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Causality from Oil Price Shocks to Macroeconomic Indicators: A Comparison for Top Oil Importer Countries

Petrol Fiyat Şoklarından Makroekonomik Göstergelere Nedensellik Analizi: En Çok Petrol İthal Eden Ülkeler İçin Bir Karşılaştırma

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Abstract

This study presents the causality effects of oil price shocks on the main macroeconomic indicators for five developed and five developing top oil importer countries. To test the causality relationship between oil price shocks and macroeconomic variables, Hatemi-J (2011) panel asymmetric causality test is performed. Results show that while negative shocks positively affect developing countries' GDP, positive shocks negatively affect developed countries' GDP. Although oil prices have a significant role in Turkiye's, Poland's, Germany's, and Italy's inflation rate, the pass-through effect is incomplete. Regarding unemployment, while positive oil price shocks increase unemployment in China and Turkiye, among the developed countries, only Germany and Singapore experience a rise in unemployment. As a result, the most negatively affected developed countries are detected as Germany and Singapore. On the other hand, among the developing countries, the most negatively affected country is identified as Turkiye. Therefore, these countries should shift to alternative energy resources to eliminate the negative effects of oil price shocks.

Keywords: Oil price shocks, inflation, unemployment, asymmetric causality

JEL Codes: E31; E24; C23

Öz

Bu çalışma, beş gelişmiş ve beş gelişmekte olan en büyük petrol ithalatçısı ülke için, petrol fiyat şoklarının temel makroekonomik göstergeler üzerindeki nedensellik etkilerini sunmaktadır. Petrol fiyat şokları ile makroekonomik değişkenler arasındaki nedensellik ilişkisini test etmek için Hatemi-J (2011) panel asimetrik nedensellik testi uygulanmıştır. Sonuçlar, negatif şokların gelişmekte olan ülkelerin GSYİH'sinde etkili (pozitif etki), pozitif şokların ise gelişmiş ülkelerin GSYİH'sinde etkili (negatif etki) olduğuna işaret etmektedir. Petrol fiyatlarının Türkiye, Polonya, Almanya ve İtalya'nın enflasyon oranında önemli bir rolü olmasına rağmen, geçiş etkisinin tam olmadığı tespit edilmiştir. İşsizlik açısından, pozitif petrol fiyat şokları Çin ve Türkiye'de işsizliği artırırken, gelişmiş ülkeler içinde ise yalnızca Almanya ve Singapur olumsuz etkilenmektedir. Sonuç olarak, gelişmiş ülkeler içerisinde en olumsuz etkilenen ülkeler Almanya ve Singapur iken, gelişmekte olan ülkeler içinde en olumsuz etkilenen ülke Türkiye olarak tespit edilmiştir. Dolayısıyla bu ülkelerin petrol fiyat şoklarının olumsuz etkilerini bertaraf etmek için alternatif enerji kaynaklarına daha fazla yönelmeleri gerekmektedir.

Anahtar Kelimeler: Petrol fiyat şokları, enflasyon, işsizlik, asimetrik nedensellik

JEL Kodları: E31; E24; C23

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1. INTRODUCTION

Oil has always had a special place in the global economy, which is still the case. Although new energy resources have been introduced, crude oil remains the primary source of energy for the entire world and has been a key indicator of economic activity since the mid-20th century (Aziz and Dahalan, 2015: 102). With the World experience of 1970s oil price shocks, the effect of these shocks on the macroeconomic indicators became an important research topic, especially from the importer countries' side, since policy actions and possible damages are more important for these countries.

