The Impact of Macroeconomic News Surprises and Uncertainty for Major Economies on Returns and Volatility of Oil Futures

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Highlights

• We test the impact of surprises and uncertainties on returns and volatility.
• We analyze the possibility of asymmetric impact due to good and bad news surprises.
• Macroeconomic surprises and uncertainty are important factors in driving oil futures.
• There is strong evidence of asymmetric effects, especially for volatility.

Abstract

We analyze the impact of macroeconomic news surprises for Canada, the Euro area, Japan, the UK, and the US relating to returns and volatility for West Texas Intermediate and Brent crude oil futures. We look at futures markets, since they are widely believed to predict spot market movements. We also investigate the possibility of an asymmetric impact of good and bad macroeconomic news surprises, as well as the role of economic uncertainty for these economies in affecting oil futures market movements. Two major conclusions can de drawn from our study: (a) macroeconomic surprises, as well as uncertainties for other economies (over and above that of the US) were found to be important in driving oil futures, with the effect of these other economies being relatively stronger than the US in some instances; and (b) there is strong evidence of asymmetric effects, especially for volatility.

Keywords: Macroeconomic news surprises; Uncertainty; Oil Futures; Returns and Volatility
JEL Codes: C32; Q41

1. Introduction

There exists a large literature that has analysed the impact of macroeconomic news on returns and volatility of both spot and futures international financial (bonds, currency, equities, and real estate investment trust (REIT)) markets (see for example, Kishore and Marfatia (2013), Cakan et al., (2015), Belgacem et al., (2015), and Caporale et al., (2016) for detailed reviews in this regard). In this context, there is also a burgeoning literature that looks into the role of such news in explaining movements of the commodity markets, but primarily involving the spot market (see for example, Frankel and Hardouvelis (1985), Barnhart (1989), Ghura (1990), Cai et al. (2001), Hess et al.

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(2008), Roache and Rossi (2010), Kilian and Vega (2011), Chatrath et al., (2012), Elder et al., (2013), Scrimgeour (2014), Baum et al., (2015), Belgacem et al., (2015), and Caporale et al., (2016)). The evidence, in general, is mixed, with most of the studies showing weak evidence of effect of surprises on commodity market returns and volatility.

However, commodity futures markets have recently emerged as a highly popular asset class for investors and fund managers. The rapidity in financialization of commodity markets has also caused the number of market participants to increase significantly. Besides being used for hedging and speculative purposes, commodity futures can also help to diversify away the risk of diversified stock/bond portfolios, particularly in times of financial crises and bearish equity markets. Thus, the knowledge of factors that drives commodity futures markets is likely to constitute valuable information for investors. In addition, commodity futures prices are believed to help in predicting the spot prices (Reeve and Vigfusson, 2011; Chinn and Coibion, 2014), and hence, determining the drivers of the former is of tremendous importance in determining the future path of the spot market of commodities.

In addition, amongst the commodities, one of the most important markets is oil, with it being the most traded commodity around the world (Sévi, 2014). Besides this, the role of the oil market (returns and volatility) in affecting global economic activity, inflation, financial and other commodity markets is quite well-recognized (see for example, Baffes (2007), Baumeister et al., (2010), Saghaian (2010), Peersman and Van Robays (2012), Gupta et al., (2015), Mohaddes and Pesaran (2016), Balcilar et al., (2017), Gupta and Wohar (2017), and references cited therein). Against this backdrop of importance of the oil market and the role of futures prices acting as a leading indicator for the spot market, in this paper, we analyze the role of macroeconomic surprises of not only the US economy, but also other important economies, which are also major exporters and importers of oil, in affecting returns and volatility of the West Texas Intermediate (WTI) and Brent Crude futures market. Specifically speaking in terms of the surprises analysed, besides the US, we look at Canada, Euro area, Japan and UK. This is specifically where we deviate from existing studies on the commodity markets and surprises, which have primarily only concentrated on US surprises. In addition to the surprises, we also analyze the role of macroeconomic uncertainty of Canada, Euro Area, Japan, UK and US on the returns and volatility of the oil futures. We also analyze the asymmetric impact of macroeconomic news surprises, i.e., distinguish between good (positive changes) and bad (negative changes) macroeconomic news. As developed by Scotti (2016), macroeconomic uncertainty is the weighted average of the squared surprises from a set of releases, where the weights depend on the contribution of the associated real activity indicator to a business condition index as in Aruoba et al., (2009). In this regard, we also contribute to the recent work of Andreasson *et al*., (2016) that analysed the impact of uncertainty on oil futures (besides other commodity futures). But again Andreasson *et al*., (2016) only looked at the role of US uncertainty.

