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Consumer Confidence on Heating Oil Prices: An Empirical Study of their Relationship for European Union in a Nonlinear Framework

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Abstract:

The present paper studies the EU consumer sentiment - heating oil stock prices relationship given the recent changes in the EU economy with the assistance of threshold cointegration.

According to our findings, the existence of linearity against threshold cointegration is rejected for all the variables with the exception that of skewness, while the estimation of the threshold vector error correction model does not confirm the short-term dynamics in most cases.

Having in mind that oil prices can affect economic activity in real and financial terms and is perceived as news by the consumers, the conclusion reached is in line with the existing literature, according to which consumer confidence is strongly affected by the news dissemination and by the signals of economic growth.

The major practical implication of the study is the policy makers' acquisition with tools to create economic condition that improve consumer confidence and promotes economic growth

Keywords*: Consumer sentiment, heating oil prices, threshold cointegration.*

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1. Introduction

The recent financial crisis appeared for first time in USA and spread all over the world with the assistance of different economic mechanisms. According to Stiglitz (2008), the crisis was closely related to the concept of consumer sentiment. Consumer confidence according to previous studies (Starr, 2012) is highly correlated with real economy while within the last decade, the confidence indexes have attracted the attention of market analysts, policy makers and macroeconomists.

The importance and value of consumer confidence indexes have been stressed in a number of researches, many of which have focused on the explanatory and their prediction ability in relation to consumption (Katona, 1975; Acemoglu and Scott, 1992; Huth *et al.*, 1994; Carroll *et al.*, 1994; Bram and Ludvigson, 1998; Eppright *et al.*, 1998; Ludvigson, 2004; Deés and Soares Brinca, 2011).

The issue of consumption has become highly interesting for the researchers after the second world war while a number of theories have been developed for its interpretation, with the most worthy to be the following; the relative income hypothesis by Duesenberry (1948), the life cycle hypothesis by Modigliani and Brumbergh (1954) and permanent income hypothesis by Friedman (1957). These theories have been tested empirically and new or alternative theories have emerged. Based on Lucas's (1978) famous critique about the consumption function, Hall (1976) formulated the random walk model of consumption according to which under rational expectations, only unexpected changes in permanent income should affect current consumption and consequently the only available useful information at t-1 is the consumption in order to predict consumption at time t (first order autoregressive process). Other empirical studies have introduced liquidity constraints and precautionary savings factors being attributed to the excess sensitivity of consumption to current income (Flavin, 1985; Zeldes, 1989; Jappelli and Pagano, 1989; Hahm 1999, Hahm and Steigerwald, 1999; Menegatti, 2010; Deés and Soares Brinca, 2011).

In addition, Katona (1975), Blanchard (1993), Acemoglu and Scott (1994), Eppright *et al.* (1998) and Akerlof and Shiller, (2008) have introduced the psychological and sociological approach to consumption. To be more specific, Katona argued that consumption is not only related with the ability to pay but also the willingness to pay, and confidence indices may capture social attitudes affecting perceptions of the economic environment apart from the environment itself. Acemoglu and Scott (1994) supported the view that a change in confidence can modify consumers' behavior in consumption in an upredictable way by economic variables, like income. Akerlof and Shiller, (2009) based Keynes, (1936) claimed that animal spirits[1] in consumer and business confidence are highly significant in understanding economic fluctuations. Therefore, investment decisions are not based on quantitative data of future profits and stylized facts but rather on feelings (Braley *et al.*, 2009; Black *et al.*, 2009).

Furthermore, an insight to the consumer confidence indices involves not only the interpretation of consumption, but also their predictability on fluctuations in economy (Blanchard 1993; Matsusaka and Sbordone 1995; Howrey 2001; Haugh 2005; Afshar *et al.,* 2011). Barsky *et al.* (2009 and 2012) and Vuchelen (2004) have studied the relationship of consumer confidence with macroeconomic aggregate variables such as unemployment, growth rate, interest rates and exchange rates, while Bachmann and Sims (2011), argue that confidence plays a role in government spending, especially during economic recessions. Another strand of the empirical literature has focused on the interaction of confidence indexes with the stock market (Fisher and Statman 2003; Qiu and Welch 2005; Baker and Wurgler 2006, Lemmon and Portniaguina 2006; Schmeling, 2009; Chung *et al.*, 2012).

It is broadly believed that the way an economy behaves is closely related to rational expectations of economic agents. Similarly, the way a consumer behaves reflects security and consequently formulates a specific purchasing attitude. This assumption turns consumer attitude into a determinant parameter of the movement of economy (i.e expansion and growth or contraction and recession). The broadening of the concept of consumer confidence with the inclusion of other features has led to the contemporary concept of consumer sentiment. Even though consumer confidence is a determinant of modern economy it is still an unmeasurable variable defined by the evolving economic behavior of consumers.

Several studies employing Grangers' causality methodology confirmed that measures of consumer confidence may well predict or be predicted by a wide range of economic variables, despite the differences in the data observed not only across countries but also across variables (Curtin, 2007). The present study tries to interpret the behavior of consumer confidence as a function of energy prices given that is the major expense for the consumers.

The rest of the paper is structured as follows; section 2 presents the existing literature, section 3 describes the data and the methodology employed, in section 4 the results are presented, section 5 a discussion on the findings of the study and section 6 concludes.

2. Literature review

Within the last few decades, consumer confidence and its relationship to macroeconomic fundamentals has been a subject of thorough survey, reflecting also the impact of other non - economic factors. The theoretical background that stands behind the relationship among the economic decisions and the consumer confidence is, as mentioned in the section of introduction, the permanent income hypothesis (PIH) (Hall, 1978). Implicitly, confidence is related to theories of consumption, given that confidence is considered a variable that captures uncertainties. Thus, the consumer confidence serves as a signal for uncertainty and therefore as a predictor for changes in consumption. This result is not validated in case of constrained

liquidity or even uncertainties in future income (Hamilton and Flavin, 1985; Zeldes, 1989; Jappelli and Pagano, 1989; Hahm 1999, Hahm and Steigerwald, 1999; Menegatti, 2010). Accordingly, the empirical studies should validate negative correlation between confidence today and consumption growth from today to tomorrow. Important empirical studies are those of Ludvigson (2004), who finds evidence against this argument, along with previous studies including those of Carrol, Fuhrer and Wilcox (1994), or Bram and Ludvigson (1998).

