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# CONDITIONAL CORRELATION BETWEEN OIL AND STOCK MARKET RETURNS: THE CASE OF MEXICO

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## **Abstract**

In this study we analyze the relationship between the Oil price (under de Brent reference) and the returns of the companies listed on the Mexican Stock Market. The period of analysis was for 208 weeks of information from 2006 to 2010. We found positive conditional correlation using a BEKK model. And we provide graphical evidence of each company and the Oil price.

## **Resumen**

En este estudio se analiza la relación entre el precio del petróleo (bajo la referencia del Precio Brent) y la rentabilidad de las empresas que cotizan en la Bolsa Mexicana de Valores. El periodo de análisis fue semanal de 2006 a 2010 (siendo 208 observaciones). Se encontró correlación positiva condicional utilizando un modelo de BEKK. Se presentan gráficas del comportamiento de cada empresa y el precio del petróleo.

*JEL Classification: C13, F37, O16*

*Keywords: Financial markets, Oil price, BEKK model*

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## 1. Introduction

Oil returns and its volatility may have significant effects on the financial markets. In this study we analyze the conditional correlation between oil and stock market returns. There are several studies that seek to discover the kind of influence that exists between the stock and oil markets. One first discussion around oil price volatility is regarding where and when is an impact on stock markets. Some studies have rejected the hypothesis that oil price influence in some way the returns.

Research on volatility of stock markets returns have been approached in the literature from three different perspectives.

First, volatility of stock markets returns has been related to key macroeconomic indicators. Oil price returns and its volatility has a major impact on the economic activity and hence on futures and spot stock market returns. If oil price affects real GNP, it will affect the earnings of companies for which oil is a direct or indirect operational cost. Thus, an increase in oil prices will possibly cause expected earnings to decline, and this will bring about an immediate decrease in stock prices if the stock market efficiently capitalizes the cash flow implications of the oil price increase. If the stock market is not efficient, there may be a lag in the adjustment to oil price changes.

This approach is motivated by research finding verifying existence of significant causal links between oil price change and key macroeconomic indicators. Hamilton (1983) argues that almost all United States recessions since the World War II have been preceded by oil shocks. Schwert (1989) employed vector autoregressive model (VAR) using bond returns, growth rate of producer price index, and the monetary base, as relevant macroeconomic indicators explaining volatility of stock market returns. King, Sentana, and Wadhwani (1994) employ a multivariate model using data for a number of developed and emerging markets to study the linkage between stock returns and observable factors, such as interest rates, industrial production, oil prices; and unobservable factors that are not reflected in the published data of stock markets.

Hui Guo and Kevin L. Kliesen 2005 find that a volatility measure constructed using daily crude oil futures prices has a negative and significant effect on future gross domestic product (GDP) They used a measure of volatility constructed from daily crude oil futures prices traded on the NYMEX, and find that over the period 1984-2004 oil price volatility has had a significant and adverse effect on various key measures of the U.S. macro economy such as fixed investment, consumption, employment, and the unemployment rate. This finding, is consistent with the nonlinear effect documented by Hamilton (1996 and 2003), means that an increase in the price of crude oil generally matters less than increased uncertainty about the future direction of prices (increased volatility). Mork (1994) shows a negative correlation between oil prices and aggregate measures of output and employment for a group of oil importing countries. Wassal (2005) uses Johansen cointegration technique to show existence of long-run relationship between stock market indicators such as

liquidity and size, with macroeconomic indicators for a number of oil exporting countries in Asia, Africa, and Latin America.

A second approach of modeling volatility of stock markets returns is by focusing exclusively on oil price volatility as a predictive indicator for stock market returns. Jones and Kaul (1992; 1996), find that oil price movements do indeed affect U. S. stock returns. In particular, their first study examines the effect of oil prices on stock prices. They detect significant effects of oil prices on aggregate real stock returns, including a lagged effect, in the period from 1947 to 1991. Bashar (2005) employs VAR analysis to study the effect of oil price change on GCC stock markets, and shows that only Saudi and Muscat markets have predictive power of oil price increase. Hammoudeh and Aleisa (2004) use Johansen cointegration to examine the relation between oil prices and stock markets in GCC countries, and conclude that the Saudi market is the only market in the group that can be predicted by oil future prices.

The third approach focuses on the impact that oil shocks has on different sectors of the economy. Malik and Ewing (2009) focus on the relationship between oil and the financial, industrial, consumer, health, and technology sectors. Hwang *et al.* (2004), after modeling the oil price volatility with the aid of a GARCH model, constructed a VAR model and they examined the Granger causal effects between oil price volatility, exchange rates, stock market returns, inflation and industrial production. The focus is set on Canada, Italy, Germany, U.S., U.K. and Japan. It has been concluded that the volatility of oil price changes leads to negative stock returns in three out of six cases, while it affects the industrial production in just two cases.

In this study we use multivariate GARCH specifications, especially BEKK in order to identify the conditional correlation between the oil and stock returns from Mexican market.

## 2. Literature Review

The impact oil prices volatility can make to the stock markets has been a question address in different perspective over time. One first question appears in the literature is how to measure the volatility by itself, and a second one is how to measure the relation between that volatility to another variable like the stock market prices. In general, there have been two main lines of research in the context of transmission of shocks among financial time series and analysis of volatility or variance. One is the cointegration analysis, often adopted to study the co-movements between different financial markets over a long period of time; Kasa (1992) was among the first to use this approach. He investigates the transmission of shocks among international stock prices and stock returns. The second line of research examines the time path of volatility in financial variables such as stock prices and stock returns.

