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Asymmetric response of Investor sentiment to Economic Policy Uncertainty, interest rates and oil price uncertainty: Evidence from OECD countries

Hassen Guenich¹, Khalifaoui Hamdi^{2*} and Néjib Chouaibi¹

Abstract: The question of the economic policy uncertainty, interest rate and oil price volatility and their effects on investor sentiment is rarely addressed by the literature. Thus, we are motivated to provide new insights into the study of these effects based on asymmetric analysis. Our empirical study is based on the monthly frequency of 22 OECD countries and ranges from January 2000 to June 2021. Using the Nonlinear Autoregressive Distributed Lag (NARDL) panel model, we find that economic policy uncertainty, interest rate and oil price uncertainty have disproportionately asymmetric effects on OECD investor sentiment in the short and long run. Indeed, when occurring volatility of these variables, investors will certainly adopt, according to their sentiments, different directions and strategies of investment decision-making.

Subjects: Consumer Psychology; Economic Psychology; Investment & Securities; Risk Management

Keywords: Economic policy uncertainty; interest rate; oil price volatility; investor sentiment; asymmetric relationships; NARDL

JEL classification: E44; E71; G41; Q43

1. Introduction

Economic policy uncertainty (EPU), oil price uncertainty (OPU) and interest rates (IR) are carefully controlled by market actors as they are effective and influential in shaping future investor expectations. On the other hand, investor sentiment, as measured by the economic confidence index, is an important determinant of the stock and money markets given its vital role in financial and economic development. However, identifying the variables that affect it remains an important challenge. In fact, an examination of these variables and their impact on investor sentiment proved to be important. Such an issue is of long standing interest to policymakers, market participants and academics. Over the last decade, academics have become increasingly interested in investors' sentiments and their potential impact on economic and financial indicators. Investor sentiment is a fundamental aspect of the capital market, as it causes frequent instabilities in share prices and therefore creates uncertainty about the future return on any investment. It can be defined as a rough measure of stock market attitudes at a given time period. Baker and Wurgler (2006) state that investor sentiment may be explained as the way investors form beliefs or as the optimism/pessimism of an investor about the future of asset returns in the integrated stock market activity.

The current research question seems to investigate factors that influence investor's sentiment and consequently investment decision-making. Thus, we have chosen to estimate the effects of economic policy uncertainty, interest rates and oil price uncertainty on investors' sentiment. These variables, which appear to be most influential on the investor's entrepreneurial behavior, constitute the pillars of the business climate of the majority of investors. However, it is important to note that the issue of interaction between investors' sentiment and macroeconomic variables remains indeterminate. Obviously, monetary and political stability is a guarantee and a risk-free insurance for investment. The investors' sentiment varies depending on the volatility of macroeconomic variables and uncertainty of the economy.

According to the relevant literature, investor sentiment can be influenced either by the volatility of the exchange rate, the interest rate, the stock market, the oil price or by the economic policy uncertainty. Causality between investors' sentiment and the other variables is sometimes bidirectional, unidirectional and sometimes absent. The impact in both directions can be symmetrical and asymmetrical, depending on the characteristics of the country panels chosen, the estimation method and the magnitude of the shock and volatility of macroeconomic variables.

Vurur (2020) asserts that the causality is two-way between investor sentiment and exchange rate and one-way between interest rate and investor sentiment. He et al. (2019), however, claim that the causality is bidirectional between crude oil prices and individual investor sentiment. In addition, oil price has significant long-run and short-run asymmetric effects on individual investor sentiment, while individual investor sentiment has no asymmetric effect on oil price. The results of Zhang and Li (2019) show that there is a co-movement between investor sentiment and extreme risk in the crude oil market. Investor sentiment can cause extreme risk in the crude oil market but not vice versa. However, Kumari and Mahakud (2016) and Le and Luong (2022) find a unidirectional causality of sentiment to stock market volatility. On the other hand, investor sentiment responds significantly and asymmetrically to stock market volatility during crisis periods (Rupande et al., 2019; Solanki & Seetharam, 2018; Soltani & Boujelbene Abbes, 2022) and to the increase in economic policy uncertainty (Zhang, 2019). Conversely, investor sentiment shocks lead to significant fluctuations in stock prices (Li, 2015; Solanki & Seetharam, 2018) and increased risk in the oil market (Zhang & Li, 2019)

The impact of EPU on oil price can be transmitted via declines in growth, investment, and demand (Antonakakis et al., 2014; Jones and Olson, 2013). Besides, the oil price volatilities can have an impact on the economy through macroeconomic policies such as fiscal policy (Pieschacón, 2012), and stock markets through investor sentiments (Nartea et al., 2020; Xiao et al., 2019; Yang et al., 2019). However, economic policy uncertainty can have an asymmetric impact on investor sentiment explained by real options theory and financial constraints (Zhang, 2019).

Apart from the studies of Marschner and Ceretta (2021) and Vurur (2020), who have addressed the question of the direct impact of the interest rate on investor sentiment, the majority of previous studies have attempted to investigate the impact of interest rate on investment and not on investor sentiment (Holt, 2000; Florio, 2004; Aghion et al., 2010; Georgiadis, 2015; Wang et al., 2017). This implies that monetary policy conduct in OECD countries influences widely investor sentiment on investment choice and decision-making. However, when the interest rate increases, the investor becomes more reticent and risk-averse, otherwise, he becomes more encouraging and enterprising. In addition, previous studies have tried to provide more explanations for the influence of sentiment on financial markets. Still, these studies have ignored the fact that the stock market's reaction to investor sentiment is preceded by the impact of EPU and interest rate. Some researchers (Vuchelen, 2004; Menkhoff and Rebitzky, 2008; Kurov, 2010; Silvia and Iqbal, 2011; Cohen and Kudryavtsev, 2012; Zhang, 2019), posit that these two variables influence the stock market via investor's sentiment to economic and monetary news, as this directly affects the risk of stocks and the investor's risk aversion. This context reinforces the need for new studies that seek to explain investor sentiment.

