Empirical linkage between oil price and stock market returns and volatility: Evidence from international developed markets

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Abstract

This paper examines empirically whether oil price shocks impact stock market returns. Using monthly data for eight developed countries from January 1991 to September 2013, strong negative connections between oil price and stock market returns is found in seven of the selected countries. Oil price changes are without significant effect on the stock market of Singapore. On the volatility of returns, the changes in oil prices are significant for six markets and they have no much effect on the others.

Keywords: Oil price shocks; Stock market return; EGARCH.

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Introduction

For a long time since the tremendous oil price shocks of the 1970s till the last recent days Oil prices have been showing spectacular movements which has been at the forefront of the increase in uncertainty of the energy sector. During the period spanning from 2007 to 2008, the oil price has increased from 60 dollars to cross the threshold of 100 dollars reaching the record of 147 dollars by barrel in July. The prices have been shown a decrease by August to reach only 115 dollars, and they have had been dropped back four months later to be traded at 45 dollars at the end of December 2008. The cycle was being launched again around March and April 2009 when oil was traded at about 40 dollars per barrel to reach by August 2009 the level of more than 70 dollars per barrel. In the first half of January 2014, the Brent oil crude was traded at more than 107 dollars per barrel.

The rise and fall in oil prices form one of the serious factors that really affect consumers, producers and Markets particularly in terms of costs, trading strategies and incentives to launch new investment in technology or reorganize former ones.

No long time after the tremendous oil price shock of the 1970s a large body of literature has been developed to identify the impact of the oil price fluctuations on the real economic activity. Authors such as Hamilton (1983), Jimmenez-Rodriguez and Sanchez (2005), Cunado and Perez de Gracia (2005) among others have investigated the interdependence between oil prices and GDP in the major developed countries. The work realized by Hamilton (1983) establishing oil price shocks as a factor contributing to recession in the American economy was stimulated many studies on the impact of oil price on various macroeconomic activities. Findings reveal that oil price shocks have a statistically significant effect on macroeconomic activities in the G-7 (Cologni and Manera, 2008; Kilian, 2009), G-7 and Norway (Jimmenez-Rodriguez and Sanchez, 2005) and Asian countries (Cunado and Perez de Gracia, 2005).

Despite the significant body of research has examined the effect of oil price shocks on GDP, only a few researchers have focused on the relationship between oil prices changes and the stock market returns. The most known works in this field remain those of Jones and Kaul (1996), Sadorsky (1999), Huang et al. (1996), El-Sharif et al. (2005), Naifar and Al Dohaiman (2013), Chang and Yu (2013), Mohanty, et al. (2011), Nguyen and Bhatti (2012). While Huang et al. (1996) do not find a significant linkage between oil price shocks and stock returns for some specific markets such as the S&P 500 stock market, several authors such as Nandha and Faff (2008), Papapetrou (2001), Sadorsky (1999), Issac and Ratti (2009), and

Shimon and Raphael (2006) confirm the negative reaction of stock returns following the increase in oil prices. For Ciner (2001) the real stock returns are significantly sensitive to the oil price futures, but this connection is non-linear.

This study estimates the effect of oil price shocks and oil production on stock market returns and volatility using monthly data for high countries over the period spanning January 1991 to September 2013. We argue that it is important to consider the effect of different macroeconomic aggregate variables to supervise the direct and indirect effect of oil price shocks on stock returns in order to understand in more details how investors react to the changes in oil prices over the time.

An EGARCH-M model is conducted to specify the macroeconomic variables effect on both returns and volatility of the stock market returns. Evidence supports the negative connections between oil price changes and stock market returns for all selected countries with exception to the case of Singapore where the oil price shocks have no impact on stock price. The oil price fluctuations exert significant positive effects on the volatility of stock returns for all selected countries with the exception to the cases of the France and the UK where there is no significant relationship between oil price shocks and the volatility of stock returns.

The rest of this paper proceeds as follows. In section two, we present the literature review on the sensitivity of stock market returns to oil price chocks. Section III focuses on the empirical analysis. In this section we present the variable definitions and the modeling approach. The discussion of empirical findings is the subject of the fourth section. And finally, section V concludes.

2. Literature review

Recently, the connections between oil price and stock returns has come to the forefront of public attention and this probably because of the fact that crude oil prices have been showing an exceptional volatility which has led to an increase in uncertainty of the energy sector, the whole economy as well as the financial markets. The problems caused there to be a concern with a re-examination of what exactly can be the explication of the negative connection between oil prices and the stock returns. Previous studies documented that oil price increases and volatility leading to higher inflation and unemployment and therefore depress macroeconomic growth and financial assets (Shimon and Raphael, 2006).

The oil price changes have attached a great deal of attention of both financial practitioners and market participants for two reasons. Firstly, they affect substantially decisions made by producers and consumers in strategic planning and project appraisals. Secondly they determine investors' decision in oil-related activities, portfolio allocations as well as risk management. Because of these influences the ability to accurately forecast the oil price changes is of high importance for decision making in the financial area. In this line, Arouni et al. (2012, p. 284) argue "*Aggregate output dynamics and corporate earnings can be also severely affected, and policymakers should consider the volatility impacts of oil price when conducting economic policies. Moreover, to the extent that oil price volatility provides information about risk levels and how financial asset returns should behave in response to oil shocks, accurately modeling and forecasting oil price volatility are crucial for financial decisions involving oil investments and portfolio risk management particularly with regard to the valuation issues of oil-related products and energy derivative instruments*". This indicates that investors can likely better manage their portfolio once they make an efficient oil-volatility forecast (Kroner et al., 1995). Considering these findings many studies have been conducted to examine the behavior of oil price and volatility because of their macroeconomic and microeconomic effects in the whole economy and in the specific case of financial markets.