Another theory introduced to interpret the consumption as a function of consumer confidence is related to the animal spirits according to which political tensions or other non-economic factors may well affect the consumer attitude through uncertainties. Animal spirits is a concept introduced by John Maynard Keynes (1936), referring to the optimistic views of investors; their decisions are not based on rational economic thought but on instincts and predispositions. In case animal spirits are high, other irrational reasons take over. Thus, according to the theory, investment decisions are not based on quantitative evidence of future profits and stylized facts but rather on feelings (Black *et al.*, 2009).

The existing literature uses two different indices to describe the consumer attitude; to be more specific, the Consumer Sentiment of University of Michigan Index and the Conference Board Consumer Confidence Index. These two indices are mostly used by policymakers, financial analysts, and journalists. The formation of consumer confidence is strongly affected by the news reporting (Starr, 2012). To be more specific, the impact of the news media on consumers' perceptions of the economy is conducted through three channels. The first one involves the publication of the latest economic data and the opinions of professionals to consumers. Second, consumers receive a signal about the economy through the tone and volume of economic reporting. Last but certainly not least, the greater the volume of news about the economy, the greater the likelihood that consumers will update their expectations about the economy (Casey and Owen, 2013).

The role of consumer confidence in macroeconomics has been empirically surveyed by focusing on different dimensions of the subject. For instance, the pass-through effect in terms of a global economy has been studied by Deés and Soares Brinca (2011). Other empirical works survey the role of confidence in economic fluctuations. This strand of empirical literature is limited (Barsky and Sims 2009; Bachmann and Sims, 2011). Barsky and Sims (2009), confirm that surprise changes in consumer confidence are associated with long-lasting movements in macroeconomic aggregates, while Bachmann and Sims (2011), study the role of confidence in the transmission mechanism of government spending shocks only in periods of recession. Another issue being extensively surveyed is the direction of the existing relationship among the consumer sentiment and macroeconomic variables. Explicitly, empirical studies detect whether consumer sentiment reflects the impact of past or future values of macroeconomic variables including income employment, GDP and many others or alternatively if consumer sentiment may successfully

predict extreme phases of an economic cycle for instance a great recession or a period of recovery. Furthermore, in some other empirical works the predictability of confidence indicators on periods of strong fluctuations in the economy is empirically confirmed (Howrey 2001; Haugh 2005) while as last but not least issue in terms of previous empirical work involves the relevance of consumer sentiment when major political or economic shocks are observed has to be mentioned (Garner, 1991; Throop, 1992).

Until recently in the literature, the oil price changes have been considered as a significant source of economic fluctuations. This result was confirmed for the oil crisis in 1970s. Though, since the late 1990s, the global economy has experienced two oil shocks similar to those of the 1970s in terms of sign and magnitude but, in terms of macroeconomic variables such as Gross Domestic Product growth and inflation in the crisis have remained relatively stable in much of the industrialized world. The relationship between oil price shocks and the macroeconomic variables has been a subject of extensive study. The way oil shocks are transmitted to real economy is twofold. First, oil is the most important input in every type of economic activity and thus an increase in oil prices is a limitation in economic activity and secondly there is an immediate impact on inflation in the case of highly energy dependent economies.

These effects though are related also with the sentiment of confidence among the consumers leading to fulfilling expectations. In that case consumer sentiment serves as a means of transmission of the oil price fluctuation to real economy. The impact of oil price as expected is greater in oil-importing countries, since they are characterized by weak policy frameworks, low foreign exchange reserves, and limited access to international capital markets. This result is validated by Hamilton (2009a) according to the findings of whom, the key mechanism whereby energy price shocks affect the economy is through a disruption in consumers' (and firms') spending on goods and services other than energy.

Another issue is the duration of the price shocks since it determines their impact to the economy. Besides, a distinction between temporary and permanent shocks is a difficult process. Implicitly, uncertainties caused by large changes in oil prices can have significant effects on consumer confidence and therefore on growth. The pattern of oil prices evolution posts the 1973 period is characterized by great volatility exhibiting nonlinearities, a result attributed mainly to supply disruptions over the last four decades. A range of values $40 to $147 per barrel has been observed within the last decade. The first value refers to the oil price in 2014, while the second one in the year 2008. Significant changes form an economic environment of uncertainty since the global economy becomes vulnerable to the dispersion of economic crises (Killian and Vigfusson, 2010). This stylized fact makes the survey of oil price volatility an interesting subject of survey for the interpretation and the predictability of the appearance of economic crises through its impact on the macroeconomic variables through its impact on the consumer confidence.

Not only nonlinearities but also asymmetry in the transmission of oil shocks to the real output or to other macroeconomic variables has recently become an issue of renewed interest with most of the empirical work cited, not to have directly tested the hypothesis of an asymmetric transmission of oil price innovations. The methodology mostly used to aim to quantify these asymmetric responses is the censored oil price VAR methodology that Kilian and Vigfusson (2009) proved to be invalid.

Empirically the relationship between consumer sentiment and oil price evolution has been surveyed with the assistance of linear regression models (Edelstein and Kilian, 2009; Ramey and Vine 2010). Their analysis though cannot be used as an adequate methodology in order to validate nonlinear adjustment in consumer sentiment in response to oil price innovations. They have documented adjustments in U.S. consumer sentiment in response to retail energy price innovations, while they transform retail energy price data to allow for time-variation. Though, the type of nonlinearity considered in these two papers is totally different from other works including that of Mork (1989) or Hamilton (1996 and 2003), in which they employ retail energy prices rather than the price of oil, without taking into consideration asymmetric responses.

In most cases, a combination of nonlinearity along with asymmetric responses has been validated especially in cases of oil – importing countries. To be more specific, consumers in oil-importing economies respond to increases in the price of oil only if the increase is large relative to the recent past. In that case no motivation can be identified for using nonlinear models based on net oil price increase. In addition, based on Hamilton's definition according to which consumers do not respond to net decreases in the price of oil, implies the potential omission of net decreases from the model. In other words, consumers respond asymmetrically to net oil price increases and net oil price decreases and they do so in a very specific fashion. In that case the use of models derived by censoring energy changes to exclude all energy price decreases seemingly have larger effect on macro economy while vic versa the effects seem to be limited (Killian and Vigfusson, 2010).