Starting from the price effects, a positive shock to oil prices explicitly increases the cost of production for the oil importer countries. Therefore, these cost increases are often transmitted to consumer prices through various channels. Moreover, shocks to the oil price have the potential to increase prices insofar as they limit the supply of actual output (Gao, Kim and Saba, 2014:313). In terms of unemployment, an increase in oil prices may cause firms to go bankrupt and close, leading to higher unemployment. Since capital is fixed, laying off employees becomes the only option to reduce rising costs (Cuestas and Alana, 2018: 166). As Loungani (1986) indicates, sustained increases in oil prices have the potential to alter the production structure and significantly affect unemployment. A positive shock in oil prices could increase the marginal cost of production in various oil-intensive industries and encourage firms to switch to less oil-intensive production techniques. This shift, in turn, leads to a reallocation of labor and capital across sectors, which may eventually affect unemployment. However, both positive and negative oil price shocks can have significant effects on GDP, unemployment, and prices. Moreover, the effects of these shocks may differ depending on whether the country is developing or developed. As Taghizadeh-Hesary et al. (2016) indicate, developed countries can be more resilient than developing ones. This is because developed countries can substitute fuel with nuclear energy, gas, and renewables and have more strategic oil stocks. In addition, energy efficiency goals set by the government can make developed countries less sensitive to oil price shocks.

The study aims to examine the effect of both positive and negative oil price shocks on fundamental macroeconomic indicators for both developed and developing countries. For this purpose, data from five developed and five developing countries are used. Countries are selected from the list of top 20 oil importers. Therefore, the selected developed countries are Germany, Italy, Japan, Singapore, and South Korea. Moreover, selected developing countries are China, India, Indonesia, Poland and Turkiye. In the study, besides the crude oil price, aforementioned countries' GDP, unemployment, and consumer price index were used. To test the causality relationship between oil price shocks and macroeconomic variables, Hatemi-J (2011) panel asymmetric causality test is performed.

The rest of the study is organized as follows: the second section explains the empirical literature, the third section presents data and methodology, the fourth section exhibits estimation results, and section five provides the conclusion.

2. LITERATURE

Many empirical studies have researched the relationship between oil price shocks and macroeconomic variables in developed and developing countries.

Studies on the effects of oil price movements on unemployment include the following: Loungani (1986) used a dispersion index for the U.S.'s 28 industries and found that an increase in oil prices increases unemployment in the sample period between 1947 and 1982. Mory

(1993) also used the U.S.'s data from 1951 to 1990 and found that rises and falls in real oil prices asymmetrically affect output and employment. Keane and Prasad (1996) investigated the effect of oil price shocks on wages and employment in the U.S. economy. They found that while rises in oil prices decrease aggregate employment in the short term, they tend to increase aggregate employment in the long term. The long-run effect seems to result from the substitution between energy and labor in the aggregate production function. Employing the Hodrick–Prescott filter method, Ewing and Thompson (2007) researched the cyclical co-movements of oil prices with industrial production, stock prices, consumer prices, and unemployment for the U.S. economy between 1982 and 2005. Their findings show that oil prices lag industrial production, lead consumer prices, and negatively correlate with unemployment cycles. Doğrul and Soytaş (2010) researched the association between oil prices, interest rates, and the unemployment rate in Turkiye. Using the Toda-Yamamoto procedure, they found that oil prices affect unemployment in the sample country. Cuestas and Alana (2018) investigated the relationship between oil price shocks and unemployment in Central and Eastern Europe. Employing the NARDL model, they concluded that although there is not a strong correlation between the variables in the short run, in the long run, oil price shocks move with the natural unemployment rate in the same direction. Employing both ARDL and NARDL models, Nusair (2020) investigated the effect of oil price shocks on unemployment in Canada and the U.S. economy. ARDL findings prove that oil price changes have a positive effect on unemployment. NARDL findings also show that increasing and decreasing oil prices have a significant and positive long-run impact in all cases.

