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OIL PRICE RISK IN THE EUROZONE: A SECTORAL ANALYSIS

Abstract

This study investigates how oil price movements impact the main Eurozone industry supersectors returns. We use a multifactor market model in which we incorporate oil price changes as an additional risk factor. In order to account for possible breaks in the relationship, we use the Bai and Perron (1998, 2003) breakpoints identification methodology. We find evidence of the presence of structural instabilities on the relationship between sector stock returns and oil price changes. Different breakpoints are identified, particularly the 2003 Iraq invasion year, the 2008 subprime crisis and the 2012 Euro debt crisis. Moreover, our results prove that stock return sensitivities to oil prices are time varying and sector dependent. Besides, the subprime financial crisis appears to induce a significantly positive effect on the oil-stock market nexus. However, the Euro debt crisis has a mostly negative effect. The other identified breakpoints do not seem to have any significant effect on the oil stock market nexus.

Keywords supersector returns, oil market, breakpoints, Eurozone

JEL Classification C22, G12, Q43

INTRODUCTION

Oil price is an important economic data that policymakers, investors, speculators, firm managers, risk managers, portfolio managers… watch carefully. Accordingly, empirical investigation of the reaction of equity returns to oil price changes are important for accurately determining asset pricing models and forecasting the return and sensibility of stock markets. In this way, investors would be conscious of the oil price movements' effects on the risk and the value of their portfolios and this is particularly the case of international investors seeking for international diversification benefits.

Several studies investigated the oil stock market nexus and confirmed the interaction between stock market and oil market movements (Balcilar & Ozdemir, 2013; Basher & Sadorsky, 2006). Recently, Aloui et al. (2012) and Filis et al. (2011 showed that this relationship is time varying. Besides it was shown by Moya-Martínez et al. (2014) and Degiannakis et al. (2013) that it is also sector dependent. Therefore, the aim of our study is to investigate how oil price movements impact the main Eurozone industry supersectors returns. The sectoral analysis in the case of the Eurozone is of particular interest. In fact, it will be valuable to investors by shedding light on the oil stock market relationship at the sectoral level.

The paper is organized as follows. Section 1 includes a review of relevant literature. Section 2 describes data used and preliminary statistics. In Section 3, we present the methodological framework of the study. Section 4 analyses and discusses the empirical results. Finally, we present some concluding remarks.

1. LITERATURE REVIEW

Hamilton (1983) was the first to demonstrate the existence of a statistically significant correlation between oil shocks and some US recession prior to 1972. As an extension, subsequent studies addressed the issue of the relationship between oil market and stock market. Chen at al. (1986) found no statistical relationship between oil price movements and stock returns behavior. Sadorsky (1999) identified a significant negative short-term relationship between oil price volatility and aggregate S&P500 market index returns from January 1947 to April 1996.

Subsequent studies analyzed the effect of oil price fluctuations on the stock market of different countries. They all reached different conclusions and this was explained essentially by the status of the country (Park and Ratti, 2008…) and the origin of oil shocks (Filis et al., 2011…). More recently, other studies sustained that it is important to examine the oil/stock prices nexus in a sector-wise perspective. A general finding is a positive relationship linking oil market prices and Oil and Gas Sector returns (Faff and Brailsford, 1999; Sadorsky, 2001; El-Sharif et al., 2005). Based on 35 global industry indices listed from DataStream from April 1983 to September 2005, Nandha and Faff (2008) demonstrated a significant negative impact of WTI oil price increases on the equity returns for all sectors, except for Mining and Oil & Gas. El-Sharif et al. (2005) and Mohanty et al. (2011) demonstrated that the non-Oil and Gas sectors are barely sensitive to oil price fluctuation. Elyasiani et al. (2011) showed that US market discriminates the effects of the oil price movements on the basis to whether an industry is an oil-substitute, oil-related, oil-user or financial from 1998 to 2006.Lee et al. (2012) showed that, at the industry level, the relationship between oil price shocks and some sector indices is statistically significant for some countries.

Several recent studies focused on the time varying feature of the oil stock market relationship Fan and Xu (2011) Lee and Zeng (2011) and Moya-Martinez et al. (2014), among others, showed that the oil/stock market relationship is time varying and that the long-run relationship is characterized by the presence of several breakpoints. Moreover, turbulent states and crisis are more likely to influence the oil/stock market relationship and that they can cause a total reversal in the relationship type. Zhu et al. (2014) demonstrated that the relationship between crude oil prices and Asia-Pacific stock market returns is mostly mild. This relationship was positive before the global financial crisis, except in Hong Kong, but it increased significantly as a consequence of the crisis except in the cases of Japan and Singapore.

2. DATA AND DESCRIPTIVE STATISTICS

The empirical investigation is based on daily sample set, which covers the period from January, 2nd 2001 to August, 17th 2015 for a total of 3674 daily observations. Our sample starting date is chosen so that data for the Eurozone and the exchange rate exist and are valid.