In general, our results show the importance of the role of macroeconomic surprises, as well as uncertainties, of other economies in driving oil futures, over and above that of

the US; with the effect of these other economies being relatively stronger than the US in some instances. Given this, we highlight the need to look at macroeconomic news and economic uncertainties, of major role players in the oil market, when it comes to explaining the movements in returns and volatility of WTI and Brent crude oil futures, since ignoring information from other economies is likely to lead to an underestimation of the movement in the oil market futures due to omitted variable bias. The remainder of the paper is organized as follows: Section 2 presents the data and methodology, while Section 3 discusses the results. Finally, Section 4 concludes.

2. Data and Methodology

2.1 Data

In this paper, we will rely on the WTI and BRENT futures price of crude oil for the analysis. For this purpose, we have used daily settlement prices available over the period between January 1, 1991 to May 17, 2016 to construct our times series of daily returns for WTI and BRENT futures contracts. Our choice of the estimation period is determined by the availability of the measure of macroeconomic surprises and the proxies of economic uncertainty. Data on WTI and BRENT futures prices are collected from *Datastream International*. The returns are calculated as the daily percentage change of settlement prices. To compile-time series of futures returns and driven by liquidity considerations we collect data on nearest and second nearest contracts and we suppose that trader hold future contract to the last day of the month prior to expiration month. At that date, he rolls his position to the second nearest contract and held it to the last day of the month prior to the delivery month. The same procedure will be repeated to the next set of nearest and second nearest contracts.

To test the oil futures sensitivity to macroeconomic surprises and economic uncertainty, we use two real-time real activity indexes proposed by Scotti (2016) and are available for download at: https://sites.google.com/site/chiarascottifrb/research/surprise-and-uncertainty-indexes. The first represent a surprise index which summarizes recent macroeconomic surprises and measure the degree of optimism and pessimism of agents about the state of the economy, while the second is a real-activity uncertainty index which measures the uncertainty related to the state of the economy.

For the United States, daily real-time, real-activity surprise and uncertainty indexes are available over the entire period from 1991 to 2016. Whereas, daily data for the United States (US), United Kingdom (UK), Euro area (EA), Canada (CA) and Japan (JA) are available for the period between May 15, 2003 and March 31, 2016. As indicated in Scotti (2016) the macroeconomic surprises and economic uncertainty indexes are daily and get updated every time new information become available. Therefore, if there are no new data, these indexes are equal by construction to their values on the previous day. Based on this, we will use the change in these indexes that represent indication that new information has been released. For instance, a positive change in the surprise index indicates that the economy is doing better than expected. Whereas, a positive change in the uncertainty index suggests that agents are more uncertain about the state of the current economy.

2.2. The model

To examine the response of WTI and Brent future markets to macroeconomic surprises and real-activity uncertainty and to explore the effect of these indexes proposed by Scotti (2016) on explaining returns and volatility, we will firstly propose the following GARCH (1,1) model including separately contemporaneous surprises and uncertainty effects in the mean equation and the conditional variance equation.

$$r_t = \alpha_0 + \sum_{j=1}^{J} \delta_j Z_t^{i,j} + \varepsilon_t,\ \varepsilon_t \sim N(0, \sigma_t^2) \quad (1)$$

$$\sigma_t^2 = \beta_0 + \beta_1 \sigma_{t-1}^2 + \beta_2 \varepsilon_{t-1}^2 + \sum_{j=1}^{J} \gamma_j Z_t^{i,j} \quad (2)$$

In equation (1), the mean equation, r_t is the daily return on the WTI and BRENT futures contracts. In equation (2), the variance equation, σ_t^2 depends on the lagged conditional variance σ_{t-1}^2 , and the lagged squared stochastic disturbance term that is assumed to be normally distributed with zero mean ε_{t-1}^2. To capture the effect of surprise and uncertainty on return and conditional volatility, we add $\sum_{j=1}^{J} \gamma_j Z_t^{i,j}$ to the mean and the variance equations, where i, denote the change in the surprise index and the change in the uncertainty index and j, denote country.[1]