Oil price movements have also been associated with consumer price changes or inflation. Gao, Kim and Saba (2014) investigated the degree to which the oil price shock was passed through to disaggregated component CPIs in the United States. They found that oil price shocks positively affect only energy-intensive CPIs rather than Food and Beverage, Apparel, Housing, and Medical Care CPIs. Nusair (2019) employed both the ARDL and NARDL models to investigate the effect of oil price changes on inflation in Gulf Cooperation Council countries. His results reveal that only an increase in oil price has a positive significant effect on inflation, which is the sign of an incomplete pass-through effect of oil price on domestic inflation. Employing the NARDL model, Lacheheb and Sirag (2019) investigated the effect of oil price shocks on inflation in Algeria. They found that while positive shocks in oil prices cause an increase in inflation, the negative shock effect is not significant. Topan et al. (2020) investigated the effects of oil prices on inflation in Spain. Their findings show that oil price changes explain over half of the volatility in total inflation. Zakaria, Khiam and Mahmood (2021) searched the influence of oil prices on inflation rates in South Asian countries. Using cointegration, VAR, linear, and non-linear causality tests, they found that oil price shock positively affects inflation in South Asian countries, and this impact is permanent. Moreover, the effect of negative oil price shock is not significant while a positive shock to the oil price significantly raises inflation. Goh, Law, and Trinugroho (2022) researched the effect of oil price shocks on inflation in Indonesia. Using the NARDL method, they concluded that while the increase in oil prices increases inflation with a greater deviation, a decrease in oil prices decreases inflation with a lower deviation. Therefore, the effects of positive oil price shocks are more dominant.

In terms of the output market, the earliest studies were done by Hamilton (1983, 1985), Gisser and Goodwin (1986), and Hooker (1996). All of them found a negative relationship between oil prices and output. However, Hooker's (1996) study shows that this negative relationship weakened after 1973 for the U.S. Bjørnland (2000) researched the effect of oil price shocks on GDP and unemployment for Germany, Norway, the UK, and the US. Using the S-VAR model, he found that oil price shocks have a significant negative effect on output except

Norway. Tang, Wu, and Zhang (2010) attempted to research the impacts of oil price shocks on the Chinese economy. Employing the S-VAR model, they found that rising oil prices negatively affect output and investment but positively effect China's inflation and interest rates. Sakashita and Yoshizaki (2016) investigated the effect of oil price shocks on both consumer prices and industrial production in emerging countries. Using the SVAR approach, they reached that unexpected oil supply shocks have no long-run influence on production except in Russia. Employing multivariate econometric methods, Nusair and Olson (2021) aimed to research the effect of oil prices on domestic output for ASEAN-5 countries. Using both the ARDL and NARDL methods, they found that while the symmetric model does not indicate a significant relationship, the asymmetric model reveals the relationship between the variables. Shocks to oil prices affect Asian countries' domestic output both short- and long-term. Findings of the nonlinear causality test also support these results.

Unlike other studies, this study aims to investigate the effect of oil price shocks on three leading macroeconomic indicators for top oil importing in developed and developing countries. Therefore, in addition to examining the different effects of oil price shocks on macroeconomic variables, it also aims to compare their effects on developed and developing countries.

3. DATA AND METHODOLOGY

This study tests the causality relationship between oil price shocks and macroeconomic variables for developed and developing countries. For this purpose, data from five developed and five developing countries are used. Countries are selected from the list of top 20 oil importers. Depending on the availability of the data, the selected developed countries are Germany, Italy, Japan, Singapore, and South Korea. Moreover, selected developing countries are China, India, Indonesia, Poland and Turkiye. Since the most important macroeconomic indicator of a country is GDP, this variable is selected as one of the macroeconomic indicators. Moreover, as Okun (1970) stated, unemployment and inflation are the two macroeconomic factors that affect a nation's citizens the most, these two variables were chosen for the analysis. Therefore, in the study, besides the crude oil price, GDP, unemployment, and consumer price index were used. The data is obtained from the DataStream database and covers the period from 1991 to 2021. All the data is used in logarithmic form.

Before examining the asymmetric causality relationship, the first cross-section dependency test was conducted to see whether a shock from any sample country under investigation affects the other sample countries. Then, the slope homogeneity test and unit root tests were performed.