The major works on oil fluctuations have been focused around the effects on macroeconomic variables. Among others, Rebeca and Sanchez (2004, 2009), Nung et al. (2005), Sandrine and Mignon (2008), Jacobs et al. (2009) and Yazid Dissou (2010) documented that macroeconomic variables are significantly sensitive to oil price increases and volatility. Eksi et al. (2012) argue that since oil constitutes a substantial input for many industries, the increase in oil price leads to economic crises by creating significant cost-push inflation and higher unemployment. In this line, Basher and Sadorsky (2006) presume that a rise in oil prices acts as inflation tax and lead therefore consumers to look for alternative energy sources from one hand and increases risk and uncertainty from the other hand, and this affects seriously the stock price and reduce wealth. Using a multifactorial model of arbitration that allows for both conditional and unconditional risk factors these authors found robust evidence that oil price risk impacts the performance of stock markets in emerging countries.

Despite the important number of studies developed on the links between oil price movements and the macroeconomic activity a few papers studying the connections between oil price volatility and stock returns are identified. Some papers add other variables to supervise the stock returns behaviors. Among others oil production is introduced as an explanatory variable by Kilian (2009), Kilian and Park (2009) and Güntner (2013). Bernanke et al. (1997) and Lee et al. (2012) introduced the short-term interest rate. Sadorsky (1999), Park and Ratti (2008) and Cunado and Perez de Gracia (2003, 2005, 2013) developed models that associate the stock returns to different variables including oil price, oil production, short-term interest rate and industrial production.

Jones and Kaul (1996) used quarterly data for Canada, Japan, the UK and the US over the period 1947-1991 to test whether the reaction of stock returns to oil shocks can be justified in terms of current and future changes in real cash flows and or changes in expected returns. The aim of the study is to determine if stock markets are rational, defined as fully conforming to the impact of oil price shocks on dividends. Based on a standard cash-flow dividend valuation model and employing the Producer Price Index for fuel to proxy the oil price index, evidence in the case of the US and Canada supports the fact that the reaction of stock prices to oil price shocks can be completely accounted for by the effects that induce these shocks to real cash flows. Findings for the Japan and the UK are without important significance. Using a Vector Autoregressive (VAR) model over the period 1979-1990, Huang et al. (1996) found that daily oil futures return presents no significant effect on the broad-based market indexes such as the S&P 500. Three years later, Sadorsky (1999) developed an unrestricted VAR model including monthly data of oil prices, stock returns, short-term interest rate, and industrial production over the period 1947-1996. Their results show that oil price played a vital role in explaining the US broad-based stock returns. These findings invalidate those of Huang et al. (1996). They are in contrast also to the results observed in Chen et al. (1986) according to which returns generated by oil futures are without significant impact on stock market indices such as S&P 500, and there is no gain in considering the risk caused by the excessive volatility of oil prices on stock markets. The non significant connection between oil price shocks and the stock price is also confirmed in 2009 by Apergis and Miller. Their findings do not support a large effect of structural oil market shocks on stock price in eight developed countries.

Park and Ratti (2008) examine the effects of oil price shocks and oil price volatility on the real stock returns of the US and 13 European countries over the period from January 1986 to December 2005. Using a multivariate VAR model they found that oil price shocks exert a statistically significant impact on real stock returns in the same month or within one month. Evidence shows also that this result is robust to reasonable changes in the VAR model of variable order and inclusion of additional variables.

Along the same line, Naifar and Al Dohaiman (2013) have investigated the nature of the relationship between crude oil prices, stock markets' return and macroeconomic variables. Their analysis has been conducted in two steps. Firstly, the authors examined the impact of oil price change and volatility on stock market returns under regime shifts using a sample composed of the Gulf Cooperation Council (GCC) countries. To generate regime probabilities for oil market variables they employed a Markov regime-switching model. Two-state Markov switching models have been used what are the crisis regime and non crisis regime. In a second time, they investigated the non-linear connections between oil price, interest rates and inflation rates before and during the subprime crisis. They considered various Archimendean copula models with different tail dependence structures. The main findings they obtain show a regime dependent relationship between GCC stock market returns and OPEC oil market volatility with exception to the case of Oman. Their results show also an asymmetric dependence structure between inflation rates and crude oil price and that this structure orients toward the upper side during the recent financial crisis. They found moreover a significant symmetric dependence between crude oil prices and the short-term interest rate during the financial crisis.

Moreover, many recent papers have investigated whether future stock market returns can be predicted based on past oil price changes. Among other, Driesprong et al. (2008) used data from eighteen developed and thirty emerging countries. Their main objective is to test if monthly oil price evolutions contribute to predict the stock market return. Their results confirm the significant predictability in twelve developed markets as well as in all selected emerging markets. Hong et al. (2002) documented a significant negative association between the lagged petroleum industry returns and the US stock market. These findings confirm those of Papapetrou (2001) using 1989-1999 monthly data of the Greek stock market. The results of his study show, in fact, that oil price forms an important component in explaining stock price movements, and the increases in oil price shocks induce serious depressions in real stock returns.