To measure the performance of the Eurozone equity market, EURO STOXX 50 Europe's leading Blue-chip index is used. It covers 50 stocks from 12 Eurozone countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain. Furthermore, we make use of the EURO STOXX supersector indices, which are divided into 19 Supersectors according to the Industry Classification Benchmark (ICB) to analyze the sector indices returns' exposure to oil price movements. These supersectors are namely: Automobiles & Parts, Banks, Basic Resources, Chemicals, Construction & Materials, Financial Services, Food & Beverages, Health Care, Industrial Goods & Services, Retail, Insurance, Media, Oil & Gas, Personal & Household Goods, Real Estate, Technology, Telecommunications, Travel & Leisure and Utilities. Equity market data are collected from STOXX Ltd database.

For the oil data, we use the Brent crude oil price index. Data on oil prices are sourced from the Energy Information Administration (EIA). All data for this paper are expressed in Euro as our primary concern is on Euro area. Brent crude oil prices are converted to Euro using *Dollar/Euro* exchange rate extracted from The European Central Bank.

We compute daily returns R_t as the difference in the natural logarithm of two consecutive prices as follows:

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right) \text{ for } t = 1,\ 2,\ \ldots,\ T, \quad (1)$$

Two oil variables are used as risk factors, namely: oil price return (*OILR*) to compute oil price changes effects on stock market and the scaled oil price (*SOP*) as another proxy for oil price shocks.

The Scaled oil price (*SOP*) is another independent variable used in this paper. Proposed by Lee et al. (1995), *SOP* is a variable representing the unexpected oil shock reflecting the variability and the magnitude of the forecast error term ξ_t. Subsequent works, as Sadorsky (1999); Park and Ratti (2008); Arouri (2011) and Scholtens and Yurtsever (2012), used this proxy.

Lee et al. (1995) proposed to construct this variable by means of a univariate error GARCH (1,1) process to compute the unexpected component and conditional variance of oil price.

$$OILR_t = c_0 + \sum_{i=1}^{m} c_i \cdot OILR_{t-i} + \xi_t, \quad (2)$$

$$\xi_t \sim N(0, h_t),$$

$$h_t = \lambda_0 + \lambda_1 \cdot \xi_{t-1}^2 + \lambda_2 \cdot h_{t-1},$$

$$SOP_t = \frac{\xi_t}{h_t^{\frac{1}{2}}}, \quad (3)$$

with $OILR_t$ is the oil price returns in day t, ξ_t is the error term following a GARCH (1,1) process, h_t is the conditional oil price volatility, SOP_t: is the scaled oil price in day t.

Table 1 provides the summary descriptive statistics and stochastic properties of the daily return series and SOP. The standard deviation shows that SOP and oil price returns experience higher volatility than market and sector returns, standing for the great instability of crude oil prices over the sample period. Other sectors namely: Automobile and Parts, Banks, Basic Resources and Insurance also present high volatilities compared to the rest of the sectors and to the market index. The Jarque-Bera test statistic rejects the null hypothesis of normality for all return series and SOP at 1% significance level. As for stationarity, Augmented Dicky Fuller (ADF) and Zivot and Andrews' (ZA) unit root tests show that all return series are stationary at conventional level.

Last three columns of Table 1 report the Spearman-rank correlation between the variables of interest. Correlations between supersector equity returns and oil price returns and volatilities are all positive and highly significant, suggesting that for the study period the oil and the Eurozone stock prices have moved in the same direction. As expected, the Oil and Gas and Basic Resources supersectors show the strongest correlation with oil prices (34% and 25% respectively). Besides, correlations between the overall market index and supersector returns are positive and high on average. The low correlation among the independent variables (market return, oil price changes in one hand and market return, SOP in the other hand) indicates that multicollinearity is not a problem. However, SOP and oil returns are highly correlated suggesting that these two variables should not be used as independent variables simultaneously.

3. EMPIRICAL METHODOLOGY

The relationship between stock market and oil market can be modeled by means of a multifactor market model (Arouri, 2011; Phan et al., 2015...) in which oil market is included as an additional risk factor.

$$\mathrm{R}_{i,t} = \beta_{0,i} + \beta_{1,i}\mathrm{MR}_t + \beta_{2,i} OILR_t + \varepsilon_{i,t}, \quad (4)$$

$$\mathrm{R}_{i,t} = \beta'_{0,i} + \beta'_{1,i}\mathrm{MR}_t + \beta'_{2,i} SOP_t + \varepsilon_{i,t}, \quad (5)$$

where R_{it} denotes the daily return on the stock index of the i^{th} supersector in day t, MR_t the return on the market portfolio, $OILR_t$ the return on oil prices expressed in Euro, SOP_t is the scaled oil price in day t, and ε_{it} is a random error term.

From a globally diversified industry portfolio, the returns will be mainly influenced by the general

Table 1. Descriptive Statistics.

