Modeling the linkage between North and Southern Mediterranean stock markets

Adel Boubaker[a1]

[a]Department of finance, University of Tunis el Manar, Tunis, B.P 248 El Manar II 2092 Tunisia

Abstract

To enhance our understanding in the basin Mediterranean stock markets, the paper investigates the relationship between the countries signatories of the Agadir Agreement which are Morocco, Tunisia, Egypt and Jordan for Southern Mediterranean Markets and France, Italy, Spain and Athens for Northern Mediterranean stock markets. We use the copula approach to model the linkages (dependence structure) between these markets. Our empirical results show that there is significant increase in the dependence between these markets after the Agadir Agreement. Moreover, the long-run result shows that there is no evidence of a relationship between these markets before the Agadir agreement. Whether, the linkages between these markets become more significant after the Agadir Agreement. However, Egypt and Morocco seem the first to react to this Agreement and occupy the large share of trade with the Northern European markets. This framework permits us to quantify the potential impact on the relationship between financial markets of the Agadir Agreement.

Keywords: copula approach; cointegration; Agadir agreement; variance decomposition**,** Basin Mediterranean stock markets.

[1]Corresponding author Tel: (+216)98430378. *E-mail address:* Adel.Boubaker@fsegt.rnu.tn

1. Introduction

The recent wave of financial globalization since the mid-1980s has been marked by a surge in capital flows among industrial countries and, more notably, between industrial and developing countries. This process of globalization is enabling international financial markets to become more correlated and connected than ever before. In this context, an understanding of correlations and interactions among various financial markets is an important issue for investors, financial institutions and government. Thus, there is a great deal of research focusing on the linkages of international equity markets.

Early literature focused on the correlations among the developed financial markets (see for example, Eun and Shim (1989) [11], Hamao, Masulis and Ng (1990) [13], King, Sentana and Wadhwani (1994) [15]). The cited papers show that developed financial markets are interconnected and that the volatility of the US stock market is transmitted to other developed markets.

In the last 20 years, with the development of emerging financial markets, financial economists have become increasingly interested in the relationship between emerging and developed markets and its meaning to financial liberalization and global integration.

While global stock market linkages have been widely studied for the developed markets and emerging markets in Asia, Middle East, western European and Latin America, research on the linkages of the emerging markets in North Africa with the developed markets is limited. Thus, interest has been rekindled in North Africa stock markets in recent times on account of their fast growth and relatively low correlation with the more developed markets in EU-Mediterranean region.

The Agadir agreement provides us with an opportune backdrop to investigate the short and long-run co-movement between North Africa and Northern European Mediterranean stock markets. This agreement was signed in Rabat on Feb. 25th, 2004establishing a Free Trade Area Amongst Arab Euro-Mediterranean Countries[2]. Agadir Agreement, which entered into force on July 6th 2oo6, adopts the Pan-EUROMED Rules of Origin that allow for diagonal accumulation of origin amongst the its member countries through the possibility of using production input components originating in any of the member countries of Agadir Agreement, EU countries or EFTA countries, to comply with the required rules of origin for the purpose of exporting their products to EU markets exempted from customs duties under their Association Agreements with the EU. The Agreement also aims to harmonizing general and sectorial economic policies in member countries in relation to foreign trade, agriculture, industry, financial and taxation systems, services, and customs with the view of achieving objective competition amongst member countries. The agreement provides for full liberalization of trade in industrial and agricultural goods as of its date of entry into force. Moreover, member countries are committed under the Agreement to eliminate all non-tariff barriers including quantitative restrictions, financial, administrative and technical barriers that may be imposed on imports. It thus becomes an important research endervor to investigate the

[2] Agadir Agreement was signed in Rabat on Feb. 25th, 2004 pursuant to Agadir Declaration which was signed by Jordan, Egypt, Tunisia and Morocco on May 8th. 2001.

short and long-run relationships between country signatories of the Agadir agreement under the broader EU-Mediterranean process.
From the perspective of international investors, weak market linkage offers potential gains from international portfolio diversification, while strong market linkage or co-movement in returns eliminates the potential benefits of diversification into emerging markets. In addition, studying long-term co-movement would offer for international investors important benefits with longer-term investment horizons that diversify in these emerging markets.
Since, this knowledge would be useful for regulators, academic research, professional fund managers and investors.

The purpose of this paper is to investigate short-run and long-run co-movements between countries signatories of the Agadir agreement which are Morocco, Tunisia, Egypt and Jordan for Southern Mediterranean Markets and France, Italy, Spain and Athens for Northern Mediterranean stock markets during the 2000-2010 periods, using copula approach and cointegration techniques.
As mentioned above, this research is distinguishable from a number of previous studies in several ways. First, while most studies examine mainly short-run market relationships through correlation tests (Defusco et al (1996) [9]; Savva, Osborn, and Gill (2004) [19]) and also analyze volatility spillover using ARCH/GARCH model (Veiga and McAleer (2003) [25] ; Dao and Wolters (2008) [8]), the study explores whether there are both linkages and long-run co-movements between countries signatories of the Agadir agreement. Evidence of such long-run co-movement would suggest greatly overstated benefits for European investors with longer-term investment horizons who diversify in these emerging markets. Then to model the linkage between stock returns, we use, in the first step, a new approach, copula functions, to consider some facts in finance such as leptokurticity, asymmetry and tails dependence. Then, in the second step, we employ the developed cointegration techniques that allow for structural shifts in the long-run relationship.
The paper proceeds as follows: Section 2 discusses previous empirical studies. Section 3 clarifies the empirical methodology and presents the models and the sample used. Section 4 synthesizes all the results data and section 5 concludes.

