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The Impact of Oil Price Shocks on the Moroccan Financial Market (From 1994 to 2010): Composite and Sectorial Level

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Abstract

This study investigates the association between oil price shocks and stock returns in Morocco. More precisely, it determines whether there is a statistically significant impact of oil shocks on MASI returns as well as on different economic sectors listed in the Moroccan stock market. The data will be analyzed in a (DCC MGARCH) model developed by Engel in 2002. This model enables forecasting and analyzing volatility of time series. As Morocco subsidizes fuel, an increase in oil price is absorbed by the government's investment budget causing a balance of trade deficit that negatively affects the growth of the country. This fund could be used in improving infrastructure and creating jobs. A slowdown in the economy negatively affects the stock market and companies' earnings. Thus, the results of this paper have many implications on policy makers as well as private and institutional investors. In addition, the findings of this study indicate an existence of a significant correlation between oil, MASI index and the Moroccan economic sectors, and these correlations fluctuate during events that trigger oil price shocks. Moreover, this study shows a spillover effect between the volatility of the Moroccan market and the oil market.

Keywords: GDP Growth, Stock Returns, GARCH.
JEL Classification: E31, O16

1. Introduction

The oil market has tremendous importance since it is the fuel of the economic activity across the world. The economy worldwide has been affected by the fluctuations and perturbations regarding fuel price during 2008 to 2010. The increasing tendency of crude oil value has a negative macroeconomic impact on oil importing countries. This increase in the oil price causes growing inflation rates which leads to a reduction of household income and reduced purchasing power. Furthermore, this increase results in lower profit margins for organizations and causes policy makers to increase interest rates. Moreover, this situation creates uncertainty for investors who tend to postpone their investment decisions, therefore slowing down economic activity.

This paper's purpose is to investigate the link between oil price shocks and market returns in the Moroccan stock market. More precisely, it determines whether there is a statistically significant impact of oil shocks on MASI returns. The aim of this article is to evaluate the Moroccan government's decision at the period of the study. The Moroccan government changed the rule of fuel subsidies and started the new strategy in 2012. In addition, if the oil price increases (or decreases) sharply in the near future, what would be the effect on the Moroccan stock market in terms of the entire market and all sectors? First, this paper will investigate the effect of oil price changes on MASI's returns, and then will discuss each economical sector's return by using their indices' returns.

There are studies that have investigated the association between oil price changes and the economy of the country (Hooker, 1996; Burbidge and Harrison, 1984 and Bruno and Sachs, 1982). Furthermore, there are studies that have explored the impact of oil price changes on different macroeconomic variables (i.e., inflation rate, GDP, exchange rate… etc.). Also, many empirical researches have "confirmed that oil price increases have strong and negative consequences for the world economy" (Hamilton, 1983, Burbidge and Harrison, 1984, Gisser and Goodwin, 1986, Bjørnland, 2000, Cunado and Perez de Gracia, 2003).

The opinions toward the effect of oil prices on market returns differ. For example, Ciner (2001) found significant nonlinear Granger causality in studying the impact of oil price fluctuations on S&P 500 index returns. On the other hand, Odusami (2009) found a nonlinear effect of unexpected oil prices on excess US stock market returns after separating the distribution of aggregate US stock returns into variance components. However, Chen et al. (1986) found that oil price shocks have no effect on asset prices. Furthermore, Bhar and Nikolova (2009) have measured the oil price effect on stock returns for Brazil, Russia, India and China. The results vary among those countries that depend on the country's economic structure to be net import or export of oil.

Moreover, a significant relationship between oil price changes and stock returns will improve the prediction of stock prices. Thus, private as well as institutional investors could minimize the risk for their investments in these stocks. Furthermore, a positive relationship between the oil price and stock returns should suggest that investors could anticipate buying stock to benefit from an expected stock price increase in the future. On the other hand, a negative relationship between the oil price and stock returns should suggest that investors could go short in stock to avoid a downturn of their investments. However, Moroccan policy makers could devise appropriate policies to manage stock markets, for example, if fuel price fluctuations have a negative effect on the financial market. The policy makers should endeavor to reduce Morocco's reliance on energy imports for its energy needs. Furthermore, policy makers could encourage the use of alternative energy sources.

There are few studies that have studied Morocco's stock market and oil prices. However, this study will use the Dynamic Conditional Correlation Multivariate Generalized Autoregressive Conditional Heteroscedasticity (DCC MGARCH) model that was developed by Engel in 2002. This method enables forecasting and analyzing the volatility of time series when the volatility varies over time (Orskaug, 2009). Utilization of DCC MGARCH will improve the analysis of the relationship between oil prices and the Moroccan stock market returns.

The paper is organized as follows: Section 2 cites the motivation of this study and surveys the previous studies in the field. Section 3 discusses the methodology. Section 4 describes the data. Section 5 summarizes the findings. Finally, Section 6 states the conclusion and the limitations of the study.