Related to the method, researchers have commonly used variations of a class of models known as autoregressive conditional heteroscedasticity, or ARCH, to estimate time variant conditional variances.

According to forecasting literature, over longer time periods, historical volatility often outperforms other estimators. Historical volatility beats GARCH forecasts in both the Day and Lewis (1993) study as

well as the Duffie and Gray (1995) forecasts for crude oil. The same result is achieved for four-week forecasts in this study, but importantly, the two-week forecasts indicate greater accuracy for GARCH forecasts over historical volatility. GARCH models produce damped forecasts, which being an average of the recent volatilities and the underlying mean volatility, tend to mean-revert the further ahead the model is asked to forecast, which could explain the better performance over the shorter horizon. The increased forecast efficiency could also be a result of using a longer sample period to estimate GARCH parameters, as compared to the other studies.

Within-sample tests of the forecasting models yield results that are in conformance with earlier studies and other financial time series forecasting literature. The GARCH GED model is found to increase the maximum log-likelihood function value significantly, demonstrating that the GED conditional distribution is better able to capture the fat-tailed distribution characteristic of financial price returns, confirming the applicability of a similar conclusion reached by Xu and Taylor (1994) for currency returns.

Recent research, Hammoudeh *et al.* (2004), has used multivariate GARCH specifications, especially BEKK, to model volatility spillovers between the crude oil and stock markets.

In order to model oil uncertainty, Kuper, Gerard H. (2002) measures oil price uncertainty based on the conditional standard deviations. The time-varying conditional standard deviations are estimated using univariate GARCH models. His preferred model was a symmetric GARCH(1,3) model.

Sharma, Namit (1998) compares different methods of forecasting price volatility in the crude oil futures market. He compares the forward-looking implied volatility measure with two backward-looking time-series measures based on past returns. He compares a historical volatility estimator and a set of estimators based on GARCH models.

Jones and Kaul (1992) Using a standard cash-flow dividend valuation model find that the reaction of Canadian and U.S. stock prices to oil price shocks can be completely accounted for the impact of these shocks on the real cash flows; but they recognize that the results for Japan and the U.K. are not as strong.

Sadorsky (1999) has tried to examine the relationship between oil price volatility, stock market returns and the economic activity by using an unrestricted vector autoregression model. Sadorsky focused on the American economy and covered the period 1947:1-1996:1. His results confirm that both the oil prices and the oil price volatility play an important role in affecting economic activity. The results also reveal that changes in oil prices affect the economic activity even though changes in the economic activity have little impact on oil prices. The impulse response functions show that oil price movements are important in explaining movements in the stock returns. Positive shocks to oil prices depress real stock returns while shocks on stock returns have positive impact on the interest rates. According to his findings there is evidence that oil price volatility shocks have asymmetric effects on the economy.

Huang, Masulis and Stoll (1996), investigate the impact of oil price shocks on the U.S. equity market from a financial markets perspective. Within the

framework of a vector autoregression (VAR) model, they examine the dynamic interactions between daily oil futures returns and stock returns. They find evidence of Granger causal effects from oil futures to stocks of individual oil companies which is understandably expected; they detect no impact on a index like the S&P 500. Based on this result, they concluded that the influence of oil price shocks on the aggregate economy is more of a myth than reality.

Moreover, a study by Maghyereh (2004), reveals that oil shocks have no important effect on stock index returns. Maghyereh examines the dynamic linkages between crude oil price shocks and stock market returns in 22 emerging economies. The vector autoregression (VAR) analysis is carried out by using daily data covering the period between 1/1/1998 and 30/4/2004. This study utilized the generalized approach to forecast error variance decomposition and impulse response analysis in favor of the more traditional orthogonalized approach. Inconsistent with prior research on developed economies, the findings imply that oil shocks have no significant impact on stock index returns in emerging economies. The results also suggest that stock market returns in these economies do not rationally signal shocks in the crude oil market.

Ågren (2006) presents strong evidence of volatility spillovers from oil prices to stock markets using the asymmetric BEKK model for Japan, Norway, UK and US stock markets, but quite weak evidence for Sweden. Malik and Hammoudeh (2007) find that oil markets transmits volatility to the Gulf equity markets, but only in the case of Saudi Arabia its market volatility impact to the oil market is significant.

In the purpose of explain the relationship between future and spot prices formation, some studies have also dealt with the lead-lag relationship between spot and futures for the oil market. Hammoudeh et al. (2004) find that there are two-way interactions between the S&P Oil Composite index, and oil spot and futures prices. Bopp and Sitzler (1987), tested the hypothesis that futures prices are good predictors of spot prices in the heating oil market, and found that, even when crude oil prices, inventory levels, weather, and other important variables were accounted for, futures prices still made a significant positive contribution to describing past price changes.

Aloui and Jammazi (2009) use a two-regime Markov-switching EGARCH model to examine the relationship between crude oil shocks and stock markets; they focus on two major crude oil markets, (WTI and Brent), and three developed stock markets, (France, UK and Japan). The results show that the net oil price increase variable play a significant role in determining both the volatility of real returns and the probability of transition across regimes.

