact, this country is surrounded by areas that have been living in war and misery for long years, so it has experienced a massive influx of refugees, mostly Syrians, that provoke a source of economic, social and demographic pressures. As a result, the government has decided to close the borders, and since then tourism as well as foreign investment are under threat and are in constant decline.

It is found out that the inflation rate have negative impact on Tunisian stock market volatility, which means that an increase in the consumer price index will cause a depreciation in the stock market return in Tunisia in the long run. This is in perfect

[1] Named as the capital "Amman" Amman Stock Exchange Index, which is the Index of private institution founded in 1999 Jordan

accordance with the actual economic situation in Tunisia, especially since the revolution, a general increase in the prices of goods have been detected which affected the investment and the economic growth. Consequently, stock market returns were highly affected by the lack of investment and the decrease of transactions due to lower expected returns. Nevertheless, the volatility of the inflation rate is significant for Turkey, Morocco and Egypt which means that a positive variation in the inflation rate will be followed by a positive fluctuation in the stock markets of these countries. This situation could be explained with the fact that an appreciation in the inflation rate which is the result of an increase in the prices of goods, would affect the earnings of companies, which in turn will be able to expand their market share and make new investments.

The results of this study affirmed that the interest rate does have a positive influence on Egyptian stock market, however, its volatility does have a negative impact on the stock market dynamic in Egypt and Turkey. Obviously, a decrease in interest rates will cause a decrease in the banks' earnings and on the contrary an increase in these rates is very beneficial for the banking sector which is of crucial importance for the good health of the stock market in Egypt. At the same time a high volatility of the interest rate makes the stock market riskier and more uncertain, as a result, investors will look for other alternatives safer to invest their money in rather than betting it in shares on the stock market.

From the same perspective, the gold price impact positively the stock market of only Jordan among the five countries belonging to the MENA region, while the volatility of this precious metal affects the stock market dynamics in Morocco. It is well known that the gold and the stock returns are negatively correlated as the gold is considered as a safe haven, so at the time when the investment in stock prices is being very risky, the portfolio managers choose the precious metal as a refuge. This explain perfectly the fact that if the volatility of the gold prices is increasing, then it is no longer considered as a safe haven and subsequently the dynamic of the stock market will increase as well but it the opposite direction. Yet, the findings are contracted with the facts asserted in the literature, due to the lack of the importance of gold in Jordan, indeed this precious metal is not available enough to be traded.

Finally, the volatility of the oil price is statistically significant for both Jordan and Egypt, but it doesn’t affect these two stock markets movements in the same way. Indeed, it is noticed that the volatility of oil price has positive impact on Jordan stock market dynamics while having a negative influence on Egypt market. Accordingly, negative shocks have positive effect on stock market dynamic in Egypt but affect badly the Jordan stock market. This difference is due to the fact that Egypt is considered as an oil-importing country, so a fall in the oil prices will lead to the appreciation of the local currency, consequently the imports prices will be less expensive for the Egypt and this have a great influence on its stock market returns. At the same time the Egyptian stock market dynamic is affected positively by the price of oil, Egypt’s economy depends highly on foreign investments and especially on those from the Gulf countries, namely Kuwait, Saudi Arabia and the United Arab Emirates, which hold the Egyptian economy at arm's length. Meanwhile, the Jordan economy does not rely primarily on oil, in other words, the activity of the active traded companies that belong to the Amman Stock Index Exchange does not depend on crude oil. Yet, the higher the volatility of the oil price, the more important the diversification of investments becomes for oil-exporting countries. Indeed, similar to Egypt, the Jordanian economy has historically benefited from massive

investments from the Gulf countries, so if the oil market becomes risky, it's crucial for Gulf countries to find less risky investments.

C. Economic Interpretation (specific comments for each country)

To sum up, among the macroeconomic variables used in this study, only the price of the inflation rate impact negatively Tunisian stock market movements. An appreciation of the inflation rate in Tunisia will be followed by an important decrease in the stock market return. Economically, the central bank can control the inflation rate thanks to relationship that exist between this macroeconomic variable and the interest rate (interest rate policy). In other words, if the inflation rate is increasing the central bank imposes a high policy interest rate that will automatically be reflected in the interest rates required by commercial banks, therefore money creation will be reduced and inflation rate will fall. Yet, a rise in inflation level signals lower expected returns and this will be followed by a fall in economic investments.