Referring to the aforementioned studies, we can deduce that the relationships between investor sentiment and EPU, OPU and interest rates can be either symmetric or asymmetric. Thus, the present study is motivated by the evidence of changes in investor sentiment in response to these variables. So, our study contributes to the existing body of research, both from a theoretical and methodological perspective. Firstly, it enriches the research in order to better understand the theoretical effects of economic policy uncertainty, oil price uncertainty and interest rate volatility on investor behavior, a phenomenon that seems to be less investigated. Secondly, compared to previous studies, it brings an improvement in the empirical estimates, using an appropriate econometric model for the identification of asymmetric relationships in the short and long run based on the nonlinear autoregressive distributed lag model (NARDL). Thirdly, at the implicit level, behavioral finance has shown, contrary to classical financial theory, that due to cognitive and sentimental biases, investor's decision-making is not always rational and sometimes appears to be erroneous. Thus, our research aims to examine whether investor sentiment responds symmetrically or asymmetrically to increase or decrease in economic policy uncertainty, oil prices and interest rates.

Nevertheless, it is important to note that changes in EPU, OPU and interest rates, both positive and negative, cannot systematically have a symmetric effect on investor sentiment. The decision to invest in a changing environment is often related to the investor's character traits, the state of his cortex, his cognitive abilities and his degree of risk aversion. Low or high investor sentiment does not usually run counter to rationality or cognition. In most situations, sentiment facilitates cognitive processes and helps the investor to make decisions (Damasio, 1994). As a process of adjustment and evaluation, it plays a moderating role in rational decision-making (Gratch, 2000). The evidence should consider investor sentiment as an early warning signal, whether to modify investment portfolios or to anticipate economic and financial trends.

Our estimated results indicate that economic policy uncertainty, interest rates and oil price uncertainty has disproportionately asymmetric effects on OECD investors' sentiment in the short and long run. However, the volatility of independent variables reduces confidence, changes investors' strategies and investment decision-making.

Methodologically this paper is structured as follows: The next section reviews the recent related literature. The third section lays out the NARDL model and data. The fourth section analyzes the empirical results based on univariate and multivariate analysis. The fifth and the last section summarizes the research conclusions and provides recommendations.

2. Literature review

The literature dealing with the issue of investor sentiment and its determinants is not exhaustive. Indeed, the link between investor sentiment and economic and political uncertainty, oil price uncertainty and interest rate uncertainty remains uncertain and complicated, as the impact of individual psychological behaviors on financial market dynamics is not yet evident.

2.1. Investor sentiment and Economic Policy Uncertainty

Many studies (Bloom, 2009; Allen et al., 2012; Jurado et al., 2015; Narrea et al., 2020; Yang et al., 2019; Zhang, 2019; Narrea et al., 2020; Marschner & Ceretta, 2021) have exposed that EPU has consequences not only on real economic activity (production, purchase and flow of goods and services that firms produce within an economy) but also on the consumer's spending and investment decisions of economic actors. For example, the International Monetary Fund (2012, 2013) proposes that uncertainty over the US and European fiscal and monetary policies donated to an economic decline in 2008 and 2009.

Baker et al. (2016) construct an EPU index based on newspaper coverage frequency. They show that the EPU index affects the intensity of the business cycle and investment performance. They find that policy uncertainty is linked to greater stock price volatility and reduced investment, which

have a significant effect on employment absorption in policy-sensitive sectors like defense, finance, and infrastructure construction projects. Moreover, the results of Marschner and Ceretta (2021) indicate that Brazilian investor sentiment is affected by economic uncertainty to varying degrees and time horizons. On the other hand, to document the negative influence of economic policy uncertainty on stock market returns, Brogaard and Detzel (2015) examine the effect of EPU in the cross-section of stock returns and they propose that the EPU may have a positive effect on stock prices if economic policy-induced uncertainty raises equity risk premium. They conclude that EPU influences both economic and financial aspects.

Based on US and BRICS data respectively, Nartea et al. (2020) and Makololo (2020), have analyzed the influence of EPU on firm performance and investor sentiment. They contribute to understanding how the EPU significantly influences firm performance and corporate decisions. Consequently, policymakers and investors should be conscious of it to prevent any negative effects. Likewise, Zhang (2019) shows the existence of a clear impact of economic policy uncertainty on investor sentiment, which can be explained by real options theory and financial constraints. Testing the hypothesis that the EPU premium is stronger (weaker) after periods of low (high) investor sentiment, Nartea et al. (2020) find that the uncertainty premium is negative and significant only after periods of low investor sentiment. However, it vanishes after periods of heightened feeling. In the same vein Srikanta and Amartya (2022) show that, for the group of seven countries in different market conditions, an increase in EPU increases market volatility and reduces return only in contemporaneous periods. The estimation results also suggest that the impact of EPU is significant in the bear market and has an insignificant impact in the bull market. Also, Pastor and Veronesi (2013) document that an increase in EPU makes stocks more volatile and correlated, especially when the economy is weak. Compared to Kang et al. (2017), Brogaard and Detzel (2015), and Kang and Ratti (2013) that show a negative relationship between EPU and stock market return, Bali et al. (2017) discover that general economic uncertainty is also evaluated in the cross-section of stock returns as they document a negative economic uncertainty in the American market. They show that the negative uncertainty is explained by the limited contribution of pessimistic investors and investors with a high aversion to uncertainty. Christou et al. (2017) find that stock market returns in the Pacific Rim countries have significant negative effects relating to the increased levels of EPU. Raza et al. (2017) examine the equity premium for Canada, France, Germany, Italy, Japan, the UK and the US (the G7 countries) founded on monthly data EPU using a novel technique called quantile regression models. They report the existence of a negative association between equity premium and the EPU in all G7 countries and the estimates also signal a negative association, particularly in the extreme low and extreme high tails.

