PAIN AT THE PUMP: IS THERE AN ASYMMETRIC INFLUENCE OF OIL VOLATILITY ON GASOLINE VOLATILITY IN FRANCE?

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ABSTRACT

We investigate, for the first time, the relationship between gasoline volatility and crude oil volatility. We aim to examine if the so-called asymmetric relationship between gasoline and crude oil prices holds for volatility. The approach employed is based on the asymmetric dynamic conditional correlation model as applied to the US WTI oil volatility and the French Super Carburant 95 gasoline volatility from 1990 to 2014.

The results reveal that gasoline volatility tends to be overreactive to changes in crude oil volatility. Moreover, it appears that the government taxation policy might amplify the gasoline volatility.

Keywords: Gasoline, Crude oil, Volatility, Asymmetry, Correlation, Taxation effect.

JEL Classification: Q41, Q43, C5, G1, Q4.

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1. INTRODUCTION

The rise of US benchmark oil West Texas Intermediate (WTI) to 145 USD per barrel on July, 3 2008 and its subsequent collapse to under 30 USD per barrel on December, 23 2008 is the biggest nominal swing in the history of oil. The large rise in 2008 prices has not been completely reversed. Moreover, the price fluctuations of petroleum products have become a great concern to all economic agents (e.g., consumers, producers, and speculators). It has been shown that higher oil prices induce a subsequent recession in advanced economies and that oil price volatility has become one of the most important issues facing the oil industry. These type of sudden variations in oil prices have contributed to create a climate of uncertainty for developed economies. At the same time, the gasoline price has constantly climbed in Western Europe, to the detriment of the household and several economic sectors. This rise might be accounted for, not only by the rise of taxation share[1], but also the direct effect of the oil price. Given that the public's sharp attention to retail price variations in France, the government launched the gasoline price's comparator[2] on January, 2 2007, covering 8,000 petrol stations. The main public accusation is that petrol stations respond more rapidly when crude oil prices rise than when they fall. However, there remains some doubt about the existence of an asymmetric reaction of gasoline prices to oil prices. Numerous studies have discussed the relationship between crude oil and gasoline. Some have exhibited empirical evidence of asymmetry, mainly in US or UK markets [See Bacon (1991), Karrenbock (1991), Balabanoff (1993), Borenstein, Cameron, and Gilbert (1997), Balke, Brown, and Yücel (1998), Brown and Yucel (2000), Galeotti et al. (2003), Grasso and Manera (2007)], whereas others cast doubt on that evidence [See Rao and Rao (2008), Clerides (2010), Silva et al., (2013)]. Frey and Manera (2007) provide a technical discussion on the literature of asymmetry in commodities and show that, among 69 articles, only 11 show no evidence of asymmetries of any kind. Looking across the whole industry, asymmetry is typically found for fragmented wholesale distribution systems (Peltzman, 2000), but sometimes with only very weak evidence of asymmetry (Clerides, 2010). Some studies, especially those focused on France (Audenis et al., 2002; Lamotte et al., 2013), share the same conclusion about the existence of asymmetry in the gasoline-oil price relation. However, price asymmetries are not model or data independent. Indeed, these studies might have been affected by the periodicity of the data, the sample period, or the model specification. Among the interesting responses to that question, asymmetry seems to be more sensitive to model specification than to sample period (Balke et al., 1998). Indeed, most of the papers quoted above used econometric approaches, such as ordinary least squares, cointegration or threshold models, to gauge the asymmetric effect.

To our best knowledge, most of these empirical papers failed to conclusively close the debate about asymmetry, with the majority conclude that there is evidence of asymmetry but only focusing on price level. Indeed, although the above cited articles studies might differ by the sample (data, period, frequency), their findings

[1] http://ec.europa.eu/energy/observatory/oil/doc/prices/map/2014-08-11-taxation-oil-prices.pdf
[2] http://www.prix-carburants.gouv.fr/

are limited because they all rely on similar closed models. Therefore, despite the number of published works on the issue of gasoline-oil asymmetry, the possibility of an asymmetric gasoline-crude oil relationship solely for the volatility dimension has yet to be explored.