2. Literature review:

Studies of world capital markets have typically focused on the merits of diversification, the lead relationship and co-movement of equity prices among market indices. On that note, many studies have focused on the movement of world exchange indices during a worldwide financial crisis. Moreover, many researchers have investigated the relationship among worldwide financial markets. The primary focus of the empirical research has been the relationships among the financial markets of industrialized countries. Most advanced economies deregulated their capital markets, removed barriers to international investment, and improved accessibility to information.
Several research studies the relationship between financial markets have been mentioned. In developed markets context, Hamao et al. (1990) [13] observed evidence of price volatility spillovers from New York to Tokyo, London to Tokyo, and New York to London, but no price volatility effects in other directions. Liu and Pan (1997) [17] studied the mean and volatility spillovers from U.S. and Japanese stock markets to four other Asian stock markets

and found that the U.S. market is more influential than the Japanese market in transmitting returns and volatilities to the other four Asian markets. Ng (2000) [18] studied volatility spillovers from Japan and U.S. market to pacific-basin stock markets. Cheung and Westermann (2001) [6] concluded that the spillover did not change between U.S and European market before and after the introduction of the EURO. While analyzing volatility spillover between U.S., UK and Japanese market using high frequency data. Alaganar and Bhar (2002) [1] examined the information flow between dually listed Australian stocks' trades in Australia and U.S. using a bivariate GARCH model and found unidirectional information flow from U.S. market to Australian market. Baele (2002) [3] investigated the time-varying nature of the volatility spillover from the U.S. (global effects) and the aggregate European stock markets (regional effects) into individual European stock markets. Christiansen (2003) [7] examined mean and volatility spillover effects from both the U.S. and European markets into the individual European bond markets and found negligible mean-spillover but volatility spillover effect was substantial. Veiga and McAleer (2003) [25] found that volatility spillover took place from UK to the U.S. and Japan and from the U.S. to UK. Savva, Osborn, and Gill (2004) [19] examined the spillover among U.S., German, UK and French markets using dynamic correlation framework and found that European markets (only UK and German) are affected by the U.S. market. They also conclude that the correlation between European markets has increased after the introduction of the EURO. Syriopoulos (2007) [24] investigated the short-run and long-run linkages between emerging and developed European stock markets and found that emerging markets co-integrated well with their developed counterparts.

In emerging markets context, Defusco et al (1996) [9] showed that the U.S. market and emerging markets of pacific Basin, Latin America and the Mediterranean are not integrated with each other. This independence implies the existence of long-term gains from the international diversification in these markets. Bekaert and Harvey (1997) [4] analyzed the volatilities of emerging equity markets and found that in integrated markets global factors influence the volatility, whereas local factors affect the segmented markets. In, Kim, Yoon, and Viney (2001) [14] studied the volatility transmission among Asian countries during the Asian Financial Crisis period from 1997 to 1998. They found reciprocal spillover between Hong Kong and Korea. Jang and Sul (2002) [14] investigated the co-movement of Asian stock markets prior to, during and after the Asian Financial Crisis. They found that the co-movement among the Asian markets increased during the financial crisis period. Gilmore and McManus (2002) [12] examined the links of short and long term between the U.S. and the three emerging markets of Central Europe (Czech Republic, Hungary and Poland). They showed that these markets are not integrated between them but on the contrary, they are perfectly segmented. This means that these markets represent a source of considerable international diversification for U.S. investors. Serrano and Rivero (2002) [21] examined the long-run relationships between the markets of Latin America and the U.S. market over the period January 1995 to February 2002. They proved the existence of links and co-movements of long-run relationship between these markets. The existence of such co-movement implies a certain degree of integration between them which negatively affects the potential gains from long term to a U.S. investor in these markets.

More recently, Dao and Wolters (2008) [8] studied the volatility interdependence of four stock market indices, Dow Jones, Nikkei, Hang Seng and STI using a multivariate stochastic volatility model. They found that the volatilities of these indices moved together. Lee (2009) [16] used bivariate GARCH model and examined the volatility spillover effects among six Asian countries. He found that there are statistically significant volatility spillover effects across the stock markets of these six countries. Yaser et al (2009) [26] investigated the lead lag relationship between the MENA countries and regions. They found not market causality and spillover from one country to another in the North Africa region, where in the gulf cooperation council (GCC) region, the result show more interaction and linkage in these markets.

3. Data and methodology:

3.1. Data environment:

This paper mainly analyzes the dynamic relationship between countries signatories of the Agadir agreement. The data used consist of daily stock index returns over the period 3 January 2000 to 31 December 2010. This period is decomposed into two sub-periods to characterize the impact of Agadir Agreement effect on the relationship between these markets: pre-Agadir Agreement which spreads out from January 3th, 2000 till July 6, 2006 counting and post-Agadir Agreement which begins the July 7th, 2006 and ends December 31th, 2010.

The data under consideration are: the EGX30 index (Egypt), TUNINDEX (Tunisia), MASI index (Morocco) and ASE index (Jordan) for the Southern Mediterranean markets and CAC40 (France), IGBM index (Spain), MIB30 index (Italy) and ATI index (Greece) for the European Mediterranean markets. Excluding weekends and holidays, we have 2712 daily observations for the Southern Mediterranean stock markets and a total of 2811 daily observation for the North Mediterranean stock markets.

The data were converted to continuously compounded returns $r_{i,t} = \mathrm{Ln}\left(\frac{P_{i,t}}{P_{i,t-1}}\right)$, where $P_{i,t}$ represents the value of index i at time t.

3.2. Methodology:

In the framework of this paper, we focus our attention to two approaches of analysis to examine the long-run and short-run links between countries signatories of the Agadir Agreement. The first one is the copulas functions to consider laws of distribution more corresponding to the stylized facts observed on the financial markets and fully specify the dependence structure between the stock market returns. The second approach is the co-integration techniques that allow for structural shifts.

3.2.1. . Copulas Functions analysis:

A copula is a multivariate cumulative distribution function whose marginal distribution is uniform on the interval [0,1]. The importance of the copula is that it can capture the dependence structure of a multivariate distribution. This is justified by the Sklar's (1959) [23] theorem.