Up to now, we suppose that oil future price sensitivity to macroeconomic surprises and uncertainty are symmetrical. As indicated by Roache and Rossi (2010), given the asymmetrical nature of commodity markets it will be reasonable to explore the effect of negative and positive surprises on future returns and volatility. For this purpose, we will add dummy variables d_t and $(1-d_t)$, that capture the positive and negative surprises, respectively to the mean and variance equation of the GARCH (1,1) model (*where, d_t = 1 if surprise is positive and 0 otherwise*). The new representation of the GARCH (1,1) model identifies the possibility that return and volatility may differently react to positive and negative news. The following model will be estimated:

$$r_t = \alpha_0 + \sum_{j=1}^{J} \gamma_j^{+} d_t^j Z_t^j + \sum_{j=1}^{J} \gamma_j^{-} (1 - d_t^j) Z_t^j + \varepsilon_t \quad (3)$$

$$\sigma_t^2 = \beta_0 + \beta_1 \sigma_{t-1}^2 + \beta_2 \varepsilon_{t-1}^2 + \sum_{j=1}^{J} \gamma_j^{+} d_t^j Z_t^j + \sum_{j=1}^{J} \gamma_j^{-} (1 - d_t^j) Z_t^j \quad (4)$$

In this model γ_j^{+} and γ_j^{-} are the coefficients that will be checked in order to evaluate the asymmetric impact of surprise indexes of different countries, j, on return and conditional volatility.

3. Empirical results

3.1. Oil markets' sensitivity to macroeconomic surprise and uncertainty indexes

We examine the daily response of WTI and Brent futures returns and volatility to US macroeconomic surprise and uncertainty during the period between January 1, 1991 to May 17, 2016, and US and others economies during the period between May 15, 2003

[1] It should be noted that this model will be estimated separately for surprises and uncertainty measures and the exponent, i, is used to distinguish between these indexes.

and March 31, 2016. Focusing on the results reported in Table 1, several interesting observations emerge.

First, the result from the macroeconomic surprise illustrate that there is no relation between of macroeconomic news of not only the US economy (for short and long samples)[2], but also all other important economies, and the return and the volatility of Brent oil futures. The result from the WTI future contract shows that its return is significant and positively related with the Canadian macroeconomic surprise at the 10 percent level of significance. The coefficients from WTI and Brent (futures returns) confirm the evidence of weak oil responses to the US surprises reported in Kilian and Vega (2011) and Chatrath et al. (2012). Meanwhile, the result demonstrates the importance of the Canadian economy in driving WTI futures returns; whereby, a positive change in the Canadian macroeconomic surprise index (that is, the Canadian economy is doing better than expected) appreciates the returns on WTI futures. The result also shows that WTI futures volatility is significant and negatively related to the U.S. macroeconomic surprise at the 1 percent significance level for the period between short-sample, and it is also negative and significant at 10 percent significance level for the long-sample. So, we can say that an increase in U.S. macroeconomic surprise will decrease the crude oil variability. Therefore, when the U.S. economy is doing better than expected, this will help to stabilize WTI futures market.

Table 1. WTI and Brent sensitivity to macroeconomic surprise and uncertainty indexes

	BRENT				**WTI**			
	Mac. Surprise		***Uncertainty***		***Mac. Surprise***		***Uncertainty***	
	1991	***2003***	***1991***	***2003***	***1991***	***2003***	***1991***	***2003***
δ^{US}	0,00054	0,00281	0,00062	-0,00012	0,00014	0,00286	-0,00172	0,00054
	(0,36658)	(1,32974)	(0,75760)	(-0,12679)	(0,08033)	(1,00381)	(-0,71305)	(0,53238)
δ^{UK}	-	0,00864	-	0,00121	-	0,00250	-	0,00044
	-	(1,36841)	-	(1,24844)	-	(0,38662)	-	(0,41788)
δ^{EA}	-	-0,00025	-	0,00159	-	0,00417	-	0,00100
	-	(-0,08881)	-	(1,40198)	-	(1,21983)	-	(0,84115)
δ^{JA}	-	-0,00069	-	-0,00225*	-	0,00014	-	-0,00215
	-	(-0,15050)	-	(-1,82556)	-	(0,02934)	-	(-1,61440)
δ^{CA}	-	0,00318	-	-0,00107	-	0,00676*	-	0,00013
	-	(1,08302)	-	(-1,08926)	-	(1,72293)	-	(0,12169)
γUS	-0,00001	-0,00001	0,00002	**2,00E-06*** **	-0,00002*	**-0,00006*** **	**0,00008*** **	2,50E-06*
	(-1,33352)	(-0,67445)	(0,31000)	(2,13655)	(-1,70174)	(-2,62343)	(3,95495)	(1,78231)
γUK	-	8,72E-06	-	**-3,72E-06*** **	-	-0,00009	-	**-0,00001*** **
	-	(0,19979)	-	(-3,24737)	-	(-1,58255)	-	(-3,39613)
γEA	-	-0,00002	-	-2,28E-06*	-	-0,00002	-	-2,10E-06
	-	(-0,87210)	-	(-1,93664)	-	(-0,57223)	-	(-1,49316)
γJA	-	-0,00002	-	6,85E-07	-	0,00002	-	-1,12E-06
	-	(-0,86987)	-	(0,41340)	-	(0,61604)	-	(-0,51952)
γCA	-	0,00003	-	-3,47E-07	-	-1,10E-06	-	-1,20E-06
	-	(1,64453)	-	(-0,34734)	-	(-0,04427)	-	(-0,89110)