At the same time, the Turkish stock market's movement is found to be affected positively by the inflation rate volatility and negatively by the fluctuation of the interest rate. This means that if the volatility of the interest rate rise, then the stock market dynamic will decrease, which is evident, since the investors and the financial actors always search for stability and safe area, but the high volatility of the interest rate makes the stock market very risky to invest in. on the other hand, an increase in the level of inflation will rise the purchasing thresholds of consumers who fear a greater increase in future prices. Consequently, economic growth will improve and so will productive investments.

Referring to our findings, we are able to acclaim that the Moroccan Stock market dynamic is very influenced by both the exchange rate and its volatility. It's is also proved that the inflation rate volatility and the fluctuation of the gold price have impact on this stock market evolution. Being the first world exporter of phosphates, among the top 10 of countries in the exportation of some agriculture product, and at the same time, the world leader in the production of green energy, Morocco is in a strength position in relation to the evolution of the exchange rate, which naturally affects the state of its stock market and its economy in general. In addition, the gold is considered as one of the main mining products that are currently being exploited in this country which explain the important role of this precious metal in the good health of the stock market in Morocco.

It is also detected that, on the one hand, the volatility of the inflation rate has positive effect on Egyptian stock market dynamic. Following the price liberalization and the disengagement of the state from the economy in the early 1990s, the inflation rate in Egypt become very unpredictable and this causes the fluctuation of its stock market. On the other hand, the interest rate, the oil price, and its volatility have power on Egyptian stock market movements, this is due to the liberal economic policies introduced by the early of 1990s known as "The Capital Market Law" that puts government out of step with the economy. The high level of the interest rate proposed by Egypt will attract investors from member countries of the Gulf Cooperation Council (GCC) seeking to diversify the economy outside the oil sector. Obviously, they must promote an increased the role of the private sector to support economic growth and create more jobs, but also to prepare MENA economies for the post-oil era.

The fifth country used for this study is Jordan and it is brought into being that its stock market's fluctuation is affected by the variations of both the gold price and the oil price in a positive way. Yet, this stock market is affected negatively by the exchange rate return. These results should be treated in a serious way by the Jordan economy's managers. Indeed, although the gold price is not considered as a principal natural resource in Jordan, the gold traders seem to have an important part in stock market investments and especially after the Arab Spring in 2011. Furthermore, it is well known that the oil is considered among the most crucial energy compartment all around the world, that's why the volatility of its price affect exporters and importers in on opposite way. For the case of Jordan, the resource in black oil is very low thus, it is heavily dependent on oil imports to fulfill its domestic energy needs. These two macroeconomic variables are related, the more the price of oil is important, the more the GCC countries will search for new foreign investments that provide safest returns. So, it will be very attractive for these investors to put their money on gold in Jordan as its price is increasing and this will rise considerably stock market returns in this country.

Panel B of Table 3 reports the results of diagnostic checks initiated on the EGARCH model. Overall, EGARCH model can adequately give a complete descriptive of the dynamic relationships between two financial variables. According to the LM test, it is evident that all our series contain ARCH effect since statistics reject the null hypothesis of no ARCH effect. Then, the Ljung-Box statistics (for 36 lags) show no evidence of autocorrelation in the residuals. So the model is well fitted as it is free from autocorrelation.

For Morocco and Egypt time's series estimations, we use the GED rather than the Normal distribution because it shows off better results. The GED parameters are slightly higher than 2 which means that the residuals distributions are platykurtic.

V. Conclusion

This paper aims to highlight the influence of the volatility of five crucial macroeconomic variables on the stock market returns' dynamic for five countries belonging to the MENA zone and that were neglected by the previous researches in the literature as only few works have analysed data of these countries and they were not studied simultaneously never before. In fact, these five stock markets have undergone several social and political events that have affected their economic and financial situations throughout the period chosen for our research, i.e. from January 2002 till January 2017. Needless to mention the importance of exploring and clarify the relationship between the fluctuation of macroeconomic variables namely the exchange rate, the inflation rate, the interest rate and two commodities prices (Gold and oil), and the movements of stock market returns especially for the investors, policy makers and portfolio managers. For this purpose, we tested several GARCH models in order to adopt the best methodology that not only gives the best estimation in term of performance according to the information criteria but also describes better the reality and provides better evidence that could be useful for the international portfolio managers. A large and well expanded economic interpretation is given for every country according to our findings.

