

OIL PRICE FLUCTUATIONS AND JOB CREATION SECTORS IN EAST JAVA PROVINCE: TESTING FOR NON-LINEARITY

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ABSTRACT

This research intends to trace the effects of fluctuations in Brent and WTI oil prices on the job creation sector of East Java Province. The GARCH (1,1) method is used to track the value of oil price fluctuations and the NARDL method is used to find the magnitude of the asymmetric effects. Data from the quarterly time series 2011Q1-2022Q4 is also used in this research. The results of the asymmetric test show a significant positive influence between negative fluctuations in Brent and WTI oil prices on the job creation sector in the short run. A significant negative influence exists between positive fluctuations in Brent and WTI oil prices in the long run. The test results have contributed to a more complex theoretical study of the impact of oil price fluctuations on the business sector at the provincial level. The test results have produced practical recommendations for stakeholders in East Java Province, namely policymakers and business actors who need to create and use new alternative fuels in production activities—for example, using domestic oil or renewable energy so that it can reduce dependence on international oil price movements. Policymakers can also implement international oil import tariffs and quotas to curb its use.

Keywords: Oil Price Brent, Oil Price WTI, Job Creation Sectors.

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ABSTRAK

Penelitian ini bermaksud untuk melacak pengaruh fluktuasi harga minyak Brent dan WTI terhadap sektor lapangan usaha Provinsi Jawa Timur. Metode GARCH (1,1) digunakan untuk melacak nilai fluktuasi harga minyak dan metode NARDL digunakan untuk mencari besaran pengaruh secara asimetris. Data dalam bentuk time series kuartalan 2011Q1-2022Q4 juga digunakan dalam penelitian ini. Hasil uji asimetris terlihat bahwa terdapat pengaruh positif signifikan antara fluktuasi negatif harga minyak Brent dan WTI terhadap sektor lapangan usaha dalam jangka pendek dan terdapat pengaruh negatif signifikan antara fluktuasi positif harga minyak Brent dan WTI dalam jangka panjang. Hasil uji telah berkontribusi dalam kajian teoritis yang lebih kompleks tentang dampak fluktuasi harga minyak terhadap sektor lapangan usaha di tingkat provinsi. Hasil uji tersebut telah menghasilkan rekomendasi yang efektif terhadap stakeholders di Provinsi Jawa Timur, yaitu para pembuat kebijakan dan pelaku usaha perlu untuk menciptakan dan menggunakan alternatif bahan bakar baru dalam aktivitas produksi. Misalnya, menggunakan minyak domestik atau renewable energy sehingga dapat mengurangi ketergantungan terhadap pergerakan harga minyak internasional. Pembuat kebijakan juga dapat menerapkan kebijakan tarif dan kuota impor minyak berskala Internasional untuk membendung penggunaannya.

Kata Kunci: Harga Minyak Brent, Harga Minyak WTI, Sektor Lapangan Usaha

JEL: E32; J63; Q43; L60

Introduction

Fluctuations in international oil prices are a significant factor that has a profound implication for the country's economic activities, including specific regions. These prices play a critical role in determining the input costs for production, such as electricity generation, operation of production machinery, and transportation of goods to the market. Over the past decade, oil prices have shown to be highly volatile. In 2007, there was an extraordinary surge in oil prices, reaching US\$145 per barrel, followed by a sharp decline to below US\$40 per barrel in 2008 after the financial crisis. This extreme increase was driven by rapid economic growth in developing countries, leading to a positive demand shock (Hamilton, 2009; Kilian & Hicks, 2013). Subsequently 2014, oil prices experienced another downturn, attributed to the shale oil revolution, causing an increase in the spread between WTI and Brent in Europe from 2011 to 2014. In general, the decline in oil prices resulted from oversupply, high inventory levels, and reduced demand (Klein, 2018; Baumeister & Kilian, 2016). In 2022, oil prices rebounded, influenced by global geopolitical instability and an upsurge in oil demand.

The impact of the increase in oil prices is strongly felt in the economic performance of East Java Province. This is evident in the fourth quarter of 2022, where economic performance grew positively but slower than in the previous quarter. In the quarterly report, the economic performance of East Java grew by 4.76% (YoY), which is lower than the 5.59% growth recorded in the third quarter of 2022. The slowdown in the economy of East Java in the fourth quarter of 2022 is mainly attributed to the deceleration of domestic and external demand due to the escalation of global uncertainty, the impact of the adjustment in oil prices on September 3, 2022, and the completion of several government incentives. This is reflected in the lower growth of Household Consumption, foreign exports, and interregional trade. The domestic and external slowdown has led to a decline in the performance of East Java's key industries, namely Manufacturing, Trade, Accommodation, and Food Service.