Similarly, Issac and Ratti (2009) test the long run relationship between the world price of crude oil and international stock markets. They used a Vector Error Correction model over the period spanning January 1971 through March 2008. The results for six OECD countries confirm a clear long-run connection between oil price and real stock market returns what means a negative reaction of real stock prices to the increase in oil prices.

The negative reaction of real stock prices to the increase in oil price is attributed according several authors to the direct effects of this increase on cash flows and inflation. In fact, oil price can corporate cash flow since the oil price constitutes a substantial input in production. Moreover, oil price changes can influence significantly the supply and demand for output at industry sector and even at whole economy level. Consequently, oil price changes can influence the firm performance through its effect on the discount rate for cash flow because the direct effect that may exert on the expected rate of inflation and the expected real interest rate. These direct and indirect effects of the high volatility in oil prices seem likely to increase uncertainty at firms and in the economy. In this line, Bernanke (1983) and Pindyck (1991) documented that higher change in energy prices creates uncertainty about future energy price and incites, consequently, firms to postpone irreversible investment decisions in reaction to the profit prospects.

Other studies provide important evidences on the connections between oil price and stock returns. Among others, by introducing nonlinear effects, Ciner (2001) confirms the negative impact of oil price futures on real stock returns. The same result showing that oil price increases lead to reduce stock returns is commonly shared by many authors such as O'Neil et al. (2008) for US, UK and France, Park and Ratti (2008) for US and 12 European oil importing countries, and Nandha and Faff (2008) for global industry indices (except for attractive industries).

Reboredo and Rivera-Castro (2013) examine the connection between oil price and stock market returns using daily data that consists of the aggregate S&P 500 and Dow-Jones Stoxx Europe 600 indexes and US and European industrial sectors (automobile and parts, banks, chemical, oil and gas, industrial goods, utilities, telecommunications, and technologies) over the period from 01 June 2000 to 29 July 2011. Based on wavelet multi-resolution analysis they found that oil price changes have no much effect on stock market returns in the pre-crisis period at either the aggregate as well as the sectoral level. With the onset of the financial crisis, their findings support the positive interdependence between oil price shocks and the stock returns at both the aggregate and the sectoral level.

The analysis of the relationship between oil price risk and stock returns have been also the subject of the study of El-Sharif et al. (2005) for a sample composed of the UK-listed oil and gas firms. They find that changes in crude prices, the stock market condition as well as the exchange rate as risk factors exert significant impacts on oil and gas stock returns.

Aloui and Jammazi (2009) developed a two-regime Markov-switching EGARCH model to the interdependence between crude oil shocks and stock returns. Using data for France, UK and Japan over the period spanning January 1987 to December 2007, findings show that net oil prices play a crucial role in determining firstly the volatility of real returns and secondly the probability of transition across regimes.

3/ Empirical Analysis

3.1/ Variable definitions and Modeling Approach

We use monthly data to analyze the impact of oil price shocks on 8 international stock markets over the period from January 1991 to September 2013. The starting date of the sample period is determined by the availability of monthly stock market return. The countries included in the analysis are US, SWISS, FRANCE, CANADA, UK, AUSTRALIA, JAPAN and SINGAPORE. Other papers that also use monthly data are those of Sadorsky (1999), Park and Ratti (2008), Driesprong et al. (2008), Lee et al. (2012), and Cunado and Perez de Gracia (2013) among others. The data for stock market indices are compiled by DataStream and completed based on information available in the "LesEchos.fr" pages. Returns in each market, denoted R_t, are computed using the first difference in the natural logarithms of the aggregate stock market indices following the following equation: $R_t = \left(ln(P_t) - ln(P_{t-1})\right) \times 100$, where P_t represents the stock market index at the time t. To avoid the impact of the inflation rate we use approximately the real stock returns instead of the returns calculated for each market. The real stock return is computed as the difference between continuously compounded returns on the stock price index and the inflation rate. The inflation rate is measured as the first logarithmic difference of the consumer price index. This proxy for the real stock return is already used by Park and Ratti (2008) and Cunado et Perez De Gracia (2013). The data for the oil price and the oil production are obtained from the Energy Information Administration (EIA) database and the International Financial Statistics (International Monetary Fund). Finally the data for the macroeconomic variables (Oil production, Industrial production and Short-term interest rates) are compiled by the International Financial Statistics (International Monetary Fund) and the Global Financial Data.

Based on the studies realized by Sadorsky (1999), Park and Ratti (2008), Cunado et Perez De Gracia (2013), Bernanke et al. (1997) Kilian and Park (2009) and Güntner (2013), Lee et al. (2012) we include the oil price, oil production, industrial production and short-term interest rates in the analysis to supervise the behavioral of international stock markets return to the oil price shocks. The variables used in our model are computed as follows.

In this paper we use the real national price for each country as a proxy for the oil price. The real national price is computed as the product of the nominal oil price and the exchange rate deflated by the consumer price index of each country. The UK Brent nominal price is used as a proxy to the nominal oil price. This proxy is commonly used by several authors such as Cunado and Perez de Gracia, (2003, 2005, 2013) and Engemann et al., (2011) in order to investigate the type of interconnections between oil shocks and macroeconomic variables. The exchange rate refers to the number of units of local currency per one USD. The data for the exchange rate are compiled from the OANDA pages.