Another strand of literature refers to the relationship among the consumer confidence measures and the future stock index returns (Akthar *et al.,* 2011). According to Ciner (2014), investor sentiment is an important factor in the stock market. To be more specific, as empirically surveyed and validated in several studies, consumer sentiment could forecast stock returns (Fisher and Statman (2003), Baker and Wurgler (2006), Lemmon and Portniaguina (2006), Baker and Wurgler (2007) and Schmeling (2009). Thus, evidently macroeconomic variables shape consumer sentiment and consumer sentiment the value of a stock price. Consequently, an interesting issue is the fit of the sentiment within behavioral economics and behavioral finance with the aid of economic theories and financial market returns. The literature distinct in the setting in which they are applied with

behavioral finance typically studied in the context of financial markets and asset prices and behavioral economics in the context of macroeconomic models.

In terms of empirical works, the relationship between consumer sentiment and stock prices is surveyed with the assistance of frequency dependent regression methods, that confirmed the existence of a time-varying relation between consumer confidence and stock returns. Furthermore, the existing empirical literature confirmed that in the case of a small firm higher levels of consumer confidence imply greater returns in the short term, but negative returns in the medium term, while also reverse causality is validated.

The present manuscript aims to provide empirical evidence for the relationship between consumer sentiment and heating oil stock prices. In recent literature the crude oil prices are commonly used in surveys regarding consumer confidence. The present manuscript on the other hand uses heating oil prices given that they are closely related to crude oil prices despite the seasonality, but they are also better perceived by the consumers and consequently affecting the consumer confidence. This issue is interesting given the link between consumer sentiment and the sources of economic fluctuations (oil prices) and it aims to assess the causal relationship among the two variables. The time period studied includes the post 1973 oil crises period while including also the most important financial crisis occurred in 2008-2009 has been attributed to loss of consumer confidence according to Stiglitz (2008). Furthermore, it is mostly agreed that the longevity and the depth of the crisis is strongly related to the erosion of consumer confidence (Dees and Brinca, 2013). In addition, the stock prices may well reflect the situation in the economy while the oil prices are a mirror of economic fluctuation. Thus, the study of such a relationship may well be of extreme interest since it can validate the role of consumer sentiment as a transmission mechanism of a crisis to the whole economy. In addition, as mentioned above the volatility and asymmetry in the oil price behavior may also determine the behavior of consumer sentiment and consequently the dispersion of a financial crisis to the whole economy through the consumer sentiment.

3. Data and Methodology

The concept of cointegration has been extensively used in the past in order to capture the compatibility of nonstationarity with long – run equilibrium relationships through the tendency for the variables to move together in the long run (Balke and Fomby, 1997). Studies that must be mentioned are those of Campbell (1997), studying the income-consumption relationship, the one of Campbell and Shiller (1987) involving the relationship of stock price and dividends, the work of Johansen and Juselius (1990) for the money demand along with many others.

Real economy is characterized by nonlinearities and asymmetries and therefore, linear cointegration is not adequate to capture such nonlinearities necessating the extensive use of nonlinear cointegration. The concept of threshold cointegration was

initially introduced by Balke and Fomby (1997), in order to describe cases of cointegration in which the adjustment process is allowed only after the deviation exceeds some threshold point. Furthermore, the methodology may adequately capture asymmetries in the process of adjustment and consequently positive and negative deviations to be corrected differently (Chevalier, 2011).

The present paper employs a three-regime threshold cointegration model as data generation process for bivariate time series, specifically the consumer confidence in the European Union along with the prices of heating oil, the variance, the skewness and the kurtosis of the heating oil prices respectively. The variance is used as a proxy for the uncertainty, asymmetry describes the asymmetric effect of unexpected macroeconomic news, and kurtosis is used to indicate how flattening or "peakedness" of heating oil prices distribution can affect the consumer confidence.

We derived the data regarding the Flash European Union Consumer Confidence indicator, used as a proxy for consumer confidence, from the European Commission. The consumer confidence indicator is the arithmetic average of the balances (in percentage points) of the answers to the questions on the financial situation of households, the general economic situation, unemployment expectations (with inverted sign) and savings, all over the next 12 months. Balances are seasonally adjusted. In addition, the daily time series of heating oil prices were derived from Bloomberg.

We have used the returns of heating oil prices in stock exchange because they reflect the variations of all the different retail prices that vary depending on where a supplier is in relation to a refinery or major storage facilities. Furthermore, we employed monthly data for the time period 1996:1-2015:3, while the variables of variance, asymmetry and kurtosis were calculated based on daily prices in terms of monthly data. The variables employed and their evolution as a function of time are illustrated in the following figures 1, 2, 3, 4 and 5 respectively.

Figure 1. *The evolution of consumer confidence in European Union*

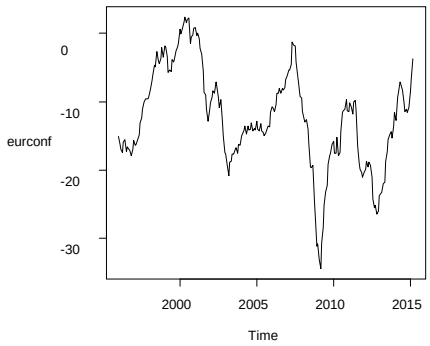
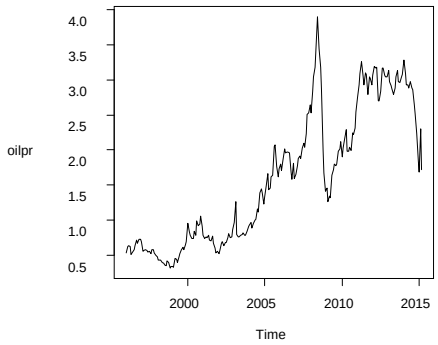


Figure 2 illustrates the evolution of heating oil prices as a function of time.

Figure 2. *The evolution of heating oil prices*



The next Figures 3, 4 and 5 illustrates the evolution of variance, kyrtosis and skewness for the variable under review respectively.