The examination of how fluctuations in oil prices impact economic performance has produced varied findings. For example, Hamilton (1983) discovered evidence indicating a significant association between oil price shocks and the United States economy, concluding that such shocks contributed to recessions in the United States from 1948 to 1972. Subsequently, Mork (1989) argued that upswings in oil prices negatively correlated with economic growth and highlighted a notable asymmetric effect. Conversely, downturns in oil prices show a weak correlation with economic growth. Lee et al. expanded on previous research by introducing normalized oil shock variables, utilizing a Vector Autoregressive Model (VAR), and updating data until 1992. Test results suggested that consistent fluctuations in oil prices have a more substantial impact on economic growth than erratic changes.

Recent research has initiated a closer examination of the intricate relationship between oil prices and economic performance, particularly within specific domains such as business sectors, given the substantial influence of oil prices on shaping the economic landscape. Davis & Haltiwanger (2001) contribute to this exploration with their study focusing on the impact of oil price shocks on job creation and destruction within the U.S. manufacturing sector from 1972 to 1988. The study's findings indicate that oil price shocks account for 20–25 percent of the variability in job growth, a magnitude twice that of monetary shocks. The responses of jobs over two years to an upswing in oil prices are influenced by capital intensity, energy intensity, and product durability. Notably, job destruction displays a heightened short-term sensitivity to oil and monetary shocks compared to job creation, except for small and young plants. The dynamics of job growth exhibit an asymmetric response to fluctuations in oil prices, with oil price shocks sparking considerable activities related to job reallocation.

Based on the issues above, this research aims to investigate the impact of fluctuations in Brent and WTI oil prices on the business sector in East Java Province. According to the Indonesian Ministry of Trade (2023), the contribution of exports of goods and services to Indonesia's gross domestic product (GDP) continues to increase to 24.49 percent in 2022. The increase partly influences this increase in exports on a regional scale, such as the increase in exports of East Java Province, which can contribute around 9.94% to the value of national exports. The GARCH (1,1) method is employed to monitor the volatility of oil prices, while the NARDL method is used to assess the magnitude of asymmetric effects. The study utilizes quarterly time series data from 2011Q1 to 2022Q4. The novelty this research introduces lies in a more focused research sample at the small regional scale of East Java Province, applying the NARDL method to examine asymmetric effects and using more recent data.

The asymmetric test results reveal a significant positive influence of negative fluctuations in Brent and WTI oil prices on the business sector in the short run. Conversely, positive fluctuations in Brent and WTI oil prices have a significant negative impact on the business sector in the long run. These findings contribute to a more complex theoretical understanding of the effects of oil price fluctuations on the business sector at the provincial level. The test results also provide practical recommendations for stakeholders in East Java Province, including policymakers and business actors, to create and utilize alternative fuels in production activities. For instance, domestic or renewable energy could reduce dependence on international oil price movements. The government could implement tariff policies and international oil import quotas to control usage. The structure of this study includes an introduction, literature review, data and methodology, results and discussion, and conclusion.

Literature Review

Empirical Framework

Davis & Haltiwanger (2001) delved into the impact of oil price fluctuations on the business sector, mainly focusing on the manufacturing industry in the United States from 1972 to 1988. Their study aimed to evaluate how oil price shocks influenced job creation and destruction. The results highlighted that oil price shocks contributed to 20–25 percent of the variability in job growth, a significance twice that of monetary shocks. Over two years following an increase in oil prices, job responses exhibited an increase in correlation with factors such as capital intensity, energy intensity, and product durability. Notably, job destruction displayed a much higher short-term sensitivity to oil and monetary shocks than job creation, with exceptions for small and young factories. Employment growth responded asymmetrically to fluctuations in oil prices, and oil price shocks instigated substantial activities related to job reallocation.

Davis & Haltiwanger (2001) formulated an empirical framework to evaluate the repercussions of oil price fluctuations on the business sector. Their study specifically focused on the impacts of oil price shocks on job creation and destruction within the U.S. manufacturing sector spanning from 1972 to 1988. The study's outcomes revealed that oil price shocks accounted for 20–25 percent of the variability in employment growth, a magnitude twice that of monetary shocks. The employment response over two years following an upswing in oil prices displayed an augmented correlation with capital intensity, energy intensity, and product durability. Job destruction demonstrated significantly higher short-term sensitivity to oil and monetary shocks than job creation, except for small and young plants. In light of the substantial role of oil prices in shaping economic trajectories, recent research has commenced linking the relationship between oil prices and economic performance in more targeted domains, such

as the business sector. [Davis & Haltiwanger's \(2001\)](#) study delves into this matter, scrutinizing the impact of oil price shocks on job creation and destruction in the U.S. manufacturing sector from 1972 to 1988, with results indicating that oil price shocks contributed to 20–25 percent of the variability in employment growth, twice that of monetary shocks. The employment response over two years to an increase in oil prices exhibited a heightened correlation with capital intensity, energy intensity, and product durability. Job destruction, in particular, demonstrated considerably greater short-term sensitivity to oil and monetary shocks than job creation, barring small and young plants.