Monthly data on oil production are available in the US EIA (Energy Information Administration). The use of this variable together with the oil price is motivated by the wish to benefit from the dispersion between oil supply and oil demand shocks. This variable is earlier used by Kilian (2009), Kilian and Park (2009) and Güntner (2013).

To supervise the indirect effects of oil price shocks on real stock returns we include two variables commonly used in previous studies. Based on the studies of Bernanke et al. (1997), Sadorsky (1999), Park and Ratti (2008) and Lee et al. (2012) and Cunado and Perez de Gracia, (2013), we use the short-term interest rate. The use of this variable is motivated by the fact that central bank react sensitively to higher oil prices through the short-term nominal interest rate. This reaction induces an indirect effect of oil price shocks on real economic activity and therefore on real stock market returns. The second indirect effect of the oil price shocks on the real economic activity and therefore the real stock returns is supervised using the industrial production variable. The real industrial production is computed as the nominal industrial production deflated by the consumer price index of each country. This measure is inspired based on the works of Sadorsky (1999), Park and Ratti (2008) and Cunado and Perez de Gracia, (2013).

To investigate the direct and indirect effects of oil price shocks on stock markets return and volatility we employ an Exponential Generalized Autoregressive Conditional Hetéroskedasticity model with an ARCH-in-mean term, the so-called EGARCH-M model. The use of the EGARCH specification allows supervising the possible asymmetries in effects.

Our model includes real stock returns (R) as endogenous variables and Oil Price (OILP), Oil Production (OILPROD), Industrial Production (INDPROD), and Short Term Interest Rate (STIR), as regressors. The model is defined by the following equations (Equations 1 to 4):

$$R_t = \alpha_0 + \alpha_1 OILP_t + \alpha_2 OILPROD_t + \alpha_3 INDPROD_t + \alpha_4 STIR_t + \sum_{i=1}^{n} \beta_i R_{t-i} + \mu\sqrt{h_t} + u_t \quad (1)$$

$$u_t = \sqrt{h_t e_t} \;, \qquad e_t \approx iid.(0,1) \quad (2)$$

$$h_t = \exp(c + \lambda_1 OILP_t + \lambda_2 OILPROD_t + \lambda_3 INDPROD_t + \lambda_4 STIR_t + \phi \log g_{t-1} + \delta \log h_{t-1}) \quad (3)$$

$$g_t = |e_t| - V|e_t| - Ze_t \quad (4)$$

Where e_t has a generalized distributed error. Z and V represent respectively the asymmetry and the scale terms. In the formula 1, α_0 denotes the constant term; α_1 to α_4 capture the macroeconomic variables effect on returns; β_1 to β_4 are the coefficients of the lagged return terms; n describes the lag order for each country calculated by the Final Prediction Error Criterion; μ, the coefficient on the Arch-in-mean term representing the market price of risk, and $\mu\sqrt{h_t}$ represents the market risk premium for expect volatility. We assume that investors are risk averse and therefore we expect μ to be positive. In the equation 3, *exp* express the inverse of the natural logarithm function; c represents the constant term; λ_1 to λ_4 measure the macroeconomic variables' effects on volatility; φ and δ represent the coefficient on the lagged squared residual and the lagged squared variance, respectively. There are three advantages of using such a specification. Firstly; we can explain the effect of macroeconomic variables on both return and variance specifications. Secondly, it allows us to measure the ARCH-in-mean effects. Finally, we can evaluate the asymmetric effects of surprises on the volatility of returns. Compared to GARCH models the EGARCH specifications offer different advantages. First, if we apply the logarithm of the ε_t term, the variance h_t will take positive values and therefore estimation of equation 3 does not require restrictions except that of $\delta < 1$ for EGARCH, which facilitate the numerical computation. Secondly, we can capture the leverage effect by the coefficient Z. As admitted in (Hamilton, 1994, pp. 668-669), evidence on asymmetry in stock-price behavior has been concluded by many researchers. Negative shocks assume to increase volatility more than positive shocks do. Since higher oil price increases the production costs and therefore reduces the value of equity, a higher oil price induces an increase in the risk of holding stocks. Generally we assume that the error term ε_t is normally distributed, which is obviously too strong as a hypothesis. Consequently, this assumption has been relaxed and we have supposed that ε_t has a generalized distributed error.

3.2 Estimates

The efficient market assumption indicates that stock market returns can't be forecast and therefore stock returns should be regressed only on the constant term. However, because of the market macro structural characteristics, the macroeconomic variables impact is often present in the stock market returns.

The estimating results of the volatilities and specifications on the market returns for 8 countries are presented in Tables 1 to 3. In Table 1, β_0 is the constant term of the return specification. Coefficients β_1 to β_5 evaluate the autoregressive behavior of returns (i.e. the estimated coefficients on the lagged terms of market return). α_1 to α_4 measure the macroeconomic variables effect on the return specification. Finally, the risk premium can be measured by μ representing the coefficient on the ARCH-in-mean.

In Table 2, we report the estimates of the variance specification. The detail explanation of terms c, φ, δ, Z and V are given in section 3.1 (modeling approach). The coefficients λ_1 to λ_4 measure the impact of macroeconomic variables on the volatility of the stock market. In addition, the Table 2 contains the skewness and kurtosis for the non-standardized residuals and summarizes the return specification and diagnostic as well as the variance equations.