	Mean (.10³)	Min	Max	Std. Dev.	Skew.	Kurt.	J-B	Unit Root Tests		Correlation		
								ADF	ZA	MR	OILR	SOP
MR	-0.080	-0.082	0.104	0.0153	0.009	7.41	2988***	-45.84***	-27.82***	1.00		
OILR	0.149	-0.194	0.184	0.0218	-0.223	9.33	6178***	-61.50***	-16.05***	0.14***	1.00	
SOP	-12.725	-7.412	4.296	1.0020	-0.269	4.97	641***	-30.51***	-60.89**	0.14***	0.98***	1.00
Auto & Parts	0.252	-0.357	0.410	0.0217	2.296	91.13	1193288***	-30.49***	-28.33**	0.78***	0.12***	0.12***
Banks	-0.019	-0.136	0.177	0.0199	0.082	9.69	6839***	-57.56***	-29.14**	0.89***	0.11***	0.11***
Basic Resources	-0.005	-0.138	0.159	0.0202	-0.103	9.17	5854***	-58.60***	-36.29**	0.70***	0.21***	0.21***
Chemicals	0.249	-0.086	0.125	0.0152	0.028	8.49	4633***	-60.46***	-17.72**	0.82***	0.15***	0.15***
Construction & Materials	0.141	-0.107	0.123	0.0163	-0.071	8.06	3937***	-59.99***	-27.16***	0.83***	0.15***	0.15***
Financial Services	0.051	-0.103	0.122	0.0154	-0.177	8.95	5460***	-44.34***	-20.02***	0.81***	0.14***	0.14***
Food & Beverages	0.212	-0.072	0.065	0.0110	-0.356	7.10	2655***	-45.99***	-21.47***	0.68***	0.11***	0.11***
Health Care	0.116	-0.087	0.096	0.0134	-0.140	6.96	2418***	-62.16***	-28.71***	0.71***	0.09***	0.09***
Industrial Good &Service	0.078	-0.103	0.115	0.0149	-0.123	8.93	5394***	-58.20***	-23.52**	0.84***	0.15***	0.15***
Insurance	-0.165	-0.121	0.135	0.0200	0.112	9.12	5751***	-58.57***	-19.88***	0.90***	0.11***	0.11***
Media	-0.135	-0.110	0.113	0.0146	-0.206	9.17	5860***	-37.76***	-20.32***	0.81***	0.10***	0.10***
Oil & Gas	-0.041	-0.101	0.130	0.0158	-0.041	9.49	6465***	-30.79***	-26.79*	0.80***	0.30***	0.30***
Personal & Household Go	0.165	-0.094	0.091	0.0148	-0.037	6.34	1719***	-61.35***	-20.90***	0.84***	0.10***	0.10***
Real Estate	0.228	-0.086	0.087	0.0131	-0.169	8.69	4994***	-57.87***	-16.43***	0.60***	0.12***	0.11***
Retail	-0.002	-0.128	0.076	0.0134	-0.257	8.65	4937***	-60.51***	-36.81***	0.79***	0.11***	0.11***
Technology	-0.205	-0.140	0.104	0.0195	-0.030	6.81	2227***	-60.20***	-18.37**	0.80***	0.11***	0.11***
Telecom	-0.138	-0.099	0.104	0.0147	0.018	7.34	2889***	-45.59***	-19.99***	0.82***	0.07***	0.08***
Travel & Leisure	0.0767	-0.126	0.076	0.0148	-0.253	7.06	2569***	-56.57***	-23.36***	0.63***	0.05***	0.05***
Utilities	-0.042	-0.114	0.156	0.0140	0.007	12.79	14712***	-46.88***	-19.72***	0.81***	0.13***	0.12***

Notes: The table provides the basic descriptive statistics of daily return series from January 2001 to August 2015. It includes mean (Mean), minimum (Min), maximum (Max), standard deviation (Std. Dev) values, Skewness (Skew) and Kurtosis (Kurt) measures. J-B refers to the statistic of the Jarque-Bera test for normality. ADF and ZA refer respectively to the Augmented Dickey-Fuller (ADF), and Zivot and Andrews (ZA) unit root tests statistics. The last three columns report Spearman rank correlation coefficients among dependent and independent variables used in this study. *, **, and ***represent statistical significance at the 10%, 5% and 1% levels, respectively.

Table 2. Multiple breakpoints identification: Bai and Perron (1998, 2003) Test.