The realm of the automotive industry offers a unique backdrop for comprehending the consequences of oil price shocks. The oil price shock instigated by the 1973 OPEC crisis led to an uptick in the demand for smaller and fuel-efficient cars, concurrently diminishing the demand for larger vehicles. American automobile manufacturers encountered difficulties adapting to this shock because their resources were predominantly aligned with oil production. Consequently, despite certain manufacturing plants equipped for small car production operating at total capacity, overall capacity utilization and output experienced a decline due to the oil price shock, as detailed in the study by [Bresnahan & Ramey \(1993\)](#).

In summary, [Davis & Haltiwanger \(2001\)](#) conducted a comparative analysis of the dynamic responses of employment and job flows concerning positive and negative oil price shocks. They explored the hypothesis that if oil price shocks are principally influential due to their impact on the alignment between the desired factor distribution and actual inputs, then employment outcomes will be contingent on the scale of the price change, irrespective of its direction. Conversely, if oil price shocks hold significance primarily because they shift the overall labor supply or demand, as suggested by [Kim & Loungani \(1992\)](#), [Rasche & Tatom \(1981\)](#), and [Rotemberg & Woodford \(1996\)](#), then employment would demonstrate a more or less symmetrical response to both positive and negative impacts of oil price shocks.

Previous empirical examinations of the impact of oil price shocks on the pace of job creation and sectoral destruction, utilizing meticulous sectoral measurements, have been conducted. These measurements entail collating data at the plant level within the Longitudinal Research Datafile (LRD), as [Davis & Haltiwanger \(1996\)](#) outlined. The detailed sectoral data provide a more comprehensive assessment of the role of oil shocks and assist in discerning alternative interpretations regarding accurate responses to oil shocks. For example, interpretations emphasizing simultaneous monetary policy behaviors reveal distinct sectoral response patterns compared to interpretations focusing on the effects of monetary policy on the reallocation of oil shock impacts. Furthermore, the breakdown of changes in sectoral employment into job creation and destruction components also contributes to interpreting responses to oil shocks.

Our research aims to advance an empirical study on the impact of oil price fluctuations on the business sector. The novelty we introduce in this study involves a more focused research sample at the small regional scale of East Java Province, utilizing research methods employing GARCH (1,1) to monitor oil price fluctuation values and NARDL to track asymmetric impact magnitudes, along with a more recent data period.

Calculation Framework

We applied the same estimation technique used in the study by [Lee et al. \(1995\)](#) to determine the values of oil price fluctuations. According to [Lee et al. \(1995\)](#), both increases and decreases in oil prices are measured based on their volatility using the AR(p)-GARCH(1,1)

method. [Olasehinde-Williams & Godwin \(2018\)](#) stated that this method is one of the best models for measuring fluctuations in financial data. The model can be described as follows:

$$OIL_t^{real} = \mu + \sum_{i=1}^p \alpha_i OIL_{t-i}^{real} + e_t \quad (1)$$

where μ is an unconditional mean, the AR order lag is set to $p=4$ following [Mork \(1989\)](#), and α_i are the parameters of the autoregressive part. The disturbance term e_t is modeled as a GARCH(1,1) process with variance h_t which is defined as:

$$e_t = \sqrt{h_t} \zeta_t$$

$$h_t = \gamma_0 + \gamma_1 e_{t-1}^2 + \gamma_2 h_{t-1} \quad (2)$$

where γ_0 , γ_1 , and γ_2 refer to GARCH parameters and $\zeta_t \sim N(0, 1)$ i.i.d. for all $t = 1, \dots, n$. The standardized residual $e_t^* = \frac{e_t}{\sqrt{h_t}}$ is then censored and we obtain the positive and negative oil price measures of Lee et al. (1995) by

$$O_{LNR,t}^+ = \max(e_t^*, 0) \text{ and } O_{LNR,t}^- = \max(e_t^*, 0) \quad (3)$$