Conforming to the estimates of the return specification, which are detailed in Table 1, we can affirm the following: Oil price increases exert negative effects on stock market returns for all selected countries with the exception of the case of Singapore where there is non-significant effect. Results show also a negative association between stock market returns and the oil production variable for the cases of the US, Switzerland, France, Canada, UK, and Japan. For the Singapore and Australian stock market, oil price production is without significant effect on returns. The industrial production enforces the increase of stock market returns. The more the industrial production is more enforced, the more the firms become with high performance and therefore the aggregate stock market index rises. This result is not surprising since all selected countries are higher developed. Moreover, we find a significant connection between stock market returns and the short-term interest rate for only three countries: Switzerland, Canada and Singapore. The Japan presents the specificity that we do not have short interest[3]. Because of this specificity, we do not make tests for short-term interest rate.

In Table 1, the estimates of the coefficient μ are also given. The estimate of μ is statistically significant only in Switzerland, France, Australia and Japan. A negative sign of μ capture the fact that investors seem not to be risk averse. This is the case of Japanese investors usually supposed as the most optimistic investors all over the world.[4] We notice here that this result can be considered as no surprising especially in the case of the Japanese markets. In fact, as Asian population, the Japanese investors are more exposed to the overconfidence bias[5]. They underestimate their exposition to risk and make aggressive reactions inducing an increase in trading volume. This finding is consistent with the prediction of Odean (1998) according to which the behavior of the overconfident investors consisting to underestimate their exposition to risks and to act aggressively leads to an increase in their trading volume.

A positive sign attributes however the risk aversion. European populations, at their head the French population, are the pioneer of pessimism and are therefore risk averse. In fact, the French population has no confidence in the future. This population is the most pessimistic population in the world[6]. It has no confidence in politics[7], in drugs[8], in the medias[9]… This implies therefore that French investors are more averse to risk. They react negatively after all crises or rather a simple loss or a bad news.

-- Insert Table 1 here --

The variance specification estimates are summarized in Table 2. Based on the estimated coefficients and maintaining the 1-percent level of statistical significance, it can be said that the variances of the stock return volatility are in the major selected markets significantly sensitive to the evolutions of Oil prices than to the other macroeconomic variables. The short-term interest rate impacts significantly stock returns on for the cases of the Switzerland and the Singapore. The short-term interest rate is without significant effect on the stock returns for

[3] For more details see Boynton et al. (2009).
[4] see Yates, Lee and Shinotsuka (1996) and Yates, Lee and Bush (1997) for more details
[5] We remind here that numerous psychologists have investigated the behavior of populations and conclude that Asian population exhibits overconfidence in general knowledge (see Yates, Lee and Shinotsuka (1996) and Yates, Lee and Bush (1997) for more details). This implies specifically among others that Asian investors may suffer from psychological bias from which the overconfidence bias. They underestimate their exposition to risks and make aggressive decisions which can be reflected in their trading volumes.
[6] The BVA-Gallup Survey, Le Parisien-Aujourd'hui France, January 2011).
[7] Cevipof Study, January 2011.
[8] CSA Survey – Le parisien Aujourd'hui France, after the plectrum business, 2011.
[9] TNS Sofres-La Croix, February 2011.

the cases of the rest of our selected countries. The oil production exerts significant effects on stock returns only for the cases of the Swiss, Canadian and Australian Markets. Regarding the industrial production, the stock returns are significantly highly sensitive for the cases of the Switzerland, France, UK and Australia. This variable, is without significant effects on stock returns for the cases of the US, Canada, Japan and Singapore.

In Table 2, the estimates of φ, δ, Z and V are as well reported. The estimates of φ are positive and statistically significant at 1% for all samples countries. Z has a negative sign for the UK and a positive sign for Australia with non significant effect for the two stock markets. In the rest of the selected sample, Z presents a statically significant positive effect on the volatility of stock returns. The positive sign indicates that in fact a positive shock increases volatility, while a negative shock decreases volatility. For all sample countries, the estimate of V is positive and statistically significant.

-- Insert Table 2 here --

3.3 Specification tests

Firstly, for the whole sample, the estimated coefficient for δ in the EGARCH specification is less than unity and therefore the conditional variance is not explosive. Secondly, we use the non-parametric bias tests[10] to find out whether the sign and the size effects are present in our samples[11]. The statistics of these tests, a normalized residual e_t can be computed by the ratio dividing the residuals by the conditional variance square root. Then we define two dummy variables m_t and p_t defined by: m_t equals to 1 (respectively p_t equals to 1) if the normalized residual is negative (respectively if the normalized residual is positive) and m_t (respectively p_t) equals 0 otherwise. After that we define two interactive variables as $sm_t = m_t e_t$ and $sp_t = p_t e_t$. Then, we regress the normalized residual e_t on constant term, m_t and sp_t. For the sign, negative size and positive size tests we evaluate respectively the null hypotheses H_0: $m_t = 0$, H_0: $sm_t = 0$ and H_0: $sp_t = 0$. We evaluate all the three null hypotheses for the joint test. Finally, we report in the Table 3 all the statistics and their associated p-value. The null hypothesis cannot be rejected. Therefore, our sample does not show the sign and size effects.

[10] The Sign Bias Test, the Positive and Negative Size Bias Tests and the Joint Test.
[11] The approach is developed based on the work of Yalcin and Yucel (2006).