Figure 3. *The evolution of the variance (volatility) of heating oil prices*

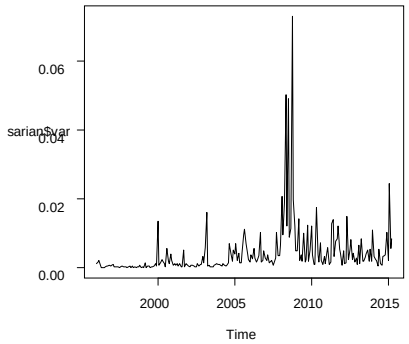


Figure 4*. The evolution of skewness of heating oil prices*

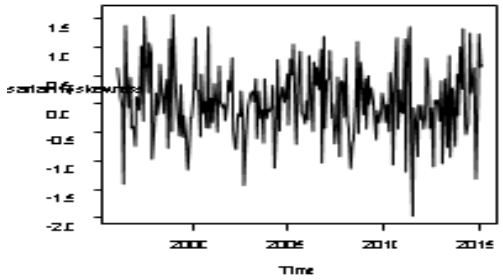
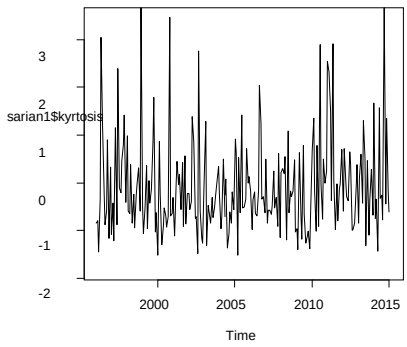


Figure 5. *The evolution of kurtosis of heating oil prices*



The first step in our study involves the implementation of a unit root test in order to test stationarity of the variables employed. The unit root test used is the DF – GLS the main feature of which is to come very close to the power envelope for a wide range of alternatives, and was introduced by Elliot, Rothenberg and Stock (1996, 2001) (hereafter ERS). The particular tests are referred as efficient unit root tests and are characterized by higher power compared to ADF or PP unit root tests, especially when the time series under review is marginally non-stationary.

The next step in our analysis as mentioned above is to employ threshold cointegration, and consequently to estimate the threshold VECM. Prior to the estimation of TVECM, we conducted a test to decide whether this nonlinear model is superior to a linear VECM. The test was proposed by Hansen and Seo (2002) and enables us to test a linear VECM against a two-regime TVECM. To be more specific, the test validates whether the difference between the parameter matrices in the two regimes, is significantly different from zero. In that case, the TVECM captures some dynamics of the given time series in case the linear VECM does not, and accordingly, the TVECM is superior to a linear VECM. A time series with dimension k is said to follow a k regime TVECM of order p in case it satisfies the following relationship:

$$\Delta y_t = c_j + \Pi_j y_{t-1} + \Gamma_{1j} y_{t-1} + \cdots . + \Gamma_{p-1,j} y_{t-p+1} + u_{tj}$$
$$\textit{If} \qquad \gamma_{j-1} \leq \gamma_{t-d-1} \leq \gamma_j \qquad (1)$$

Where;
$p \geq 0, \qquad k > 1$

j = 1,...,k and γ_i are real numbers such that $-\infty = \gamma_0 < \gamma_1 < \cdots < \gamma_k = \infty$, and u_{tj} is a K-dimensional white noise process for each j = 1,...,k. p denotes the order of the autoregressive term AR, d denotes the threshold delay, that is the time delay of the threshold variable y_{t-d-1} compared with y_{t-1}, the integer j denotes the regime number,

while the numbers $\gamma_1,...,\gamma_{k-1}$ denote the k−1 thresholds which divide the threshold space into k regimes. It should be mentioned that in each of the k regimes, the time series y_t is a linear VECM. However, all pivotal differences may be detected in k linear models (otherwise, we may reduce k by merging some of the regimes), and which one of these k models we use when computing y_t, is governed by the value of the threshold variable y_{t-d-1}. Thus, the TVECM is nonlinear.

When estimating a TVECM, we must select values of a few parameters including the number of thresholds, the number of lags and the value of beta. Accordingly, we may take beta equal to unity in the estimation of the TVECM. Alternatively, we could find the optimal value of beta by using the grid search of the TVECM function in the package tsDyn, the process that we preferred in our study.

4. Results

The results derived for each variable through the employment of the DF-GLS test are provided in the following Table 1:

Table 1. *Results of the unit root DF-GLS test*

Variable	DF-GLS	I(p)
eurconf	-2.162579	P=1
Δeurconf	-7.328705	
Stpho	3.2520	P=0
ΔStpho	-	
varspho	-2.89187**	P=0
Δvarspho	-	
kyrtosisspho	-2.892738	P=0
Δ kyrtosisspho	-	
skewnesspho	-2.78543	P=0
Δskewnesspho	-	

Note: *The critical values o the DF-GLS detrending of series with intercept for 1,5 and 10% respectively are the following: -2.575144, -1.942243, -1.615759.*

According to the results the null hypothesis of existence of unit root is rejected for every level of significance. Thus, the stationarity for the time series under review (variance, skewness and kyrtosis for the stock prices of heating oil) is confirmed.

As far as the consumer confidence for the European Union is concerned the null hypothesis of unit root cannot be rejected for every level of significance detrending of series with intercept. Consequently variable concerning consumer confidence is confirmed to be I(1).

The next step involved our effort to detect the existence of a long run relationship among the two variables, the consumer confidence for European Union and stock prices of heating oil. The results derived are ambiguous and do not provide us with a clear conclusion on the existence of a sole long run relationship. For that reason, we employed tests to detect the existence of threshold cointegration with the assistance of Hansen and Seo (2002) test since in that case the two variables do not necessarily reach the equilibrium simultaneously.

The R package tsDyn was employed for the empirical process. This package is free downloadable and was developed by Narzo et.al (2009) and by Stigler (2010). This software part implements nonlinear autoregressive (AR) time series models. In the case of univariate series, a non-parametric approach is available with the assistance of additive nonlinear AR, while parametric modeling and testing for regime switching dynamics is available when the transition is either direct (TAR: threshold AR) or smooth (STAR: smooth transition AR, LSTAR). On the other hand, in the case of multivariate series, a range of TVAR or threshold cointegration TVECM models can be estimated with two or three regimes. The tests conducted are applicable to both TVAR and TVECM models (Hansen and Seo 2002 and Seo 2006).