The results of this paper are not perfectly the same as the common findings in the literature, this is due to the large database and to the new framework employed for this study. Indeed, to our best knowledge, an EGARCH model that combine simultaneously

five macroeconomic variables as an explicative power has never been established before in such an issue. It is clear that stock markets dynamics are not influenced by the same fluctuations of the same macroeconomic variables, it depends especially on the economic strategy adopted by each country, its natural resources, its industry or even better, the events that shocked its economy during this study period…and way more factors that this paper try to explain. In summary, we were able to notice that the Tunisian stock market movements are affected only by the price of the inflation rate. This situation is controlled by the Tunisian government, since it mainly depends on the monetary policy adopted by the central bank. The volatility of this macroeconomic variable is detected to have positive impact on the stock market dynamic in Turkey. Meanwhile, the fluctuation on the interest rate affects negatively the activities of this same stock market.
Moroccan stock market should pay more attention for the commercial balance, as its fluctuation is very influenced by the exchange rate. Indeed, the exchange rate and its volatility affect the stock market in Morocco differently. Adding to that, the inflation rate volatility as well as the gold price volatility affect the stock market evolution in Morocco in a positive way. So, the maintain of the stability in the price of gold will be beneficial for the stock market of Morocco.

Throughout the results we were able to conclude that similarly to Turkey and Morocco, The Egypt stock market dynamic is as well being affected positively by the volatility of the inflation rate, due to the lack of prices control. This proves the findings of Al-Sharkas and Al-Zoubi (2011) which support the long-run relationship between the inflation rate and the stock market returns. It is found also that the Egyptian stock market movement is influenced by not only the interest rate and the oil price but also their volatilities.

Finally, conferring to this study, the Jordan stock market evolution depends especially on the volatility of the commodities, namely gold and oil, as well as on the exchange rate return. These results are in perfect accordance with the work of Ajmi et al. (2014) who acclaimed those changes in oil prices affect the market returns of Jordan.

The conclusions and the economic interpretation drawn by this study are very beneficial for international investors because it illuminates the opportunities, they must not miss in order to take advantage of stock market investments based on the evolution of macroeconomic variables. An extension for this study could be to consider a larger database in term of period and countries, for example consider all countries of the entire Mediterranean basin so we will be able to compare developed economics and emerging ones.

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APPENDIX 1: GARCH MODELS

Table 5
GARCH Models Specificities

Models	Presentation	Definition
TARCH	Sometimes called GJR-GARCH model, the threshold ARCH is usually used to analyze Asymmetric volatility. Indeed, it is often noticed that the volatility of financial variables is different along positive and negative trends (Engle and Ng 1993). The downwards movements of share prices are usually associated with higher volatility of financial data. From this perspective, Zakoian (1994) and Glosten et al (1993) proposed the TARCH model.	The conditional variance for the TARCH (1.1) model is defined by: $\delta_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \gamma\varepsilon_{t-1}^2 d_{t-1} + \beta\delta_{t-1}^2$ Where: If ε_t is negative then d_t=1, otherwise d_t=0. In fact, in this model, volatility tends to fall with the good news (ε_{t-1}>0) and to rise with the bad news ($\varepsilon_{t-1} < 0$). In other word, good news has an effect of α while bas ones has an impact on $\alpha + \gamma$. The persistence of shocks is given by $\alpha + \beta + \gamma / 2$.
IGARCH	It's a non-stationary GARCH model presented by Engle and Bollerslev (1986). This model relates to the case of a unit root in the process of the conditional variance (the sum of α_i and β_i is equal to 1). It is characterized by an effect of the persistence in the variance. In fact, for the Integrated GARCH model, average volatility does not exist and shocks on volatility persist over time.	The process that presents the IGARCH model (p, q) is as follows: $V(\varepsilon_t \mid F_{t-1}) = h_t$ $h_t = \alpha_t + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j}$ Where: F_{t-1}: denotes all available information at time t-1. h_t: The conditional variance