	UDmax	WDmax	SupFt (1/0)	SupFt (2/1)	SupFt (3/2)	SupFt (4/3)	SupFt (5/4)	Number of breaks			Break dates
								SEQ	Schwarz	LWZ	Sequential
MR	73.72**	73.72**	73.72**	18.48**	6.81			2	2	1	9/13/2008 - 08/06/2012
Auto & Parts	28.32**	28.32**	28.32**	23.74**	6.19			2	2	0	1/28/2009 - 7/20/2012
Banks	154.10**	192.46**	154.10**	38.64**	27.41**	16.66		3	3	3	2/24/2008 - 5/10/2010 - 5/25/2013
Basic Resources	259.26**	259.26**	259.26**	58.16**	30.70**	31.76**	0.00	4	4	1	7/03/2003 - 12/28/2005 - 9/06/2008 - 1/03/2013
Chemicals	45.37**	49.81**	45.37**	17.67**	28.97**	14.80		3	1	0	3/19/2003 - 11/15/2005- 6/04/2013
Construction & Materials	414.15**	414.15**	414.15**	47.09**	29.44**	2.59		3	2	1	3/13/2003 - 1/26/2006 - 2/05/2013
Financial Services	45.59**	69.80**	27.52**	49.08**	29.08**	42.03**	0.00	4	4	0	4/24/2003 - 5/15/2006 -11/10/2008 - 7/23/2012
Food & Beverages	53.82**	73.68**	51.63**	21.15**	89.43**	12.57		3	3	0	3/12/2003 - 12/02/2008 -4/25/2013
Health Care	67.76**	79.00**	29.87**	123.21**	2.24			2	2	0	12/04/2008 - 9/27/2012
Industrial Goods & Services	123.39**	123.39**	123.39**	63.69**	26.14**	8.28		3	3	2	11/26/2003 - 1/14/2010 -7/05/2012
Insurance	218.27**	218.27**	218.27**	17.85**	7.21			2	2	1	7/01/2008 - 6/10/2013
Media	62.34**	62.51**	62.34**	20.44**	6.24			2	1	1	5/13/2005 - 11/19/2008
Oil & Gas	41.27**	54.39**	41.27**	31.08**	19.67**	2.29		3	3	1	2/03/2005 - 12/16/2008 -5/30/2013
Personal & Household Goods	68.97**	77.07**	68.97**	22.28**	11.01			2	1	1	9/02/2008 - 6/02/2013
Real Estate	573.06**	573.06**	573.06**	9.33				1	2	1	3/05/2005
Retail	30.74**	35.84**	22.38**	51.21**	5.58			2	2	0	10/24/2008 -11/02/2011
Technology	171.17**	171.17**	171.17**	21.81**	3.94			2	2	1	2/09/2005 - 7/23/2008
Telecom	36.81**	44.69**	35.45**	53.45**	16.95**	4.87		3	3	1	3/16/2003 - 11/10/2008- 4/04/2012
Travel & Leisure	161.34	161.34**	161.34**	7.26				1	1	1	2/25/2012
Utilities	75.61**	88.83**	75.61**	13.72				1	3	1	1/31/2005

Notes: The results of the procedure developed by Bai and Perron (1998, 2003) is reported in this table. The effective sample size is 3674. A maximum of five breaks are allowed and a trimming parameter of 0.15 is used, so each segment has at least 735 observations. The double maximum tests (*UDmax* and *WDmax*) test the null hypothesis of no structural break against an unknown number of breaks. The Sup $F_T\left(\ell+1\ell\right)$ is a sequential test of the null hypothesis of ℓ structural change vs. the alternative hypothesis of a $\ell+1$ change. (AIC) and (SIC), indicate the optimal number of breaks according to Akaike Information Criterion and Schwarz Information Criterion. Break dates are selected based on the sequential procedure. *, **, and ***indicate statistical significance at the 10%, 5% and 1% levels, respectively.

market sentiment $\left(\beta_1 \, or \, \beta_1^{'}\right)$ and the oil price changes (β_2) or the scaled oil price ($\beta_2^{'}$) . The remaining influences, if any, will be in the residuals.

3.1. Structural Breakpoints identification

Following Broadstock et al. (2012), Lee et al. (2012) and Moya-Martinez et al. (2014), we consider the possibility of instabilities in the stock market/oil market relationship. We use the tests of multiple structural breaks proposed by Bai and Perron (1998, 2003) which allows testing for multiple breaks at unknown dates.

If m is the number of breakpoints, the model for each supersector is re-estimated in $m+1$ regimes $\left[T_{j-1};T_j\right]$ with $j=1,\ldots m+1$ as follows:

$$\mathrm{R}_{\mathrm{i,\,t}} = \beta_{0,i,j} + \beta_{1,i,j}\mathrm{MR}_{\mathrm{t}} + \beta_{2,i,j} \cdot OILR_t + \varepsilon_{\mathrm{i,t}}$$

$$\text{for } j=1,\ldots m+1 \text{ and } t = T_{j-1},\ldots,T_j \qquad (6)$$

3.2. Modeling the oil-stock market relationship:

Following Phan et al. (2015) among others, we use a GARCH-type specification to assess the conditional volatilities of i^{th} sectors and to trace the persistence of oil price shocks to sector index returns. Bollerslev (1987) recommends consideration of non-linear conditional error distributions such as the *Student-t* distribution in order to capture the leptokurtosis presence in asset returns. Therefore, the analytical specification of the error term for each sector i $\left(i = 1 \; to \; 19\right)$ is based on *t-Student* distribution.

Three GARCH-type models are estimated for each supersector, namely: GARCH (1,1)[1] (Bollerslev, 1986), GJR-GARCH (1,1) (Glosten et al., 1993) and EGARCH (1,1) (Nelson, 1991). Then the most appropriate univariate GARCH specification to each series is identified on the basis of Schwarz criterion (SCH), Akaike criterion (AIC) and the Log Likelihood criterion (LogL). The final step consists on re-estimating the best identified GARCH-type model for each supersector but this time accounting for the breakpoints[2].