2. Motivation and Background

Since 1869, US crude oil prices adjusted for inflation to average $23.67 per barrel in 2010 dollars compared to $24.58 for world oil prices. In the 1970s, as a result of the Yom Kippur war between Israel and Egypt the oil price increased to $14.57 per barrel. In the 1980s, the Iran–Iraq conflicts strapped crude oil prices to increase to $35 per barrel. Moreover, Sharma (1998) stated that the world depression and use of alternative energy caused a decrease in demand while supply increased, resulting in reduced oil price during the 1980s. However, in 1990 the Iraqi invasion of Kuwait initiated a rise in crude oil prices. On the other hand, the oil price attained its lowest level since 1973 as an effect of the downturn of the US economy. The recovery of the US economy in the mid-1990s has had a positive effect on oil prices. In 1998, the oil price fell sharply as an effect of the Asian Crisis. During the 21st century, the growing world economies and growing demand for oil induced a rise in prices until the events of September 2001 reversed this tendency. The Organization of the Petroleum Exporting Countries (OPEC) had to intervene by 2002 to cut down production. In market anticipation of this cut, the price increased to $25 per barrel. In 2003, the reduction in supply due to the war on Iraq and the strike on Venezuela, and high demand for oil worldwide, triggered price tendency. Another important factor that contributed to the actual level of the oil price is the conversion from MTBE as an additive to ethanol. In 2008, the oil price reached a record of $147.27. In 2009, the oil price slightly decreased as a result of a decline in the demand of oil. This history of oil, therefore, can raise a question about the contribution of oil price fluctuations to stock market performance.

Oil price shocks have been the cause of many recession consequences in the past for oil importing countries. The effect of the oil price worldwide motivates researchers to investigate the relationship between oil price shocks and the economic activities. Hammes and Wills (2005) investigated the effect of oil price after the Bretton Wood agreement vanished by USA on US economy. They found that an oil price increase was a source of a slowdown in the economic activities. Bjørnland (2008) argues that oil price shocks typically have real effects. The higher energy prices affect output via the aggregate production function by reducing the net amount of energy used in production. Therefore, an increase in oil prices leads to a rise in the production costs, thus inducing firms to lower their outputs. The reduction in output and income tempts rational consumers in oil importing countries to hold back on consumption and investment, as well as spending. The holding back on consumption reduces aggregate demand and output.

On the other hand, studies showed only a negligible effect of oil shocks on GDP . Furthermore, Roubini and Sester (2004) stated that the impact of such a phenomenon depends on many factors, mainly the dependency of an economy on energy. Furthermore, the oil net importer countries will reflect an oil price increase as consumption tax, thus the economy growth will decrease and inflation rate will increase.

The influence of oil price shocks on a macroeconomic level has been largely debated and discussed in the past. However, the impact of oil price shocks on financial markets around the world has only been recently addressed. Driesprong et al. (2008) examined the effect of changes in oil prices on stock returns and their predictability. They found a significant negative impact of oil shocks over stock returns in developed and emerging stock markets, which was the same result found by Jones and Kaul (1996). Some studies documented a significant impact of oil price shocks on market price and have a statistically significant impact on real stock returns in the US and in 13 European countries during 1986-1997. Filis et al. (2011) explored the contemporaneous and lagged time varying correlation between stock market prices and oil prices for oil importing and exporting countries. They found that lagged correlation results in a negative influence of oil prices in stock markets. Furthermore, the time varying correlation reveals that the correlation between oil price shocks and stock markets differs between oil importing and exporting countries. Kilian and Park (2009) state that the response of stock returns may differ greatly depending on the cause of the oil price shock. The demand shocks are most important that explain the global economy's future demand on commodities. This demand drives the industrial sector by expectation. Furthermore, higher oil prices driven by an unanticipated global economic expansion have persistent positive effects on cumulative stock returns within the first year of the expansionary shock. Fayyad and Daly (2011) employed the Vector Auto Regression (VAR) analysis for five countries, mainly the Gulf Cooperation Countries (GCC), UK and US. They found that there is a positive relationship between stock prices returns and oil price increases. In addition, a VAR analysis demonstrates that fuel prices and their volatility are significantly affecting real stock returns, Sadorsky (1999). Furthermore, Bjornland (2008) claimed that high oil prices result in more wealth for oil exporting countries. Thus, a positive effect of oil price changes can be anticipated for oil exporters.