3.1. Cross-Section Dependency and Homogeneity Test

Cross-section dependency is a typical case, especially in countries with related economic characteristics like transition, emerging, and developing countries. Because of some reasons like globalization, financial integration, and internalization, an economy of a similar country can be affected by any shock in other countries. As a result, the empirical study using panel data most likely needs to look into cross-sectional dependency. Four tests are widely used to test cross-section dependency (Qamruzzaman and Jianguo, 2020: 832). Since our time dimension is larger than the cross-section, Breusch-Pagan's (1980) LM and Pesaran's (2004) CD_{LM} test were conducted to determine the existence of cross-section dependency. Test statistics can be calculated from the model below:

$$y_{it} = \alpha_i + \beta_i'.x_{it} + \mu_{it} \qquad i = 1,2,..,N; t = 1,2,....,T \qquad (1)$$

Test hypotheses are as follows:

$H_0: Cov(\mu_{it}, \mu_{jt}) = 0 \ for\ all\ t\ and\ i \neq j$

$H_1: Cov(\mu_{it}, \mu_{jt}) \neq 0\ for\ at\ least\ some\ i \neq j$

The test statistics that are developed by Breusch and Pagan (1980) and Pesaran (2004) are given below:

$$LM_{BP}(\text{BP}, 1980);\ \ LM = \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} T_{ij} \hat{p}_{ij}^2 \rightarrow X^2 \frac{N(N-1)}{2} \quad (2)$$

$$CD_{LM}\ (\text{Pesaran}, 2004);\ \ CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T_{ij} \hat{p}_{ij}^2 - 1) \rightarrow N(0,1) \quad (3)$$

If the estimated statistics are greater than the critical values or the probability values are lower than the significance levels, the null hypothesis will be rejected. Contrarily, the zero hypothesis cannot be rejected, proving the absence of cross-sectional dependence. The findings of the cross-sectional dependence test are shown in Table 1:

Table 1: Results of the Cross-Section Dependency Test

Developing countries												
Variable	***lgdp***		***lcpi***		***lunemp***		***Model1***		***Model2***		***Model3***	
Test	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.
Breusch-Pagan LM	303.7	0.00	270.5	0.00	71.88	0.00	294.9	0.00	230.6	0.00	57.54	0.00
Pesaran scaled LM	65.67	0.00	58.26	0.00	13.83	0.00	63.71	0.00	49.33	0.00	10.63	0.00
Developed countries												
Variable	***lgdp***		***lcpi***		***lunemp***		***Model1***		***Model2***		***Model3***	
Test	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.	Test stat.	P-v.
Breusch-Pagan LM	244.0	0.00	210.8	0.00	45.38	0.00	179.2	0.00	250.3	0.00	61.34	0.00
Pesaran scaled LM	52.32	0.00	44.91	0.00	7.911	0.00	37.8	0.00	53.74	0.00	11.48	0.00

Note: Here model 1 is $lgdp_{it} = \beta_0 + \beta_1 loil_{it} + u_{1it}$, $Model\ 2\ is\ lcpi_{it} = \alpha_0 + \alpha_1 loil_{it} + u_{2it}$, and Model 3 is $lunemp_{it} = \theta_0 + \theta_1 loil_{it} + u_{3it}$.

According to the results, the null hypothesis is rejected for all the variables for both developed and developing countries. Therefore, we can conclude that a shock from any sample country affects others.

Secondly, the homogeneity test is performed. Δ and Δadj tests developed by Pesaran and Yamagata (2008) were used to test the slope homogeneity. This test is a standardized version of Swamy's (1970) test of slope homogeneity. The delta test, which tests the slope homogeneity, is expressed as follows:

$$\Delta = \sqrt{N}\left(\frac{N^{-1}\hat{S}-p}{\sqrt{2p}}\right) \rightarrow N(0,1), (N,T) \rightarrow \infty, , \frac{\sqrt{N}}{T^2} \rightarrow 0 \quad (4)$$