Sklar's Theorem: Let F_{XY} be a joint distribution function with margins F_X and F_Y. Then there exists a copula C such that for all x, y in R,

$$C(u_x, u_y) = C(F_x(x), F_y(y))$$
$$= F(F_x^{-1}(u_x), F_y^{-1}(u_y))$$
$$C(u_x, u_y) = F(x, y)$$

If F_X and F_Y are continuous, then C is unique; otherwise, C is uniquely determined on Ran F_X×Ran F_Y and C is invariant under strictly increasing transformations of the random variables.

From Sklar's theorem, we notice that a joint distribution F_{XY} can be decomposed into its univariate marginal distributions F_X and F_Y, and a copula C, which captures the dependence structure between the variables X and Y. Thanks to these decomposition, we can distinguish the marginal distribution's behaviors of the dependence structure.

The density of a bivariate law can be written also in terms of the density of the copula associated and marginal densitiesf_x andf_y :

$$f(x,y) = c(F_X(x), F_y(y)) \times f_x(x)\, f_y(y)$$

That is, the density of F has been expressed as the product of the copula density and the univariate marginal densities. It is in this sense that we say that the copula contains all the information given by the joint distribution of a pair of random variables outside of the marginal.

Noun	parameters	Copulas
Gaussian	ρ	$C(u_x, u_y, \rho) = \varphi_\rho(\varphi^{-1}(u_x), \varphi^{-1}(u_y))$
Student	ρ, k	$C(u_x, u_y, \rho, k) = T_{\rho,k}(T_k^{-1}(u_x), T_k^{-1}(u_y))$
Clayton	$\theta > 0$	$C(u, v, \theta) = (u^{-\theta} + v^{-\theta} - 1)^{\frac{-1}{\theta}}$
Gumbel	$\theta \geq 1$	$C(u, v, \theta) = \exp[-[(-\text{Ln}(u))^\theta + (-\text{Ln}(v))^\theta]]^{\frac{1}{\theta}}$
Frank	$\theta \neq 0$	$C(u, v, \theta) = -\frac{1}{\theta}\text{Ln}[1+\frac{(\exp(-\theta_u)^{-1})(\exp(-\theta_v)^{-1})}{\exp(-\theta)-1}]$

This table above shows the characteristics of the different models of copulas where the variables u and v are cumulative distribution function.φ_ρ is the bivariate normal distribution function with the correlation coefficient ρ. φ^{-1} is the inverse of the univariate normal distribution. $T_{\rho,k}$Is Student distribution of standard bivariate correlation matrix function of ρ and degree of freedom. The parameter θ measures the degree of dependence between risks.

Both Gaussian and Student-t copulas belong to the elliptical-copulas family. They were applied to symmetric distributions. However, the Clayton, Gumbel and Frank copulas are called Archimedean copulas. They have the great advantage to describe a variety of dependence structures including the so-called asymmetric dependencies, where the coefficients of lower tail and upper tail are different.

3.2.2. Cointegration Approach:

The analysis of the relationship of co-integration (Engel and Granger (1987) [10]) leads to discuss possible co-variations of the variables. More formally, a set of variables(X_t, Y_t) is called co-integrated ifX_t and Y_t are similar integrated and there is a linear combination of these variables called co-integrating relationship, which is stationary.
Often the economic variables, especially the stock market, have the distinction of being integrated of order1. They are not stationary in level and have a unit root but are stationary in terms of variation.
Based on the non-stationary series, Engle and Granger (1987) [10] have shown that a linear combination of two or more non-stationary series may be stationary. If this combination exists, the non-stationary series are said to be co-integrated. This co-integration can be interpreted as an equilibrium relationship between long-term variables.
Determining relationships co-integration based on the Johansen test is based on a system autoregressive error correction. A model for error correction (VEC: Vector Error Correction) is a VAR (Vector autoregressive) limits used for the treatment of non-stationary series supposed to be co-integrated.

The vector error correction is of the form:

$$\Delta Y_t = \sum_{i=1}^{p-1} \beta_i \Delta Y_{t-1} + \beta_p Y_{t-p} + \eta + \varepsilon_t$$

Y_t : is a k vector of endogenous variables.
β_i : Parameters to be estimated.
P: lag length
η : is a vector
ε_t **:** is a vector of shocks.

4. Empirical results and discussion:

4.1. Summary statistics:

The descriptive statistics for the corresponding return series are presented in the **Table 1**. As measured by the standard deviation, market return volatility of southern Mediterranean country is highest in the Jordan, followed by Egypt, Morocco, and Tunisia, while return volatility of North Mediterranean country is highest in Italy, followed by Athens, France, and Spain. In terms of skewness, Tunisia, Jordan, Spain, and Athens, are skewed to the left, while Egypt, Morocco, Italy, and France are skewed to the right. Investors in positively skewed markets would be willing to accept smaller returns than investors in negatively skewed markets when the market is up, provided that the losses are not too serious when the market is down. All series exhibit excessive kurtosis, a fairly common occurrence in high frequency financial time series data and implies that the generalized autoregressive conditional heteroscedasticity (GARCH) model suggested by Bollerslev (1986) [5] is appropriate. The Jarque–Bera statistic rejects the null hypothesis of normality for all return series. It is also interesting to note that the Q-statistic which is used for detection of autocorrelation is significant in all cases, implying that the past behavior of the market may be more relevant.