2.2. Investor sentiment and interest rate

The interest rate is an indicator that can be used to measure the cost of investing and borrowing. Thus, investment is highly sensitive to the interest rate. The increase in the real interest rate reduces confidence in the economy, which leads to low corporate investment (Chavarri, 2010; Nainggolan et al., 2015). In addition, an increase in interest rates negatively affects investment and consumption, and can, therefore, affect corporate performance and its market value.

Numerous studies have shown that the relationship between the real interest rate and investment is negative. With the Exception of the work of Vurur (2020) and Marschner and Ceretta (2021), which showed the existence of a direct unidirectional relationship, from interest rate to investor sentiment, most studies have shown that interest rate has an asymmetric impact on macroeconomic indicators such as national income and price levels (Florio, 2004; Georgiadis, 2015) or unemployment (Kocaarslan et al., 2020). Besides, the study of Long et al. (2020) shows that the real interest rate hurts investment and its inhibitory effect is stronger than the pulling effect. Based on the related literature, the interest rate can represent the interest rate of financing to a certain extent, and it is very likely to have an asymmetrical impact on investment. Finally, although the link seems obvious, it is necessary to study the asymmetric impact of interest rate on investor sentiment.

2.3. Investor sentiment and oil price uncertainty

Fluctuations in the crude oil market and their economic/ financial influences attract the attention of a large number of scholars. Numerous variables can affect the oil price dynamics such as demand side, economic growth, oil future prices, exchange rates, stock prices speculation, investor attention, and investor fear. (Dowling et al., 2016; Li et al., 2015; Wen et al., 2014).

Stambough et al. (2012) find evidence that investor sentiment is a significant factor in illustrating stock-pricing anomalies which lead to the development of behavioral finance areas, linking investor sentiment to the general mood investors' exhibit toward a particular market or asset. Deeney et al. (2015) suggest a measurement of investor sentiment for West Texas Intermediate (WTI) and Brent crude oil futures. The Oil Sentiment index (OSI) includes principally the historic volatility of oil prices, Crude oil futures trading volumes, the Put-call ratio (PCR) of oil options and the ratio of speculative trading in futures markets. They use principal component analysis to construct the OSI and they find that sentiment plays a significant role in explaining WTI and Brent prices.

Narayan and Narayan (2017) investigate the effects of oil price news on stock returns. Their findings suggest that oil price news predicts market returns of some sectors. Ding et al. (2017) apply the principal component analysis method (PCA) to construct an index of Chinese stock market investor sentiment. The results indicate that in the long term, the international volatility of crude oil prices significantly and negatively influences the Chinese stock market investor sentiment index whereas investor sentiment does not affect crude oil, energy, and petroleum prices.

Recently, investor sentiment as an emerging indicator has attracted significant attention in the crude oil market (Dai & Wen, 2018; Wen et al., 2019; Xiao et al., 2019). Investor sentiment is the feeling of a market, or emotions of market players, as revealed through the activity oil market, prices and other commodity market news of the securities traded in that market. It can help to clarify the volatilities in oil prices. Indeed, high sentiment predicts subsequent low oil returns particularly in the long-term and vice versa.

Ding et al. (2017), based on an SVAR model, show that international crude oil price fluctuations have a significant Granger causality effect on investor sentiment in the Chinese stock market. They show that investor sentiment is contagious by international crude oil price volatility. Qadan and Nama (2018) apply parametric and nonparametric techniques to show that investor sentiment has the power to contain informative information for expecting oil price uncertainty and find that investor sentiment, captured by nine different proxies' variables, has a significant effect on oil prices. This study shows also that retail investors grab their attention to the oil market in response to the oil price uncertainty.

In addition, much empirical and theoretical research assumes that an asymmetric relationship between oil price and investor sentiment is crucial to financial markets and economic activity, indicating that positive and negative shocks are transmitted at the same magnitude. However, many studies (Hu et al., 2018; He et al., 2018; Xiao et al., 2019; He et al., 2019; Wen et al., 2019) prove that the asymmetry appears in the response to oil price uncertainty and investor sentiment.

A review of the managerial and financial literature dealing with the issue of the response of investor sentiment to the volatility of macroeconomic variables reveals that no studies have been conducted in this direction, i.e., the response of investor sentiment to economic policy uncertainty, oil price uncertainty and interest rates. Therefore, our motivation is to examine the extent to which these variables influence OECD investor sentiment over the period January 2000 to June 2021.

3. Data, model and methodology

3.1. Data

For the present study, three independent variables are used. They represent the main and most reported mechanisms of transmission of economic policy uncertainty, energy price uncertainty and interest rate.

The dependent variable that represents investor sentiment is measured by:

- The Business Confidence Index (BCI) used in previous studies (Fernandes et al., 2013; Zhang, 2019; Piccoli et al., 2018).
- The Consumer Confidence Index (CCI) perceives as an alternative measurement of investors' sentiment.

Table 1 lists and describes the dependent, independent and control variables.

Table 1. Description of the variables			
Variable	Notation	Description	Unit of measure
Investor sentiment:	BCI	Measures the business sentiment to developments in production, orders, and stocks of finished goods in different economic sectors, especially the industrial one.	Index
	CCI	Measures the consumer's sentiment to the general economic situation and their finances, the database is downloaded from OEDC stat	Index
Economic policy uncertainty	EPU	Measures the uncertainty of economy based on Baker et al. (2016) information from the main newspapers in the country. These data are obtained from https://www.policyuncertainty.com	Index
Interest rate	IR	The basic interest rate of the economy	Monthly %
Oil price uncertainty	OPU	Oil price uncertainty based on a standard deviation of Brent oil price	Dollar
Inflation rate	CPI	The official inflation rate of the OEDC countries was downloaded from OEDC Stat.	Monthly %
Economic growth	LnGDP	The gross domestic product which represents the economic growth of countries	Dollar
Money supply	LnM2	Broad Money supply reflects the real liquidity in the economy	Dollar

3.1.1. *Dependent variable: Investor sentiment*

Investor sentiment reflects the combined expectations and beliefs of investors on the fundamentals of the economy and markets (Baker & Wurgler, 2006). Future developments of households' consumption and saving, based on answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings are the main indicators of consumer confidence. Lemmon and Portniaguina (2006) and Qiu and Welch (2004) argue that the changes in the consumer confidence index (CCI) can successfully predict variations in stock prices and that it is a relatively reliable measure of investor sentiment (Akhtar et al., 2011). Hence, we use the OECD CCI as our proxy for investor sentiment. We collect the CCI of the OECD countries from the OECD database from January 2000 to June 2021. Then, we classify each month in the sample into quintiles according to the change in the CCI.