It is suggested mean and variance bias-adjusted versions of Δ test for small samples:

$$\Delta_{adj}= \sqrt{N}\left(\frac{N^{-1}\hat{S}-E(Z_{iT})}{\sqrt{var(Z_{iT})}}\right) where\ E(Z_{iT})=p, var\left(Z_{iT}=\frac{2p(T-p-1)}{T+1}\right) \quad (5)$$

Pesaran and Yamagata (2008) consider the panel data model with fixed effects and heterogeneous slopes, and they formed the following model:

$$y_{it}=\alpha_i+\beta_i'.x_{it}+\varepsilon_{it} \qquad i=1,2,..,N; t=1,2,....,T \quad (6)$$

To see the existence of slope homogeneity, the following hypothesis is tested:

$H_0: \beta_i=\beta\ for\ all\ i$
$H_1: \beta_i\neq\beta_j\ for\ a\ nonzero\ fraction\ of\ pairwise\ slopes\ for\ i\ =\ j.$

Rejecting the null hypothesis means that we have slope heterogeneity rather than homogeneity. The test findings are presented in Table 2.

Table 2: Slope homogeneity test results

Developing countries				Developed countries			
Models	*Test*	*statistic*	*p-value*	*Models*	*Test*	*statistic*	*p-value*
Model 1	Δ test	2.436	0.007	Model 1	Δ test	3.846	0.000
	Δadj	2.563	0.005		Δadj	4.046	0.000
Model 2	Δ test	1.179	0.119	Model 2	Δ test	6.390	0.000
	Δadj	1.241	0.107		Δadj	6.724	0.000
Model 3	Δ test	1.075	0.141	Model 3	Δ test	3.916	0.000
	Δadj	1.131	0.129		Δadj	4.121	0.000

Notes: As indicated above, while oil prices are the independent variable in all models, the dependent variable is GDP in model 1, the dependent variable is cpi in model 2, and finally, the dependent variable is unemployment in model 3.

The results show slope heterogeneity for both developed and developing countries. The next step is to test the unit root of the variables.

3.2. Panel Unit Root Test

Since the results of the cross-section dependency test prove the existence of cross-section dependency, it is required to perform a second-generation unit root test. Therefore, it is preferred to perform Smith, Leybourne, Kim, and Newbold's (2004) second-generation unit root test, which is strengthened by using bootstraps. This test examines the stationarity levels of the variables using five different statistics: $\overline{Max_s}, \overline{Min_s}, \overline{LM_s}, \bar{t}_s, \overline{WS_s}$. As indicated, test statistics are derived by using bootstrap. Therefore, problems like heteroscedasticity and autocorrelation that can occur in other methods are resolved. The hypothesis of the test can be expressed as follows:

H_0: Existence of unit root

H_1: There is no unit root

Suppose the probability value is less than the significance levels or the computed test statistic is greater than the bootstrap crucial values. In that case, the zero hypothesis will be rejected, indicating the stationarity of the variable. The results of the Smith et al. (2004) bootstrap unit root tests are presented in Table 3. Since t-bar statistics ($\bar{t}_s$)are used for the test, values in the parenthesis are the p-value for t-bar.

Table 3: Panel Unit Root Test of the Variables

	Variable	Constant		Constant and trend		Order of integration
		Level (p-value)	First difference (p-value)	Level (p-value)	First difference (p-value)	
Developing countries	**loil**	-0.714 (0.237)	-8.890 (0.000)	0.588 (0.721)	-8.021 (0.000)	I(1)
	lgdp	-0.906 (0.741)	-4.169 (0.000)	-1.537 (0.775)	-4.294 (0.000)	I(1)
	lcpi	-1.077 (0.674)	-4.632 (0.000)	-2.669 (0.080)	-3.762 (0.001)	I(1)
	lunemp	-1.502 (0.470)	-5.700 (0.000)	-1.836 (0.733)	-6.130 (0.004)	I(1)
Developed countries	**lgdp**	-2.246 (0.067)	-4.601 (0.000)	-1.936 (0.625)	5.377 (0.000)	I(1)
	lcpi	-3.345 (0.000)	-	-2.392 (0.278)	-3.446 (0.003)	I(1)
	lunemp	-2.362 (0.019)	-3.941 (0.000)	-2.656 (0.090)	-4.089 (0.000)	I(1)

To account for the unit root impact, we need to incorporate an extra unrestricted lag in the VAR model, as suggested by Toda and Yamamoto (1995), as each variable has one unit root. Therefore, while the VAR model includes unrestricted extra lag for unit root effects, as forwarded by Toda and Yamamoto (1995), the HJC information criteria were employed in the lag selection process.