Table1:
Descriptive statistics forallreturn series:

	Tunisia	**Jordan**	**Egypt**	**Morroco**	**Italy**	**France**	**Spanish**	**Athens**
Mean	0.000217	-0.00056	0.000234	-0.00015	$8.79E^{-05}$	3.20E-05	4.43E-05	-9.3E-05
S&D	0.002236	0.043185	0.003380	0.003620	0.010586	0.006710	0.006217	0.006921
Skewness	-0.25509	-0.04491	0.086988	0.190192	0.19462	0.159337	-0.13442	-0.20784
Kurtosis	12.38948	14.5699	6.135430	8.486280	8.869784	9.349461	12.92979	7.491217
J-B	9929.117 [00000]	3055.87 [00000]	1107.330 [00000]	30558711 [00000]	7368.165 [00000]	3629.128 [00000]	8860.021 [00000]	1826.750 [00000]
Q(11)	25.91 [0.0001]	33.124 [0.0001]	40.325 [0.0004]	59.450 [0.0001]	23.247 [0.0001]	125.231 [0.0002]	25.423 [0.0000]	40.325 [0.0000]

Notes: The sample of daily returns is from 01January 2000 to 31 December 2010. Q(11) is the Ljung–Box statistic for serial correlation. Jarque–Bera statistic is used to test whether or not the series resembles normal distribution. Actual probability values are in brackets.

4.2. Correlation and copula function:

Our estimation is done in two steps as permitted by the copula functions: the first one is the test of adjustment to a marginal distribution throughout the period to select the appropriate marginal distribution. Then we use the test of adequacy of copulas allows us to validate the choice of the copula selected for a couple of variable and estimate its parameters.

Table 2
The test of adjustment to marginal distributions

Country	**Index**	**Information Criteria**			**Marginal distribution associated**
		-SIC	-AIC	-HQIC	
Tunisia	**TUNINDEX**	-87352	-87339	-87344	Levy
Jordan	**ASE**	-97789	-97775	-97780	Levy
Egypt	**EGX 30**	-87240	-87227	-87231	Levy
Morroco	**MASI**	-87142	-87129	-87134	Levy
Italy	**MIB 30**	-91987	-91974	-91978	Levy
France	**CAC 40**	-92340	-92326	-92331	Levy
Spain	**IGBM**	-92327	-92333	-92338	Levy
Greece	**ATI**	-92553	-92540	-92545	Levy

A test of adjustment to a marginal distribution is made on the stock indices returns. Therefore, we choose the estimation that minimizes the three information criteria; Schwarz (SIC), Akaike (AIC) and Hannan-Quinn (HQIC); to select the appropriate marginal distribution.
In our sample, the law of levy shows best fits for the indices studied among the following laws: the law of Laplace, Logistic, Normal, Student, Studentt_3, Levy and the law of Cauchy.

Table 3
The test of adequacy of copulas for Southern Mediterranean stock markets

Copules	**-SIC**	**-AIC**	**-HQIC**
Clayton	N/A	N/A	N/A
Frank	N/A	N/A	N/A
Gumbel	-7,91	-2	-4,14
Normal	-53,62	5,36	-15,91
Student	**-113,57**	**-48,7**	**-72,09**

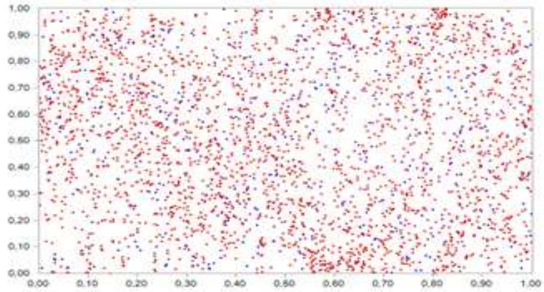
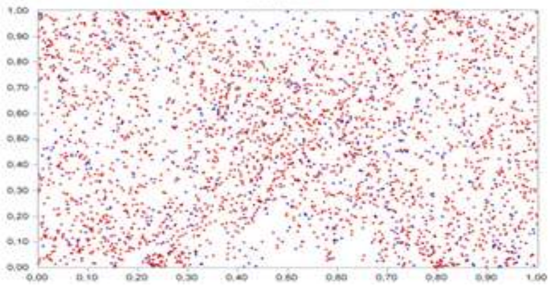


Table 4
The test of adequacy of copulas for North Mediterranean stock markets

Copules	**-SIC**	**-AIC**	**-HQIC**
Clayton	26.9	32.03	29.88
Frank	-17.69	-11.75	-13.90
Gumbel	-22.17	-16.23	-18.37
Normal	230.00	289.34	267.98
Student	**433.56**	**498.82**	**475.33**



In our case, the dependence between the countries signatories of the Agadir Agreement is modeled by the copula student after having made the test of adequacy of copulas Student, Clayton, Gumbel, Frank and Normal.
To estimate the parameters of the copula, we used the IFM (Inference Functions for Margins), or method of inference functions of marginal parametric estimation method proposed by Shih and Louis (1995) [22]. First, we estimate the marginal parameters of the method of maximum likelihood estimators and then we introduce in the copula log-likelihood function to determine the parameters of the copula.

Table 5: Parameters of copulas for the pre-Agadir agreement period

	MASI	**TUNINDEX**	**EGX 30**	**ASE**	**CAC 40**	**ATI**	**IGBM**	**MIB 30**
MASI	1	0.056	0.032	-0.013	-0.011	-0.019	-0.11	0.027
TUNINDEX	0.056	1	0.011	-0.0057	0.0017	0.035	-0.017	-0.033
EGX 30	0.032	0.011	1	-0.03	-0.037	-0.00063	-0.002	-7.5e^{-005}
ASE	-0.013	-0.0057	-0.03	1	-0.021	-0.059	-0.021	-0.041
CAC 40	-0.011	0.0017	-0.037	-0.021	1	0.0081	0.02	0.04
ATI	-0.019	0.035	-0.00063	-0.059	0.0081	1	0.054	0.018
IGBM	-0.11	-0.017	-0.002	-0.021	0.02	0.054	1	-0.023
MIB 30	0.027	-0.033	-7.5e^{-005}	-0.041	0.04	0.018	-0.023	1

Table 5 shows the values of the estimated parameters of the student copulas, for the pre-agreement period. During this period, there is a positive dependence between the following indices: MASI/ TUNINDEX, MASI/ EGX30, MASI/ ITALY, CAC40/ ATI, CAC40/MIB30, ATI/ IGBM, ATI/ MIB30, IGBM/ CAC40. The intensity of this dependence differs from one index to another. However, ASE index had a negative dependence between all the indices used in this sample. [Thus, there is no relationship between Jordon and the other countries].
In order to try to answer the question of the change of the dependence after the signing of the Agadir agreement, we estimate the parameters of multivariate copulas existing for the second period.
We find as before that overall the Student copula models better the dependence structure between the stock market returns. Results of parameters copulas estimates are presented in the following table.