4. EMPIRICAL RESULTS

4.1. Break dates

Table 2 reports the results of Bai and Perron (1998, 2003) multiple structural breakpoint test. The analysis of the results reveals the existence of several breakpoints that can be grouped into five breakpoint dates namely 2003, 2005, 2008, 2010 and 2012.The first structural break took place in 2003. It is common to 7 supersectors (Constructions & Materials, Chemicals, Financial Services, Basic Resources, Food & Beverages, Industrial G&S and Telecom). It coincides with the 2003 Iraq invasion which seems to increase markets uncertainty. Moya-Martínez et al. (2014) also found evidence of a breakpoint in the same period for the Spanish market.

The second break is identified in 2005-2006. It affects 9 supersectors which are Basic Resources, Chemicals, Constructions & Materials, Financial Services, Oil & Gas, Media, Technology, Real estate, and Utilities. 2005 was a year of recovery for the global economy after a period of recession in 2004 and in much less scale for the Eurozone.

In 2008, 13 supersectors exhibit structural changes, namely: Auto & Parts, Banks, Basic Resources, Insurance, Personal Household & Goods, Financial Services, Media, Health Care, Food & Beverages, Oil & Gas, Retail, Technology, Telecom. The financial disorder caused by the subprime crisis intensified and reached levels not seen in decades. Fan and Xu (2011), Broadstock et al. (2012) and Moya-Martinez et al. (2014) also reported the existence of this breakpoint.

Another Break is noted in 2010 only for two sectors (Banks and Industrial G&S). This year coincides with the beginning of the Euro sovereign debt crisis. The last structural break occurs between 2012 and 2013. It is common to 14 supersectors out of 19 (Auto & Parts, Banks, Basic Resources, Constructions & Materials, Chemicals, Insurance, Industrial G&S, Financial Services, Health Care, Food & Beverages, Oil & Gas, Personal Household & Goods, Travel & Leisure and Telecom,). This breakpoint might be related

1 Bollerslev et al., 1992, p. 10, 20.deeply suggest the estimation of low-order GARCH models, and above all they recommend GARCH (1,1).