On the other hand, other studies found an insignificant effect of oil shocks on market returns . Maghyereh (2004) concluded that in emerging countries oil price shocks have no impact over stock market returns. Furthermore, Apergis and Miller (2009) state that international stock market returns have an impassive reaction in response to oil shocks. This is a result of analyzing eight developed countries. Cong et al. (2008) conducted the same study for the Chinese stock market through a multivariate VAR model. They found the influence of oil price shocks on the Chinese stock market to be insignificant. Furthermore, Mohanty et al. (2010) have shown an insignificant relationship between oil shock and the stock markets for Central and Eastern European countries (CEE). However, the magnitude of the impact varies across firms and over time which can be explained by each country's and firm's specific characteristics. Al-Fayoumi (2009) studied the relationship between changes in oil prices and stock market returns in Turkey, Tunisia and Jordan. Those countries are characterized as net oil importer countries. Using the Vector Error Correction Model (VECM), it was found that oil prices do not lead to a change in stock market returns in these countries. Binti Abdul Jalil et al (2009) used a co-integration method to find no long-run relationship between oil prices and the stock market. Furthermore, there is no effect of oil price movements over the stock market as result of the causality test.

As an emerging country, Morocco has achieved many economic and financial developments in the recent years that makes it an attractive investment platform for national and foreign investors. Moreover, Morocco has been relatively stable politically and economically. The main natural resources that are characterized as wealth for Moracin are phosphates, fish, silver and copper. The rental income of those resources contributes to the kingdom's goal of sustainable development. Nevertheless, the country is completely dependent on importation of its energy needs. In fact, the current political turmoil in the Arab world and the increasing demand for energy, especially in developing countries, have created a challenge for oil producers in the region. This instability has contributed to high oil price volatility. Among emerging countries, for instance, China's oil demand reached 9.86% in 2009 of the world's total demand. Besides, Bhar and Nikolova (2009) stated that oil price shocks are an important determinant of the future economic growth and stability of the developing countries of today. Furthermore, the economic impact of higher oil prices on developing countries is generally more severe than that for industrialized countries. This is mainly due to the inefficiency of energy usage.

The increase of the oil price in the past few years has pushed up the cost of foreign energy imports in Morocco. The Moroccan government subsidizes oil expenses, which represents approximately two thirds of the Moroccan investment budget and 5.5% of GDP in 2010. In 2011, the deficit has reached 45 billion Moroccan Dirhams that exactly equals to subsidized expenses. This situation raised a question of whether the budget deficit has an impact on the GDP or not. Nelson and Singh (1994) have analyzed the relationship between budget deficit and economic growth in seventeen developing countries to find no significant relationship between budget deficit and economic growth. On the other hand, Keho (2010) tested the relationship between the budget deficit and economic growth in West African Economic and Monetary Union (WAEMU) by using Granger causality test. The result is ambiguous in those countries that show no causality between budget deficit and economic growth. This result supports the Ricardian equivalence approach. However, in the other countries the result supports the neoclassical theory by proving that budget deficit has negative effects on economic growth.

Indeed, such an important impact on the economy could also have an adverse effect on the stock market. Shahbaz et al. (2008) have suggested a strong relationship between stock market development and economic growth. Lahrech (2009) examined the influence of US and Canadian macroeconomic fundamentals on Canadian stock prices using Johansen's multivariate co-integration test and vector error correction model (VECM). The finding shows an evidence of a long-run association between Canadian stock prices, US stock prices and Canadian, as well as US fundamentals. Hence, through this study we expect to prove a relationship between oil price and the Moroccan stock market returns.

3. Methodology

A DCC-GARCH model developed by Engle (2002) was used in this study to model the co-movement of the oil price changes and the Moroccan stock market returns, as well as the co-movement of the oil price changes and the sectorial returns. The MASI index is a stock index that tracks the performance of all companies listed on the Casablanca Stock Exchange. On the other hand, Brent price is the benchmark used for crude oil price around the world.

GARCH models are more suitable for capturing asset return volatility which is characterized by occurring in bursts in a phenomenon called "volatility pooling" that serve the aim of this study. The aim of this study is to test the association between the market returns and oil returns. The actual level of volatility is inclined to be positively correlated with its level during the immediate preceding periods. However, financial returns variance is unlikely to be homoscedastic. Accordingly, it is suitable to use a model that does not assume that the variance is constant and describes how the variance of the errors evolves, Brooks (2005). Furthermore, negative shocks have a greater impact on volatility than positive shocks, Black (1976), Christie (1982) and Lahrech and Sylwester (2008).

To represent the Engle (2002) DCC model for the purpose of this study, we use r_{it} as a random variable with 0 as a mean and H_t as a standard deviation. Let $r_t = [r_{1t}, r_{2t}]'$ be a 2x1 vector containing the MASI (or sectorial) return and Brent oil price index series where: $r_t|\Omega_{t-1} \sim N(0, H_t)$ $H_t \equiv \{h_{it}\}$ for i = 1,2 is the conditional variance covariance matrix of the MASI (or sectorial) return and Brent oil price index vector $r_t = [r_{1t}, r_{2t}]'$ and Ω_t is the information set that includes all information up to and including time t.