The likelihood ratio (LR) test outcomes imply that the null hypothesis of “no macroeconomic variables’ effects” can be rejected (the conditional variance equation). The results of LR tests are summarized in Table 2. We can see that all country statistics are larger than the Chi-square (with four degrees of freedom) value of 9.4877 at the 5-percent level of significance.

We use the Ljung-Box Q Statistics (for 3-, 6-, 9-, and 12- months lags) to test the presence of autocorrelation of the conditional standardized residual. These statistics are reported in Table 3. For France, UK and Singapore, it is not significant at 3-, 6-, 9- and 12-months lags. For the Switzerland, the Q statistic is not significant at 3-months lags. For Australia and Japan, it is significant only at 3-months lags and 9-months lags respectively. For the US, it is not significant at 6- and 9-months lags. And finally, for Canada it is not significant at 3- and 12-months lags.

-- Insert Table 3 here --

Then, the presence of ARCH effect is tested with the Lagrangian Multiplier test (LM). Since we employ an EGARCU-M we run a LM test on the mean residuals. The LM test can be performed by an OLS regression of squared estimated residual terms on constant term and on their 3-, 6-, 9-, and 12-lags. We dressed the EGARCH-M estimation after confirming the rejection of the null hypothesis of no ARCH effect based on the results of the LM test estimates on constant terms. Table 3 reports statistics for the specification tests. For France, Canada, and UK, LM(ARCH) p-values are not significant at 3-, 6-, 9-, and 12- months lags. This result allows rejecting the null hypothesis that the ARCH effect is not present. For the US and Japan, the p-value of this test is not significant at 9- and 12-months lags. For the Switzerland and Singapore, the p-values are significant for only 3-months lags and 6-months lags respectively. For the case of Australia, the LM(ARCH) p-values are not significant at 3- and 12- months lags.

4. Discussion of empirical findings

Results in Table 1 provide us evidence for the presence or absence of macroeconomics variables’ effects. With the exception of the case of Singapore where there is non-significant effect, the Oil price exerts a significant negative effect on stock market return for all selected countries. In the same way, the Oil production presents in his turn a significant negative impact with the exception of the case of the Australia as well as the Singapore. The industrial production is significantly positively associated to the stock market returns for selected countries. However, the short-term interest rate is statistically significant only for the cases of three countries which are Canada, Switzerland and Singapore where a negative effect is observed.

The assumption of efficient market asserts that stock market returns are uncertain and follow a random walk. This implies that it is difficult to profit from anticipating price movements. This assumption can be challenged by the presence of macroeconomic variables' effects since this hypothesis suggests that investors will build up strategies to look at any regular pattern that may exist in financial markets.

We find significant negative effects of oil price shocks on stock market returns for all selected countries with exception to the case of Singapore where the results is not significant at the 10% level. This result is in line with the finding of Cunado and Perez De Gracia (2013) who examined the impact of oil price shocks on stock returns in 12 oil importing European economies over the period spanning February 1973 to December 2011. We find also that oil production has a significant negative effect on stock returns for the US, Switzerland, France, Canada, UK and Japan. The negative effects of oil price and oil production on stock returns can be due to higher energy costs.

The industrial production exerts significant positive effects on stock market returns for all selected markets. However, short-term interest rate have in the major cases no significant effects on stock returns with exception to the Switzerland, Canada and Singapore where there is a negative reaction of stock returns to the increase in short-term interest rate.

On the other hand, the stock return volatility is statistically significantly sensitive to the oil price variation for all selected countries with the exception of the cases of France and UK. For the oil production, a significant positive effect is observed for the cases of the Switzerland, Canada and Australia. There is not significant effect for the rest of the selected countries. Finally, while the industrial production presents significant negative effect for the cases of Switzerland, France, and the UK and a positive one in the case of the Australian market, the short-term interest rate is statistically significant for only the Switzerland and the Singapore with a positive sign.

Table 4 summarizes the results for the impact of oil prices and other macroeconomic variables on stock market returns and volatility based on various significance criterions e.g. 1%, 5% and 10%.

-- Insert Table 4 here --

Results in Table 4 show that all macroeconomic variables have not significant effects on stock returns and volatility for all selected countries at the 1% significance level with the only exception for the case of Australia where the oil price exerts a negative effect on the volatility at 1% significance level. At the 5% significance level, the oil price exerts significant effect on returns for 3 countries which are the US, Switzerland and Canada, and on the volatility for 4 countries which are the US, Canada, Japan and Singapore. Therefore, the effect on both stock returns and volatility at 5% level is observed in the cases of US and Canada. At the 10% level, oil price presents significant effect in 4 countries: France, Australia, UK and Japan. On volatility, only the Switzerland has a significant effect of oil price.

Considering the oil production, the effect is significant at 5% on the returns for the cases of France, Canada, UK and Japan, and on the volatility for the cases of the Switzerland and Australia. At the 10% significance level, the effect of oil production on returns is observed in the cases of the US and Switzerland and on the volatility in the case of Canada. On both returns and volatility considered together, there is not significant effect, neither at 5% nor at 10%.

The industrial production exerts significant effects on stock market returns at 5% in the case of the US, France, Canada, UK and Japan and at 10% significance level in the cases of the Switzerland, Australia and Singapore. On the volatility, the effect is significant at 5% in the cases of the Switzerland, France and UK and at 10% in the case of Australia. On both return and volatility, the industrial production has a significant effect at 5% in the case of France and UK and at the 10% level in the case of Australia only.