Andreas Ektor Lake, Constantinos Katrakilidis (2009) analyze the influence of the oil price returns and its volatility on the stock market returns, the futures index returns and their respective volatilities in the cases of Greece, US, UK and Germany. The volatilities of the stock indices and the oil price have been measured by applying EGARCH models, while the existence of possible causal relationships between the variables has been examined in the context of structural equation models (SEM).

Malik and Hammoudeh (2007) model the conditional correlations and examine the volatility spillovers between crude oil return, (Brent and WTI) and stock index returns, FTSE100, NYSE composite, S&P500 composite index, and

Dow Jones Industrials. Some of these issues have been examined using models of multivariate conditional volatility, (the CCC model of Bollerslev, 1990; VARMA-GARCH model of Ling and McAleer, 2003; VARMA-AGARCH model of McAleer, Hoti and Chan, 2008; and DCC model of Engle, 2002)

There have been contradictory results around whether oil volatility influences emerging stock markets or not. It seems to be that the period taken to evaluation and the relationship between the markets and the importance of the oil production in the economy lead different results. Zarour (2006) shows different results according to the period of the tests. For the period 27 May 2003 to 24 May 2005, oil prices can predict Gulf stock markets, except for Abu Dhabi. But for the period 25 May 2001 to 23 May 2003 using his impulse response functions the responses of Gulf markets to oil returns shocks are small in general. Maghyreh (2004) finds that oil shocks have no significant impact on stock index returns in 22 emerging economies. Arouri and Fouquau (2009) find a significant positive relation between oil prices and the stock index of Qatar, Oman and UAE; but no evidence of a relationship between oil price changes and stock market returns for Bahrain, Kuwait and Saudi Arabia. Basher and Sadorsky (2006) show strong evidence that oil price risk has a significant impact on stock price returns in emerging markets. Hammoudeh and Aleisa (2004) show that the Saudi market is the leader among Gulf countries stock markets. They also found it can be predicted by oil futures prices.

In the specific case of Mexico we found some studies which focus on the relationship between the oil market and the performance of the stock market. Fredj Jawadi and Mondher Bellalah (2011) investigate the efficiency hypothesis for oil markets while testing for whether oil price dynamics depend on stock market fluctuations or not. They finally reject the hypothesis, using nonlinear econometric modeling for four countries: France, the USA, Mexico and the Philippines. Filis, Degiannakis and Floros (2011) investigate the time-varying correlation between stock market prices and oil prices for Oil-exporting: Canada, Mexico, Brazil and Oil-importing: Germany, Netherlands applying a DCC-GARCH-GJR approach. They show time-varying correlation does not differ for oil-importing and oil-exporting economies but the correlation increases in respond to important aggregate demand-side oil price shocks. Jawadi and Leoni. (2009) study the oil price evolution in a nonlinear framework to test the interdependence hypothesis between oil and stock markets in four countries: USA, France, Mexico and the Philippines. They conclude the oil price is nonlinear, mean-reverting toward the equilibrium and with an adjustment speed that increases according to oil price deviations. Other approach has been to study different influences for the mexican stock market, lets say world stock market, investment flows, macroeconomic variables, the day before and so on. The studies differ in focus and technics; Mohamed el hédi Arouri and Fredj Jawadi, (2011), Werner Kristjanpoller Rodríguez (2009) Diamandis, Panayiotis F. (2009), Yochanan Shachmurove (1998), Duran-Vazquez, Lorenzo and Ruiz (2011), Canarella, Giorgio and Sapra, Sunil K. and Pollard, Stephen K. (2007) Jawadi, Fredj Nicolas Million and Mohamed el hédi Arouri (2009) Clark, John and Elizabeth Berko (1997), Cermeño Bazán, Rodolfo and M. Pavel Solís Montes (2012).

### 3. Methodology

The stock market is one of the most important sources for enterprises to raise money. This allows businesses to be publicly traded, or raise additional capital for expansion by selling shares of ownership of the company in a public market. The liquidity that an exchange provides affords investors the ability to quickly and easily sell securities.

The stock exchanges are organized markets that help finance this pipeline is conducted in a free, efficient, competitive, equitable and transparent manner, following certain rules agreed in advance by all market participants.

The first step to describe the conditional correlation is to build the returns from prices. We take the price of the active  $i$  in period  $t$ ,  $P_{it}$ , and compute the rate of return as:

$$r_{it} = \ln P_{it} - \ln P_{it-1}. \quad (1)$$

The mean equation for the returns is given by a first order autoregressive model:

$$r_{it} = \phi_0 - \phi_1 r_{it-1} + \varepsilon_{it} \quad (2)$$

where  $\varepsilon_{it}$  it is the error term of the return series. A BEKK model (a variant of the bivariate GARCH) in which the volatility of the return of assets is related with the volatility of the oil return is used.

The diagonal BEKK parameterization for the bivariate GARCH(1,1) model is given by

$$H_t = M + A' \varepsilon_{t-1} \varepsilon'_{t-1} A + D' \varepsilon_{t-1} I_{t-1} I'_{t-1} \varepsilon'_{t-1} D + B' H_{t-1} B \quad (3)$$

where  $H_t$  is the conditional variance matrix

$$H_t = \begin{pmatrix} \sigma_{it}^2 & \sigma_{iot} \\ \sigma_{iot} & \sigma_{ot}^2 \end{pmatrix} \quad (4)$$

with  $\sigma_{it}$  it and  $\sigma_{ot}$  the volatilities of the asset  $i$  and oil respectively and  $\sigma_{iot}$  the covariance asset and oil returns at time  $t$ .  $M$  is a  $2 \times 2$  matrix of three constant parameters.  $A$  is a  $2 \times 2$  diagonal matrix of parameters that measures the relation between the conditional variance with past squared errors.  $D$  is a  $2 \times 2$  diagonal matrix of parameters that measures the leverage effect using the indicator function  $I_t$  which takes the value of one if the returns at  $t$  are negative. And  $B$  is a  $2 \times 2$  diagonal matrix of parameters that measures the relation between the current conditional variance with past conditional variance.