The model that will be used to capture the common properties of equity returns variance is GARCH (1,1): GARCH (1,1) model: $h_t = \omega + \alpha\, \varepsilon_{t-1}^2 + \beta h_{t-1}$

A GARCH (1,1) model is used to determine a one period ahead estimate for the variance calculated based on relevant past information. The current fitted variance (h_t) represents a weighted function of a long-term average value dependent on (ω). Information about volatility during the previous period is ($\alpha \varepsilon_{t-1}^2$) and the fitted variance from the model during the previous period is ($\beta\, h_{t-1}$) Brooks (2005).

The multivariate DCC GARCH structure can be explained by first rewriting the conditional variance covariance matrix as: $H_t = D_t R_t D_t$. Where $D_t = \text{diag}(\sqrt{h_{1t}}, \sqrt{h_{2t}})$. This is the 2x2 diagonal matrix of time varying standard deviations from univariate GARCH models with $\sqrt{h_{it}}$ on the diagonal and R_t is the time varying conditional correlation matrix.

In order to model the dynamics of correlations Engle (2002), we adopt a GARCH type of structure. The DCC process can be described by:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1}$$

$$Q_t = (1-a-b)\bar{Q} + a\,\varepsilon_{t-1}\varepsilon_{t-1}' + bQ_{t-1}$$

Where $Q = \{q_{ij,t}\}$ is the conditional variance-covariance (correlation) matrix of the standardized residuals. $\bar{Q}$ is the unconditional variance covariance matrix of the $\mathcal{E}$'s and is constant over time. $Q_t^* = \text{diag}\{\sqrt{q_{ii,t}}\}$ is a diagonal matrix containing the square root of the diagonal elements of Q_t

and is a positive definite matrix which guarantees the $R_t = Q_t^{*-1} Q_t Q_t^{*-1}$ that is a correlation matrix with ones on the diagonal and every other element less than one in absolute value. The typical element ρ_{ijt} of R_t will be the form of $\rho_{ijt} = q_{ijt} / \sqrt{q_{iit} q_{jjt}}$. The **a** and **b** are scalar parameters that capture the effect of previous shocks and previous dynamic correlations.

The DCC model parameters are estimated through the maximum likelihood method. Engle (2002) shows that the log-likelihood function can be expressed as:

$$L = -\frac{1}{2} \sum_{t=1}^{T} \{2 \log(2\pi) + 2 \log|D_t| + \log|R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t\}$$

To understand the relationship between Brent oil and the different indices, we studied the different volatilities through a pairwise Granger test (1969). Therefore, we investigated the short-run interactions between the variables using the Granger equation using a two-way causation. If the null hypothesis is accepted, it means that the variable Granger is the cause of the other one. In case they both cause each other, we call this a feedback system. The bivariate regression equation is:

Volatility (MASI or sector) = $\alpha+\alpha_1$ Volatility (MASI or sector)$_{t-1}$ $+\ldots+\alpha_n$ Volatility (MASI or sector)$_{t-n}$ $+\beta_1$ Volatility (Brent)$_{t-1}$ $+\ldots+ \beta_n$ Volatility (Brent)$_{t-1}$ + $\varepsilon_{1,t}$

Volatility (Brent) = $\alpha+\alpha_1$ Volatility (Brent)$_{t-1}$ $+\ldots+\alpha_n$ Volatility (Brent)$_{t-n}$ $+\beta_1$ Volatility (MASI or sector)$_{t-1}$ $+\ldots+ \beta_n$ Volatility (MASI or sector)$_{t-n}$ + $\varepsilon_{2,t}$

Where the reported F-statistics are the Wald statistics for the joint hypothesis:

$$\beta_1 = \beta_2 = \beta_3 = \cdots = \beta_n$$

4. Data

The study examines the relationship between oil price shocks and the financial market. To analyze this relationship, we examined the effect of oil price on economic sectors, Eryigit (2009). The data used in this study will be daily data. More specifically, we used the closing prices of MASI stock market indexes as well sectorial indices and Brent crude oil index, Rault and Arouri (2009). MASI is the composite index that is used to describe the performance of the Moroccan companies listed in the Moroccan stock exchange. Brent price is a common price that is used to proxy crude oil by using average prices of different type of cured oil, Maghyereh (2004). In addition, it is the reference used for oil purchases in Morocco.

The reactions of industry-level stock returns are important to shed light on the effect of oil shocks on the economy. Indeed, several sectors outside the energy sector are affected by oil price changes, Dhawan and Jeske (2008). More or less of the strongest responses to oil demand shocks are found in the automotive industry, retail industry, consumer goods and tourism related sectors. This study will include 21 industry indexes, mainly mines, forestry, paper, chemical, oil, gas, electronic, electrical equipment, beverages, food production, retail, transport, banking, insurance, holdings, real estate, financing companies, computer hardware, software services, building and construction materials. Moreover, Park and Ratti (2008) indicate that oil price shocks are more significant using the Brent dollar index than by converting to the national currency. Thus, we converted data value into US dollars. The exchange rates used were extracted from Oanda Corporation which is a financial services provider of currency conversion. Finally, the nominal data was transformed to natural logarithms. The data covers the period between January 26, 1994 and December 31, 2010 for the MASI and Brent oil indices, and between January 1, 2004 and December 31, 2010 for the other sectors due to the limitation of availability of the data.