The short-term interest rate presents a significant effect on returns at 10% level only for the cases of the Switzerland, Canada and Singapore. The effect on the volatility is significant only for the cases of the Switzerland and the Singapore at 10% significance level giving therefore significant effect on both returns and volatility for these two latter countries.

Conclusion

The relationship between oil price changes and macroeconomic factors has received considerable attention over the period starting the tremendous oil crisis of 1973. In recent years, researchers have attached more specifically a great deal of attention to the connections between oil price shocks on stock market returns. This paper investigates whether oil prices impact returns and volatility. Using monthly data for eight international stock markets over the period starting in January 1991 to end in September 2013, we estimate an EGARCH-in-M model to supervise in addition to the effects of oil price on returns the asymmetry in stock-price behavior.

We find that stock market return and oil price are negatively correlated whereas the oil price fluctuations increase the volatility of returns. Indirect effects of the oil price changes on stock returns and volatility are supervised by introducing industrial production and short-term interest rates. Findings based on our model support direct and indirect oil price effects on stock markets returns and their volatility with some differences in significance. Our results confirm those found in previous studies such as those of Jones and Kaul (1996), Sadorsky (1999), Huang et al. (1996), El-Sharif et al. (2005), Naifar and Al Dohaiman (2013), and Chang and Yu (2013). The explanation of the negative impact of oil price shocks on the stock returns and the positive effects on the volatility is intuitive. Since oil constitutes a substantial input for many industries, the increase in oil price leads to economic crises by creating significant cost-push inflation and higher unemployment. Consequently a rise in oil prices acts as inflation tax and increases risk and uncertainty, and this affects seriously the stock price and reduce wealth.

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Tables

Table 1: Estimates of reurns and volatility

	US	Swiss	France	Canada	UK	Australia	Japan	Singapore
β_0	0.024 (0.711)	0.081** (0.040)	0.116 (0.26)	0.070 (0.68)	0.162* (0.091)	0.013* (0.068)	-0.193 (-0.388)	0.373 (0.0176)
β_1	0.033* (0.083)	0.061*** (0.000)	0.037** (0.032)	0.161** (0.042)	0.008*** (0.000)	0.146*** (0.000)	0.227*** (0.000)	0.033** (0.029)
β_2	0.017** (0.031)	0.082* (0.056)	0.199 (0.148)	0.039** (0.021)	0.018 (0.608)	0.003* (0.088)	-0.016 (-0.460)	0.091* (0.717)
β_3	0.028* (0.066)	0.018 (0.710)		-0.002 (0.263)	0.101 (0.550)	0.048* (0.081)	0.017* (0.075)	
β_4	0.011 (0.188)			0.014 (0.996)			0.023 (0.188)	
β_5				0.001* (0.077)				
α_1	-0.134** (0.045)	-0.008** (0.033)	-0.012* (0.087)	-0.006** (0.027)	-0.107* (0.055)	-0.082* (-0.069)	-0.110* (0.073)	0.259 (0.720)
α_2	-0.088* (0.078)	-0.022* (0.077)	-0.011** (0.030)	-0.014** (0.049)	-0.080** (0.019)	-0.033 (0.108)	-0.084** (0.047)	0.066 (0.270)
α_3	0.035** (0.026)	0.173* (0.063)	0.154** (0.054)	0.117** (0.038)	0.078** (0.041)	0.011* (0.089)	0.102** (0.039)	0.066* (0.098)
α_4	0.026 (0.180)	-0.081* (0.770)	0.118 (0.336)	-0.064* (0.822)	0.011 (0.711)	-0.006 (0.120)	There is no short-term interest rate	-0.277* (0.505)

Table 2: Estimates of variance equation

	US	Swiss	France	Canada	UK	Australia	Japan	Singapore
C	0.613 (0.366)	0.373 (0.414)	-0.227 (0.556)	0.113* (0.082)	0.083 (0.274)	0.066 (0.814)	0.111 (0.448)	0.113 (0.477)
φ	0.189*** (0.000)	0.137*** (0.000)	0.160*** (0.000)	0.0188*** (0.000)	0.272*** (0.000)	0.196*** (0.000)	0.218*** (0.000)	0.233*** (0.000)
δ	0.944*** (0.000)	0.913*** (0.000)	0.863*** (0.000)	0.822*** (0.000)	0.911*** (0.002)	0.907*** (0.000)	0.967*** (0.000)	0.887*** (0.000)
Z	0.154** (0.15)	0.127*** (0.000)	0.418*** (0.000)	0.013** (0.042)	-0.117 (0.277)	0.391 (0.228)	0.308** (0.047)	0.366* (0.667)
λ_1	0.361** (0.013)	0.327* (0.072)	0.205 (0.318)	0.343** (0.041)	0.106 (0.157)	1.322*** (0.003)	0.066** (0.033)	0.083** (0.024)
λ_2	0.070 (0.258)	0.041** (0.283)	0.073 (0.138)	0.026* (0.074)	0.025 (0.145)	0.0323** (0.023)	-0.002 (0.271)	0.027 (1.36)
λ_3	-0.183 (0.184)	-0.088* (0.080)	-0.237** (0.035)	0.008 (0.422)	-0.168** (0.032)	0.5132* (0..810)	-0.028 (0.247)	0.009 (0.291)
λ_4	-0.203 (0.723)	0.005* (0.079)	0.283 (0.121)	0.073 (0.740)	-0.091 (0.135)	0.263 (0.201)	There is no short interest rate	0.138* (0.056)
μ	0,1467 (0.152)	0,082* (0.095)	0.206*** (0.011)	0,155 (0.716)	-0,021 (0.180)	-0,052* (0.563)	-0,172*** (0.000)	-0,006 (0.319)
V	1.281*** (0.000)	1.103*** (0.000)	0.966*** (0.000)	1.269*** (0.000)	1.146*** (0.000)	1.183*** (0.000)	1.315*** (0.000)	1.177*** (0.000)
skewness	-0.214	0.113	0.331	0.203	-0.482	0.147	-0.354	-0.077
Kurtosis	15.005	7.578	4.405	10.622	2.292	10.381	11.194	7.952
Function value	-4873.0	-2886.3	-3917.7	-2996.9	-3084.1	-3474.4	-4118.7	-2989.6
Function value of restricted model	-5257.8	-3277.3	-4253.1	-3244.6	-3461.1	-3716.8	-4464.3	-3227.4
Presence of macroeconomic variables effect for conditional variance	384.8	391.0	335.4	247.7	377.0	242.4	345.6	237.8