Also, indicators of future developments are based upon opinion surveys on developments in production, orders and stocks of finished goods in different economic sectors. They can be used to monitor output growth and to anticipate turning points in economic activity. Thus, we employ the change in the Business Confidence Index (BCI) as an alternative measurement of investors' sentiment. The BCI reflects OECD Business' confidence, which might be more relevant to investors' confidence. Data of the Business Confidence Index (BCI) are downloaded from the OECD stat.

3.1.2. *Independent variables*

3.1.2.1. *Economic policy uncertainty (EPU)*. For economic policy uncertainty, we use the index constructed by Baker et al. (2016). This index is a weighted average of three uncertainty components: (1) newspaper coverage of policy-related economic uncertainty; (2) the number of federal tax code provisions set to expire in future years, and (3) a measure of disagreement among economic forecasters as a proxy for uncertainty. This index is closely related to the major macro-economic variables such as growth, investment, employment, etc.

To verify the asymmetric sensitivity of investor sentiment to economic policy uncertainty, we need to calculate two new panel series: increasing EPU and decreasing EPU which will be noted respectively EPU_pos and EPU_neg and calculated as follows:

$$EPU_pos_{it} = \sum_{k=1}^t 1\{\Delta EPU_{it-k} \geq 0\} \Delta EPU_{it-k} \quad (1)$$

$$EPU_neg_{it} = \sum_{k=1}^t 1\{\Delta EPU_{it-k} \leq 0\} \Delta EPU_{it-k} \quad (2)$$

3.1.2.2. *Oil price uncertainty (OPU)*. We use the monthly oil prices of Brent in order to calculate the uncertainty of oil price. Database of this variable is collected from investing.com web Site and covers the period January 2000-June 2021. The Brent crude oil price uncertainty is presented by standard deviation. Volatility is the error in estimating a parameter, such as the mean of a sample, the difference in means between two experimental treatments, or the predicted response that has given a certain change in conditions. Uncertainty is measured with a variance or its square root, which is a standard deviation. The measurement of uncertainty through standard deviation is used in many experiments in social sciences and finances. So, the more risky and volatile firms have a higher standard deviation, and conversely. The standard deviation is the square root of the variance, and so computed by

$$\sigma_y = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n - 1}} \quad (3)$$

To check the asymmetric responses of investor sentiment, we calculate the positive and negative variation variable of the EPU (EPU_pos and EPU_neg), the OPU (OPU_pos and OPU_neg):

$$OPV_pos_{it} = \sum_{k=1}^t 1\{\Delta OPU_{it-k} \geq 0\} \Delta OPU_{it-k} \quad (4)$$

$$OPV_neg_{it} = \sum_{k=1}^t 1\{\Delta OPU_{it-k} \leq 0\} \Delta OPU_{it-k} \quad (5)$$

3.1.2.3. *Interest rate (IR)*. The interest rate refers to the required return necessary to make a project or investment worthwhile. If it is financed externally, it is used to refer to the cost of debt. The discount rate is the interest rate used to determine the present value of future cash flows in a discounted cash flow. This paper selects the real interest rate as the proxy index to measure the change in the interest rate of the investment. The variable will be noted in the following work as IR and divided into increasing interest rate (IR_pos) and decreasing interest rate (IR_neg). These new two variables are calculated as follows:

$$IR_pos_{it} = \sum_{k=1}^t 1\{\Delta IR_{it-k} \geq 0\} \Delta IR_{it-k} \quad (6)$$

$$IR_neg_{it} = \sum_{k=1}^t 1\{\Delta IR_{it-k} \leq 0\} \Delta IR_{it-k} \quad (7)$$

3.2. Model

To examine the asymmetric effect of EPU, OPU and IR on investor sentiment in OECD countries, we use the following regression model.

$$\begin{aligned} Investorsentiment = & \begin{cases} BCI_{i,t} \\ CCI_{i,t} \end{cases} = \alpha_0 + \alpha_1 \begin{cases} BCI_{i,t-1} \\ CCI_{i,t-1} \end{cases} + \alpha_2 EPU_{pos_{i,t}} + \alpha_3 EPU_{neg_{i,t}} + \alpha_4 IR_{pos_{i,t}} \\ & + \alpha_5 IR_{neg_{i,t}} + \alpha_6 OPU_{pos_{i,t}} + \alpha_7 OPU_{neg_{i,t}} + \alpha_8 LnGDP_{i,t} + \alpha_9 LnM2_{i,t} + \alpha_{10} CPI_{i,t} + \varepsilon_{i,t} \end{cases} \quad (8) \end{aligned}$$

The Nonlinear Autoregressive Distributed Lag (NARDL) model can capture the asymmetric effects both in the short and the long run and also can be used when variables are mixed by I(0) and I(1).