2 The same methodology is carried out using the SOP as risk factor instead of the oil index return.

Table 3. Results of sub-samples estimations with OILR as independent variable

	Breaks	Sub–Samples	OILR				SOP			
			Intercept	MR	OILR	Adj. R^2	Intercept	MR	SOP (.10−3)	Adj. R^2
MR	2	1/03/2001 – 9/12/2008	2.85E–05		–0.0040	0.00	–5.14E–06		–0.126	0.00
		9/15/2008 – 8/03/2012	–4.63E–04		0.2537***	0.16	–3.40E–04		5.105***	0.14
		8/06/2012 – 8/17/2015	4.00E–04		0.0723***	0.03	4.61E–04		1.227***	0.03
Automobiles & Parts	2	1/03/2001 – 1/27/2009	2.44E–04	0.98016***	–0.0202***	0.31	2.17E–04	0.9807***	–0.409**	0.31
		1/28/2009 – 7/19/2012	7.25E–04*	1.09158***	0.0807***	0.70	7.30E–04*	1.1014***	1.353***	0.69
		7/20/2012 – 8/17/2015	4.04E–04	1.00327***	–0.0210	0.67	3.96E–04	1.0030***	–0.308	0.67
Banks	3	1/03/2001 – 2/20/2008	2.07E–04**	0.89400***	–0.1332***	0.89	2.15E–04	0.9814***	–0.270	0.67
		2/21/2008 – 5/10/2010	–5.09E–05	1.32081***	–0.0252	0.80	–3.33E–04	1.0470***	–0.388	0.16
		5/11/2010 – 5/28/2013	–1.38E–03***	1.48932***	–0.1246***	0.83	9.88E–04**	1.0555***	1.289***	0.68
		5/29/2013 – 8/17/2015	1.79E–04	1.1325***	0.0065	0.68	2.34E–04	1.0294***	–0.559*	0.72
Basic Resources	4	1/03/2001 – 7/04/2003	–3.45E–05	0.49019***	0.0362**	0.38	6.75E–05	0.4923***	1.282***	0.38
		7/07/2003 – 12/29/2005	–5.74E–06	0.92871***	0.0255*	0.47	4.93E–06	0.9287***	0.560*	0.46
		12/30/2005 – 9/02/2008	1.03E–03**	1.05056***	0.1397***	0.47	0.0010**	1.0521***	2.548***	0.46
		9/03/2008 – 1/02/2013	–2.43E–04	1.16710***	0.1137***	0.76	–1.93E–04	1.1756***	1.979***	0.76
		1/03/2013 – 8/17/2015	–2.57E–04	0.87985***	0.0978***	0.57	–2.35E–04	0.881***	1.375***	0.57
Chemicals	3	1/03/2001 – 3/18/2003	–1.26E–04	0.67215***	–0.0077	0.63	2.69E–06	0.6737***	–0.108	0.64
		3/19/2003 – 11/14/2005	3.58E–04**	0.9694***	–0.0054	0.76	3.57E–04**	0.9692***	–0.128	0.76
		11/15/2005– 6/03/2013	5.03E–04***	1.0734***	0.0410***	0.76	5.13E–04***	0.8419***	0.782***	0.76
		6/04/2013 – 8/17/2015	–1.83E–05	0.96272***	–0.0273***	0.81	–3.57E–05	0.9672***	–0.612***	0.81
Construction & Materials	3	1/03/2001 – 2/12/2003	4.98E–04	0.47706***	0.0015	0.53	4.72E–04	0.4795***	0.0259	0.54
		3/13/2003 – 1/25/2006	4.83E–04***	0.74269***	0.0080	0.69	4.86E–04***	0.7423***	0.161	0.69
		1/26/2006 – 2/04/2013	1.32E–04	1.0936***	0.0167*	0.82	1.38E–04	1.0947***	0.270	0.82
		2/05/2013 – 8/17/2015	3.39E–04	0.95057***	0.0169	0.79	3.58E–04*	0.9487***	0.373*	0.78
Financial Services	4	1/03/2001 – 4/24/2003	–1.51E–05	0.74982***	–0.0071	0.75	7.18E–05	0.7513***	–0.0279	0.76
		4/25/2003 – 5/11/2006	9.30E–04***	0.55832***	0.0162**	0.52	9.39E–04***	0.5582***	0.361**	0.52
		5/12/2006 – 11/05/2008	–2.78E–04	1.00070***	0.0342**	0.74	–2.70E–04	1.0018***	0.662**	0.74
		11/06/2008 – 7/23/2012	–3.97E–05	0.86179***	0.0236*	0.77	–6.00E–05	0.8641***	0.352	0.77
		7/24/2012 – 8/17/2015	4.29E–04**	0.74663***	–0.0461***	0.69	4.14E–04**	0.7459***	–0.670***	0.69
Food & Beverages	3	1/03/2001 – 3/12/2004	1.96E–04	0.37049***	–0.0180	0.44	3.47E–04	0.3950***	–0.335	0.47
		3/13/2003 – 12/01/2008	1.62E–04	0.60469***	–0.0014	0.59	1.61E–04	0.6047***	–1.48E–05	0.59
		12/02/2008 – 4/24/2013	6.54E–04***	0.47266***	0.0336***	0.50	6.74E–04***	0.4726***	0.700***	0.50
		4/25/2013 – 8/17/2015	5.10E–05	0.71589***	–0.0198	0.67	5.32E–05	0.7149***	–0.239	0.66
Health Care	2	1/03/2001 – 11/28/2008	–1.17E–04	0.71166***	–0.0117	0.57	–9.31E–05	0.7124***	–0.307*	0.58
		12/01/2008 – 9/27/2012	7.94E–04***	0.51926***	0.0242**	0.47	7.89E–04***	0.5154***	0.643***	0.47
		9/28/2012 – 8/17/2015	3.12E–04	0.84156***	–0.0444***	0.65	3.12E–04	0.8401***	–0.600***	0.65
Industrial Goods & Services	3	1/03/2001 – 11/25/2003	1.32E–04	0.60455***	–0.0002	0.66	1.15E–04	0.6042***	–1.64E–04	0.67
		11/26/2003 – 1/13/2010	1.31E–04	0.99425***	0.0128**	0.81	1.36E–04	0.9952***	0.260**	0.81
		1/14/2010 – 7/02/2012	6.48E–04***	0.9016***	0.0676***	0.85	6.89E–04***	0.9040***	1.090***	0.85
		7/03/2012 – 8/17/2015	9.20E–05	0.80334***	–0.0005	0.60	9.29E–05	0.8031***	2.75E–04	0.60
Insurance	2	1/03/2001 – 6/30/2008	–1.20E–04	1.11188***	–0.0323***	0.84	–1.23E–04	1.1121***	–0.684***	0.85
		7/01/2008 – 6/07/2013	2.24E–04	1.19821***	–0.0314***	0.84	2.02E–04	1.1987***	–0.591***	0.84
		6/10/2013 – 8/17/2015	3.14E–04*	0.89896***	–0.0322***	0.83	3.02E–04*	0.8983***	–0.489***	0.83
Media	2	1/03/2001 – 5/13/2005	–2.68E–04	0.95983***	–0.0070	0.69	–4.11E–04**	0.9529***	–0.217	0.69
		5/16/2005 – 11/18/2008	–2.64E–04*	0.71778***	–0.0302***	0.75	–2.78E–04*	0.7179***	–0.583***	0.75
		11/19/2008 – 8/17/2015	2.03E–04	0.68237***	–0.0068	0.71	2.05E–04	0.6797***	0.0317	0.71

Table 3 (cont). Results of sub-samples estimations with OILR as independent variable