3.3. Asymmetric Causality Test

To test the causality relationship between oil price shocks and macroeconomic variables, Hatemi-J (2012) panel asymmetric causality test is performed. This test is preferred because it allows us to see both positive and negative shocks' effects on the dependent variable. It also performs well in case we have not normally distributed data and the volatility is time varying. These properties are useful, especially if we have financial or energy-related data sets (Hatemi-J et al., 2017: 1587).

Transforming data to cumulative positive and negative shocks was first performed by Granger and Yoon (2002). However, they used this approach for the cointegration test. Then, Hatemi-J used this method to perform an asymmetric causality test to see whether positive and negative shocks can affect the dependent variable differently. Panel causality relationship can be described as the following process:

$$y_{i,t} = y_{i,t-1} + \varepsilon_{i1,t} = y_{i,0} + \sum_{j=1}^{t} \varepsilon_{i1,j} \tag{7}$$

$$x_{i,t} = x_{i,t-1} + \varepsilon_{i2,t} = x_{i,0} + \sum_{i=1}^{t} \varepsilon_{i2,j} \tag{8}$$

For i=1,…,n. Where n is the size of the cross-sectional dimension and $\varepsilon_{i,t}s \sim N(0, \delta^2_{\varepsilon_{i,t}})$ are white noise. Then, we can describe the positive and negative shocks as following:

$$\varepsilon_{i1,t}{}^{+} = \max(\varepsilon_{i1,t}, 0),\ \varepsilon_{i1,t}{}^{-} = \min(\varepsilon_{i1,t}, 0) \tag{9}$$

$$\varepsilon_{i2,t}{}^{+} = \max(\varepsilon_{i2,t}, 0),\ \varepsilon_{i2,t}{}^{-} = \min(\varepsilon_{i2,t}, 0) \tag{10}$$

Then, cumulative sum of the shocks can be expressed as follows (Hatemi-J, 2011:4)

$$y_{i,t}^{+} = y_{i,0}^{+} + \varepsilon_{i1,t}^{+} = y_{i,0} + \sum_{j=1}^{t} \varepsilon_{i1,j}^{+} \tag{11}$$

$$y_{i,t}^{-} = y_{i,0}^{-} + \varepsilon_{i1,t}^{-} = y_{i,0} + \sum_{j=1}^{t} \varepsilon_{i1,j}^{-} \tag{12}$$

$$x_{i,t}^{+} = x_{i,0}^{+} + \varepsilon_{i2,t}^{+} = x_{i,0} + \sum_{j=1}^{t} \varepsilon_{i2,j}^{+} \tag{13}$$

$$x_{i,t}^{-} = x_{i,0}^{-} + \varepsilon_{i2,t}^{-} = x_{i,0} + \sum_{j=1}^{t} \varepsilon_{i2,j}^{-} \tag{14}$$

The next stage is testing the causal link between these components. Considering that only the causality relationship between positive shocks is tested, assuming $y_t = (y_{i,t}^{+}, x_{i,t}^{+})$ the following p-lag VAR model is used to test the causal link between these components. (Hatemi-J, 2012: 449):

$$y_t^{+} = v + A_1 y_{t-1}^{+} + \cdots + A_p y_{t-1}^{+} + u_t \tag{15}$$

In the equation, y_t^{+} represents the variable vectors of size 2×1, v represents constant vectors, and u_t represents error term vectors. Ar matrix is a parameter matrix with 2x2 dimensions and lag number r (r = 1,…, p). The proper lag structure was chosen using the following Hatemi-J (2012) information criteria:

$$HJC = \ln(|\widehat{\Omega}_j| + j(\frac{n^2 lnT + 2n^2 \ln(lnT)}{2T}), \quad j = 0, \dots, p. \tag{16}$$