In order to identify the long- and short-run asymmetric impacts of our described independent variables (INDV), we construct an unrestricted error correction model. In this regard, independent variables are decomposed into a partial sum of positive and negative changes as suggested by Shin et al. (2014), as follows:

$$INDV_pos_{it} = \sum_{k=1}^t 1\{\Delta INDV_{it-k} \geq 0\} \Delta INDV_{it-k} \quad (9)$$

$$INDV_neg_{it} = \sum_{k=1}^t 1\{\Delta INDV_{it-k} \leq 0\} \Delta INDV_{it-k} \quad (10)$$

$$INDV_{it} = INDV0_{it} + INDV_pos_{it} + INDV_neg_{it} \tag{11}$$

Where, $INDV0_{it}$ is the initial value of the independent variable.

In this case the asymmetric error correction model (AECM) is defined as follows:

$$\begin{aligned} \Delta \begin{cases} BCI_{it} \\ CCI_{it} \end{cases} = & \alpha_0 + \alpha_1 \left\{ \begin{matrix} BCI_{i,t-1} \\ CCI_{i,t-1} \end{matrix} \right\} + \alpha_2 EPU_{pos_{i,t-1}} + \alpha_3 EPU_{neg_{i,t-1}} + \alpha_4 IR_{pos_{i,t-1}} + \alpha_5 IR_{neg_{i,t-1}} + \\ & \alpha_6 OPU_{pos_{i,t-1}} + \alpha_7 OPU_{neg_{i,t-1}} + \alpha_8 LnGDP_{i,t-1} + \alpha_9 LnM2_{i,t-1} + \alpha_{10} CPI_{i,t-1} + \\ & \sum_{t=1}^T a_i \Delta \begin{cases} BCI_{i,t-1} \\ CCI_{i,t-1} \end{cases} + \sum_{t=1}^T b_i^+ \Delta EPU_{pos_{i,t-1}} + \sum_{t=1}^T b_i^- \Delta EPU_{neg_{i,t-1}} + \sum_{t=1}^T c_i^+ \Delta IR_{i,t-1} + \\ & \sum_{t=1}^T c_i^- \Delta IR_{neg_{i,t-1}} + \sum_{t=1}^T d_i^+ \Delta OPU_{pos_{i,t-1}} + \sum_{t=1}^T d_i^- \Delta OPU_{neg_{i,t-1}} + \sum_{t=1}^T e_i \Delta LnGDP_{i,t-1} + \\ & \sum_{t=1}^T f_i \Delta LnM2_{i,t-1} + \sum_{t=1}^T g_i \Delta CPI_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{12}$$

Where, $\alpha_2, \alpha_3, \dots, \text{and } \alpha_{10}$ are the coefficients of the long-run impact of increasing and decreasing of independent variables on investor sentiment.

While $\sum_{t=1}^T b_i^+, \sum_{t=1}^T c_i^+, \dots, \sum_{t=1}^T d_i^+$, and $\sum_{t=1}^T b_i^-, \sum_{t=1}^T c_i^-, \dots, \sum_{t=1}^T d_i^-$ are respectively the short run coefficient of rising and falling independent variables.

Following the Pesaran et al. (2001), and Shin et al., (2014), the long-run cointegration relationship between variables in AECM is examined by the Pesaran-Shin-Smith F test (F_{PSS}) and F_{BDM} test. The AECM estimation will be examined by normality test, Breusch-Godfrey LM test for serial autocorrelation, Breusch-Pagan test for heteroskedasticity.

4. Empirical analysis

4.1. Univariate analysis

Table 1 summarizes the descriptive statistics of the independent and dependent variables of the sample countries under study, which were calculated from their data statements, showing the mean, the median, the maximum, the minimum, the skewness, kurtosis, the SD and Jarque-Bera normality test for each variable.

As shown in Table 2, the average and median of investor sentiment (BCI) are 100.110 and 100.23. These high values mean that the OECD countries are a good space for investment. The mean (maximum) values of respectively EPU_pos and EPU_neg are 1688.9 (5761.8), and -1651.5 (0.000) with an SD respectively of 1233.7 and 1205.5, suggesting that economic policy uncertainty in the OECD countries is rather volatile and high on average. The averages of interest rate (IR) of increasing and decreasing series are respectively 7.244 and -11.25 and the median is respectively 5.600 and -9.080. These ratios show that the OECD countries succeed to encourage investment by keeping the interest rate in its low values. The means (SD) increasing and decreasing series of Brent oil price uncertainty are respectively 22.47 (13.48) and -8.378 (11.39) which indicate that oil price is more volatile in its decreasing series. The values of Skewness, Kurtosis and the Jarque-Bera tests indicate that our variables are not normally distributed.

Before carrying out empirical estimation, all data need to be tested for stationarity. This paper uses Im, Pesaran & Shin test. It can be seen from the test results in Table 3 that at a significance level of 5%, we find variables that are integrated of zero-order I (0) such as IR_pos, IR_neg, OPU_pos

Table 2. Descriptive statistics

	BCI	CCI	EPU-pos	EPU-neg	IR-pos	IR-neg	OPU-pos	OPU-neg	LNGDP	LNCP1	LNMS3
Mean	100.110	100.1148	1688.9	-1651.5	7.244	-11.25	22.47	-8.378	1.430	10.24	4.606
Median	100.23	100.25	1455.9	-1407.0	5.600	-9.080	27.59	-2.631	1.477	10.29	4.607
Maximum	105.676	109.15	5761.8	0.0000	34.12	0.000	35.28	0.000	2.670	11.001	4.66
Minimum	83.2254	91.8728	0.000	-5663.02	0.000	-46.27	0.000	-35.28	0.999	9.275	4.541
Std. Dev.	1.98533	1.9350	1233.7	1205.5	7.398	10.83	13.48	11.39	0.124	0.413	0.017
Skewness	-0.6482	-0.258	0.8001	-0.7392	1.998	-1.328	-0.526	-1.429	-0.305	-0.524	-0.326
Kurtosis	4.4688	3.47577	3.102	2.913	6.938	4.452	1.581	3.187	6.886	2.508	3.534
Jarque-Bera	810.11	111.18	243.95	208.12	2986.7	870.4	296.2	778.99	1468.55	127.38	67.60
Probability	0.0000	0.0000	0.0000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Observations	2277	2277	2277	2277	2277	2277	2277	2277	2277	2277	2277

and CPII(0). But, the CCI, GDP, EPU_pos, EPU_neg, OPU_neg and M3 are integrated of order one I (1), which conforms to the NARDL model for data stationarity requirement. Therefore, we can use the NARDL model to test whether there is an asymmetric relationship between the independent variables and investor sentiment.