	Breaks	Sub–Samples	OILR				SOP			
			Intercept	MR	OILR	Adj. R^2	Intercept	MR	SOP (.10–3)	Adj. R^2
Oil & Gas	3	1/03/2001 – 1/28/2005	2.98E–04	0.72555***	0.0582***	0.65	–8.63E–05	0.8584***	1.676***	0.81
		2/01/2005 – 12/15/2008	1.16E–04	0.90937***	0.1768***	0.78	1.73E–04	0.9149***	3.389***	0.77
		12/16/2008 – 5/29/2013	–7.76E–05	0.85455***	0.0851***	0.84	–5.75E–05	0.8466***	1.921***	0.84
		5/30/2013 – 8/17/2015	–1.77E–04	0.86993***	0.1601***	0.71	–1.37E–04	0.8723***	2.198***	0.70
Personal & Household Goods	2	1/03/2001 – 9/03/2008	4.68E–05	0.93420***	–0.0138**	0.81	3.55E–05	0.9342***	–0.280**	0.81
		9/04/2008 – 5/31/2013	7.40E–04***	0.76089***	0.0274**	0.76	7.47E–04***	0.7601***	0.637***	0.76
		6/03/2013 – 8/17/2015	2.86E–05	0.78057***	–0.0584***	0.70	1.94E–05	0.7805***	–0.942***	0.69
Real Estate	1	1/03/2001 – 3/01/2005	8.55E–04***	0.11084***	–0.0016	0.12	8.25E–04***	0.1108***	–0.113	0.13
		3/02/2005 – 8/17/2015	3.04E–04**	0.68483***	0.0056	0.55	3.02E–04**	0.6863***	–1.11E–05	0.55
Retail	2	1/03/2001 – 10/23/2008	–2.06E–04	0.72217***	–0.0035	0.69	–2.06E–04	0.7222***	–0.0676	0.69
		10/24/2008 – 11/02/2011	2.74E–04	0.59661***	0.0133	0.64	2.79E–04	0.5975***	0.249	0.64
		11/03/2011 – 8/17/2015	1.11E–04	0.78496***	–0.0215*	0.72	9.18E–05	0.7864***	–0.425**	0.72
Technology	2	1/03/2001 – 2/08/2005	–4.04E–04	1.29884***	0.0112	0.71	–3.70E–04	1.3045***	0.214	0.71
		2/09/2005 – 7/22/2008	–2.04E–06	1.04292***	–0.0168	0.65	–6.21E–06	1.0431***	–0.351	0.65
		7/23/2008 – 8/17/2015	4.18E–04**	0.76670***	0.0043	0.66	4.26E–04**	0.7657***	0.147	0.66
Telecom	3	1/03/2001 – 3/13/2003	–6.53E–04	0.98638***	–0.0572***	0.72	–8.00E–04	0.9811***	–1.512***	0.73
		3/14/2003 – 11/07/2008	–6.63E–05	0.77150***	–0.0279***	0.71	–7.20E–05	0.7715***	–0.584***	0.71
		11/10/2008 – 4/02/2012	–2.09E–04	0.69837***	–0.0353***	0.70	–2.23E–04	0.6940***	–0.517***	0.70
		4/04/2012 – 8/17/2015	–7.81E–05	0.88440***	–0.0186	0.70	–7.97E–05	0.8832***	–0.231	0.70
Travel & Leisure	1	1/03/2001 – 2/23/2012	1.20E–04	0.73597***	–0.0216***	0.59	1.17E–04	0.7357***	–0.504***	0.59
		2/24/2012 – 8/17/2015	5.16E–04	0.31590***	–0.0855***	0.08	4.93E–04	0.3118***	–1.077***	0.08
Utilities	1	1/03/2001 – 1/28/2005	4.29E–04**	0.61467***	–0.0157**	0.69	4.51E–04***	0.6155***	–0.307*	0.71
		1/31/2005 – 8/17/2015	5.06E–05	0.81244***	–0.0069	0.73	4.71E–05	0.8127***	–0.137	0.73

Notes: This table presents optimal GARCH–type estimation results for the multifactor linear model (equation 4) using OILR as independent variable. Breaks reports the number of breaks selected by the sequential procedure by Bai and Perron at the 5% significance level. MR is the market sensitivity, OILR is oil price sensitivity. Coefficients of the multifactor linear model (equation 5) using SOP as independent variable are reported with SOP as the scaled oil price. *, **, and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively.

to the world economy slowdown registered in 2012 and to the financial disturbances that have plagued the Eurozone financial landscape caused by the political and financial instabilities witnessed by several Eurozone economies. In fact, 2012 was the year in which the Euro debt crisis intensified.

4.2. The oil stock market nexus

For each supersector, we further divide the full sample according to the identified breakpoints and then estimate equations (4) and (5) with the optimal GARCH type residual model for each of the sub-samples. All estimations present a high R^2 adjusted and a near to 2 Durbin Watson indicating a good fit of the models.

The estimation results of the linear models using OILR and SOP as independent variables (Table 3) show that the scaled oil prices and the change in oil prices have the same effects (sign and significance) on stock market returns. Results also confirm that regardless of the supersector and the subsample estimated, all market coefficients (MR) are statistically significant and positive at the 1% level.