Equation (3) represents the following system of equations for multivariate conditional variance:

$$\begin{aligned}\sigma_{it}^2 &= m_{11} + a_{11}^2 \varepsilon_{it-1}^2 + d_{11}^2 \varepsilon_{it-1}^2 I_{it-1} + b_{11}^2 \sigma_{it-1}^2 \\ \sigma_{ot}^2 &= m_{22} + a_{22}^2 \varepsilon_{ot-1}^2 + d_{22}^2 \varepsilon_{ot-1}^2 I_{ot-1} + b_{22}^2 \sigma_{ot-1}^2 \\ \sigma_{iot}^2 &= m_{12} + a_{11}a_{22}\varepsilon_{it-1}\varepsilon_{ot-1} + d_{11}d_{22}\varepsilon_{it-1}\varepsilon_{ot-1} + I_{it-1}I_{ot-1} + b_{11}b_{22}\sigma_{iot-1}^2\end{aligned}\quad (5)$$

The first equation in (5) represents the variance equation of the return of the asset  $i$ , the second equation represents the variance evolution of the return of oil prices and the third equation measures the covariance between oil and asset returns. All the parameters, in the first two equations are squared to assure positive variance.

The conditional correlation is constructed from (5) as

$$\rho_{iot} = \frac{\sigma_{iot}}{\sigma_{it}\sigma_{ot}} \quad (6)$$

Estimation of (3) is made assuming normally distributed errors maximizing the following log likelihood function:

$$l(\theta) = -T \ln(2\pi) - \frac{1}{2} \sum_{t=1}^T (\ln |H_t| + \varepsilon_t' H_t^{-1} \varepsilon_t) \quad (7)$$

where  $T$  is the number of observations and  $\theta$  the parameter set.

#### 4. Empirical Results

The Bolsa Mexicana de Valores, (BMV) is a financial institution that operates by grant from the Department of Finance, in conformity with the Law on Securities Market. There are several types of indexes, among which are: IPC®, INMEX®, IMC30®, IDIPC®, IRT®, and LIVES®. The main stock index is the CPI or the Price and Quotations Index, which represent the 35 most traded shares of around 80 companies listed.

We collected weekly close prices for thirty stock companies included in January 2011 IPC, conformation, the stock price index (IPC) itself and Brent oil prices. Our sample goes from December 30th, 2005 through December 31th, 2010. Descriptive tatistics of returns are presented in Table 1.

Table 1. Descriptive Statistics for Weekly Returns.

	Mean	Median	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Probability
ALFA	0.0026	0.0043	0.0699	-1.9504	20.1716	3372.12	0.0000
AMERICAMOVIL	0.0029	0.0064	0.0563	-0.8750	9.9949	565.40	0.0000
ARA	-0.0019	-0.0033	0.0779	-0.6411	13.7939	1284.91	0.0000
ARCA	0.0035	0.0050	0.0398	-0.7820	7.2500	223.02	0.0000
ASURESTE	0.0027	0.0054	0.0541	-0.2359	5.1672	53.50	0.0000
AXTEL	-0.0011	-0.0031	0.0718	-0.0365	6.5800	139.44	0.0000
BIMBO	0.0036	0.0063	0.0561	-0.8889	12.0992	934.78	0.0000
CEMEX	-0.0032	0.0048	0.0977	-0.9539	18.4654	2640.64	0.0000
COMERCI	-0.0007	0.0020	0.1720	-11.6515	172.6934	319060.43	0.0000
ELEKTRA	0.0061	0.0059	0.0713	-0.0492	6.4768	131.56	0.0000
FOMENTO ECOMEX	0.0038	0.0057	0.0584	-1.0139	11.1793	772.26	0.0000
GCARSO	0.0047	0.0034	0.0669	-0.2969	7.6725	241.26	0.0000
GEO	0.0001	0.0034	0.0832	-1.6932	15.7127	1882.25	0.0000
GFBNORTE	0.0033	0.0055	0.0799	-2.0579	24.2087	5075.89	0.0000
GINBURSA	0.0041	0.0029	0.0594	0.1916	6.5813	141.07	0.0000
GMEXICO	0.0075	0.0124	0.0801	-0.6760	7.4933	239.44	0.0000
GMODELO	0.0025	0.0013	0.0515	-0.4157	6.2504	122.41	0.0000
GRUMA	-0.0065	-0.0048	0.0999	-2.3417	18.7352	2931.16	0.0000
HOMEX	0.0004	0.0054	0.0908	-1.3991	13.2389	1225.24	0.0000
ICA	0.0012	0.0060	0.0895	-3.5746	40.2116	15614.50	0.0000
INDUSTRIAS CH	0.0023	0.0001	0.0655	-1.5066	16.2676	2013.05	0.0000
KIMBERLYCLARCK	0.0033	0.0020	0.0554	-1.9937	19.7922	3239.42	0.0000
MEXICHEM	0.0090	0.0096	0.0790	-3.1371	33.2514	10380.34	0.0000
PENOLES	0.0079	0.0104	0.0874	-0.0346	9.8575	511.45	0.0000
SORIANA	0.0029	0.0071	0.0629	-0.9634	12.7648	1077.32	0.0000
TELEF DE MEX	0.0012	0.0027	0.0481	-0.7451	7.3757	232.37	0.0000
TELEVISA	0.0013	-0.0005	0.0518	-0.0730	7.5036	220.80	0.0000
TVAZTECA	0.0019	0.0013	0.0502	0.1516	6.1070	105.98	0.0000
URBI	0.0001	0.0022	0.0886	-2.6341	33.8767	10669.72	0.0000
WALMART	0.0030	0.0037	0.0497	0.0863	4.3327	19.64	0.0001
IPC	0.0024	0.0054	0.0506	-0.6773	11.2501	760.14	0.0000
BRENT	0.0019	0.0057	0.0461	-0.2937	4.8197	39.76	0.0000