As a novelty in this research, we employ the Nonlinear Autoregressive Distributed Lag (NARDL) method to track the magnitude of asymmetric influences following the acquisition of oil price fluctuation values from the GARCH (1,1) method. The NARDL method can accurately estimate parameters in the long run and obtain valid t-statistics. Moreover, the NARDL method can compute variables at different order levels and produce short-term and long-term estimates within a single model ([Pesaran et al., 1996](#); [Harvey, 2018](#); [Ari et al., 2019](#)). The long-run estimation model is as follows:

$$O_{LNR,t}^+ = \max(e_t^*, 0) \text{ and } O_{LNR,t}^- = \max(e_t^*, 0) \quad (4)$$

where; JOB is the job creation sectors in East Java Province, CPI is inflation in Indonesia, ER is exchange rate Rupiah per US Dollar, and OIL is the fluctuation in oil price Brent or WTI. The use of the error correction framework is needed to estimate the short term effect. By using the ECM model, that is:

$$\begin{aligned} \Delta JOB_t = & \alpha_0 + \alpha_1 JOB_{t-1} + \alpha_2 CPI_{t-1} + \alpha_3 ER_{t-1} + \alpha_4 OIL_{t-1} \\ & + \sum_{i=1}^{n1} \alpha_{5,i} \Delta JOB_t + \sum_{i=0}^{n2} \alpha_{6,i} \Delta CPI_t + \sum_{i=0}^{n3} \alpha_{7,i} \Delta ER_t \\ & + \sum_{i=0}^{n4} \alpha_{8,i} \Delta OIL_{t-1} + \varepsilon_t \end{aligned} \quad (5)$$

For the NARDL model, oil price fluctuation variables encompass positive and negative changes. Consequently, these two changes result in the creation of two new variables as follows:

$$\begin{aligned} OIL-POS_t = & \sum_{j=1}^t \Delta OIL_j^+ = \sum_{j=1}^t \max(\Delta OIL_j, 0) \\ OIL-NEG_t = & \sum_{j=1}^t \Delta OIL_j^- = \sum_{j=1}^t \min(\Delta OIL_j, 0) \end{aligned} \quad (6)$$

The equation above shows that the $OIL-POS$ variable is the partial sum of the positive changes in ΔOIL , while the $OIL-NEG$ variable is the partial sum of the negative changes in ΔOIL . The error-correction model of NARDL is as follows.

$$\begin{aligned}\Delta JOB_t = & \alpha_0 + \alpha_1 JOB_{t-1} + \alpha_2 CPI_{t-1} + \alpha_3 ER_{t-1} + \alpha_4 \Delta OIL-POS_{t-1} \\ & + \alpha_5 \Delta OIL-NEG_{t-1} + \sum_{i=1}^{n1} \alpha_{6,i} \Delta JOB_t + \sum_{i=0}^{n2} \alpha_{7,i} \Delta CPI_t + \sum_{i=0}^{n3} \alpha_{8,i} \Delta ER_t \\ & + \sum_{i=0}^{n4} \alpha_{9,i} \Delta OIL-POS_t + \sum_{i=0}^{n5} \alpha_{10,i} \Delta OIL-NEG_t + \varepsilon_t\end{aligned}\quad (7)$$

Data and Methodology

The data utilized to depict the correlation between the dependent variable (business sector) and independent variables (exchange rate, inflation, and oil price fluctuations) consists of secondary data presented in the form of quarterly time series data spanning from 2011Q1 to 2022Q4. This dataset is obtained from authoritative sources, including the Federal Reserve Bank of St. Louis (FRED), Bank Indonesia, and the Central Statistics Agency of East Java Province. The selected data period is designed to encompass pivotal global events that substantially influence the variations in key variables. These events encompass the aftermath of the global financial crisis, geopolitical unrest such as the Russia-Ukraine war, and the onset of the COVID-19 pandemic, all of which have precipitated uncontrolled fluctuations in oil prices.

There are several stages of estimation techniques in this study. First, the value of oil price fluctuations is determined, followed by stationarity tests, the optimal lag length is selected, and NARDL bound tests are conducted. Subsequently, diagnostic tests are performed by examining heteroscedasticity, autocorrelation, model specification, and model fitness. Finally, robustness tests are used to assess the model's resilience.

Result and Discussion

Statistical Description of Variables and Stationary Test

Before initiating the analysis using the NARDL approach, it is imperative to confirm that each variable has undergone the stationarity test, and the outcomes should exhibit stationarity at either the I(0) level or the first difference I(1). The stationarity test is crucial for establishing the presence or absence of a unit root among the variables, thereby validating the relationships within the equation. We applied the Augmented Dickey-Fuller (ADF) test to verify the stationarity of the variables, with the null hypothesis positing that the variables are non-stationary (containing a unit root). The ADF test statistic is then compared to the corresponding critical values. Suppose the absolute value of the test statistic falls below the critical values. In that case, the null hypothesis is accepted, signifying that the time series is non-stationary, and we can proceed to use the differenced series. The outcomes of the ADF test, coupled with descriptive statistics, affirm that all variables are integrated at the first difference level. Specifically, the ADF test results are detailed as follows.