Table 6: Parameters of copulas for the post-Agadir agreement period

	MASI	**TUNINDEX**	**EGX 30**	**ASE**	**CAC 40**	**ATI**	**IGBM**	**MIB 30**
MASI	1	-0,029	-0,0048	-0,035	0.0026	-0,027	0,03	-0,16
TUNINDEX	-0,029	1	0.0064	0,014	0.00094	0,04	-0,052	0,042
EGX 30	-0,0048	0.0064	1	0,079	-0,049	0.0098	-0,029	-0,17
ASE	-0,035	0,014	0,079	1	-0,059	-0,026	0,018	-0,12
CAC 40	0.0026	0.00094	-0,049	-0,059	1	0,023	-0,04	-0.0054
ATI	-0,027	0,04	0.0098	-0,026	0,023	1	-0,013	0,051
IGBM	0,03	-0,052	-0,029	0,018	-0,04	-0,013	1	-0,079
MIB 30	-0,16	0,042	-0,17	-0,12	-0.0054	0.051	-0,079	1

The dependence parameters increased between MASI/CAC40, MASI/IGBM, TUNINDEX/ASE, TUNINDEX/ ATI, TUNINDEX/ MIB30, EGX30/ ASE, EGX30/ ATI, ASE/ ATI, ASE/ IGBM, CAC40/ ATI and ATI/ MIB30index.Therefore, we notice that Jordon is entered into dependency relationship with some countries after the signing of the Agadir Agreement. So, more this parameter is higher, greater is the dependence. It thus means that these indices are more and more dependent upon the signature of this accord. This result is important in the fact that member countries are committed under the Agreement to eliminate all non-tariff barriers including quantitative restrictions, financial, administrative and technical barriers that may be imposed on imports.
However, in the first period, the dependence between Egypt with Jordon, France and Athens had a positive dependence but the sense of dependence varied in a negative one when an extreme event occurred (Agadir agreement). It even has for the sense of dependence between France with Spain. Moreover, it’s the same case for Italy with Morocco and France. These countries become less dependent between each other.
In the first step of this paper, for testing on short-run links, the copula approach was employed. From the copula student analysis, we can conclude that the markets considered are interrelated between each other however the sign and the degree of dependence varies from one country to another.
In the next step, long-term links are explored. An appropriate approach for this purpose is the cointegration test. From the perspective of investors, long-term co-movements would offer

greatly overstated benefits for the country signatories of the Agadir agreement investors with longer-term investment horizon.

4.3. log-run relationship and the cointegration approach:

In this section, we investigate the long-run relationships between countries signatories of the Agadir agreement through the cointegration approach. To implement the Johansen test, we first examine the time series properties of these variables. We use Augmented Dickey Fuller (ADF) and Phillips-Perron tests to find out the order of integration of both the series. If these series are found to be of the same order of integration then we can apply the co-integration tests.

4.3.1. Testing for unit root and Stationary:

Stationary is unavoidable prerequisite for VAR model implementation. Thus, we tested all involved time series for unit root and stationary. All of the variables are expressed in natural logarithms to reduce unwanted variability (heteroskedasticity) in the data. We proceed to investigate the stochastic properties of the series considered in the model. We do so by analyzing their order of integration on the basis of a series of unit root tests. Specifically, we perform the Augmented Dickey–Fuller (ADF), and Phillips–Perron (PP) tests. The results of these formal tests are summarized in **Table 7**. According to these results, we could remark that the negatively large values for the ADF and PP test statistics in the table reject the null hypothesis of a unit root.

Table 7: Unit root test

	ADF		**PP**	
	Test	p-value	Test	p-value
Tunisia	-40.0037	0.0000	-40.5250	0.0000
Jordan	-18.38824	0.0000	-64.48397	0.0001
Egypt	-28.578	0.0000	-38.06817	0.0000
Morroco	-37.01678	0.0000	-36.6468	0.0000
Italy	-46.0981	0.0001	-46.09981	0.0001
France	-25.93529	0.0001	-55.8877	0.0001
Spanish	-49.59427	0.0001	-49.88523	0.0001
Athens	-52.93898	0.0001	-52.93915	0.0001

ADF and PP are the augmented Dikey-Fuller (ADF)and Phillips-Perron (PP)unit root tests, with 5% critical value of -1.94.The p-value presents the probability to accept the null hypothesis of non-stationary series.

4.3.2. Cointegration test:

First, we use both the Trace and the maximum Eigen value Johansen tests to examine whether the series are cointegrated. The critical values of tests vary according to the hypothesis of the presence or absence of constant and trend in cointegrating relationships. These tests give the number of cointegrating relationship between stock markets considered in our sample.

It is important to note that the trace testis used to determine the number of cointegrating relationship, but not if the variables are cointegrated or not.

The tables below show the result of Trace test and maximum Eigen value test for the sub-periods.