The Casablanca Stock Exchange (CSE) was established in 1929. In 2015, the market capitalization ended up with 453 billion of MAD (45.3 billion of US$). Furthermore, the trading volume was 28 billion of MAD (2.8 billion of US$). The number of listed shares of 75 companies are distributed in 22 sectors, accumulating 2.5 billion of shares.

5. Empirical Results

5.1. Descriptive Statistics

Before analyzing the graphs it is important to understand events that could influence volatility in oil prices and returns. According to Hamilton (2009) and Killian (2010) the main historical events that may have triggered oil price shocks are summarized in the table below:

Table 1: Historial events correponding to oil price shocks origin

Event	Year
Iraq invasion of Kuwait	1990
First war in Iraq	1991
Collapse of the Soviet Union	1991
Asian economic crisis	1997
Oil production quotas cuts by OPEC	1998-1999
Housing market boom	2000
9/11 terrorist attack in New York	2001
PDVSA workers strike	2002
Second war in Iraq	2003
Chinese economic growth	2006-2007
Global financial crisis	2008

Volatility clustering is clearly apparent from the graphs in Appendix A. It is important to note that the volatility occurs in bursts. There are periods of relative tranquility before periods of perturbations. Also, we observed some perturbations during 2008 for all the returns which represent the period of the global financial crisis. Concerning the Brent oil daily returns, there is another shock that was registered in 2001. Furthermore, this shock could be explained by the 09/11 terrorist attack in the US.

Table 2: Statistics Summary

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Brent	0.000446	0.181297	-0.19891	0.024043	-0.100093	7.65177
MASI	0.000533	0.062765	-0.06830	0.011472	-0.004438	7.80566
Mines	0.000577	0.091327	-0.08054	0.022446	0.070257	3.91778
Transportation	1.000305	1.099064	0.889535	0.022557	0.105204	4.68220
Oil and Gas	0.000530	0.084544	-0.09872	0.019827	-0.070448	4.50286
Retail	0.001033	0.081015	-0.07943	0.017783	0.165130	4.73080
Building and Construction Materials	0.000660	0.078281	-0.07666	0.017466	-0.088597	5.21475
Chemical	0.000033	0.090290	-0.089000	0.022183	0.140416	4.51993
Real State	0.001078	0.116788	-0.096940	0.020077	0.203102	6.70876
Food Production	0.000446	0.055463	-0.090410	0.016136	-0.334059	4.85401
Forestry and Paper	0.000074	0.105224	-0.113700	0.030245	-0.149505	3.859052
Electronic and Electronical Equipment	0.000486	0.114303	-0.103850	0.026423	0.064399	4.306504
Beverages	0.000493	0.090002	-0.113090	0.020067	-0.280744	5.351040
Banking	0.000906	0.069885	-0.082010	0.016836	-0.062796	5.086695
Insurance	0.000695	0.074952	-0.085400	0.018250	0.104308	4.781729

	Mean	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Holdings	0.000408	0.131573	-0.089930	0.019027	0.226063	0.226063
Financing	0.000591	0.072778	-0.064650	0.016249	0.081207	4.742812
Computer Hardware and Software Services	0.000503	0.095613	-0.080920	0.022130	0.264378	4.670728

On average, the respective values of the MASI index daily return and Brent Oil index daily return amount to (0.000446) and (0.000533). In addition, the Brent oil returns are more volatile than MASI, which means the returns for Brent are spread apart and more risky than MASI's, with (0.024043) for Brent and (0.011472) for the MASI returns.

The skewness as a measure of symmetry shows that the Brent Oil series are negatively skewed (-0.100093) which indicates that oil returns are skewed to the left (the left tail is longer than the right one). On the other hand, we observed the opposite effect for MASI returns (0.004438). Concerning Kurtosis, both MASI and Brent Oil indices have relatively high values that respectively are (7.805666) and (7.65177). These values signal "peaked" distributions. Overall, the maximum log differential return is attained by the transportation sector with a value of (1.099064). The riskier sector in Morocco is forestry and paper with the highest standard deviation (0.030245). Most sectors are skewed to the right, and this is a sign of a long right fat tail. Kurtosis value is also higher than three, which indicates asymmetric distributions.