Table 1: Stationary Test Result

Variables	Level (0)		First Difference		Stationary Level
	t-statistic	Probability	t-statistic	Probability	
<i>JOB</i>	-1.9342	0.3140	-5.1461**	0.0001	I(1)
<i>CPI</i>	-0.8722	0.7884	-4.1848**	0.0020	I(1)
<i>ER</i>	-2.1359	0.2321	-8.9496**	0.0000	I(1)
<i>OIL-POS (BRENT)</i>	0.1937	0.9693	-6.6058**	0.0000	I(1)
<i>OIL-NEG (BRENT)</i>	-0.8737	0.7877	-6.8114**	0.0000	I(1)
<i>OIL-POS (WTI)</i>	0.1792	0.9683	-7.1513**	0.0000	I(1)
<i>OIL-NEG (WTI)</i>	-0.0607	0.9475	-7.0869**	0.0000	I(1)

Noted : (**) significant at 5%; (*) significant at 10%

Furthermore, considering the outcomes presented in Table 2, it is observed that the exchange rate variable showcases a standard distribution, given that the Jarque-Bera probability value surpasses the 5% significance threshold. Furthermore, the business sector and exchange rate data exhibit a rightward skewness with elongated tails on the left side, as denoted by the negative skewness values for these variables. Conversely, the remaining variables display left-skewed distributions with lengthy tails on the right side, as positive skewness values indicate. Notably, the Brent oil price volatility and exchange rate variables feature kurtosis values below 3. This characteristic signifies that the data adheres to a normal distribution and manifests a well-defined peak.

Table 2: Statistical Description of Variables

Measures	JOB	VOL (BRENT)	VOL (WTI)	NER	CPI
Mean	4.930417	131.9894	122.2342	12866.02	11.04813
Median	5.595000	100.3108	99.63736	13464.00	-5.46409
Maximum	7.050000	329.3858	327.3235	16367.01	230.8406
Minimum	-5.87000	34.61882	28.26482	8597.000	-64.6880
Standard Deviation	2.626759	86.26413	78.27500	2106.830	62.56576
Skewnes	-2.841613	0.848288	1.099238	-0.776404	1.848903
Kurtosis	10.43545	2.584309	3.403648	2.419374	6.736497
Jarque-Bera	175.1698	6.102338	9.992460	5.496680	55.27036
Probability	0.000000	0.047304	0.006763	0.064034	0.000000

Determining the appropriate lag for the dependent variable's response to changes in the independent variable holds significance, and selecting the optimal lag becomes pivotal. The Akaike Information Criterion (AIC) was employed in this study, allowing for the consideration of up to four lags. According to [Widarjono \(2007\)](#), AIC serves as a tool to choose the most suitable regression estimation model, describing a model that fits both existing data (in-sample forecasting) and future data (out-of-sample forecasting). The test outcomes reveal that the optimal lag for the models involving Brent and WTI oil prices is identified as (4,0,3,0,1). Following this, examining the long-term cointegration among these series is imperative. To ensure unbiased estimates, irrespective of whether the variables in the model are integrated I(0) or I(1), this study employs the NARDL cointegration test proposed by [Pesaran et al. \(1996\)](#). A model is deemed cointegrated in the long term if the F-statistic value exceeds the upper limit; conversely, it is not cointegrated if it falls below the lower limit. The upper limit values for NARDL at the 5% and 10% significance levels are 4.01 and 3.52, respectively, while the lower limit values are 2.86 and 2.45. The estimation results indicate that the F-statistic value for the Brent oil price is (4.7495), and for the WTI oil price is (4.3903).

Asymmetric Bound Test

Following the acquisition of oil price volatility values from the GARCH (1,1) approach, the subsequent phase involves estimating the asymmetric bound test using the NARDL approach. A comprehensive presentation of the estimation results is provided in Table 3, culminating in the observation that adverse fluctuations in both Brent and WTI oil prices exert a notably positive influence on the business sector in East Java Province. A deceleration or decline in oil prices translates to a reduced cost of raw material production, leading to decreased output prices. This, in turn, triggers an upswing in demand for output production within the manufacturing industry. Consequently, there is a subsequent surge in the demand for labor.