4.2. Multivariate analysis

In this section we estimate the following model:

$$\begin{aligned} \text{Investorsentiment} = BCI_{i,t} = & \alpha_0 + \alpha_1 CCI_{i,t-1} + \alpha_2 EPU_{pos_{i,t}} + \alpha_3 EPU_{neg_{i,t}} + \alpha_4 IR_{pos_{i,t}} + \alpha_5 IR_{neg_{i,t}} \\ & + \alpha_6 OPV_{pos_{i,t}} + \alpha_7 OPV_{neg_{i,t}} + \alpha_8 LnGDP_{i,t} + \alpha_9 LnM2_{i,t} + \alpha_{10} CPI_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (13)$$

To analyze the impacts of economic policy uncertainty, interest rate, and oil price uncertainty on OECD countries' investor sentiment, we use the NARDL model. The longest lag period we selected is 10 periods, and the optimal lag period is 3 according to the AIC information criterion in the regression process. The empirical results are shown in Table 4. The statistical value of the bound test of cointegration based on Pesaran-Shin-Smith F approach is 3.91 which is greater than its upper critical value (3.740) at the 1% significance level. This means that the respective null hypotheses are rejected, indicating that there is a long-term cointegration relationship between variables.

Results in Table 3 show that the long-term impact coefficient of the increase in economic policy uncertainty on investor sentiment is -0.01172 , which is significant at the 1% level. This shows that the increase of OECD economic policy uncertainty has a significant detrimental effect on investor sentiment. However, the long-term impact coefficient of the decrease in economic policy uncertainty investor sentiment is 0.01062 , but statistically significant only at the 10% level. This indicates that the decrease in OECD economic policy uncertainty does not significantly boost investor sentiment. We deduce that only an increase in EPU, especially in long term, significantly influences investors' sentiment and consequently crowds out investment chances. Almost the same results are found in the short-term in the case of the increase of the EPU (1% level) and absent in the case of decrease. These findings that corroborate the majority of previous studies (Bloom, 2009; Allen et al., 2012; Jurado et al., 2015; Gilbert et al., 2019; Yang et al., 2019; Nartea et al., 2020; Marschner & Ceretta, 2021) are justified by Wald test value, presented in Table 4. In fact, EPU is an important psychological factor for investors. It reduces confidence in economic system and consequently affects investment, consumption and savings decisions. Otherwise, political and economic stability strengthen investor confidence and make them more reassuring.

Also, results in Table 3 show that the long-term impact coefficient of the increase in the interest rates is -0.7654 , which is significant at the 1% level, indicating that an increase in interest rates will negatively influence investor sentiment. However, the long-term impact coefficient of the decrease in the interest rate is 0.2391 , but is significant only at the 10% level, indicating that a decrease in interest rate does not affect significantly investor sentiment. The same results are found in the short term case with less significance in the case of the interest rate increase (5% level). These results, which are in some way similar to those of Vurur (2020) and Marschner and Ceretta (2021), imply, whether in the long or short term, that the interest rate influences investor sentiment asymmetrically. It discourages investors in the case of an increase and makes them indifferent in the case of a decrease. In addition, other studies have shown that macroeconomic indicators such as national income and price levels (Florio, 2004; Georgiadis, 2015) or unemployment (Kocaarslan et al., 2020) also respond asymmetrically to interest rate changes.

Results presented in Table 5 indicate that the Wald test findings show that the length asymmetry test value of the impact of interest rate on investor sentiment fails to pass the significance test. They show that the Wald asymmetry test in the short run is significant, indicating that the

Table 3. Unit root test

Variable	Im,Pesaran& Shin unit root test statistics (Z-t-tilde-bar)	Accepted hypothesis
BCI	-0,3456	Integrated of order 1
CCI	-0.5949	Integrated of order 1
EPU_pos	16.8138	Integrated of order 1
EPU_neg	17.8549	Integrated of order 1
IR_pos	-8.0440***	Stationary
IR_neg	-6.5116***	Stationary
OPU_pos	-10.9349***	Stationary
OPU_neg	27.9365	Integrated of order 1
GDP	4.0299	Integrated of order 1
CPI	-5.4864	Stationary
M3	-0.5175	Integrated of order 1

Note: The superscripts ***, **, and * represent 1%, 5%, and 10% significance, respectively.

Table 4. Asymmetric impact of economic policy uncertainty, interest rates and oil price uncertainty on investor sentiment (BCI)

D.BCI	variable	Coefficient	D.BCI	Variable	Coefficient
Long-run relationships	$CCI_{i,t-1}$	-0.03531***	Short run relationships	$\Delta EPU_pos_{i,t}$	-0.00164***
	$EPU_pos_{i,t-1}$	-0.01172***		$\Delta EPU_neg_{i,t}$	0.000036
	$EPU_neg_{i,t-1}$	0.01062*		$\Delta IR_pos_{i,t}$	-0.19124**
	$IR_pos_{i,t-1}$	-0.7654***		$\Delta IR_neg_{i,t}$	0.089734*
	$IR_neg_{i,t-1}$	0.2391*		$\Delta OPU_pos_{i,t}$	-0.02857**
	$OPU_pos_{i,t-1}$	-0.02696**		$\Delta OPU_neg_{i,t}$	-0.00751*
	$OPU_neg_{i,t-1}$	-0.00854*		$\Delta IPC_{i,t}$	0.09343***
	$IPC_{i,t-1}$	-0.073224**		$\Delta LnGDP_{i,t}$	-.0018**
	$LnGDP_{i,t-1}$	0.0001839***		$\Delta LnM2_{i,t}$	-1.5146**
		$LnM2_{i,t-1}$		0.910872***	Const
Normality test		$\chi^2_{norm} = 19,914$, and Prob> chi2 = 0.0006			
Breusch-Pagan test of Heteroscedasticity		$\chi^2_{het} = 1.142$, and Prob > chi2 = 0.3110			
Ramsey test of misspecification		F(3, 2255) = 0.77, and Prob > F = 0.5127			
Bound cointegration test		$F_{PSS} = 3,91$,and Prob>F = 0.003			