Within this framework we initially implemented the Hansen and Seo test (2006), through which we confirmed the threshold cointegration against the linearity for the variables of stock prices of heating oil (spho), the volatility of the stock prices of heating oil (volspho), the skewness of the stock price of heating oil (skspho), the kyrtosis of the stock prices of heating oil (kyrspho) and consumer confidence (cc) for the region of European Union. The results taken are provided in the following Table 2:

Table 2*. TVAR Model for EUAs and Energy Prices Diagnostic Tests Stat. p-value LR Test of Linearity (1vs2) and (1vs3) and finally Test of TVAR(1) against TVAR(2) (2vs3)*

Variables	Diagnostic test	statistic	p-value
cc-spho	LR test of linearity 1vs2	82.61159	0.00
	LR test of linearity 1vs3	139.643	0.020
	TVAR(1) against TVAR(2)	29.65365	0.78

cc-volspho	LR test of linearity 1vs2	54.79874	0.03
	LR test of linearity 1vs3	95.39137	0.01
	TVAR(1) against TVAR(2)	25.23224	0.52
cc-skspho	LR test of linearity 1vs2	28.60937	0.04000
	LR test of linearity 1vs3	70.65044	0.035000
	TVAR(1) against TVAR(2)	-	-
cc-kyrspho	LR test of linearity 1vs2	109.9448	0.0001
	LR test of linearity 1vs3	165.0096	0.0001
	TVAR(1) against TVAR(2)	85.0648	0.0666

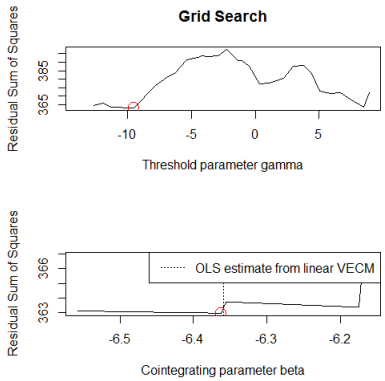
Taking into consideration the existence of thresholds as confirmed in the Tables we conducted another test Hansen and Seo test (2002). Thus, the next step involves the employment of Hansen and Seo test in the R package tsDyn for the case of three regimes in the alternative hypothesis.

As the Lagrange Multiplier (LM) test statistic used in the Hansen and Seo test in tsDyn is different from the LM statistic described in Hansen and Seo (2002), both these LM statistics, as confirmed are equal under certain conditions. The Hansen and Seo test use the SupLM statistic which is the maximum of this LM statistic when the two thresholds $\gamma 1$ and $\gamma 2$ vary over the set of all possible threshold values. However, the function LM ($\gamma 1$, $\gamma 2$) is a highly irregular function such that we must perform a grid search when maximizing this function. The global maximum of a function under explicitly given constraints is unique, i.e., the maximum value is unique, but there may be more than one point which give this maximum value. However, neither the implementation of the Hansen and Seo test used in Seo (2003) nor the implementation in the package tsDyn gives the user full control over the constraints used when maximizing LM ($\gamma 1$, $\gamma 2$), which may explain why we failed in reproducing the results in Seo (2003). In the case of three regimes, the algorithm is quadratic in the number of possible threshold values, consequently a long time is needed to be consumed given that the P-value of the test statistic is estimated with the assistance of bootstrapping. Implicitly, an algorithm which maximizes correctly, under the given constraints is preferred. The results of the methodology as evident in the following Table 3 have confirmed the existence of threshold cointegration.

Table 3. *Test of linear versus threshold cointegration (Hansen Seo test)*

Variables	statistic	p-value
cc-spho	11.36136	0.03
cc-volspho	11.49624	0.04
cc-skspho	11.25856	0.78
cc-kyrspho	22.45074	0.08

To be more specific, and according to our findings the null hypothesis of linear process is rejected for both 5 and 10% level of significance. Thus, threshold cointegration is the appropriate methodology to describe the relationship among the variables employed. In the next step and having proved that the relationship among the two variables is nonlinear we estimate the respective threshold vector error correction model (TVECM).



The percentage of observations in each regime corresponds to 16.4% 74.7% and 8.9% respectively. This result implies that the first regime is valid for the observations within the range 0-37. The middle regime is valid for the observations 38-206 and the upper regime is valid for the observations 206-226. This model comes from a linear VECM and the final TVECM is the following Table 4:

Table 4. *The coefficients of the estimated TVECM from the simulated data with* β *= -6.369652, lag=5 and threshold values* γ_1 *=-9.6851 and* γ_2 *= 8.45871.*

Regime	Term	CConfEU	oilprices
	ECT	-0.4722(2.7e-06)***	-0.0187(0.1435)

Low regime	Const	-5.5427(1.6e-05)***	-0.2243(0.1705)
	eurconf t -1	-0.0308(0.8531)	0.0203(0.3504)
	oilp t -1	0.1749(0.9045)	0.0144(0.9396)
	eurconf t -2	0.2165(0.1258)	-0.0211(0.2516)
	oilpr t -2	1.9287(0.1583)	0.2835(0.1116)
	eurconf t -3	0.1934(0.1988)	-0.0004(0.9841)
	oilpt -3	1.2613(0.3977)	-0.1079(0.5784)
	eurconf t -4	0.1911(0.2209)	0.0198(0.3303)
	oilp t -4	2.5322(0.0574).	0.1787(0.3015)
	eurconf t -5	0.2966(0.0410)*	0.0087(0.6429)
	oilp t -5	3.1212(0.0368)*	0.1417(0.4644)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

According to our findings, the vector error correction model in the case of the low regime provides an evident causality from the oil prices to the consumer confidence for the European Union and statistically significant terms is the error correction term expressing the long-term relationship. This result is indicative of an unstable situation in the first regime with a slight step back to the middle regime. Regarding the short-term coefficients are confirmed as statistically significant for 10% level of significance is the fifth lag of oil price indicating probably a persistent impact of oil prices and not an immediate one on the variable on consumer confidence.

Table 5*. The coefficients of the estimated TVECM from the simulated data with* $\beta = -6.369652$*, lag=5 and threshold values* $\gamma_1 = -9.6851$ *and* $\gamma_2 = 8.45871$*. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	oilp
	ECT	-0.0003(0.9884)	-0.0024(0.3719)
	Const	0.1650(0.1079)	0.0026(0.8423)
	eurconf t -1	0.1683(0.0300)*	0.0017(0.8668)
	oilp t -1	0.1155(0.8699)	0.1369(0.1372)
	eurconf t -2	0.0725(0.3597)	0.0068(0.5095)
	oilpr t -2	0.3633(0.6263)	-0.0234(0.8098)

middle regime	eurconf t -3	0.2535(0.0019)**	0.0144(0.1716)
	oilpt -3	-0.7517(0.3138)	0.1271(0.1912)
	eurconf t -4	0.0699(0.3787)	-0.0012(0.9113)
	oilp t -4	0.9194(0.2449)	-0.0573(0.5771)
	eurconf t -5	-0.1555(0.0447)*	0.0118(0.2387)
	oilp t -5	-1.2344(0.1141)	-0.0290(0.7748)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

In the middle regime no statistical significance impact of the oil prices on the consumer confidence is confirmed neither for the error correction term nor for the short-term relationship while as statistically significant for 5% level of significance is confirmed. The particular result indicates a stable situation.