Jarque-Bera statistics shows that returns are not normally distributed. Diagonal BEKK-GARCH(1,1) estimation results are presented in Table 2.

Table 2. Diagonal BEKK-GARCH(1,1) Estimation Results

	Mean equation		Variance equation									
	$\phi_0$	$\phi_1$	$m_{11}$	$m_{12}$	$m_{22}$	$a_{11}$	$a_{12}$	$a_{21}$	$a_{22}$	$b_{11}$	$b_{22}$	
ALFA	-0.00012 (0.00300)	0.14256 * (0.06433)	0.00089 * (0.00012)	0.00002 (0.00004)	0.00006 (0.00004)	0.13055 (0.16974)	0.25851 * (0.07777)	-0.98401 * (0.08244)	-0.17632 * (0.09768)	0.75712 * (0.04521)	0.95781 * (0.02296)	
AMERICAMOVIL	0.00496 (0.00510)	-0.20198 * (0.07510)	0.00026 * (0.00010)	0.00003 (0.00003)	0.00008 * (0.00004)	0.22726 (0.14408)	-0.08413 (0.14238)	0.47229 * (0.08486)	0.35813 * (0.07414)	0.85545 * (0.08880)	0.98884 * (0.01674)	
ARA	0.00125 (0.00291)	-0.07886 (0.07539)	0.00219 * (0.00029)	0.00002 * (0.00013)	0.00009 * (0.00005)	0.00576 (0.54808)	-0.18144 (0.15504)	1.14285 * (0.12571)	0.28246 * (0.10618)	0.31221 * (0.09231)	0.95366 * (0.02662)	
ARCA	0.00350 (0.00247)	-0.06988 (0.07976)	0.00021 * (0.00008)	0.00004 (0.00003)	0.00008 * (0.00004)	0.49732 * (0.07966)	0.01292 (0.09599)	0.22896 * (0.13442)	0.36418 * (0.06924)	0.78871 * (0.04627)	0.98944 * (0.01746)	
ASURESTE	0.00304 (0.00299)	-0.06630 (0.06873)	0.00010 * (0.00005)	-0.00001 (0.00002)	0.00007 * (0.00003)	-0.04659 (0.23333)	0.11606 (0.22062)	0.35132 * (0.06335)	0.35111 * (0.09203)	0.95055 * (0.01670)	0.94049 * (0.01975)	
AXTEL	0.00501 (0.00377)	0.06857 (0.06923)	0.00019 * (0.00007)	0.00001 (0.00002)	0.00008 * (0.00004)	-0.18955 * (0.10944)	0.16134 (0.10465)	0.35121 * (0.07790)	0.31569 * (0.08313)	0.92885 * (0.02459)	0.98606 * (0.00239)	
BIMBO	0.00159 (0.00564)	-0.00509 (0.09434)	0.00108 * (0.00024)	0.00004 (0.00006)	0.00008 * (0.00004)	0.30654 * (0.12894)	-0.05647 (0.16140)	0.70430 * (0.08194)	0.34342 * (0.06870)	0.60342 * (0.07972)	0.94120 * (0.01832)	
CEMEX	-0.00370 (0.00406)	-0.06238 (0.08958)	0.00080 * (0.00010)	0.00000 (0.00003)	0.00007 * (0.00003)	0.26566 (0.09764)	0.04833 (0.12239)	0.53295 * (0.06286)	0.35705 * (0.06040)	0.87692 * (0.01936)	0.94504 * (0.01561)	
COMERCI	-0.00412 (0.00294)	-0.13918 * (0.05779)	0.00299 * (0.00023)	0.00008 (0.00006)	0.00009 * (0.00004)	0.39920 * (0.09674)	0.21230 * (0.11551)	-2.89881 * (0.16712)	-0.21645 * (0.11440)	0.00489 (0.28570)	0.95646 * (0.02284)	
ELEKTRA	0.00702 * (0.00413)	0.04726 (0.08216)	0.00019 * (0.00009)	0.00001 (0.00002)	0.00007 * (0.00004)	0.19579 * (0.07934)	-0.16249 (0.13033)	0.34589 * (0.07631)	0.32158 * (0.08655)	0.95054 * (0.02344)	0.95761 * (0.02094)	
FOMENTO E COMEX	0.00563 * (0.00809)	-0.18021 * (0.08312)	0.00044 * (0.00017)	0.00001 (0.00003)	0.00007 * (0.00004)	0.01601 (0.21810)	-0.20804 (0.13895)	0.59410 * (0.07600)	0.27600 * (0.12279)	0.82340 * (0.05894)	0.95638 * (0.02440)	
GCARSO	0.00622 * (0.00337)	-0.13495 * (0.06877)	0.00014 * (0.00008)	-0.00002 (0.00002)	0.00007 * (0.00004)	0.08744 (0.19735)	-0.15125 (0.17675)	0.43409 * (0.05131)	0.33652 * (0.09060)	0.92988 * (0.01853)	0.95665 * (0.02178)	
GEO	0.00709 * (0.00368)	-0.19351 * (0.07370)	0.00012 (0.00012)	0.00002 (0.00003)	0.00008 * (0.00004)	0.41954 * (0.11533)	0.05651 (0.09080)	0.42126 * (0.11236)	0.33792 * (0.06268)	0.87192 * (0.03377)	0.94152 * (0.01839)	
GFBANORTE	0.00482 (0.00514)	-0.21105 * (0.07646)	0.00089 * (0.00015)	0.00004 (0.00004)	0.00008 * (0.00004)	0.19056 (0.14832)	-0.16271 (0.12881)	0.71348 * (0.06081)	0.31609 * (0.09305)	0.81996 * (0.04148)	0.95438 * (0.02248)	
GINBURSA	0.00422 (0.00338)	-0.09770 (0.07335)	0.00017 * (0.00008)	0.00000 (0.00002)	0.00008 * (0.00004)	0.29775 * (0.10900)	-0.07673 (0.16862)	0.44692 * (0.08552)	0.35004 * (0.07062)	0.88274 * (0.05928)	0.94004 * (0.01773)	