Therefore, the motivation of this paper is to address the question of the asymmetric nature of the gasoline-oil relationship in France, considering only the volatility perspective. It is important to consider the volatility relationship because market participants do not care solely about the price level, but also about the price volatility. For goverments, oil volatility is important because it may negatively affect both the real economy and their own revenues. Clearly, oil volatility may induce gasoline volatility and also fuel tax volatility. In that case, governments might adjust their fuel taxation according to the oil volatility magnitude in order to alleviate the impact of uncertainty on their revenues. This magnitude depends on the nature of the relationship between crude oil and gasoline. More precisely, the volatility spillover from the oil market to the gasoline market might be of the same sign and magnitude (positive and symmetric relation) or of an even higher magnitude (positive and asymmetric relation). In both cases, a high level of oil price uncertainty may be transformed into a problem of fiscal volatility by increasing the uncertainty about government revenues. Therefore, this research should provide a better understanding of the relationship between oil volatility and gasoline volatility, before and after taxation adjustment, to gauge the impact of fiscality on gasoline volatility.

The choice of France is motivated by the fact that prices have increased relatively fast when considering the taxes. Indeed, it is one of the countries with the highest growing level of tax on gasoline price before taxes, around 157%[3], ranked 15th in 2014[4], representing an average of 6.4% of a day's wage, while it was ranked 30th in 2012[5].

We argue that this research is relevant because it allows the long-run measurement of the asymmetric nature of the gasoline-oil volatility relationship using a time-varying conditional correlation model that allows for asymmetry between both volatility series. Given our research agenda, we implement a measure of asymmetry in conditional correlation to gauge if the impact of the lag oil volatility is asymmetric with the lead French gasoline. Specifically, to operationalize our research framework, we implement the asymmetric dynamic conditional correlation model (ADCC). We argue that the ADCC model is fully appropriate to measure the magnitude of asymmetry for several reasons. First, this model allows for asymmetry in a dynamic framework. Second, it allows for computing the lagged time-varying correlation for long time series. Third, it is a parsimonious model that is straightforward to run. Given the advantages of using this model, and motivated by the literature, we argue that our approach places emphasis on the asymmetric nature of the gasoline-oil relationship by exploring the lagged relation, thus gauging the importance and significance of the evidence for volatility asymmetry. The data used are taken from the WTI for the crude oil and the French Super Carburant 95 for the Gasoline from 1990 to 2014.

[3] See Davoust (2008).
[4] http://www.bloomberg.com/visual-data/gas-prices/20142:France:USD:g.
[5] http://data.worldbank.org/indicator/EP.PMP.SGAS.CD.

To contribute to the literature, we demonstrate the asymmetrical nature of the relationship between crude oil volatility and gasoline volatility. Moreover, we show that this asymmetry disappears when the taxes are withdrawn. To our knowledge, no other work has as yet addresses this issue.

The remainder of the paper is organized as follows: Section 2 presents the data and methodology used in our analysis; Section 3 presents the empirical results; and Section 4 summarizes the main findings and concludes.

2. DATA AND METHODOLOGY

In this section, we describe the data and methodology employed to test the asymmetrical relationship between gasoline volatility and oil volatility.

2.1. Data

This paper uses weekly data from May, 4 1990 to August, 1 2014, corresponding to 1,262 observations. This data set stems from the French Ministry of Ecology for the gasoline prices and from Datastream[6] for the WTI oil prices. The gasoline price corresponds to the premium quality (i.e., Super Carburant 95), one of the most important products for automotive consumption. According to Eurostat[7], data is collected from oil companies, supermarkets, and independent groups. Taxes are isolated from the raw price, so that gasoline can be compared to WTI without the influence of the taxation effect. Moreover, every Friday the average prices with duties and taxes are collected from each company. Data from all companies are then averaged according to the sales share of each company. This gives a national price with duties and taxes. The price without duties and taxes is calculated by subtracting the tax on value added (TVA) and excise tax on petroleum products (TIPP), which is highest for Super Carburant 95. Hereafter, Super Carburant 95 will be denoted SP 95 TTC or SP 95 (with all taxes), or Super Carburant 95 HT (without taxes).