Notes: (1) ***significance at 1%, **significance at 5%, and *significance at 10% level;

(2) F_{PSS} indicates the Pesaran-Shin-Smith F test, the critical value is adopted, k = 4, and the upper bound test statistics at 10%, 5%, and 1% are 2.450, 2.860, and 3.740 respectively;

impact of OECD interest rate on investor sentiment is asymmetric in the long run but is symmetric in the short run.

Lastly, the long and short run impact coefficients of the rising and falling of oil price uncertainty on investor sentiment are respectively -0.02696 (-0.02857) and -0.00854 (-0.00751). They are significant, respectively at the level of 5% and 10%, indicating that only increase in oil price negatively and significantly influence investor's sentiment. Indeed, the increase in the oil price affects the economies of the OECD countries, which are major oil importers, in two ways. On the supply side, the general index of producer prices increases, the competitiveness of companies'

Table 5. Wald of long and short-run asymmetry relationship test

Null hypothesis	Long run		Short-run	
	Wald statistic	p-value	Wald statistic	p-value
EPU_pos = EPU_neg	7.23	0.0072	13.50	0.0002
IR_pos = IR_neg	5.97	0.0183	4.72	0.0490
OPU_pos = OPU_neg	9.12	0.0025	0.53	0.4676

decreases and consequently investment decreases. On the demand side, purchasing power weakens, consumption decreases due to inflation and the trade balance deteriorates, resulting in lower growth. However, the decrease in oil prices may have a negative and less significant impact on OECD countries (10% level), due to the risk of deflation. These results are consistent with He et al. (2019), who show that oil prices have significant asymmetric long-run and short-run effects on individual investor sentiment, while individual investor sentiment does not have an asymmetric effect on oil prices. In contrast, the work of Zhang and Li (2019) shows that at a 1% significance level, investor sentiment causes extreme risk in the oil market but not vice versa.

The results of the Wald test show that the asymmetric impact of oil price uncertainty on investor sentiment is significant in the long run, but not significant in the short run, indicating that the effect of the oil price uncertainty is symmetric and asymmetric respectively in the long run and the short run.

Most studies that focused their research on the link between EPU and investor sentiment (e.g., Nartea et al., 2020; Yang et al., 2019; He et al., 2019; Xiao et al., 2019) or EPU and the stock market and or oil price uncertainty (Kang & Ratti, 2013; Zhang & Li, 2019; He et al., 2019; Pastor & Veronesi, 2013; Srikanta & Amartya, 2022) or interest rates and investor sentiment (Vurur, 2020; Marschner & Ceretta, 2021) have resulted in an often negative and conditional relationship. Nevertheless, our present study shows that economic policy uncertainty, interest rate and oil price uncertainty have different asymmetric effects on investor sentiment either in the short or long term. Indeed, as shown in Table 6, investor sentiment is highly sensitive to the increase (decrease) of EPU. Moreover, an increase (decrease) in the interest rate tends to be negatively (positively) associated with investor sentiment. The increase tends to lead investors to diversify their portfolios and seek better returns whenever real interest rates change. As a result, there is a reduction in consumption and investment, which means that investor expectations evaporate. However, the lowering of the interest rate helps investors' expectations. Finally, Investor sentiment is also sensitive to changes in the OPU, but unlike the EPU and interest rate, the positive impacts are greater than the negative impacts. Although to different extents, the negative relationship indicates that the oil price uncertainty leads to a reduction in investor sentiment.

In sum, we note that the increase in these three variables has a substantial significant impact on the investor's sentiment and subsequently on his investment decision, whereas their decrease is only significant in the case of the OPU.

The results presented in the diagnostic statistics summary (see rows 12, 13, 14, and 15 in Table 3) support the validity of the estimated model. The Breusch-Pagan-Godfrey LM does not reject the null hypothesis regarding the absence of heteroscedasticity. The Jarque-Bera test indicates the normality of the residuals, and the Ramsey regression equation specification error test does not reject the null hypothesis indicating any specification error in the regression equation.

Table 6. Summary of estimation

Variable	Economic Policy Uncertainty		Oil Price Uncertainty		Interest Rates	
	Long term	Short term	Long term	Short term	Long term	Short term
Increase	1%	1%	5%	5%	1%	5%
Decrease	10%	Not significant	10%	10%	10%	10%

4.3. Robustness test

The main objective of this section is to check the robustness of our main findings. We investigate whether the long and short-run coefficients of our independent variables (economic policy uncertainty, interest rate, and oil price uncertainty) keep the same signs, same significances, and same asymmetric relationships, where we use an alternative measure of the investor sentiment: Consumer Confidence Index (CCI). The new regression model is the following:

$$\begin{aligned}
 Investorsentiment = CCI_{i,t} = & \alpha_0 + \alpha_1 BCI_{i,t-1} + \alpha_2 EPU_{pos_{i,t}} + \alpha_3 EPU_{neg_{i,t}} + \alpha_4 IR_{pos_{i,t}} + \alpha_5 IR_{neg_{i,t}} \\
 & + \alpha_6 OPU_{pos_{i,t}} + \alpha_7 OPU_{neg_{i,t}} + \alpha_8 LnGDP_{i,t} + \alpha_9 LnM2_{i,t} + \alpha_{10} CPI_{i,t} + \varepsilon_{i,t}
 \end{aligned}
 \tag{14}$$