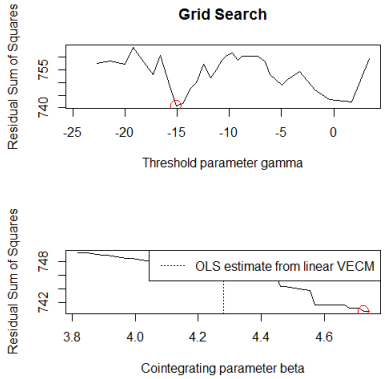
Table 6. *The coefficients of the estimated TVECM from the simulated data with β = -6.369652, lag=5 and threshold values γ_1= -9.6851 and γ_2 = 8.45871. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	oilp
upper regime	ECT	0.4902(0.3502)	0.1116(0.1033)
	Const	-6.9377(0.1862)	-1.1020(0.1073)
	eurconf t -1	0.3901(0.1117)	-0.0244(0.4441)
	oilp t -1	-0.8858(0.8576)	0.4559(0.4786)
	eurconf t -2	0.3340(0.4115)	-0.0678(0.2012)
	oilpr t -2	1.3205(0.7155)	-1.0010(0.0349)*
	eurconf t -3	-0.0534(0.8647)	-0.0386(0.3448)
	oilpt -3	3.0708(0.3400)	0.7720(0.0664).
	eurconf t -4	0.3922(0.3700)	-0.0160(0.7787)
	oilp t -4	2.5657(0.4726)	0.1718(0.7117)
	eurconf t -5	0.0313(0.9489)	0.0753(0.2360)
	oilp t -5	0.1242(0.8053)	0.1242(0.8053)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

Regarding the upper regime similar results are evident as for the case of the middle regime we should stress the fact that within the upper regime, other factors are determinant of the consumers. The non-stability of the regime is validated while a step forward to the middle regime is confirmed.

Regarding the second variable the kyrtosis calculated and based on the oil stock prices and its relationship with consumer confidence in EU. Furthermore, the next figure provides the grid search. The threshold values validated are γ_1 =-21.58958 and γ_2 = -1.37393 respectively. The percentage of observations included in each regime are 7.1% 83.2% 9.7% respectively. Thus, to be more specific the down regime is valid for the observations 0-16, the middle regime is valid for the observations 17 – 206 while the last 20 observations satisfy the final model in the upper regime.



The estimation results of TVECM are provided in the following tables 4,5 and six for the low, middle and upper regime.

Table 7. *The coefficients of the estimated TVECM from the simulated data with β = -2859.557, lag=4 and threshold values γ_1 =-21.58958 and γ_2 = -1.37393. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	kyrt
Low regime	ECT	-0.6438(0.0256)*	0.0002(0.3432)
	Const	-14.4517(0.0333)*	0.0050(0.3561)
	eurconf t -1	-0.0241(0.9403)	0.0002(0.4829)
	kyrtosis t -1	695.8689(0.4458)	-0.8462(0.2462)
	eurconf t -2	0.1407(0.6218)	-3.0e-05(0.8949)
	kyrtosis t -2	379.3736(0.1555)	-0.1584(0.4569)
	eurconf t -3	0.5267(0.0178)*	4.2e-05(0.8105)

	kyrtosis t -3	406.2154(0.0085)**	-0.1542(0.2077)
	eurconf t -4	0.2661(0.5735)	-0.0002(0.5577)
	kyrtosis t -4	218.7812(0.1516)	-0.1831(0.1331)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

As observed for the case of low regime the error correction term is statistically significant for 5% level of significance while statistically significant for 1% level of significance is the constant and the third lag for the kurtosis as an explanatory variable for consumer confidence in European Union. Within this regime the situation is unstable with a great step back to to the upper regime reflecting a stable situation.

Table 8. *The coefficients of the estimated TVECM from the simulated data with β = -2859.557, lag=4 and threshold values γ_1 =-21.58958 and γ_2 = -1.37393. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	kyrt
Middle	ECT	-0. 490(0.1340)	3.0e-05(0.0562).
	Const	-0.5493(0.0242)*	0.0005(0.0099)**
	eurconf t -1	0.2056(0.0070)**	-2.1e-07(0.9972)
	kyrtosis t -1	286.9413(0.0368)*	-1.3274(9.2e-26)***
	eurconf t -2	0.1308(0.0833).	-7.5e-07(0.9901)
	kyrtosis t -2	206.3890(0.1801)	-1.1665(6.7e-18)***
	eurconf t -3	0.1206(0.1081)	-0.0001(0.0675).
	kyrtosis t -3	9.4405(0.9641)	0.3548(0.0352)*
	eurconf t -4	0.0644(0.3767)	-8.1e-05(0.1655)
	kyrtosis t -4	236.6314(0.1167)	-0.0088(0.9413)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

As far as in the case of middle regime the error correction term is statistically significant implying also an unstable situation with a slight step back to the down regime, while regarding the short term dynamics as statistically significant for 5% level of significance is the first lag of kyrtosis, and what is also worth to be mentioned is the statistically significant impact of consumer confidence on the

kyrtosis of the oil stock prices in the long term (for 10% level of significance) as well as the lags of kyrtosis on the dependent variable which is an expected result. Implicitly the error correction term confirms a stable situation within the middle regime.

Table 9. *The coefficients of the estimated TVECM from the simulated data with β = -2859.557, lag=4 and threshold values γ_1 =-21.58958 and γ_2 = -1.37393. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	kyrt
Upper regime	ECT	-0.5025(0.0191)*	-0.0002(0.3269)
	Const	0.2754(0.4453)	8.0e-05(0.7825)
	eurconf t -1	0.1455(0.5082)	5.6e-05(0.7508)
	kyrtosis t -1	583.3336(0.1991)	-0.7160(0.0491)*
	eurconf t -2	0.3032(0.2241)	-3.9e-05(0.8439)
	kyrtosis t -2	380.6153(0.4463)	-0.5101(0.2018)
	eurconf t -3	0.3915(0.1303)	8.7e-05(0.6744)
	kyrtosis t -3	477.5004(0.3246)	-0.6372(0.1005)
	eurconf t -4	-0.1020(0.7337)	0.0001(0.6688)
	kyrtosis t -4	835.6371(0.2392)	-0.4170(0.4617)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

Finally, regarding the upper regime as statistically significant for 5% level of significance is confirmed the error correction term implying an unstable situation with a large step back to the middle regime.