GMEXICO	0.01205 * (0.00454)	-0.08933 (0.07085)	0.00096 (0.00022)	0.00005 (0.00004)	0.00009 * (0.00004)	0.28607 * (0.10751)	0.05301 (0.10472)	0.33426 * (0.08190)	0.37415 * (0.06894)	0.89357 * (0.05997)	0.95509 * (0.01707)	
GMODELO	0.00220 (0.00285)	-0.08977 (0.06690)	0.00097 * (0.00015)	0.00000 (0.00003)	0.00008 * (0.00004)	0.19132 (0.13717)	-0.14857 (0.13150)	0.57434 * (0.08455)	0.31835 * (0.09600)	0.81893 * (0.05689)	0.95695 * (0.02289)	
GRUMA	-0.00117 (0.00339)	0.13917 (0.08951)	0.00095 * (0.00023)	0.00004 (0.00003)	0.00008 * (0.00004)	0.42531 * (0.08075)	-0.13326 (0.12054)	0.75510 * (0.07578)	0.31286 * (0.07125)	0.67148 * (0.05638)	0.94062 * (0.01962)	
HOMEX	0.00127 (0.00385)	-0.01759 (0.05337)	0.00047 * (0.00014)	-0.00001 (0.00004)	0.00007 * (0.00004)	0.00227 (0.40886)	-0.12611 (0.17254)	0.71075 * (0.07132)	0.33023 * (0.08509)	0.83561 * (0.02634)	0.94294 * (0.02226)	
ICA	0.00117 (0.00339)	-0.22486 * (0.08290)	0.00026 * (0.00012)	0.00005 (0.00004)	0.00010 * (0.00005)	0.58475 * (0.10854)	-0.06022 (0.10375)	0.33365 * (0.14659)	0.36274 * (0.07827)	0.80307 * (0.04190)	0.93348 * (0.02505)	
INDUSTRIAS CH	0.00458 (0.00547)	-0.00673 (0.07941)	0.00127 * (0.00021)	0.00018 * (0.00007)	0.00008 * (0.00004)	0.15253 (0.17779)	-0.24843 * (0.09687)	0.73695 * (0.07695)	0.22316 * (0.11506)	0.64324 * (0.08104)	0.95154 * (0.02486)	
KIMBERLYCLARK	0.00525 (0.00392)	-0.24758 * (0.08878)	0.00013 * (0.00006)	0.00001 (0.00002)	0.00007 * (0.00003)	0.00036 (0.1618)	0.00079 (0.3500)	0.14309 (0.09025)	0.36470 * (0.08914)	0.97322 * (0.01278)	0.94447 * (0.00239)	
MEXICHEM	0.01383 * (0.00412)	-0.12077 (0.08408)	0.00148 * (0.00036)	0.00018 * (0.00010)	0.00008 * (0.00004)	0.26396 (0.17909)	-0.17304 (0.10645)	0.77174 * (0.08282)	0.28516 * (0.08896)	0.57651 * (0.10171)	0.95652 * (0.02270)	
PEÑALES	0.01233 * (0.00453)	-0.13453 * (0.07168)	0.00051 * (0.00021)	0.00010 * (0.00005)	0.00010 * (0.00005)	0.31510 * (0.07327)	-0.01948 (0.11781)	0.24413 * (0.11954)	0.35873 * (0.06576)	0.88948 * (0.05458)	0.95501 * (0.02066)	
SORIANA	0.00418 (0.00337)	-0.06749 (0.07567)	0.00021 * (0.00008)	0.00000 (0.00002)	0.00008 * (0.00004)	0.15678 (0.15596)	-0.08860 (0.17362)	0.55995 * (0.07507)	0.34221 * (0.07918)	0.88277 * (0.02621)	0.95920 * (0.01927)	
TELEF DE MEX	0.00142 (0.00237)	-0.05422 (0.07368)	0.00015 * (0.00007)	0.00002 (0.00002)	0.00009 * (0.00005)	0.32182 * (0.12609)	-0.11801 (0.12817)	0.40987 * (0.11012)	0.34921 * (0.08010)	0.86623 * (0.05669)	0.95434 * (0.02268)	
TELEVISA	0.00119 (0.00275)	-0.15580 * (0.07459)	0.00039 * (0.00017)	0.00004 (0.00003)	0.00008 * (0.00005)	0.11286 (0.15835)	0.25447 * (0.10712)	0.51907 * (0.06992)	0.27113 * (0.11664)	0.82894 * (0.06370)	0.92339 * (0.02709)	
TVAZTECA	0.00192 (0.00289)	-0.11162 (0.07339)	0.00024 * (0.00009)	0.00001 (0.00002)	0.00009 * (0.00004)	-0.00645 (0.34040)	-0.10008 (0.25178)	0.50898 * (0.06308)	0.37079 * (0.08466)	0.88840 * (0.02895)	0.93239 * (0.02618)	
URBI	0.00634 (0.00428)	-0.23359 * (0.08108)	0.00021 * (0.00012)	0.00004 (0.00004)	0.00008 * (0.00005)	0.09527 (0.17842)	0.27491 * (0.07203)	-0.75592 * (0.09005)	-0.15265 * (0.13756)	0.87968 * (0.02989)	0.93014 * (0.02379)	
WALMART	0.00805 (0.00299)	-0.10521 (0.07010)	0.00013 * (0.00008)	-0.00001 (0.00002)	0.00008 * (0.00004)	0.13448 (0.15079)	-0.16573 (0.14936)	0.38629 * (0.08051)	0.34157 * (0.08569)	0.92451 * (0.05049)	0.95188 * (0.02341)	
IPC	0.00247 (0.00240)	-0.12871 * (0.07392)	0.00021 * (0.00005)	0.00002 (0.00003)	0.00008 * (0.00004)	0.14477 (0.15614)	0.16462 (0.15506)	0.67284 * (0.06715)	0.35159 * (0.09969)	0.81901 * (0.04480)	0.93235 * (0.02365)	