The estimation results of model 14 are reported in Tables 7 and Table 8. The main finding is that the expected results of the effect of EPU, IR and OPU on investment sentiment are consistent. Indeed, the coefficients of the increase and decrease of economic policy uncertainty are respectively negative and significant at the 1% level, and positive and significant at

Table 7. Asymmetric impact of economic policy uncertainty, interest rate and oil price uncertainty on investor sentiment (CCI)

D.CCI	Variable	Coefficient	D.CCI	Variable	Coefficient
Long-run relationships	$CCI_{i,t-1}$		Short run relationships	$\Delta EPU_{pos_{i,t}}$	-0.00185***
	$EPU_{pos_{i,t-1}}$	-0.00935***		$\Delta EPU_{neg_{i,t}}$	0.000592***
	$EPU_{neg_{i,t-1}}$	0.002245**		$\Delta IR_{pos_{i,t}}$	-0.30507*
	$IR_{pos_{i,t-1}}$	-0.7945***		$\Delta IR_{neg_{i,t}}$	0.5373*
	$IR_{neg_{i,t-1}}$	0.1252*		$\Delta OPU_{pos_{i,t}}$	-0.13633**
	$OPU_{pos_{i,t-1}}$	-0.0366**		$\Delta OPU_{neg_{i,t}}$	-0.23062
	$OPU_{neg_{i,t-1}}$	-0.0148*		$\Delta IPC_{i,t}$	0.03674**
	$IPC_{i,t-1}$	-0.0901***		$\Delta LnGDP_{i,t}$	-0.00253**
	$LnGDP_{i,t-1}$	0.00429***		$\Delta LnM2_{i,t}$	2.0281**
	$LnM2_{i,t-1}$	1.5228***		Const	2.9732**
Normality test	$\chi^2_{norm} = 25,769$ and Prob > chi2 = 0.00041				
Breusch-Pagan test of Heteroscedasticity	$\chi^2_{het} = 1.626$ and Prob > chi2 = 0.2341				
Ramsey test of misspecification	F(3, 2255) = 0.28 and Prob > F = 0.8394				
Bound cointegration test	F _{PSS} = 3,83 and Prob > F = 0.007				

Notes: (1)***significance at 1%, **significance at 5%, and *significance at 10% level;
 (2) F_{PSS} indicates the Pesaran-Shin-Smith F test, the critical values are adopted, k = 4 and the upper Bound test statistics at 10%, 5%, and 1% are 2.450, 2.860, and 3.740 respectively.

Table 8. Wald of long and short-run asymmetry relationship test

Null hypothesis	Long run		Short-run	
	Wald statistic	p-value	Wald statistic	p-value
EPU_pos = EPU_neg	8.25	0.0041	4.06	0.0438
IR_pos = IR_neg	25.47	0.0000	5.35	0.0208
OPU_pos = OPU_neg	10.34	0.0011	1.10	0.2938

10% level. This indicates that EPU influences asymmetrically investor sentiment (CCI). Table 5 shows that the long-run coefficient of the increase and decrease of the interest rate is in opposed signs and significant at the 1% and 10% respectively. Added to that, the Wald asymmetric tests confirm our findings that the interest rate effect on investor sentiment is asymmetric in the long and short run. Finally, results presented in Tables 7 and 8 show that the increase in the oil price uncertainty effect is significant and greater than that of the decrease but not asymmetric.

5. Conclusion

The purpose of this study is to explore the response of investor sentiment to changes in the economic policy uncertainty, interest rates and oil price uncertainty. In other words, it aims to know whether the confidence attributed by investors to the OECD economies varies symmetrically or asymmetrically in response to an increase or decrease of these variables. Overall, the results show that economic policy uncertainty, interest rates and oil price uncertainty have disproportionate asymmetrical effects on investor sentiment and consequently on investment decisions.

Firstly, economic policy uncertainty and interest rates have a negative asymmetric effect on OECD investor sentiment. The increase of these variables has a significant demoralizing effect on investor sentiment in the short and long term. Nevertheless, their decrease has no significant effect on investor sentiment.

Secondly, the long and short term impact of increase (decrease) in oil price uncertainty on investor sentiment is significant at 5% (10%) level. Thus, an increase in oil price uncertainty has a more significant and negative effect on investor sentiment compared to decrease.

Based on the above analysis, our results suggest that investors, stakeholders, and economic policy makers should consider sentiment as a leading indicator for diversifying investment portfolios or to rationally anticipate economic and financial trends, mainly in crisis and uncertainty periods. Besides, OECD economic and monetary policy authorities as well as policy-makers must monitor and control with distrust the determinants of investor sentiment, given their gravity in terms of economic influence and spillover. This monitoring and control must be strengthened especially during periods of crisis and uncertainty.

Considering these constraints, OECD countries should develop strategies to strengthen their economies by promoting a stable and favorable business climate for investment. These actions reduce the risk of economic policy uncertainty and improve visibility. Nevertheless, OECD countries also need to rethink their monetary and energy policies to reassure investors and regain their confidence.

Although the results of this work are oriented towards the psychology of the investor and its importance in behavioral finance, which breaks with classical theory and presupposes that investors show rational behavior, they remain limited in theory and economic implications. The first limitation is that we have not proceeded by empirical analysis of causality between investor sentiment and EPU,

OPU and interest rate to understand which causes the other. The second limitation is that we may have omitted other determinants that are considered influential in relation to investor sentiment, such as exchange rate, market efficiency and ESG performance. The third limitation is that we have not expanded our sample for other country panels to determine whether the independent variables are generalizable or not. The last limitation is that we have not worked on crises periods to know the reaction of investors to their investment decisions. Certainly, future research on investor sentiment and its determinants should take into consideration these shortcomings in order to better understand this relationship and consequently expand the literature on behavioral finance.

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