Table 8: Trace test for the pre-Agadir agreement

	Eigen value	Trace-statistic	0.05 critical value	Prob**
None *	0.104370	771.5105	159.5297	0.0000
Atmost 1 *	0.098856	632.0721	125.6154	0.0001
Atmost 2 *	0.089687	500.3975	95.75366	0.0001
Atmost 3 *	0.080808	381.5290	69.81889	0.0001
Atmost 4 *	0.073252	274.9395	47.85613	0.0001
Atmost 5 *	0.065852	178.7065	29.79707	0.0001
Atmost 6 *	0.054674	92.53427	15.49471	0.0000
Atmost 7 *	0.016781	21.40866	3.841466	0.0000
Maximum Eigen value test for the pre-Agadir agreement				
Hypothesized No.of CE(s)	**Eigen value**	**Max-Eigen statistic**	**0.05 critical value**	**Prob****
None *	0.104370	139.4384	52.36261	0.0000
Atmost 1 *	0.098856	131.6746	46.23142	0.0000
Atmost 2 *	0.089687	118.8685	40.07757	0.0000
Atmost 3 *	0.080808	106.5895	33.87687	0.0000
Atmost 4 *	0.073252	96.23299	27.58434	0.0000
Atmost 5 *	0.065852	86.17224	21.13162	0.0000
Atmost 6 *	0.054674	71.12561	14.26460	0.0000
Atmost 7 *	0.016781	21.40866	3.841466	0.0000

Table 9

Trace test for the post-Agadir agreement

	Eigen value	Trace-statistic	0.05 critical value	Prob**
None *	0.303318	1834.380	143.6691	0.0000
Atmost 1 *	0.294526	1518.855	111.7805	1.0000
Atmost 2 *	0.271423	1214.278	83.93712	1.0000
Atmost 3 *	0.255668	937.8329	60.06141	0.0001
Atmost 4 *	0.240578	680.0642	40.17493	0.0001
Atmost 5 *	0.224150	439.8171	24.27596	0.0001
Atmost 6 *	0.202387	218.2534	12.32090	0.0001
Atmost 7 *	0.023590	20.84054	4.129906	0.0000
Maximum Eigen value test for the post-Agadir agreement				
Hypothesized No.of CE(s)	**Eigen value**	**Max-Eigen statistic**	**0.05 critical value**	**Prob****
None *	0.303318	315.5246	48.87720	0.0001
Atmost 1 *	0.294526	304.5770	42.77219	0.0001
Atmost 2 *	0.271423	276.4453	36.63019	0.0001
Atmost 3 *	0.255668	257.7688	30.43961	0.0001
Atmost 4 *	0.240578	240.2470	24.15921	0.0001
Atmost 5 *	0.224150	221.5638	17.79730	0.0001
Atmost 6 *	0.202387	197.4128	11.22480	0.0001
Atmost 7 *	0.023590	20.84054	4.129906	0.0000

We notice that in all cases, we cannot conclude on rejection of the hypothesis of no cointegration. Indeed, there are eight cointegrating relationships between countries signatories of the Agadir agreement and the number of relationship has not changed during the two sub-periods. Therefore, we have proven that there are long-run relationships between all the markets considered in our sample.

4.3.3. Forecast error variance decomposition

Variance Decomposition is another way of forecast error variance to quantify the interdependence in terms of returns among the eight markets under study. Variance decomposition breaks down the variation in each returns series into its components. As it gives the proportion of the movements in the returns series that are due to their own shocks versus shocks due to the other series, the variance decomposition provides information about the relative importance of each random shock in affecting the series in the system. In this study we use Choleski decomposition to orthogonalize the shocks, that is, the underlying shocks to the VAR model are orthogonalized before variance decompositions are computed. By design, a variable explains almost all of its own forecast error variance at a very short horizon and a smaller proportion at a longer horizon. However, the proportions of explanation are sensitive to the order of the variables in VAR when the shocks are contemporaneously correlated.We order the eight series in the VAR of the returns series before and after Agadir agreement[3]. The order in the VAR of the returns series is CAC40, ATI, MIB30, IGBM, EGX30, MASI, AGI, and TUNINDEX. We obtain the variance decomposition results of 1-day, 5-day and 10 day.

The results of variance decomposition before Agadir agreement are presented in table 10(a). In all cases, the results show no evidence of significant linkages between these markets before Agadir Agreement.

Table 10 (a): Pre Agadir-agreement period

-Variance decomposition of CAC40 (France)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	99.9	0.00019	0	0	0	0	0	0
5	91.32	0.20	2.21	0.029	0.024	3.28	0.46	2.44
10	82.86	0.35	4.56	0.039	0.033	6.76	0.88	4.49

-Variance decomposition of ATI (Athens)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0	1	0	0	0	0	0	0
5	0.09	99.03	0.082	0.061	0.26	0.38	0.017	0.065
10	0.096	99.16	0.061	0.061	0.19	0.35	0.015	0.044

-Variance decomposition of MIB30 (Italy)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.64	0.0097	98.86	0.186	0.061	0.211	0.032	0
5	1.85	0.081	97.38	0.34	0.071	0.31	0.023	0.191
10	1.93	0.076	97.04	0.34	0.071	0.32	0.014	0.192

-Variance decomposition of IGBM (Spain)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0	0.007	0	99.97	0.016	0	0	0
5	0.14	0.0068	0.129	99.37	0.026	0.118	0.004	0.08
10	0.121	0.0089	0.142	99.46	0.0177	0.075	0.006	0.06

-Variance decomposition of EGX30 (Egypt)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.100	0.0036	0	0	99.89	0	0	0
5	0.101	0.082	0.035	0.071	99.38	0.086	0.039	0.198
10	0.068	0.096	0.023	0.056	99.42	0.105	0.041	0.185

-Variance decomposition of MASI (Morocco)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.129	0.00008	0	0	0.022	99.84	0	0
5	2.44	0.017	0.054	0.051	0.015	97.39	0.005	0.022
10	3.12	0.014	0.072	0.038	0.0107	96.71	0.006	0.014

-Variance decomposition of TUNINDEX (Tunisia)

[3] In this paper we use the information criteria methods like Akaike's (1974) [2] information criterion (AIC), Schwarz's Bayesian (1978) information criterion, and Hannan-Quinn information criterion (HQIC) that show the optimal lag length where the information criterion is smallest. According to these information criterions, the appropriate leg length is 1.