Table 3: Unit root test on return

Sector	Augmented Dickey-Fuller test
Brent	(62.63966)***
MASI	(26.1074)***
Mines	(37.09397)***
Transportation	(24.64127)***
Oil and Gas	(42.76264)***
Retail	(48.12145)***
Building and Construction Materials	(41.45322)***
Chemical	(40.35579)***
Real State	(38.26487)***
Food Production	(18.0443)***
Forestry and Paper	(40.4594)***
Electronic and Electronical Equipment	(41.62446)***
Beverages	(48.94142)***
Banking	(17.99712)***
Insurance	(44.13202)***
Holdings	(43.92879)***
Financing	(48.91163)***
Computer Hardware and Software Services	(39.1037)***

*Significant at $p<0.1$ **Significant at $p<0.05$ ***Significant at $p<0.01$

In order to estimate an autoregressive model, stationary is an important property to look for to indicate that the mean variance and autocorrelation are stable overtime, as well as to examine the non-existence of a trend in the data. Moreover, stationarity of time series is a necessary condition for many applications of time series econometrics, Mishra (2010). In this paper, we used the Unit root test that tests the null of a unit root against an alternative of stationary or mean reversion. If the null hypothesis is rejected, thus the series is said to be stationary, Amara (2011).

Brent Oil, MASI and sectorial data are found to be stationary. Following an Augmented Dickey-Fuller (ADF) test statistic, the results reject the null hypothesis with p values of 0.0001 or lower confirming the existence of stationarity and no change of level overtime.

Table 4: ARCH test

Sector	F-statistic	LM-statistic
Brent	46.25672***	45.76571***
MASI	260.8343***	245.4339***
Mines	99.52692***	94.17462***
Transportation	61.94882***	59.85768***
Oil and Gas	39.39606***	38.55583***
Retail	76.03879***	72.89547***
Building and Construction Materials	93.79927***	89.03882***
Chemical	122.7692***	114.4197***
Real State	162.0425***	148.2262***
Food Production	64.14111***	61.90082***
Forestry and Paper	133.735***	124.2003***
Electronic and Electronical Equipment	78.46256***	75.11738***
Beverages	19.32643***	19.13335***
Banking	77.68785***	74.40784***
Insurance	140.7516***	130.2278***
Holdings	18.18752***	18.01755***
Financing	27.69665***	27.28802***
Computer Hardware and Software Services	96.60476***	91.55992***

*Significant at p<0.1 **Significant at p<0.05 ***Significant at p<0.01

It is important to identify that the DCC GARCH method is adequate for the data. We used the Engle (1982) test for ARCH effects to test for the identification of the DCC GARCH. Both the F-statistic and the LM-statistic that is the product of the sample size and the coefficient of multiple correlations R^2 are very significant. Thus, the suggestion is there is a presence of ARCH in the Brent Oil, MASI and sectorial returns. These results confirm the "volatility pooling" nature of indices returns.

5.2. DCC GARCH Results

Table 5: Conditional correlation (ρ) descriptive statistic

	Mean	Maximum	Minimum	Skewness	Kurtosis
ρBrent /MASI	0.000226	0.177235	-0.102441	0.635910	5.065637
ρBrent /Mines	0.023804	0.288554	-0.279003	-0.088503	7.056277
ρBrent /Trans.	0.010127	0.094888	-0.041521	0.628587	3.434396
ρBrent /Oil Gas	0.031609	0.248631	-0.148196	0.329274	3.688485
ρBrent /Retail	-0.007933	0.330282	-0.214700	0.834240	17.01682
ρBrent /Build. and Constr. Materials	-0.008532	0.322234	-0.263229	0.266223	5.716580
ρBrent /Chemi	0.002319	0.190836	-0.225821	-0.184098	6.450124
ρBrent /Real State	0.038351	0.322580	-0.222531	0.249811	4.618692
ρBrent /Food Prod.	-0.000583	0.944572	-0.361168	7.835609	206.792778
ρBrent /Foresty	-0.011671	0.107725	-0.085873	0.349572	4.646450
ρBrent /Elec. and Elec. Equip.	0.030082	0.217379	-0.118722	0.410661	2.992168
ρBrent /Beverages	-0.002367	0.032110	-0.059649	-0.326483	3.950857
ρBrent /Banking	0.027158	0.245051	-0.150845	-0.030623	3.800965
ρBrent /Insurance	0.001878	0.356200	-0.259194	0.275072	5.048672
ρBrent /Holdings	-0.025570	0.133974	-0.160703	0.047794	3.570602
ρBrent /Fin.	0.012275	0.314349	-0.190710	0.345391	3.963306
ρBrent /Computer	-0.014547	0.282926	-0.238847	0.705288	3.223550

Table 5 represents a summary statistic of the coefficient of correlation (ρ) between the Brent oil series, MASI as the composite index and the economic sectors listed in the stock exchange. Furthermore, the results above indicate that Brent oil is on average positively correlated with MASI to mines, transportation, oil & gas, real estate, chemical, financing companies and other financial activities, the banking sector, and insurance sector. This outcome has an important implication for individual as well as institutional investors to generate profit during high oil price periods. On the other hand, Brent oil is on average negatively correlated to retail, food production, forestry and paper, beverages, holdings and computer hardware and software services. Moreover, the correlation reached its highest positive and lowest negative level between the Brent oil price and food production with respectively ρ=0.94457224 and ρ= -0.36116811.