2.2. Methodology

Multivariate GARCH (MVGARCH) models are useful developments regarding the parametrization of conditional dependence. Bollerslev (1990) proposes a class of MVGARCH models in which the conditional correlations are constant. Engle (2002) and Tse and Tsui (2002) generalize Bollerslev's (1990) model by making the conditional correlation matrix time-dependent. The dynamic conditional correlation (DCC) model constrains the time varying conditional correlation matrix to be positive definite, causing the number of parameters to grow linearly by a two-step procedure. The first step requires the GARCH variances to be estimated univariately. Their parameter estimates remains constant for the next step. The second stage is estimated conditioning on the parameters from the first stage. The log-likelihood is therefore written as a sum of a volatility-part and a correlation-part. Cappiello, Engle and Sheppard (2006) generalise the DCC model to account for asymmetries in the correlation dynamics. Indeed, the ADCC version fits more closely the leverage effect observed in the equity markets.

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[6] I would like to thank Niclas Soljan and Andrea Giarola for their kind support for data collection.
[7] http://ec.europa.eu/energy/observatory/oil/doc/prices/survey-oil-bulletin-data-collection.pdf.

Let's present the ADCC model where (r_t) and (Σ_t) represent price log-returns and volatility log-variations respectively. Price log-returns are computed as the price (P_t) logarithmic first difference $r_t = \log(P_t / P_{t-1})$ of the commodity price index. Volatility log-variations are computed as the Σ_t logarithmic first difference $\Sigma_t = \log(\sigma_t / \sigma_{t-1})$ of the volatility level σ_t, computed from a univariate GARCH(1,1) model.

For ε_t, denoting an $n\times1$ vector of return innovations at time t, which is assumed to be conditionally normal with mean zero and covariance $n\times n$ matrix H_t:

$$\varepsilon_t | \Omega_{t-1} \sim N(0, H_t) \qquad (1)$$

where Ω_{t-1} represents the information set at time $t-1$. The conditional covariance matrix H_t can be decomposed as follows:

$$H_t = D_t R_t D_t \qquad (2)$$

where R_t is the $n\times n$ time-varying correlation matrix. $D_t = \mathrm{diag}(\sqrt{h_{1,t}}, \sqrt{h_{i,t}}, ..., \sqrt{h_{n,t}})$ is the $n\times n$ diagonal matrix of time-varying standard deviation of volatility extracted from univariate GARCH(1,1) models with $\sqrt{h_{i,t}} = \sigma^*_{i,t}$ on the i^{th} diagonal.

Note that GARCH(1,1) is a natural candidate for DCC/ADCC models. First, alternative specifications allowing for asymmetry within variance (e.g., EGARCH, TGARCH) would not be appropriate in the case of commodities and particularly for oil products, given that this class of assets obeys the inverse leverage effect where volatility is symmetrical to lag prices. Second, alternative models include realized volatility computed from high-frequency data and implied volatility computed from option contracts data. Unfortunately, no such datasets exist for French gasoline. For that reason, conditional symmetric volatility appears to be an appropriate specification.

The dynamic conditional correlation structure in matrix form is given by:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \qquad (3)$$

where an element of R_t has the following form:

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \qquad (4)$$

$Q_t^* = \mathrm{diag}(\sqrt{q_{ii,t}})$ is a diagonal matrix composed of the square root of the diagonal elements of the covariance matrix Q_t. (i,j) are the subscripts that represent the two commodities (oil and gasoline). The covariance matrix Q_t of the ADCC model evolves according to:

$$Q_t = \left(\overline{Q} - A^{'}\overline{Q}A - B^{'}\overline{Q}B - \Gamma^{'}\overline{Q}\Gamma\right) + A^{'}\left(e_{t-1}e_{t-1}^{'}\right)A + B^{'}\left(Q_{t-1}\right)B + \Gamma^{'}\left(\eta_{t-1}\eta_{t-1}^{'}\right)\Gamma \quad (5)$$

where the unconditional covariance matrix $\overline{Q}$ is composed of the *n*×*n* vector of standardized residuals $e_{i,t} = \varepsilon_{i,t}/h_{i,t}$ computed from the first stage procedure for which $e_{i,t} \sim N(0, R_t)$.