Table 3: Results of the specification tests

	US	Swiss	France	Canada	UK	Australia	Japan	Singapore
Sign bias test	1.225 (0.733)	0.684 (0.484)	0.561 (0.347)	0.499 (0.426)	0.385 (0.265)	0.605* (0.081)	1.025 (0.132)	0573 (0.249)
Negative size bias test	0.816 (0.599)	1.233 (0.323)	0.921 (0.336)	0.658 (0.407)	1.835 (0.931)	0.284 (0.573)	0.987 (0.504)	1.375 (0.913)
Positive size bias test	0.738 (0.271)	0. 959 (0.243)	0. 657 (0.163)	0.680 (0.211)	0.830 (0.071)*	0.345 (0.237)	0.774 (0.120)	0.852 (0.149)
Joint test	0.623 (0.336)	-0.213 (0.831)	1.521 (0.183)	0.266 (0.781)	0.704 (0.546)	0.961 (0.336)	0.819 (0.678)	0.843* (0.099)
Q(3)	50.640* (0.081)	5.6923 (0.128)	4.7972 (0.187)	7.2929 (0.121)	28.044 (0.150)	6.5677* (0.087)	16.888 (0.201)	1.4152 (0.686)
Q(6)	54.964 (0.191)	11.599* (0.072)	8.8346 (0.183)	25.987* (0.089)	54.801 (0.350)	19.124 (0.311)	22.601 (0.329)	6.7220 (0.347)
Q(9)	55.836 (0.177)	15.069* (0.089)	10.376 (0.321)	26.670** (0.021)	58.486 (0.259)	20.295 (0.489)	23.427** (0.032)	7.0921 (0.628)
Q(12)	59.347* (0.083)	19.666* (0.074)	11.380 (0.497)	34.455 (0.163)	62.380 (0.324)	28.242 (0.354)	25.136 (0.387)	8.1996 (0.769)
Arch-Lm (3)	86.041* (0.038)	53.835* (0.083)	69.444 (0.495)	63.618 (0.638)	85.287 (0.409)	44.368 (0.706)	29.078* (0.077)	35.447 (0.494)
Arch-Lm (6)	128.019* (0.085)	117.086 (0.322)	88.488 (0.240)	104.489 (0.574)	124.130 (0.288)	151.944** (0.018)	62.007** (0.046)	51.243** (0.029)
Arch-Lm (9)	165.769 (0.624)	174.983 (0.418)	107.972 (0.365)	122.606 (0.325)	202.860 (0.517)	223.121* (0.068)	131.631 (0.152)	127.671 (0.167)
Arch-Lm (12)	172.902 (0.270)	200.273 (0.483)	127.398 (0.764)	164.767 (0.288)	204.797* (0.079)	228.561 (0.629)	138.733 (0.693)	131.289 (0.704)

Table 4: Sensitivity of captured Macroeconomic factirs effects to the selected level of statistical significance

	Macroeconomic factors effects on returns			**Macroeconomic factors effects on volatility**			**Macroeconomic factors effects on both returns and volatilities**		
Selected level of statistical significance	1 %	5 %	10%	1 %	5 %	10%	1 %	5 %	10%
Oil Proce	- - - - - - - -	US Swiss - Canada - - - -	- - France - UK Australia Japan -	- - - - - Australia - -	US - - Canada - - Japan Singapore	- Swiss - - - - - -		US - - Canada - - - -	- - - - - - - -
Oil Production	- - - - - - - -	- - France Canada UK - Japan -	US Swiss - - - - - -	- - - - - - - -	- Swiss - - - Australia - -	- - - Canada - - - -		- - - - - - - -	- - - - - - - -
Industrial production	- - - - - - - -	US - France Canada Uk - Japan -	- Swiss - - - Australia - Singapore	- - - - - - - -	- Swiss France - UK - - -	- - - - - Australia - -		- - France - UK - - -	- - - - - Australia - -
Short term interest rate	- - - - - - - -	- - - - - - - -	- Swiss - Canada - - - Singapore	- - - - - - - -	- - - - - - - -	- Swiss - - - - - Singapore		- - - - - - - -	- Swiss - - - - - Singapore