Here, the number of equations in the VAR model is denoted by n, the number of observations is T, and the determinant of the estimated variance–covariance matrix of the error terms is $|\widehat{\Omega}_j|$, which is dependent on lag order j. Following the selection of the optimal lag order, the null hypothesis that the kth element of y sub t to the plus does not Granger cause the ωth element of y_t^{+}.

4. ESTIMATION RESULTS

For the developing countries, results show that there is a causality from positive oil price shocks to negative GDP only in India. On the other hand, while there is no causality from negative oil price shocks to negative GDP, there is statistically significant causality from negative oil price shocks to positive GDP shocks. Specifically, a decrease in oil prices causes an increase in GDP, especially for China, Indonesia, and Turkiye. For developed countries, positive oil price shocks have a statistically significant effect on negative GDP shocks in Germany. Moreover, there is no causality from negative oil price shocks to positive GDP.

Table 4: Asymmetric Causality from Oil Price to GDP

Country	$Oil^+ \rightarrow GDP^+$			$Oil^+ \rightarrow GDP^-$			$Oil^- \rightarrow GDP^-$			$Oil^- \rightarrow GDP^+$		
Developing countries												
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
China	1	0.699	0.403	1	1.256	0.262	1	0.036	0.850	2	8.240	0.016**
India	1	1.447	0.229	1	4.086	0.043**	1	0.282	0.595	2	0.564	0.754
Indonesia	1	1.620	0.203	1	0.782	0.377	1	0.636	0.425	2	11.333	0.003*
Poland	1	1.230	0.267	1	0.198	0.657	1	0.118	0.731	1	0.067	0.796
Turkiye	1	0.029	0.864	1	0.106	0.745	1	0.096	0.757	2	7.564	0.023**
Developed countries												
Country	$Oil^+ \rightarrow GDP^+$			$Oil^+ \rightarrow GDP^-$			$Oil^- \rightarrow GDP^-$			$Oil^- \rightarrow GDP^+$		
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
Germany	1	1.520	0.218	2	7.013	0.030**	1	0.011	0.915	2	0.461	0.794
Italy	1	3.293	0.070	2	5.101	0.078	1	5.144	0.023**	2	2.629	0.269
Japan	1	0.739	0.390	2	1.085	0.581	1	0.090	0.765	2	0.269	0.227
Singapore	1	0.420	0.517	1	0.845	0.358	1	0.281	0.596	1	0.012	0.914
S.Korea	1	0.467	0.494	1	1.933	0.164	1	0.479	0.489	1	1.229	0.268

Results show that oil price shocks have different effects on developed and developing countries' GDP. This difference may result from the difference in capacity utilization rates between developed and developing countries. Since capacity utilization is higher in developed countries than in developing ones (for example, it is about 85% in Germany while it is only 75% in China), increases in oil prices affect developed countries' production negatively, while decreases in oil prices positively affect production in developing countries.