$\eta_t = I_{e_{t<0}} \circ e_t$ is an *n*×1 dummy variable equal to unity when standardized residuals $e_t < 0$ and zero otherwise. *A*, *B*, and Γ are *n*×*n* diagonal matrices where $A = \text{diag}(\sqrt{\alpha})$, $B = \text{diag}(\sqrt{\beta})$, $\Gamma = \text{diag}(\sqrt{\gamma})$. Capiello, Engle and Sheppard (2006) show that to ensure positive definiteness of the covariance matrix Q_t, a sufficient condition is $\alpha^2 + \beta^2 + \delta\gamma^2 < 1$ where δ is the maximum eigenvalue of $\left(\overline{Q}^{-1/2}\right)\left(\overline{N}^{-1/2}\right)\left(\overline{Q}^{-1/2}\right)$. α, β and γ are scalar parameters. Furthermore, $\overline{Q} = T^{-1}\sum_{t=1}^{T} e_t e_t^{'}$, $\overline{N} = T^{-1}\sum_{t=1}^{T} \eta_t \eta_t^{'}$.

The scalar version of the ADCC model can be written as:

$$Q_t = \left(\overline{Q} - \alpha^2\overline{Q} - \beta^2\overline{Q} - \gamma^{'2}\overline{N}\right) + \alpha^2\left(e_{t-1}e_{t-1}^{'}\right) + \beta^2\left(Q_{t-1}\right) + \gamma^2\left(\eta_{t-1}\eta_{t-1}^{'}\right) \quad (6)$$

The ADCC model (Cappiello, Engle and Sheppard, 2006) reduces to the DCC model (Engle, 2002) for $\eta = 0$.

3. EMPIRICAL RESULTS

This section presents results of Equation (6) that forms the basis of our tests to examine the relationship between gasoline and oil weekly volatilities from 1990 to 2014, either with or without taxation effect.

Figure 1 displays the weekly time-varying volatility and correlation measures for the French gasoline-oil relation, which includes the SP 95 TTC price index, SP 95 TTC volatility, WTI price index, WTI volatility, and SP 95 TTC-WTI volatility correlation. The similarities between the French gasoline price index and the US crude oil price index are immediately evident, not only in terms of trend but also in terms of peaks (e.g., 1990 Gulf war, 2008 oil price swing). The same observations holds for the volatility plots, although the SP 95 TTC seems to react to factors other than WTI variations (e.g., the taxation effect), since this gasoline series includes taxes. (see Figure 1 on next page).