The next threshold error correction model was estimated for the pair volatility of the stock prices of heating oil with the consumer confidence for EU. The threshold values provided by the system and based on the value of SSR are γ_1= -12.77868 and γ_2 =-9.491907 respectively. The percentage of observations included in each regime, correspond to 31.4% 16.8% 51.8% of the total sample respectively. Implicitly the first model that is valid for the first 70 observations. The middle regime is valid for the observations 71-109 and the last 116 observations follow the model for the upper regime. The cointegrating relationship for the pair of variables is the following; Cointegrating vector: (1, -849.9384). The next Figure 6 depicts the grid search for the pair surveyed as mentioned above.

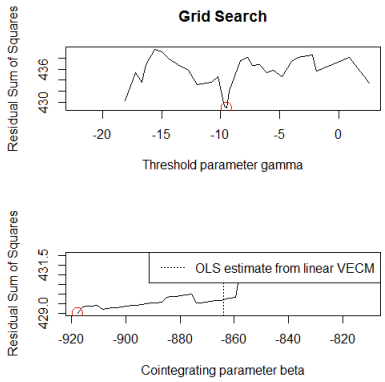


Table 10. *The coefficients of the estimated TVECM from the simulated data with β = -849.9384, lag=4 and threshold values γ_1= -12.77868 and γ_2 =-9.491907. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	var
Low regime	ECT	-0.1913(0.0006)***	0.0001(0.4726)
	Const	-2.8806(0.0018)**	0.0026(0.4589)
	eurconf t -1	0.1028(0.4077)	0.0005(0.2667)
	var t -1	37.8140(0.4054)	-0.3526(0.0424)*
	eurconf t -2	0.1369(0.2549)	0.0002(0.5885)
	var t -2	57.7927(0.1122)	-0.1844(0.1827)
	eurconf t -3	0.2940(0.0133)*	-0.0002(0.7277)
	Vart-3	70.6316(0.0109)*	-0.2148(0.0415)*
	eurconf $_{t-4}$	0.0089(0.9397)	0.0002(0.6253)
	Var_{t-4}	17.6715(0.4015)	-0.1343(0.0947).

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

Regarding the impact of volatility on the consumer confidence is statistically significant in the long term (for every level of significance) within the low regime, while the constant is statistically significant for 1% level of significance and the third lag of volatility affects in the consumer sentiment, a result that validates the existence of short-term dynamics. The results indicate an unstable situation with a significant step back to the middle regime that is stable.

Table 11. *The coefficients of the estimated TVECM from the simulated data with β = -849.9384, lag=4 and threshold values γ_1= -12.77868 and γ_2 =-9.491907. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	var
Middle Regime	ECT	0.2201(0.3403)	-0.0016(0.0770).
	Const	3.1421(0.2179)	-0.0171(0.0782).
	eurconf t -1	0.5435(0.0005)***	-0.0004(0.4890)
	var t -1	112.5577(0.0152)*	-1.2245(4.0e-11)***
	eurconf t -2	0.0879(0.6070)	0.0003(0.6290)
	var t -2	119.9615(0.0171)*	-1.6317(2.7e-15)***
	eurconf t -3	0.3068(0.0529).	0.0001(0.8241)
	Vart-3	123.9132(0.0742).	-0.8654(0.0012)**
	eurconf $_{t-4}$	-0.2576(0.1431)	-0.0002(0.7426)
	Var_{t-4}	157.3436(0.0012)**	-0.7305(8.7e-05)***

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

Regarding the middle regime only short-term dynamics are confirmed and to be more specific statistically significant is for 5% level of significance the first, the second lag of volatility while the fourth lag of volatility affects the consumer confidence, for 1% level of significance.

Table 12. *The coefficients of the estimated TVECM from the simulated data with β = -849.9384, lag=4 and threshold values γ_1= -12.77868 and γ_2 =-9.491907. The standard errors of the coefficients are in the parenthesis.*

Regime	Term	CConfEU	var
	ECT	-0. 0358(0. 1964)	-4e-05(0.7023)
	Const	-0.3343(0.0691).	0.0009(0.2160)
	eurconf t -1	0.1514(0.1098)	0.0003(0.4212)
	var t -1	16.1674(0.5734)	-0.9802(2.2e-16)***

Upper Regime	eurconf t -2	0.2026(0.0437)*	0.0006(0.1344)
	var t -2	-26.5023(0.4882)	-0.3189(0.0293)*
	eurconf t -3	0.0369(0.7291)	-0.0005(0.2152)
	Vart-3	2.8785(0.9385)	-0.1808(0.2041)
	eurconf $_{t-4}$	-0.0041(0.9676)	-0.0004(0.2533)
	Var_{t-4}	-2.7776(0.9394)	-0.0787(0.5716)

*The symbols ***, **, * denote significance at 1%, 5% and 10% level, respectively.*

Regarding the upper regime, evidently a stable situation is presented, furthermore the validity of short run dynamics can be confirmed and thus in the case of the consumer confidence as dependent variable only the constant and the second lag of consumer confidence affect its value for 10 and 5% level of significance respectively. On the other hand, when the variance is the dependent variable only the first and the second lag of the same variable is statistically significant. Regarding the final variable the skewness as evident in the following table the validity of linear cointegration is confirmed with the employment of Seo and Hansen test. The linear cointegrating vector is the following r(eurconf skewness)=(1, 0.4315693). The estimated linear Vector Error Correction Model is provided in the following Table:

Table 13. *The estimation results of the linear Vector Error Correction Model*

Term	CConfEU	sk
ECT	-0.0361(0.0132)**	-0.0030(0.0064)
Const	-0.4127(0.1865)*	-0.0220(0.0912)
eurconf t -1	0.2005(0.0669)**	-0.0383(0.0327)
sk $_{t-1}$	0.2438(0.1352).	-0.8593(0.0661)***
eurconf $_{t-2}$	0.1804(0.0679)**	0.0218(0.0332)
sk $_{t-2}$	0.3920(0.1752)*	-0.5851(0.0857)***
eurconf $_{t-3}$	0.1608(0.0686)*	0.0109(0.0336)
sk_{t-3}	0.2626(0.1783)	-0.3314(0.0872)***
eurconf $_{t-4}$	0.0455(0.0682)	-0.0407(0.0334)
sk_{t-4}	-0.0090(0.1388)	-0.1746(0.0679)*

Evidently according to our findings based on the results of linear cointegration, the existence of a sole relationship in the long term is validated when the dependent variable is the consumer sentiment for 5% level of significance and regarding the short term dynamics as statistically significant are the first lag of skewness for 10% level of significance and the second lag of skewness for 5% level of significance. What also must be mentioned is the fact that in the skewness equation, significally significant for every level of significance are all the lags of the skewness variable with exception the fourth one that is statistically significant for 5% level of significance.