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.021	0.034	0.37	0.006	0	0.07	0.23	99.26
5	0.024	0.29	1.31	0.040	0.024	0.15	0.34	97.80
10	0.015	0.28	1.43	0.048	0.023	0.15	0.32	97.71

-Variance decomposition of AGI (Jordan)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.063	0.0016	0000	00000	0.0001	0.006	99.92	0000
5	0.185	0.028	0.005	0.010	0.012	0.021	99.71	0.015
10	0.23	0.026	0.003	0.0009	0.016	0.015	99.68	0.016

The results of variance decomposition after Agadir Agreement are presented in table 10(b). The results show evidence of linkages between markets under study. For the stock index of EGX30, the proportion of the error variance attributable to own shocks in the first step is about 98.37%. By 5 days ahead, the behavior has settled down to a steady state, where about 87.18% of the error variance in the series of EGX30 is attributable to own shocks and by 10 days ahead the forecast error variance has achieved the steady state, with own shocks accounting for 84.15% of its variation.. For the stock index of MASI, 98.11% of a 1-day-ahead forecast error variance is due to its own shock and by 5 days ahead the forecast error variance has achieved the steady state, with own shocks accounting for 97.53% of its variation. For the TUNINDEX index, the proportion of the error variance attributable to own shocks in the first step is about 99.63%. By 5 days ahead, the behavior has settled down to a steady state, where about 98.29% of the error variance in the series of TUNINDEX is attributable to own shocks. And for the AGI index, 99.75% of a 1-day-ahead forecast error variance is due to its own shock, by 5 days ahead the forecast error variance has achieved the steady state, with own shocks accounting for 98.91% of its variation and by 10 days ahead the forecast error variance has achieved the steady state, with own shocks accounting for 98.8% of its variation. For both EGX30 and MASI, 1-day, 5-day and 10-day ahead forecast error variance can be explained by shocks to CAC40, ATI, MIB30 and IGBM of the North Mediterranean stock markets

Table 10(b): Post Agadir-agreement period

-Variance decomposition of CAC40 (France)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	99.61	0.38	0000	0000	0000	0000	0000	0000
5	87.39	1.61	0.169	7.176	2.492	0.481	0.286	0.383
10	84.25	2.11	0.13	9.131	3.268	0.526	0.296	0.282

-Variance decomposition of ATI (Athens)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0000	100	0000	0000	0000	0000	0000	0000
5	0.36	95.59	0.148	1.82	1.02	0.174	0.799	0.073
10	0.40	95	0.155	2.37	1.243	0.136	0.632	0.050

-Variance decomposition of MIB30 (Italy)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.056	0000	99.31	0.26	0.072	0.281	0.0134	00000
5	0.85	0.059	95.99	1.265	0.57	0.396	0.311	0.542
10	1.12	0.087	95.762	1.528	0.37	0.307	0.251	0.562

-Variance decomposition of IGBM (Spain)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	1.677	0.328	0000	97.04	0.952	0000	0000	0000
5	12.18	2.813	1.004	74.7	8.574	0.381	0.033	0.22
10	16.93	4.05	1.169	64.97	12.06	0.47	0.045	0.278

-Variance decomposition of EGX30 (Egypt)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	1.323	0.308	0000	0000	98.37	0000	00000	0000
5	6.172	1.382	0.89	4.10	87.18	0.1	0.017	0.123
10	7.769	1.632	0.99	5.18	84.15	0.06	0.011	0.166

-Variance decomposition of MASI (Morocco)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.66	0.442	0000	0.163	0.344	98.11	0.274	0000
5	0.742	0.482	0.20	0.366	0.364	97.53	0.274	0.033
10	0.792	0.47	0.12	0.370	0.144	97.65	0.245	0.031

-Variance decomposition of TUNINDEX (Tunisia)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.034	0.055	0.0016	0.024	0.218	0.0071	0.016	99.63
5	0.315	0.134	0.0353	0.375	0.795	0.0211	0.0231	98.29
10	0.324	0.111	0.027	0.428	0.88	0.0158	0.014	98.19

-Variance decomposition of AGI (Jordan)

Period	CAC40	ATI(Athens)	MIB30	IGBM	EGX30	MASI	AGI(Jordan)	TUNENDEX
1	0.117	0.018	0000	0.020	0.0854	0000	99.75	0000
5	0.204	0.025	0.103	0.0459	0.0587	0.175	98.91	0.468
10	0.191	0.026	0.101	0.046	0.034	0.194	98.88	0.524

For the North Mediterranean stock markets, 1-day-ahead forecast error variance can not be explained by shocks to Southern Mediterranean stock markets. By 5-day and 10-day ahead, the shock to the North Mediterranean stock markets can explain the forecast error variances of Southern Mediterranean stock markets. Appropriately we can said that 10% of the variation in the returns of Southern Mediterranean stock markets is caused by shocks to the North Mediterranean stock markets, indeed the extent of influence of the North Mediterranean stock markets on the returns of the Southern Mediterranean stock markets is small, indicating a weak integration of the North Mediterranean stock markets with the Southern Mediterranean stock markets. We can conclude that Egypt and Morocco are the first to react to this agreement and occupy the large share of trade with the North Mediterranean countries.

5. Conclusion:

In this paper, four Southern Mediterranean markets (Egypt, Tunisia, Jordon and Morocco) and four North Mediterranean markets (Greece, Italy, Spain and France) under the Agadir Agreement have been considered in order to examine any potential short-run and long-run co-movements between nominal stock markets returns.

For this purpose, daily data were used, where the Agadir agreement process was taken into account. The copula approach was employed for testing on short-run links and the cointegration approach for long-run links. Finally, variance decomposition was employed for determination of the endogenous and exogenous variables and quantifying the interdependence in terms of returns among the eight markets under study.