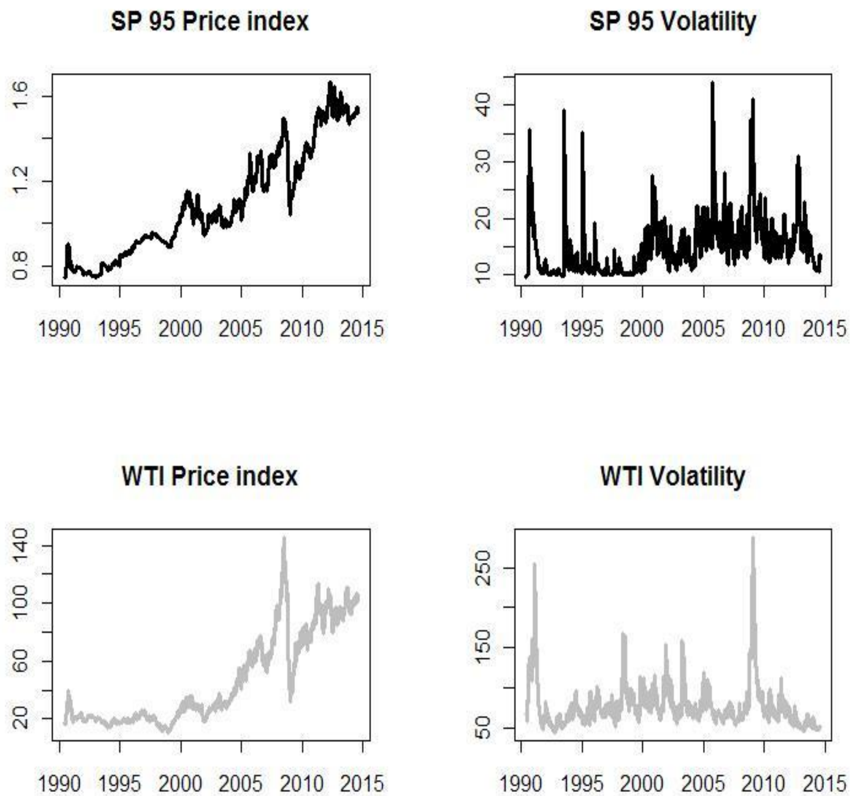

Figure 1

Figure 1 displays the weekly time-varying volatility and correlation measures for the French gasoline-oil relation. From upper left to lower right corner: SP 95 price index, SP 95 volatility, WTI price index, WTI volatility and SP 95-WTI volatility correlation. Sample period: May 4, 1990 to August 1, 2014. Number of observations: 1262.

Table 1 shows the descriptive statistics for the gasoline with taxes (SP95 TTC) and the crude oil WTI. Prices (P_t), log-returns (r_t), volatility level (σ_t), volatility log-variations (Σ_t) and the time-varying conditional correlation between SP95 TTC and WTI log-variations $\rho_t(\Sigma_{SP95,t};\Sigma_{WTI,t-1})$. These three moments of the distribution, which represent respectively the greediness, the prudence and the temperance are displayed. The hypothesis of normality is rejected at 99% for all of the series.

Table 1: Descriptive statistics

Descriptive statistics for the French gasoline including taxes (SP 95 TTC) and crude oil (WTI) concerns returns and volatility weekly time series. Sample period: May 4, 1990 to August 1, 2014. Number of observations: 1262.

	P_{SP95}	P_{WTI}	r_{SP95}	r_{WTI}	σ_{SP95}	σ_{WTI}	Σ_{SP95}	Σ_{WTI}	$\rho_t(\Sigma_{SP95,t};\Sigma_{WTI,t-1})$
MEAN	1.0933	46.4082	0.0005	0.0013	14.9070	78.7892	0.0003	-0.0002	0.1526
MEDIAN	1.0382	30.1900	0.0000	0.0042	13.7517	71.6022	-0.0174	-0.0271	0.1107
MAXIMUM	1.6664	145.6600	0.0693	0.3593	44.0846	287.4935	1.3776	0.7755	0.6844
MINIMUM	0.7454	10.7800	-0.0500	-0.3490	8.4556	45.0817	-0.1156	-0.0868	-0.0923
STD. DEV.	0.2527	31.5984	0.0097	0.0527	5.1238	29.1644	0.1074	0.0857	0.1329
SKEWNESS	0.4832	0.8035	0.4894	-0.4355	2.0247	3.0137	5.1191	2.9297	1.2920
KURTOSIS	2.0628	2.3026	10.1132	8.7737	8.7065	15.8680	49.3594	15.9378	4.6572
JARQUE BERA	95.1480***	161.1281***	2706.709***	1790.015***	2570.562***	10600.63***	118336.3***	10590.33***	493.2057***

***/**/* denotes significance at the 1%/5%/10%level.

The Philips-Perron (1988) and the Augmented Dickey-Fuller (1981) tests accept the hypothesis of a unit root for the non stationary times series WTI, but reject it for the stationary time series SP95 TTC, where the MacKinnon critical values for rejection of hypothesis of a unit root at respectively 1%, 5% and 10% are -3.9653, -3.4133 and -3.1287. For the sake of clarification we will compute for the study the log-first differences for all these variables.The price index is denoted P, the log-return is denoted r, the volatility is denoted σ, the volatility log-first difference is denoted Σ and the time-varying conditional correlation is denoted ρ_t.

The subscript SP95 stands for the gasoline SP95 TTC and the subscript WTI stands for the crude oil WTI. Volatility variables are computed from a GARCH(1,1) model.