Table 3: Short-Run ARDL Bound Test Result

Variables	Oil Price (BRENT)		Variables	Oil Price (WTI)	
	Coefficient	Prob.		Coefficient	Prob.
<i>Constant</i>	-67.2470	0.1309	<i>Constant</i>	-59.5553	0.1386
<i>GRDP_{t-1}</i>	0.5189**	0.0066	<i>GRDP_{t-1}</i>	0.5297**	0.0082
<i>GRDP_{t-2}</i>	0.5483**	0.0035	<i>GRDP_{t-2}</i>	0.5699**	0.0040
<i>GRDP_{t-3}</i>	0.4437**	0.0062	<i>GRDP_{t-3}</i>	0.4324**	0.0084
<i>GRDP_{t-4}</i>	-	-	<i>GRDP_{t-4}</i>	-	-
<i>CPI</i>	-	-	<i>CPI</i>	-	-
<i>CPI_{t-1}</i>	-	-	<i>CPI_{t-1}</i>	-	-
<i>CPI_{t-2}</i>	-	-	<i>CPI_{t-2}</i>	-	-
<i>CPI_{t-3}</i>	-	-	<i>CPI_{t-3}</i>	-	-
<i>CPI_{t-4}</i>	-	-	<i>CPI_{t-4}</i>	-	-
<i>RER</i>	2.9052	0.6348	<i>RER</i>	2.8722	0.6492
<i>RER_{t-1}</i>	-21.621**	0.0058	<i>RER_{t-1}</i>	-23.071**	0.0048
<i>RER_{t-2}</i>	-12.448*	0.0742	<i>RER_{t-2}</i>	-14.365**	0.0416
<i>RER_{t-3}</i>	-	-	<i>RER_{t-3}</i>	-	-
<i>RER_{t-4}</i>	-	-	<i>RER_{t-4}</i>	-	-
<i>OIL-POS</i>	-	-	<i>OIL-POS</i>	-	-
<i>OIL-POS_{t-1}</i>	-	-	<i>OIL-POS_{t-1}</i>	-	-
<i>OIL-POS_{t-2}</i>	-	-	<i>OIL-POS_{t-2}</i>	-	-
<i>OIL-POS_{t-3}</i>	-	-	<i>OIL-POS_{t-3}</i>	-	-
<i>OIL-POS_{t-4}</i>	-	-	<i>OIL-POS_{t-4}</i>	-	-
<i>OIL-NEG</i>	2.9591*	0.0503	<i>OIL-NEG</i>	3.7128**	0.0483
<i>OIL-NEG_{t-1}</i>	-	-	<i>OIL-NEG_{t-1}</i>	-	-
<i>OIL-NEG_{t-2}</i>	-	-	<i>OIL-NEG_{t-2}</i>	-	-
<i>OIL-NEG_{t-3}</i>	-	-	<i>OIL-NEG_{t-3}</i>	-	-
<i>OIL-NEG_{t-4}</i>	-	-	<i>OIL-NEG_{t-4}</i>	-	-

Noted : (**) significant at 5%; (*) significant at 10%

Diverging from the short-term repercussions, positive oscillations in Brent and WTI oil prices exhibit a notable adverse effect on the business sector in East Java Province over the long term. It signifies that for every one percent change in Brent and WTI oil price fluctuations, there is an anticipated increase of 115.95% and 115.70%, respectively, in the business sector of East Java Province. This observed effect aligns with the findings of the study conducted by [Davis & Haltiwanger \(2001\)](#), which concentrated on the ramifications of oil price shocks on the generation and elimination of manufacturing jobs in the United States spanning from 1972 to 1988. The study concluded that oil price shocks contributed to 20–25% of the variability in job growth, a magnitude twice that of monetary shocks. The job response over two years to an upswing in oil prices displayed an augmented correlation with capital intensity, energy intensity, and product durability. Job destruction exhibited considerably higher short-term sensitivity to oil and monetary shocks than job creation, with exceptions for small and young factories. The growth of employment demonstrated an asymmetrical response to oil price fluctuations, with oil price shocks instigating substantial activities related to job reallocation.

The influence of oil price fluctuations on the business sector manifests as an indirect effect, with the initial impact being on the output of a country or region. Should oil prices positively influence output growth, industries will consequently require more labor. Conversely, if oil prices negatively impact output growth, industries will experience a reduced demand for labor. These research findings align with the perspective put forth by [Hamilton \(1983\)](#), who provided evidence of a significant correlation between oil price shocks and the U.S. economy. Hamilton concluded that oil price shocks played a role in causing recessions in the United

States between 1948 and 1972. Additionally, Mork (1989) asserted that an increase in oil prices has a negative correlation with economic growth, highlighting a substantial asymmetric effect. Conversely, a decrease in oil prices shows a minimal correlation with economic growth. Lee et al. extended previous research by incorporating normalized oil shock variables through a vector autoregressive (VAR) model, updating data until 1992. The test results indicated that stable changes in oil prices exert a more pronounced impact on economic growth than unstable changes.