In the first step, we performed the two tests of critical importance; a test of adjustment to a marginal distribution which allows us to specify the marginal to the variables studied and a test of adequacy of copula to choose the best copula. In our case, the dependence between the stock-exchange returns is modeled by the copula student after having made the test of adequacy of copulas.

Results showed that there was an increase in the parameters of copula Student between markets after the Agadir agreement. However, the dependence between Egypt with Jordon, France and Athens had a positive, but the sense of dependence varied in a negative one when an extreme event occurred (Agadir agreement). Moreover, it's the same case for Italy with Morocco and France also for France with Spain. These countries become less dependent between each other.

In the second step, we applied the cointegration approach to detect the long-run relationship between stock market returns. Results suggest that there is no evidence of significant linkages between these markets before the Agadir Agreement. However, after the Agadir agreement, we found evidence of significant linkages between these countries.

We can notice that the extent of influence of the North Mediterranean stock markets on the returns of the Southern Mediterranean stock markets still small, indicating a weak integration of the countries signatories of the Agadir agreement under the study. Additionally, we can conclude that Egypt and Morocco seem the first to react to this agreement and occupy the large share of trade with the European country.

Our findings have important implications for international investors under the Agadir agreement process who diversify in these markets, so as to avoid any reckless lack of oversight.

To conclude, as any research, the present study conceals certain limits which are at the same time ways of researches which we plan to exploit in our future researches. Indeed, we can extend our research by examining the links between these countries though different asset classes such as commodities, bonds, energy and real estate.

Refrences

[1] Alaganar, V. T., & Bhar, R. (2002). Information and volatility linkage under external shocks: Evidence from dually listed Australian stocks. *International Review of Financial Analysis*, 11, 59−71.

[2] Akaike, H., (1974). Markovian representation of stochastic processes and its application to the analysis of autoregressive moving average processes. *Annals of the Institute of Statistical Mathematics* 26, 363–387.

[3] Baele, L. (2002). Volatility Spillover effects in European equity markets: evidence from a regime switching model, mimeo Ghent University.

[4] Bekaert, G., & Harvey, C. (1997). Emerging equity market volatility. *Journal of Financial Economics, 43, 29-77.*

[5] Bollerslev, T.(1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics* 31, 307–327.

[6] Cheung, Y. W., &Westermann, F. (2001). Equity price dynamics before and after the introduction of the Euro: A note. Working paper: UC Santa Cruz Economics.

[7] Christiansen, C. (2003). Volatility spillover effects in European bond markets. Working paper: Aarhus School of Business.

[8] Dao, C., &Wolters, J.(2008). Common stochastic volatility trends in international stock returns. *International Review of Financial Analysis*, 17, 431−445.

[9] De Fusco, R., Karels, G. and Muralidhar, K. (1996). Skewness Persistence in U.S.Common Stock Returns: Results from bootstrapping tests. *Journal of Business Finance and Accounting, 23*, 1183-1195.

[10] Engle, R. F., & Granger, C. W. J. (1987). Cointegration and error correction: Representation, estimation, and testing. *Econometrica,* 55, 251–276.

[11] Eun, C., Shim, S. (1989). International transmission of stock market movements. *Journal of Financial and Quantitative Analysis* 24, 241-256.

[12] Gilmore, C.G., and McManus, G.M.(2002). International portfolio diversification: US and central European equity markets. *Emerging Markets Review*. 3, 69–83.

[13] Hamao, Y., Masulis, R. W., & Ng, V. (1990). Correlations in price changes and volatility across international stock markets. *The Review of Financial Studies,* 3, 281–307.

[14] In, F., Kim, S., Yoon, J. H., & Viney, C. (2001). Dynamic interdependence and volatility transmission of Asian stock markets evidence from the Asian crisis. *International Review of Financial Analysis*, 10, 87−96.

[15] Jang, H., & Sul, W. (2002). The Asian financial crisis and the co-movement of Asian stock markets. *Journal of Asian Economics*, 13, 94−104.

[16] King, M. A., Enrique, S. and Wadhwani, S. (1994). Volatility and links between national stock markets. *Econometrica*62, pp. 901-933.

[17] Lee, J. S. (2009). Volatility spillover effects among six Asian countries. *Applied Economic Letters*, 16, 501−508.

[18] Liu, Y. A., and Pan, M. (1997). Mean and volatility spillover effects in the U.S. and pacific-Basinstock markets. Multinational Finance Journal, 1, 47- 62.

[19] Ng, A. (2000). Volatility spillover effects from Japan and the US to the pacific-Basin. Journal of International Money and Finance 19, 207- 233.

[20] Savva, Osborn and Gill, (2004).The Day of the Week Effect on Stock Market Volatility using EGARCH Framework. Working Paper, University of Manchester.

[21] Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics*, 6(2), 461–464.

[22] Serrano, F. J. and Rivero, S. S. (2002). Modelling the linkages between US and Latin American stock markets. *Applied Economics*, Vol. 35, PP 1423-1434.

[23] Shih, J.H. and Louis, T.A.(1995). Inferences on the association parameter in copula models for bivariate survival data. *Biometrics,* 51, 1384–1399.

[24] Sklar, A. (1959). Fonctions de répartitions : dimensions et leurs marges. *Publications de l'Institut de Statistique de l'Université de Paris*, 8(1), 229-231.

[25] Syriopoulos, T. (2007). Dynamic linkages between emerging European and developed stock markets: Has the EMU any impact? *International Review of Financial Analysis*, 16, 41−60.

[25] Veiga, B., and McAleer, M. (2003). Multivariate Volatility and Spillover Effects in Financial Markets. *http://www.iemss.org/iemss2004/pdf/risk/veigmult.pdf* 1-7.

[26] Yaser, A.A., Mohammad, N., and Ahmed, M. (2009). Dynamics linkages among equity markets in the Middle East and North African countries. *Journal of multinational financial management, 19, 43-53.*