We observe that the magnitude of the WTI volatility (78.79%) is, on average, six times higher than for the gasoline (14.91%). This is confirmed by the magnitude of their respective price, since the maximum and minimum oil price returns are also approximately six times higher (min.=-0.35%, max.=0.36%) than the gasoline price returns (min.= -0.05%, max.= 0.07%). In the same vein, we remark that the crude oil volatility min. and max. are approximately six times higher than for gasoline. Finally, the oil price volatility standard deviation (29.16%) is almost six times more volatile than the gasoline volatility standard deviation (5.12%). This surprising finding is appealing because it is unusual to observe such a proportion that remains constant for returns magnitude and standard deviation. A tentative explanation for the economic significance of this lower volatility for the gasoline retail prices may be simply due to the rigidity of prices in the retail economy. Indeed, gasoline prices are fixed by the petrol stations according to both lag crude oil prices and taxes. The opportunity cost of price adjustment may be generally higher in retail businesses (see Goldberg and Hellerstein, 2011[8]). Consequently, these costs of price adjustment may be an important source of price rigidity, which might explain the lower volatility of gasoline prices.

The conditional correlation $\rho_t(\Sigma_{SP95,t};\Sigma_{WTI,t-1})$ is, on average, about 15.26%. Nevertheless, it increases strongly up to 68.44% in periods of turmoil (e.g., July 1990, October 2008). This correlation may move into slightly negative values during calm periods (e.g., January 1995, September 2005, May 2013 etc.), although it occurred only with a probability of around 4.38%.

The positive price skewness informs about the aversion to price increases contrary to equity markets. This is because, for the main importing countries (generally the advanced economies), higher prices induce fear. The price kurtosis informs about the market temperance. Price kurtosis for both series are of the same magnitude. More interestingly, we remark that the magnitude of the risk is reversed when it comes to volatility log-variations (Σ). Indeed, we note that the gasoline skewness is doubled for the WTI and tripled for the kurtosis. This point is of particular interest as it clearly underlines the different behaviors of the price log-returns (r) and the volatility log-variations (Σ). This indicates that the fear of an increase in volatility is much higher for the French gasoline than for the WTI. A tentative explanation for this may stem from the government taxation. However, little is known about the link between taxes and oil price level, with almost no information existing about the link between taxes and oil price volatility. Therefore, few works have addressed this particular issue. More generally, the French government faces cash management problems when oil price volatility affects gasoline volatility. Indeed, gasoline volatility creates uncertainty about goverment revenues[9]. For this reason, the government's decision to retain the floating tax mechanism in 2002 was probably motivated by lowing fiscal volatility. Coady et al., (2009) explain that lowering fiscal volatility comes at the cost of increasing retail price volatility, and this mechanism might therefore explain our finding. In summary, the asymmetrical relation between oil volatility and gasoline volatility is solely due to a taxational[10] adjustment effect, since this asymmetry vanishes when removing the fiscal component from the gasoline price.

Table 2 displays the results for the ADCC model. The conditional correlation estimation ρ_t is computed from the lag WTI volatility log-variations $\Sigma_{WTI,t-1}$ and lead SP 95 TTC volatility log-variations $\Sigma_{SP95,t}$ to gauge the impact of crude oil on gasoline. All three parameters (α, β, γ) are highly statistically significant.

[8] The authors recall the first tentative explanation by Means (1935) who observe that large firms (please notice that petrol stations typically pertain to large firms) exhibit more rigid pricing behavior than small ones; in clear, they are more likely to exercise administrative control over prices by keeping them constant over several transactions, rather than allowing them to vary with market movements. Means, G., 1935, Industrial prices and their relative inflexibility, U.S. Senate Document 13, 74th Congress, 1st Session, Washington.

[9] Notice that 2013 oil revenues represent approximately 56% of the SP 95 TTC. More generally, energetic revenues represent 13,680 billions euros in France in 2013.