Table 4: Long-Run ARDL Bound Test Result

Variables	Oil Price (BRENT)		Variables	Oil Price (WTI)	
	Coefficient	Prob.		Coefficient	Prob.
<i>Constant</i>	-67.2470	0.1309	<i>Constant</i>	-59.5553	0.1386
<i>CPI</i>	0.0200**	0.0014	<i>CPI</i>	0.0189**	0.0026
<i>ER</i>	8.3340*	0.0574	<i>ER</i>	7.5009*	0.0541
<i>OIL-POS</i>	-1.1595**	0.0075	<i>OIL-POS</i>	-1.1570**	0.0214
<i>OIL-NEG</i>	0.0723	0.8746	<i>OIL-NEG</i>	0.2192	0.6325

Noted : (**) significant at 5%; (*) significant at 10%

Asymmetric Diagnostic Test

The diagnostic tests in this research encompass the ECM_{t-1} test, autocorrelation test, model specification test, and model fitness assessment. Firstly, the ECM_{t-1} test elucidates that in the event of an external shock, the business sector's performance will deviate from its growth trend. This test is employed to ascertain the speed of adjustment towards long-term equilibrium, and the coefficient should be negative and significant. The test results report 100.48% and 99.60% adjustment speeds for the Brent and WTI oil price models toward long-term equilibrium. Secondly, the Lagrange Multiplier (LM) test ensures that residuals are free from autocorrelation, with the null hypothesis indicating the presence of serial correlation. The test results indicate that the Brent and WTI oil price models are free from autocorrelation.

Thirdly, the Ramsey RESET test is applied to scrutinize the model specification, with the null hypothesis stating that the model used is correct. The test results indicate that the model used is not entirely accurate. Fourthly, the Adjusted R-squared values are employed to showcase the goodness of fit for each model or the ability of independent variables to explain dependent variables. The test results report that the ability of independent variables to explain dependent variables is 42.65% and 41.60% in the Brent and WTI oil price models. Finally, the Wald-SR (short-term) and Wald-LR (long-term) tests are incorporated to discern the alignment of research hypotheses with the null hypothesis, reporting no asymmetric influence. The test results convey that Brent and WTI oil price variables do not exhibit an asymmetric relationship with the business sector.

Table 7: Diagnostic Test Result

Model	ECM_{t-1}	LM	RESET	Adj.R ²	Wald-SR	Wald-LR
Oil Price (BRENT)	-1.0048**	0.5432	126.91**	0.4265	0.0000	0.0478
Oil Price (WTI)	-0.9960**	0.9349	129.65**	0.4160	0.0000	0.0549

Noted : (**) significant at 5%; (*) significant at 10%

Robustness Test

In both the long and short terms, stability tests were conducted to evaluate the stability of parameters by reverting the model to its Ordinary Least Squares (OLS) form. A model is deemed stable if the blue line in the Cumulative Sum of Recursive Residual (CUSUM)

and Cumulative Sum of Squares of Recursive Residual (CUSUMQ) graphs does not intersect with the red reference lines. The CUSUM test identifies systematic alterations in regression coefficients, while the CUSUMQ test detects abrupt changes in these coefficients. As illustrated in Figure 1, the CUSUM test results for the Brent and WTI oil price models reveal a stable pattern, remaining within the 5% significance bounds. However, the CUSUMQ test results present a contrasting scenario, indicating an unstable pattern for both Brent and WTI oil price models as they surpass the 5% significance bounds. It implies the existence of sudden changes (shocks) in the coefficients, leading to an unstable pattern.