[2] We use short period for the period between May 15, 2003 and March 31, 2016 and long period for the period between January 1, 1991 to May 17, 2016.

Second, we ask how economic uncertainty in US and other major global players for the oil markets, namely United Kingdom, European area, Japan and Canada, can affect oil-future returns and volatility. For this purpose, we use the new uncertainty indexes proposed by Scotti (2016). Focusing on the reported results in Table 1, only the uncertainty of Japan is found to negatively and significantly influence the return on BRENT oil future at 10 percent level of significance. When we look on the uncertainty-volatility relationship, our results highlight the importance of the role played by the uncertainty of not only the US economy, but also the other economies. For instance, during the shorter sample period, an increase in uncertainty of the US economy leads to increase in WTI and BRENT future variability, with the relation between the volatility and uncertainty is positive and significant at 10 percent level of significance or better. The result from the long sample period also highlight the importance of the role played by the US uncertainty on the WTI volatility, with the result being still positive and significant at the 1 percent level of significance. On the contrary, the results illustrate a stabilizing role of uncertainty ofUnited Kingdom and European area economies, since the change in uncertainty in the UK negatively and significantly influence the WTI and Brent volatility at 1 percent level of significance, and the change in European areaeconomic uncertainty negatively and significantly influence the BRENT volatility at 10 percent significance level.

To conclude, these results clearly identify the importance of the considering macroeconomic surprises, as well as uncertainty measures of not only US, but also other economies, when it comes to explaining movements in oil futures returns and volatility.

3.2. The asymmetric effect of macroeconomic surprises on oil markets

The presence of asymmetric response, where the impact of positive and negative surprises cancel each other, may be one possible explanation to the the insignificant impact of macroeconomic surprises on returns and volatility. In this sub-section, we attempt to test the possibility of the existence of asymmetric impact of surprise indexes on returns and volatility of WTI and BRENT futures markets by differentiating between positive and negative surprises.

The results from Table 2 demonstrates that positive changes in macroeconomic surprises in the UK and Japan are positively and significantly related to the BRENT futures returns at 10 percent significance level or better, and the relation between positive change in macroeconomic surprise in Euro area and WTI futures returns is also positive and significant at 10 percent level of significance. The result from negative change in macroeconomic surprise is mostly insignificant, with exception of the Canadian case, where the negative change in macroeconomic surprise positively influences the BRENT future returns. While, there is no impact of positive and negative changes in US macroeconomic surprises for both the long and short sample periods, this result illustrates the importance of macroeconomic surprises of other economies in driving asymmetric movements in oil futures returns. The result from volatility during the period between 2003 and 2016 shows that positive macroeconomic surprise for different countries negatively influence the BRENT volatility at 1 percent level of significance, and the negative macroeconomic surprise change in US, UK, Euro area and Japan positively influence the BRENT volatility at 1 percent significance level. The result from WTI futures also illustrates that the relation between positive change, i.e.,

good news in US and UK and the volatility is negative and significant at 10 percent significance level, whereas, the relation between negative change (bad news) in US, UK, Japan and Canada and the volatility is positive and significant at 10 significance level. The result over the period 1991 and 2016, confirms the negative impact of good news and the positive impact of bad news in US macroeconomic surprise on volatility at the 1 percent level of significance.