[10] http://www.douane.gouv.fr/articles/a10997-taxes-sur-les-produits-petroliers-notions-essentielles
http://www.developpement-durable.gouv.fr/La-fiscalite-des-produits,11221.html

Table 2: Estimates of the asymmetric dynamic conditional correlation model

Maximum likelihood parameter estimates of the asymmetric dynamic conditional correlation (ADCC) between volatility times series of French gasoline including taxes (SP95 TTC) and the U.S. crude oil WTI. The asymptotic mean test is based on the hypothesis that mean conditional correlation is equal to zero. The sample correlation level between $\Sigma_{SP95,t}$ and $\Sigma_{WTI,t-1}$ is 15.26%. Sample period: May 4, 1990 to August 1, 2014. Number of observations: 1262.

Dynamic Conditional Correlation with asymmetry $\varrho_t(\Sigma_{SP95,t};\ \Sigma_{WTI,t-1})$	a	β	γ	log$L$
Parameter estimate (standard error)	0.0518*** (0.0093)	0.8865*** (0.0228)	0.0538** (0.0274)	-1251.196
Unconditional Correlation $\varrho(\Sigma_{SP95,t};\ \Sigma_{WTI,t-1})$		95 % confidence interval		H_0: Mean = 0
Parameter estimate (t-statistic)	0.3081*** (11.4685)	(0.2572, 0.3573)	Mean test statistic (p-value)	40.6816*** (2.2e-16)

***/**/* denotes significance at the 1%/5%/10% level.
A robustness check test indicates that when replacing SP95 TTC (gasoline with taxes) by SP95 HT (gasoline without taxes), the asymmetric parameter is no longer statistically significant.
(α =0.0495*** (0.0076), β =0.8950*** (0.0191), γ =0.0204 (0.0252)).

The asymmetric parameter γ is equal to 0.0538, which means that the WTI-gasoline relation is positive and asymmetric, thus confirming the influence of the WTI volatility on the SP 95 TTC (with taxes) volatility; hence, an increase in the volatility of the US WTI should be associated in a subsequent increase in the French gasoline volatility, but with a higher magnitude.

Moreover, as a robustness check, the very same test is carried out by replacing the SP 95 TTC (with taxes) by the SP 95 HT (without taxes). Surprisingly, the asymmetric term γ is no longer significant and is half its previous level.

This finding suggests that, in the case of symmetry, the gasoline volatility reacts in the same proportion to an oil volatility shock. Whereas in the case of asymmetry, the gasoline volatility overreacts to the oil volatility shock. The positive sign of the asymmetry indicates that both volatilities move to the same direction, i.e., if the oil volatility peaks, the gasoline volatility also peaks. In other words, the inclusion of taxation induces a reaction of the gasoline volatility to the oil volatility shock that is in the same direction but more than proportional. It should be noted that this result may be robust to the class of historical volatility measures because the GARCH model encompasses both unconditional and conditional measures.

One possible explanation might be that the French gasoline volatility overreacts to the US WTI oil volatility increase only in presence of taxes. For example, a possible interpretation would be that the Government might adapt its fiscal policy (TVA, TIPP) not only according to the oil price level but also to the oil volatility log-variations. More specifically, the government might be responsible for this asymmetry through its taxation adjustment. Additionally, the goverment might increase taxation when oil is more volatile, which might explain the high level of skewness and kurtosis of the SP 95 TTC volatility log-variations described in Table 1.

4. CONCLUSION

The empirical results of this study reveal that there is a positive asymmetric response of gasoline volatility to crude oil volatility. More specifically, we find that the asymmetric response of gasoline volatility may be due to the taxation adjustment effect since this asymmetry disappears when replacing the Super Carburant 95 TTC (with taxes) by the Super Carburant 95 HT (without taxes), i.e., the relationship is symmetric without taxes and asymmetric when taxes are considered. One possible explanation for this might be that the French government adapts its fiscal policy (TVA, TIPP), not only according to the oil price level, but also according to the oil volatility variations. In that case, the government policy might be responsible for the asymmetry. One policy-oriented implication could be that the government overreacts to oil price volatility through its taxation adjustment, which tends to amplify the volatility phenomenon at the expense of the consumers. Future research is needed to explore the effects of fiscal adjustment upon oil volatility.

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