APPENDIX 2: RESULTS OF UNIT ROOT TESTS

Table 6
ADF Unit Root Test Results

	Tunisia		
	Level		
	None	With constant	With constant and trend
Rt stock market	-12.0782***(0.0000)	-12.6012***(0.0000)	-12.5943***(0.0000)
Rt Exchange rate	-9.4017***(0.0000	-9.6106***(0.0000)	-10.1225***(0.0000)
Rt Inflation Rate	-1.2589(0.1911)	-4.4155***(0.0004)	-5.5968***(0.0000)
Rt Interest Rate	-6.3916***(0.0000)	-6.3978***(0.0000)	-14.3223***(0.0000)
Rt Gold	-13.8072***(0.0000)	-13.7825***(0.0000)	-13.9542***(0.0000)
Rt Oil	-10.6488***(0.0000)	-10.6692***(0.0000)	-10.7155***(0.0000)
	Turkey		
	Level		
	None	With constant	With constant and trend
Rt Stock market	-14.3676***(0.0000)	-14.5495***(0.0000)	-14.5797***(0.0000)
Rt Exchange Rate	-12.9349***(0.0000)	-13.1665***(0.0000)	-13.3758***(0.0000)
Rt Inflation Rate	-2.2487**(0.0240)	-9.4707***(0.0000)	-7.1815***(0.0000)
Rt Interest Rate	-11.3607***(0.0000)	-11.4021***(0.0000)	-11.8250***(0.0000)
Rt Gold	-13.8072***(0.0000)	-13.7825***(0.0000)	-13.9542***(0.0000)
Rt Oil	-10.6488***(0.0000)	-10.6692***(0.0000)	-10.7155***(0.0000)
	MOROCCO		
	Level		
	None	With constant	With constant and trend
Rt Stock market	-12.8281***(0.0000)	-12.9789***(0.0000)	-13.1150***(0.0000)
Rt Exchange Rate	-14.2771***(0.0000)	-14.2648***(0.0000)	-14.4977***(0.0000)
Rt Inflation Rate	-11.0567***(0.0000)	-11.1941***(0.0000)	-11.4411***(0.0000)
Rt Interest Rate	-14.3527***(0.0000)	-14.5906***(0.0000)	-14.5747***(0.0000)
Rt Gold	-13.8072***(0.0000)	-13.7825***(0.0000)	-13.9542***(0.0000)
Rt Oil	-10.6488***(0.0000)	-10.6692***(0.0000)	-10.7155***(0.0000)
	JORDAN		
	Level		
	None	With constant	With constant and trend
Rt Stock market	-5.7005***(0.0000)	-5.7168***(0.0000)	-12.0643***(0.0000)
Rt Exchange Rate	-13.5400***(0.0000)	-13.5006***(0.0000)	-13.4765***(0.0000)
Rt Inflation Rate	-10.3509***(0.0000)	-11.3623***(0.0000)	-11.3886***(0.0000)
Rt Interest Rate	-6.2230***(0.0000)	-6.2093***(0.0000)	--6.2100***(0.0000)
Rt Gold	-13.8072***(0.0000)	-13.7825***(0.0000)	-13.9542***(0.0000)
Rt Oil	-10.6488***(0.0000)	-10.6692***(0.0000)	-10.7155***(0.0000)
	EGYPT		
	Level		
	None	With constant	With constant and trend
Rt Stock market	-11.7197***(0.0000)	-12.0269***(0.0000)	-12.1539***(0.0000)
Rt Exchange Rate	-14.4031***(0.0000)	-14.5752*** (0.0000)	-14.6139***(0.0000)
Rt Inflation Rate	-2.2617**(0.0232)	-9.4059***(0.0000)	-9.7046***(0.0000)

Rt Interest Rate	-13.2367***(0.0000)	-13.2461***(0.0000)	-13.4243***(0.0000)
Rt Gold	-13.8072***(0.0000)	-13.7825***(0.0000)	-13.9542***(0.0000)
Rt Oil	-10.6488***(0.0000)	-10.6692***(0.0000)	-10.7155***(0.0000)

Table 7
Unit Root Test Results (Panel Data)

	IPS Test					
Variables	stock market Log returns	Exchange Rate Log returns	Inflation Rate Log returns	Interest Rate Log returns	Gold Log returns	Oil Log returns
Countries	-24.5199 (0.0000)***	-22.3043 (0.0000)***	-20.9833 (0.0000)***	-22.9910 (0.0000)***	-30.0826 (0.0000)***	-22.2532 (0.0000)***

*Notes: statistical significant at: *10%, **5%, ***1% levels*
MacKinnon (1996) P-values are reported in (.)