5. Discussion and Conclusions

Most of the economic time series, as confirmed by the recent empirical literature, present structural breaks closely related to events such as financial crises or even changes in different aspects of government policy. The oil prices are certainly an indicator of the phase an economy goes through. On the other hand, it is believed that the oil prices may well reflect the behavior of different macroeconomic fundamentals. As mentioned above, the role of consumer confidence seems to be vital in the dispersion of financial crises. The present study aims to identify the relationship between consumer confidence and different moments (variance, skewness, kurtosis) of energy prices. The proxy for energy prices employed in the present survey is the heating oil stock prices for the following reasons: it is closely related to the crude oil prices, while in addition the consumers perceive better the heating oil prices. Until now most of the existing literature involves the interrelationship among economic activity and oil prices and especially oil price shocks.

In the present study, in order to capture nonlinearities, we employed the methodology of threshold cointegration. The existence of the two thresholds was confirmed with Setar Lr test, the thresholds are the same for heating oil returns and kurtosis, but it becomes different in the case of variance. Generally, regarding the oil price volatility, a relationship of negative sign is validated. This result is in line with the economic theory of permanent income hypothesis, since high volatility implies high uncertainty leading to lower consumer confidence.

To be more specific, the impact of volatility in the oil prices (variance) reflecting the uncertainties in the economic environment and their impact on the consumer confidence among and within the regimes, has provided us with the following results. The first threshold coincides with the terrorism attack in 2001 in New York. This fact is related to psychological effects and thus consumer confidence is in accordance with the theory of animal spirits introduced by Keynes (1936).

The small value, negative sign and statistical significance of the error correction term is interpreted as follows: The system consisted of the two variables that tend to move back with a limited speed to a stable position. This result is closely related to

additional factors affecting the behavior of consumer sentiment and not only the macroeconomic fundamentals as already mentioned above. Within the second regime that corresponds to a limited number of observations (an unexpected result) a stable situation is recorded, while the end of the middle regime is found in October 2004. Within this period, in terms of short-term dynamics, every lag of oil volatility evidently plays a statistically significant role in the formation of the consumer confidence (for every level of significance) implying that mainly economic factors along with psychological ones function as determinants of the consumer confidence, as synopsized in the volatility of oil prices.

The last regime started in November 2004 and lasted until the end of the sample period. Within this regime a stable situation is recorded, while the short-term dynamics are not statistically significant for no lag of oil price uncertainty. Thus, the oil price volatility does not provide us with any indication regarding the crises of 2008.

Overall, for the relationship among the oil prices and the consumer confidence according to the results obtained, a relationship of negative sign was confirmed, while oil price increases lead to increases in the overall level of prices, thereby reducing real money balances held by households affecting negatively consumer confidence resulting in reduced aggregate demand.

Regarding the role of the oil price in the consumer confidence among the regimes and according to our findings, the range of the regime differs significantly while once again the existence of the two thresholds is validated with Hansen and Seo test (2002). The first regime includes only 37 observations until December 1998. Within this regime an unstable situation is described. To be more specific, the error correction term is statistically significant with a large step back to the middle regime. Regarding the short-term dynamics, it is worth mentioning that only the fifth lag of oil price is statistically significant, indicating a long memory in the impact of oil price. Regarding the middle regime, the last observation corresponds to the last month of 2012. During that period many initiatives were taken in order to stabilize the European economy and two momentums had already being signed to prevent the bankruptcies of certain member states in the European Union. Although most of the observations are included within this period (middle regime) stability was recorded as indicated by the fact that the error correction term is not statistically significant. Furthermore, the range of each regime is an expected result in terms of statistics. That is the middle regime to be the standard regime and other two regimes to be the extreme regimes (Chevalier, 2011). Finally, within the last regime, evidently no short-term dynamics can be validated according to our findings.

As far as the case of kurtosis is concerned, according to our findings, the higher the value of kurtosis the less the consumer confidence. This is attributed to the fact that as the kurtosis is increased the distribution becomes less even with a higher density around the mean (tailedness and peakedness), which probably means that consumers

perceive oil prices around mean as normal but when the prices deviate from the mean and are at the tails of the distribution then consumers feel uncertain about this, which in turn affects their confidence. On the other hand, a low value of kurtosis gives the consumers the feeling that a greater range of values is a familiar situation, which does not greatly influence their behavior in consumption.

The situation among the regimes alters utterly in the case of kurtosis a variable that provides the asymmetry in the oil prices. To be more specific, within the first regime where 16 observations are included, (similarity with oil prices) the statistical significance of the error correction term and the constant term indicate a step backward to the middle regime that is characterized by stability. Within this period the economic factors seem to dominate and determine the consumer confidence. For that reason, as regard the short-term dynamics, the third lag of kurtosis is statistically significant for every level of significance. The last regime lasts until December 2012 is characterized by stability within which various economic events can be recorded. For that reason, regarding the short-term dynamics, the first lag of the kurtosis is statistically significant at the 5% level. The third regime within which numerous economic changes were recorded the theory of animal spirits prevailing. For that reason, no short-term dynamics is validated as statistically significant.

Regarding the relationship between the skewness of oil prices and consumer confidence, the existence of a long-term relationship was confirmed. We also found that asymmetry in oil returns, is negatively related to consumer confidence probably due to psychological reasons. Specifically, the larger the oil asymmetry the more the dispersion of oil prices in the right side of the distribution. This deviation from the ordinary prices or norm is perceived by the consumers as a further lack of security and uncertainty that the increased oil prices cause.

To summarize, according to our findings, oil prices are an important variable in the formation of consumer confidence. Not only the prices of oil, but also the moments of oil prices are related to the consumer confidence. Considering that oil prices are a significant variant in economy and perceived as news by the consumers, the result we have reached is in line with the existing literature, according to which consumer confidence is strongly affected by the news spread as well as by the signals of the economy regarding its growth.

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