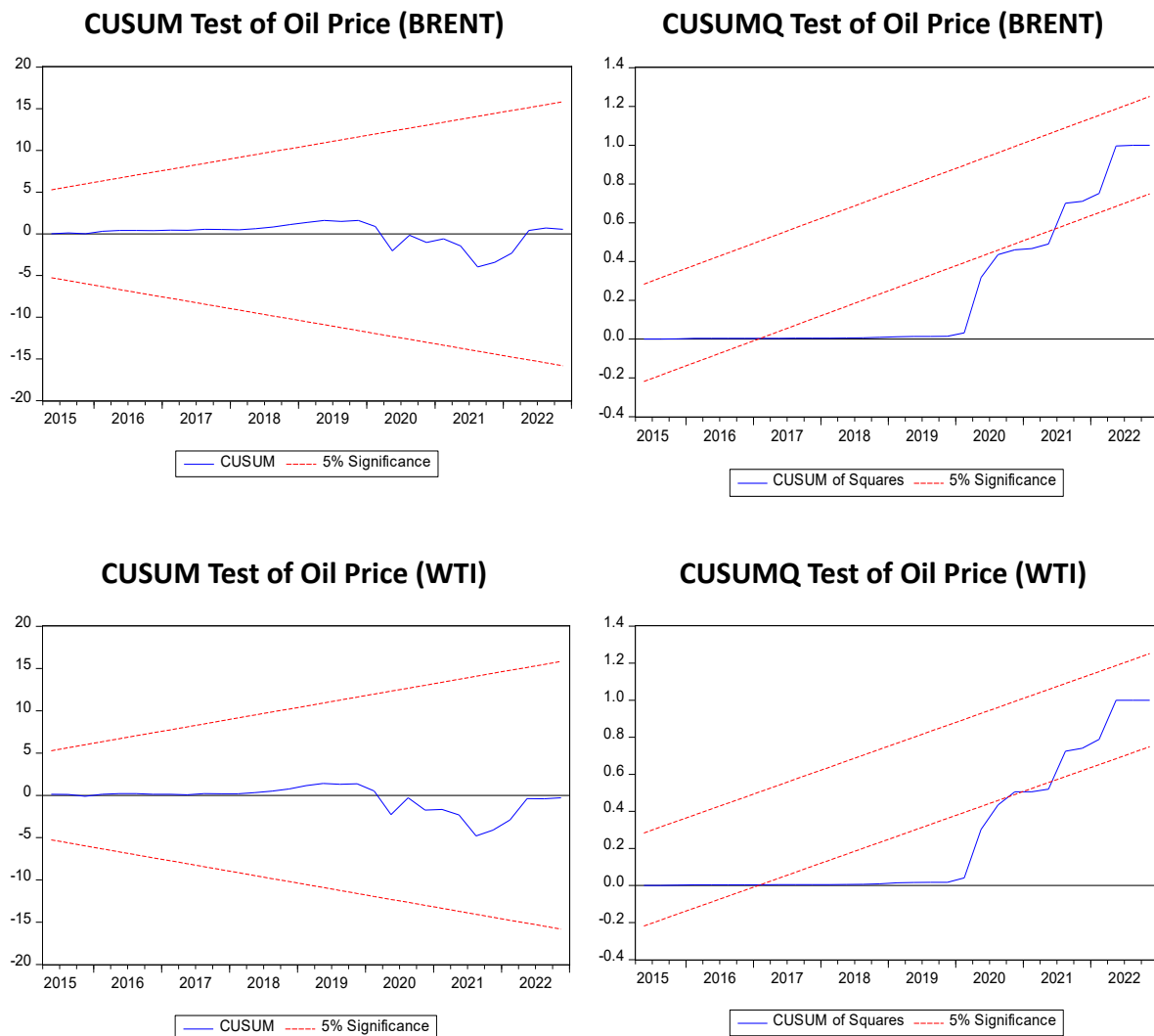


Figure 1: Robustness Test CUSUM and CUSUMQ

Source: Data processed (2023)

Conclusion

In 2022, the economic performance of East Java Province experienced a slowdown, resulting in a deceleration in the business sector. This phenomenon was attributed to internal factors, such as a slowdown in domestic demand, and external factors, including heightened global uncertainty due to the rise in oil prices. Consequently, this research aimed to investigate the influence of fluctuations in Brent and WTI oil prices on the business sector of East Java Province. The GARCH (1,1) method was employed to track the value of oil price fluctuations, and the NARDL method was used to explore the magnitude of asymmetric effects. Quarterly

time series data from 2011Q1 to 2022Q4 were utilized in this study. The results of the asymmetric tests revealed a significant positive influence of negative fluctuations in Brent and WTI oil prices on the business sector in the short term. Conversely, there was a significant negative impact of positive fluctuations in Brent and WTI oil prices on the business sector in the long term. These test results have contributed to a more nuanced theoretical understanding of the impact of oil price fluctuations on the business sector at the provincial level.

Furthermore, the above test results have yielded practical recommendations for stakeholders in East Java Province, including policymakers and business actors. They are advised to create and adopt alternative fuels in production activities, such as domestic or renewable energy, to reduce dependency on international oil price movements. The government can implement international-scale tariffs and import quotas for oil to regulate its usage. Citizens can actively participate in purchasing products in East Java Province, thereby boosting demand and, subsequently, improving economic performance and the business sector. In conclusion, recommendations are directed toward academics to incorporate more detailed analyses of specific business sectors in future research and utilize dummy variables for COVID-19 shocks to generate more comprehensive recommendations.

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