Table 2. The asymmetric effect of macroeconomic surprises in oil Markets

	BRENT				**WTI**			
	Positive		**Negative**		**Positive**		**Negative**	
	1991	***2003***	***1991***	***2003***	***1991***	***2003***	***1991***	***2003***
δ^{US}	-0,00187	0,00161	-0,001025	0,00515	-0,004071	0,00071	-0,00268	0,00689
	(-0,54941)	(0,27925)	(-0,38816)	(1,21453)	(-0,97155)	(0,08605)	(-0,88683)	(1,11434)
δ^{UK}	-	**0,02550****	-	0,00795	-	0,01533	-	0,00996
	-	(2,14892)	-	(0,53079)	-	(0,96713)	-	(0,52324)
δ^{EA}	-	0,00607	-	-0,00775	-	0,00351*	-	0,00195
	-	(0,89269)	-	(-1,38063)	-	(1,86893)	-	(0,19418)
δ^{JA}	-	0,01337*	-	-0,00027	-	0,00746	-	0,00238
	-	(1,77426)	-	(-0,01778)	-	(0,48662)	-	(0,12444)
δ^{CA}	-	-0,00295	-	**0,01614*****	-	-0,00125	-	0,01555
	-	(-0,47538)	-	(3,04464)	-	(-0,10812)	-	(1,64028)
γUS	**-0,00034*****	**-0,00035*****	**0,00050*****	**0,00037*****	**-0,00045*****	-0,00053*	**0,00061*****	0,00051*
	(-17,17499)	(-2,83814)	(23,44593)	(2,79318)	(-6,59669)	(-1,89935)	(20,77282)	(1,90447)
γUK	-	**-0,00132*****	-	**0,00135*****	-	-0,00145*	-	0,00104*
	-	(-3,55031)	-	(7,99976)	-	(-1,85936)	-	(1,69676)
γEA	-	**-0,00056*****	-	**0,00081*****	-	-0,00065	-	0,00046
	-	(-9,97478)	-	(8,53874)	-	(-1,61573)	-	(1,43637)
γJA	-	**-0,00114*****	-	0,00044	-	-0,00061	-	0,00077*
	-	(-20,88331)	-	(1,38004)	-	(-1,16684)	-	(1,72299)
γCA	-	**-0,00038*****	-	**0,00067*****	-	-0,00018	-	0,00069*
	-	(-4,43270)	-	(4,63932)	-	(-0,56624)	-	(1,77731)

Overall, the results highlight the importance of the role of macroeconomic surprise, of not only US but also other major countries in influencing the oil markets variability. However, this result also documents that the macroeconomic news have an asymmetric impact on oil futures volatility, while negative changes in macroeconomic surprise increases market volatility, positive macroeconomic surprise decreases market volatility. This result also confirms that when economies of these major countries are doing better than expected, it will help to stabilize oil futures market. Similar impacts are also reported in many other studies, like Bauwens et al. (2005) and Andersen et al. (2007).

4. Conclusion

The importance of macroeconomic news and uncertainty in determining returns and volatility in commodity spot markets is well-established. Moreover, recent works in the literature investigate the role played by macroeconomic news and uncertainty of the US in driving oil futures price fluctuations. In this paper, we focus not only on the role of

surprises and uncertainty for the US economy, but also we analyze the role of other important economies, which are also major exporters and importers of oil (namely, Canada, Euro area, Japa and UK), in affecting returns and volatility of the WTI and Brent Crude futures market. For this purpose, we independently investigate two indexes recently proposed by Scotti (2016) to the GARCH returns and volatility equations. Next, we attempt to test the presence of possible asymmetries in the relation between macroeconomic surprises and oil futures returns and volatility by differentiating between positive and negative macroeconomic news surprises on the returns and conditional volatility equations.

The main findings from these tests highlight the importance of role played by surprises and uncertainty of others major countries over and above that of the US, with the effect of these other economies being relatively stronger than the US in some instances when it comes toexplaining returns and volatility of oil futures markets. Also, our result supports the possibility of the existence of asymmetric impact of macroeconomic surprises on oil futures markets. This asymmetric impact is more pronounced for the volatility-surprise relationship.

As part of future research, following the works of Rosa (2014) and Basistha and Kurov (2015), it would be interesting to analyze the importance of monetary policy surprises in affecting movements in oil futures market. Again, unlike the above mentioned studies we can look at the role of other major economies, and not only conventional, but also unconventional monetary policy surprises, based on the changes in the shadow rate measures (developed by Krippner (2013, 2015) using models of term-structure of interest rates) on monetary policy meeting dates. Also, it would be worthwhile to go beyond returns and volatility and look at the role of macroeconomic news and monetary policy surprises on jumps of oil futures, given that, compared to continuous price changes, jumps in markets generate occasional large price changes and extreme volatility, which represent a significant source of non-diversifiable risk (as discussed in Elder et al., 2013).

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