In addition, we can note that there is a time varying and a sector dependent effect of oil price changes. All supersectors are sensitive to oil price changes at least in one sub-period except for Real Estate and Technology supersectors. These sectors appear to not depend on oil price movements because they are not particularly oil-users. This result is consistent with previous studies.

For the first three sub–periods ending in 2008, our results report a non–significant sensitivity for Foods and Beverages, Health Care and Chemicals indicating that these supersectors are not affected by oil price changes and volatilities. The same results were reported by Nandha and Faff (2008) and Moya-Martinez et al. (2014) for Foods and Health Care.

Moreover, there is evidence of a positive sensitivity for 4 supersectors (Oil and Gas and Basic Resources for the full sample period and Industrial G&S and Financial Services) from 2003 to 2008. The highest oil sensitivity is observed for the Oil & Gas supersector (0.1768). This result is consistent with theoretical expectation as oil is a direct out–put for this supersector. This finding is in line with previous studies (Mohanty & Nandha, 2011; Moya-Martinez et al., 2014) among others.

The second more sensitive sector to oil prices is Basic Resources. Arouri (2011) argued that the inflation caused by an increase in the price of oil is transmitted to other precious metal markets. This rise of the Basic Material prices will lead to higher profitability of the underlying firms. This result was also reported in Arouri (2011) and Arouri et al. (2011) for European sectors.

Negative and significant sensitivities are reported for Auto and Parts, Personal Household and Goods, Travel & Leisure, Telecommunications, Banks and Insurance for the entire sub–period and for Utilities before 2005 and Media between 2005 and 2008.The more important negative sensitivity to oil market is recorded for Banks. For this sector, oil price increases has an indirect impact on the profitability of customers leading to a negative impact on volume and profitability of the banking and insurance businesses and other consumer businesses and therefore on the value of those stocks. Thus, diminishing their profits and dropping their stocks prices. Therefore, it is unsurprising to find that the increase of oil prices negatively impacts this supersector sensitivity to oil prices. Our results confirm the previous results found by Nandha and Faff (2008) for Travel and Leisure and Arouri (2011) for Telecommunication, Financials and Utilities.

For the 2008–2012 sub–period, we can note from Table 3 that several sectors' sensitivities to oil shocks switched from significantly negative or non–significant to highly and positively significant after 2008 (Health Care, Personal Household & Goods, Auto and Parts and Chemicals). A positive effect of the subprime crisis is also reported for the Media and Banks supersectors as their sensitivities' to oil price changes turned from highly and negatively significant to negative but non–significant. This positive effect of the subprime crisis was also reported in Broadstock et al, Mollick and Assefa (2013), Zhu et al. (2014) and Tsai (2015). The post subprime crisis is a turnaround period for the world economy. In that period oil prices augmented and restored investors' sentiment which led to an increase in stock market too.

For the after 2012 sub–period, Table 3 reveals that the Euro debt crisis has a negative impact on the oil/stock market nexus. In fact, for 5 Supersectors (Health Care, Personal Household and Goods, Chemicals, Financial Services and Retail) stock market sensitivities' to oil prices become, after 2012, highly negative and significant after being either positive and highly significant or non–significant. Other supersectors' sensitivities (Industrial G&S, Food and Beverages and Auto and Parts) turn to be negative but non–significant after being highly positive and significant. We also notice a drop in the positive and significant sensitivity to oil market for Basic Resources, and the global market index. This latter dropped from 0.25, in the post subprime crisis sub–period, to 0.07 after 2012. Besides, a higher negative and significant sensitivity is recorded for Insurance and Travel & Leisure.

There is evidence that the Euro credit crisis has affected the stock market sensitivity to oil market for several Eurozone supersectors. 11 supersectors out of 14 affected by the Euro debt crisis register a sharp negative fall in the stock market sensitivity to oil shocks. Clearly, the Euro debt crisis has a strong negative effect on the oil stock market nexus in the Eurozone. The recession that hit the Eurozone since 2012 added to the sharp decrease in oil prices registered since mid–2014 could explain this negative effect on stock market sensitivities to oil markets.

CONCLUSION

This study investigates how oil price movements impact the main Eurozone industry supersectors returns. Our results show that the oil/stock market relationship is characterized by the presence of structural breakpoints. The number and the breakpoint dates differ among supersectors. The sectoral level analysis demonstrates that sector return sensitivities to oil prices are time varying and sector dependent. Before 2008, our results show strong significant and heterogeneous links between oil price changes and stock markets for most Eurozone supersectors. Besides, we report a positive response of supersectors' sensitivities to oil price changes during the 2008–2012sub–period. However, for the 2012–2015 sub–period, our results point to an overall negative response to oil price changes in some supersectors.

As every research has its own limits the work in this paper could be extended in several ways. It would be of a particular interest to study the asymmetric effect of oil prices as several studies documented that positive and negative oil prices shocks do not equally affect stock markets.

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