Equation (3) estimation results. Standar errors appears in parentheses. \*, †, ‡ denote rejection of the null hypothesis that the parameter equals zero at the 1%, 5% and 10% significance level, respectively.

In general the BEEK parameters are statistically significant so we can calculate the conditional variances and covariance. The stock conditional variance estimation in first equation of (5) reveals that the GARCH(1,1) parameters are, in general, statistically significant and the leverage effect parameter is positive as expected.

Figure 1 . Graphics for 30 Companies.

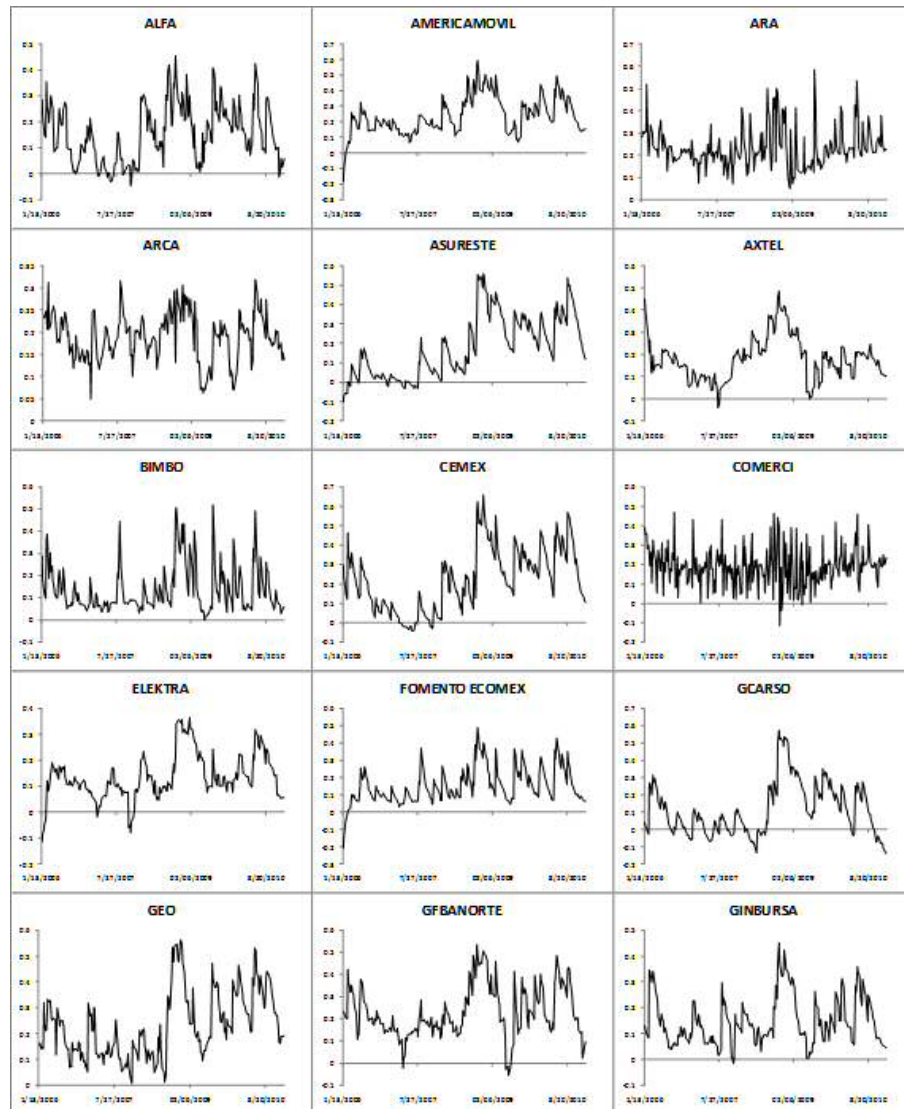
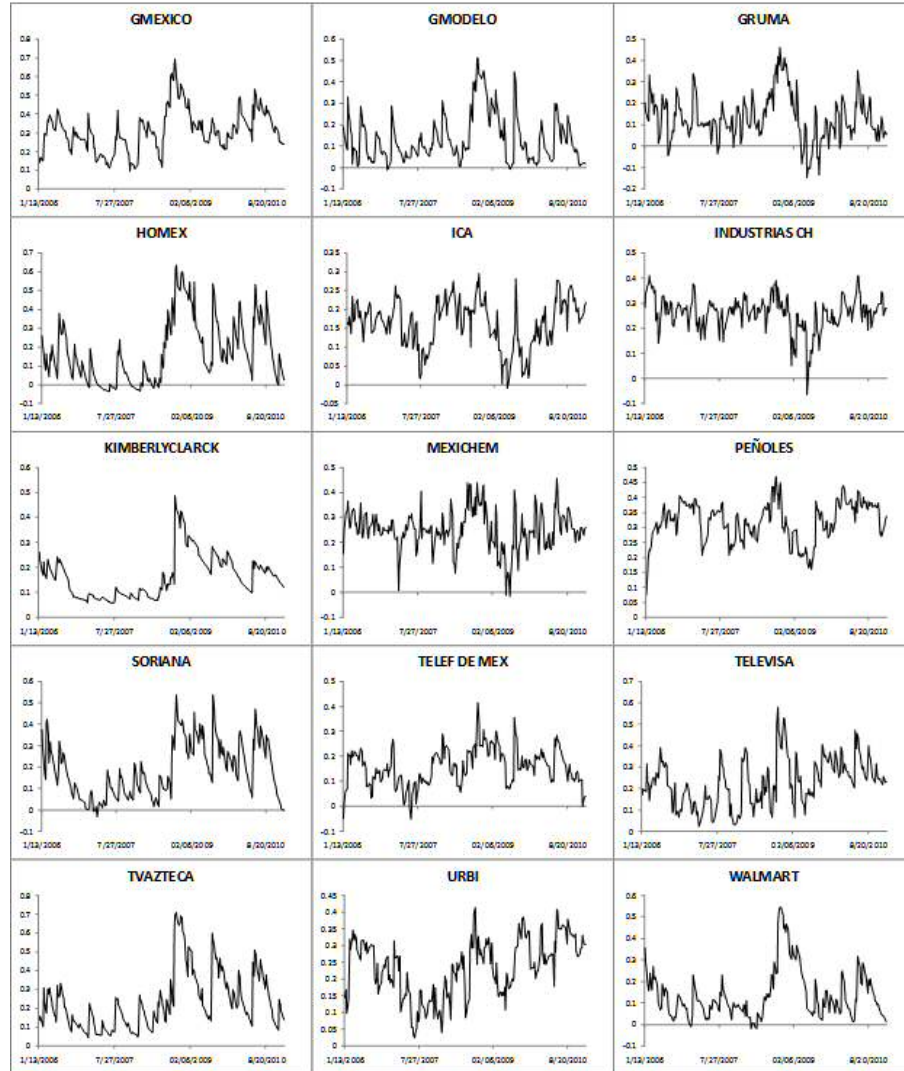




Figure 2. Graphics for 30 Companies .  
(continued)

Then the conditional correlations are computed from equation (6) and Figure 1 and Figure 2 shows the graphics for the 30 companies. The results reveal that the covariance and volatilities of stock and oil returns are significantly affected by its own news. It appears that a shock in oil and financials market is associated with a positive correlation.

This correlation is altered over time and can be seen that in general has a growth in the last half of 2008, suggesting that in times of crisis the relationship between financial assets and the price of oil grows. As early as the beginning of 2009, companies are making adjustments, and the relationship between financial markets and oil, is still positive but begins to decrease.

## 5. Concluding Remarks

We analyze the behavior of 30 companies listed in the Mexican Stock Market during the period of January 2006 to December 2010. The main focus was to analyze the correlation between the Oil prices and the stock prices. The behavior was tested under a diagonal BEKK model which parameters estimations are, in general, statistically significant so we can calculate the conditional variances and covariance. In this study we showed the graphical correlation between the variables, and we found the correlation is mainly positive, there are only few moments where is negative in some companies, but there are not an explanation regarding the economical sector or macroeconomic events.

Overall, we find that there is a main positive relation between oil and all of the examined companies. Our results provide important and useful information for financial analysis. An example is the financial and strategic decisions regarding asset pricing, risk management and portfolio allocation that require accurate estimation of the time-varying covariance matrix.

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