Apart from the correlations between oil prices, mines, chemical, beverages, and banking, the remaining sectors are negatively skewed with left fat tail. On the other hand, the remaining sectors are positively skewed including MASI index. In addition, the kurtosis results indicate a leptokurtic distribution for the correlations (kurtosis > 3).

The graphs in Appendix B represent the time varying conditional correlations captured by the DCC GARCH. Overall, the correlations vary between 0.4 and -0.4. Furthermore, the correlation with the beverage sector is relatively low compared with the rest of the sectors. During 2007 and 2008, MASI and most of the economic sectors studied that apart from computer hardware and software services, the beverages sector, mines, insurance, and real estate showed a significant negative peak in correlation due to the oil price shock during the period of Chinese economic growth. Also, a famine took place during the global financial crisis in 2008. These results illustrate the importance of oil as an indicator of the financial health of Morocco. Moreover, it appears that during oil price shocks correlation is at its highest.

However, by the end of 2008, the correlation between Brent oil, MASI and most of stocks reached their highest positive value during the Israel-Gaza tensions, and thus it influenced all returns. The beverage and mining sectors did not illustrate any significant change during the period under study.

Concerning the association between the Brent oil and MASI index, the period studied is longer than the others (from January 26, 1994, to December 31, 2010). Therefore, we observed a positive correlation from 1994 to 1996, then from 1996 to 1998. The correlation became negative due to the Asian crisis and the production quota ratio implemented by OPEC during that period. On the other hand, not all oil price shocks experienced the same impact on correlations. Moreover, whether the origin is endogenous or exogenous is complained with Killian (2009) and (2010) findings.

Table 6: DCC GARCH result

Sector	**A**	**b**
MASI	0.005162*	0.986972***
Mines	0.06353*	0191543
Transportation	0.00316	0.987356***
Oil and Gas	0.011801	0.972089***
Retail	-0.027059	0.426809
Building and Construction Materials	0.030755*	0.854109***
Chemical	0.031204	0.612781
Real State	0.034389*	.0833868***
Food Production	0.025842	-0.565591
Forestry and Paper	0.008766	0.911512***
Electronic and Electronical Equipment	0.0009033	0.979603***
Beverages	0.005938	0.875352*
Banking	0.008337*	0.984004***
Insurance	0.031788**	0.875205***
Holdings	0.00785	0.978773
Financing	0.029229**	0.893012***
Computer Hardware and Software Services	0.01056**	0.983316***

*Significant at p<0.1 **Significant at p<0.05 ***Significant at p<0.01

Table 6 indicates the values of **a** and **b**, which are scalar parameters of the dynamic correlation equation: $Q_t = (1 - a - b)\bar{Q} + a\varepsilon_{t-1}\varepsilon'_{t-1} + bQ_{t-1}$. This captures the effect of previous shocks and previous dynamic correlations respectively. Generally, previous dynamic correlations significantly affect the actual correlation that is publicized by the results. However, for most of the correlations previous shocks are not highly significant. Concerning the current correlation between the Brent oil and MASI series, both parameters are significant because they indicate a joint effect of previous shocks and dynamic correlation on actual correlations.

Table 7 indicates there are only two non-stationary correlations, which are the correlation between Brent oil, computer hardware and software services, and the banking sector. This outcome means that in general there is no change of level for correlations over time.

Table 7: Unit root test result for correlations

Sector	Augmented Dickey-Fuller test
ρBrent /MASI	(3.879936)***
ρBrent /Mines	(31.55838)***
ρBrent /Trans.	(2.754866)*
ρBrent /Oil Gas	(3.442480)***
ρBrent /Retail	(28.25276)***
ρBrent /Build. and Constr. Materials	(9.832016)***
ρBrent /Chemi	(18.90488)***
ρBrent /Real State	(10.45907)***
ρBrent /Food Prod.	(76.08348)***
ρBrent /Foresty	(8.355332)***
ρBrent /Elec. and Elec. Equip.	(2.921788)**
ρBrent /Beverages	(10.34526)***
ρBrent /Banking	-2.337426
ρBrent /Insurance	(8.788532)***
ρBrent /Holdings	(3.258386)***
ρBrent /Fin.	(8.037738)***
ρBrent /Computer	-2.081268

*Significant at p<0.1 **Significant at p<0.05 ***Significant at p<0.01

Table 8 summarizes the results found by demonstrating the pairwise Granger Causality Test. This test has an important implication that indicates the time series can be used to forecast other series. Furthermore, the Brent oil volatility Granger causes volatility in the Moroccan composite index MASI, the real estate sector, financing companies, banking, insurance, mines, retail and chemicals. However, MASI, real estate, banking, insurance, financing companies, mines, retail, and chemicals volatility do not Granger-cause volatility in the Brent oil time series. Finally, for the Brent Oil time series, oil & gas, food production, forestry and paper, beverages, holdings, and computer hardware and software services it was found that neither variable Granger-causes the other.

Brent Oil was found to have an effect on MASI index and some economic sectors which indicates a spillover effect.

Table 8: Pairwise Granger Cuasality test

Null Hypothesis	F-Statistic	Probability
Brent oil does not granger cause MASI	4.95309	0.00710
MASI does not granger cause Brent oil	0.23308	0.79210
Brent oil does not granger cause Mines	0.31885	0.72703
Mines does not granger cause Brent oil	3.32479	0.03621
Brent oil does not granger cause Transportation	0.63113	0.53211
Transportation does not granger cause Brent oil	1.37545	0.25300
Brent oil does not granger cause Oil and Gas	1.39013	0.24932
Oil and GAS does not granger cause Brent oil	0.14410	0.86580

Null Hypothesis	F-Statistic	Probability
Brent oil does not granger cause Retail	0.15027	0.68048
Retail does not granger cause Brent oil	5.14080	0.00594
Brent oil does not granger cause Building and Const.	0.33143	0.73244
Building and Const. does not granger cause Brent oil	3.36886	0.03466
Brent oil does not granger cause Chemical	1.22551	0.29386
Chemical does not granger cause Brent oil	2.58553	0.07565
Brent oil does not granger cause Real State	5.66815	0.00351
Real State does not granger cause Brent oil	1.73254	0.17714
Brent oil does not granger cause Food Production	0.04802	0.95310
Food Production does not granger cause Brent oil	0.72878	0.48264
Brent oil does not granger cause Forestry	0.04806	0.61849
Forestry does not granger cause Brent oil	0.80728	0.44623
Brent oil does not granger cause Electronic	0.29905	0.74155
Electronic does not granger cause Brent oil	2.17113	011436
Brent oil does not granger cause Beverages	0.46388	0.62891
Beverages does not granger cause Brent oil	0.43987	0.64418
Brent oil does not granger cause Banking	10.9413	0.000019
Banking does not granger cause Brent oil	1.70227	0.18258
Brent oil does not granger cause Insurance	2.50692	0.081818
Insurance does not granger cause Brent oil	0.77461	0.461041
Brent oil does not granger cause Holdings	0.91053	0.402504
Holdings does not granger cause Brent oil	0.00270	0.997299
Brent oil does not granger cause Financing	2.67296	0.069340
Financing does not granger cause Brent oil	0.10867	0.897040
Brent oil does not granger cause Computer	1.95535	0.141830
Computer does not granger cause Brent oil	1.02537	0.358888

6. Conclusion

This study examined the association between Brent Oil and the Moroccan financial market (composite and sectorial level). The dataset used for this study consisted of a daily data of log differential returns and covered the period of January 26, 1994, and December 31, 2010, for the MASI and Brent oil indices. Due to the limitation of data, we covered the period between January 1, 2014, and December 31, 2010, for the sectoral level. The method used for this study is DCC GARCH that was developed by Engel in 2002. The DCC GARCH is a suitable model to capture the time varying correlation between the oil commodity return and the different time series under study.

This study indicates that the Brent Oil shocks effectively have an impact on the Moroccan financial market. However, those shocks do not have the same impacts on the different sectors that are depending on the origin of the shock.

In proceeding with the investigation, the findings show that the daily stock returns are stationary. Nonetheless, the stock returns do not follow a normal distribution. Furthermore, we tested for ARCH effect to determine whether they are present in the residuals and if GARCH type class of models is appropriate for the data or not. The findings of DCC GARCH indicate that on average there is a small positive correlation between Brent Oil and MASI as well as mines, transportation, oil & gas, real estate, chemical, financing, other financial activities companies, banking sector and insurance sector. Moreover, the study points out that during oil price shocks correlation is at its highest. Furthermore, previous dynamic correlations affect actual ones. In the case of the Brent Oil and MASI index, there is a joint effect of previous shocks and dynamic correlation on actual correlations. Approximately most of the Moroccan economic sectors were found to Granger cause Brent Oil, and Brent Oil was found to have an effect on MASI index. In addition, Brent Oil was found to have an effect on financial and real estate sectors, which indicates a spillover effect between the Moroccan stock market returns and Brent Oil prices. Furthermore, most of unsubsidized sectors are not caused by oil thus explained how government stressed with oil fluctuations.

This study may have many implications for Moroccan policy makers as they indicate that oil price fluctuations do have an impact on financial market. However, Moroccan government subsidizes oil expenses which puts more stress on the government budget as oil prices rise. These results show that if oil expenses are eliminated, oil shocks would have a greater impact on the Moroccan financial market. Among the strategies that would be a beneficial to the Moroccan economy is to reduce Morocco's dependency on oil imports. This strategy will help the country maintain financial stability in the market. In addition, individual as well as institutional investors could benefit from this research by considering oil price volatility as another variable to predict stock returns for hedging.

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