Table 5: Asymmetric Causality from Oil Price to Inflation

Country	$Oil^+ \rightarrow CPI^+$			$Oil^+ \rightarrow CPI^-$			$Oil^- \rightarrow CPI^-$			$Oil^- \rightarrow CPI^+$		
Developing countries												
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
China	3	0.851	0.837	1	2.823	0.093	1	0.011	0.915	1	0.068	0.794
India	1	1.106	0.293	1	3.157	0.076	1	0.013	0.908	1	2.024	0.155
Indonesia	1	0.025	0.873	1	0.002	0.965	1	34.747	0.000*	1	0.002	0.966
Poland	3	27.286	0.000*	1	0.360	0.549	1	0.263	0.608	1	1.286	0.257
Turkiye	3	9.897	0.019**	1	0.722	0.395	1	0.616	0.433	1	0.064	0.800
Developed countries												
Country	$Oil^+ \rightarrow CPI^+$			$Oil^+ \rightarrow CPI^-$			$Oil^- \rightarrow CPI^-$			$Oil^- \rightarrow CPI^+$		
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
Germany	1	25.584	0.000*	1	0.181	0.671	1	0.273	0.601	1	1.617	0.203
Italy	1	0.807	0.369	1	0.042	0.837	1	0.009	0.925	1	0.028	0.868
Japan	1	0.441	0.506	1	1.581	0.209	1	1.862	0.172	1	0.904	0.342
Singapore	1	8.029	0.005*	2	1.002	0.606	1	2.047	0.153	1	1.884	0.170
S.Korea	1	0.055	0.814	2	1.409	0.494	1	9.739	0.008*	1	3.849	0.050

Table 5 shows the causal relationship from oil price to consumer prices. For the developing countries, results show that an increase in oil prices causes an increase in consumer prices in Poland and Turkiye. Furthermore, a decrease in oil prices causes a decline in consumer prices, especially in Indonesia. From the perspective of the developed countries, positive oil price shocks cause an increase in CPI in Germany and Singapore. Also, negative oil price shocks cause a decrease in CPI, especially in South Korea. These results prove that the pass-through effect of oil price shocks is generally weak for the sample countries.

Table 6: Asymmetric Causality from Oil Prices to Unemployment

Country	$Oil^{+} \rightarrow UNEMP^{+}$			$Oil^{+} \rightarrow UNEMP^{-}$			$Oil^{-} \rightarrow UNEMP^{-}$			$Oil^{-} \rightarrow UNEMP^{+}$		
Developing countries												
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
China	2	13.553	0.001*	1	0.146	0.702	1	0.013	0.909	1	0.002	0.967
India	1	0.863	0.353	1	0.146	0.703	1	0.453	0.501	1	0.278	0.598
Indonesia	1	0.002	0.964	1	0.196	0.658	1	0.002	0.966	1	8.380	0.004*
Poland	2	2.957	0.228	2	0.736	0.692	1	1.457	0.227	2	90.160	0.000*
Turkiye	2	26.129	0.000*	1	0.107	0.743	1	0.026	0.872	1	1.746	0.186
Developed countries												
Country	$Oil^{+} \rightarrow UNEMP^{+}$			$Oil^{+} \rightarrow UNEMP^{-}$			$Oil^{-} \rightarrow UNEMP^{-}$			$Oil^{-} \rightarrow UNEMP^{+}$		
	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.	L	MWald	Prob.
Germany	3	8.326	0.040**	1	0.279	0.597	1	33.144	0.000*	1	0.000	0.988
Italy	3	3.330	0.343	1	3.077	0.079	1	0.126	0.723	3	30.06	0.000*
Japan	3	0.609	0.894	1	1.582	0.208	1	0.106	0.744	3	7.437	0.059***
Singapore	3	19.635	0.000*	1	0.317	0.573	1	0.968	0.325	1	15.376	0.000*
S. Korea	3	1.787	0.618	1	0.810	0.368	1	0.655	0.418	3	10.413	0.015**

Table 6 exhibits the causality results from oil price shocks to unemployment. According to results for developing countries, an increase in oil prices causes unemployment, especially in China and Turkiye. Moreover, a fall in oil prices causes an increase in unemployment, especially in Indonesia and Poland. Considering that the decreases in oil prices may have occurred when countries face recession (considering the drop in oil prices in global recessions), an increase in unemployment could result from such an economic environment.

Developed countries' results also show that an increase in oil prices causes an increase in unemployment in Germany and Singapore. On the other hand, a decrease in oil prices causes a decline in unemployment, especially in Germany. Lastly, the decrease in oil prices appears to have coincided with an increase in unemployment in Italy, Japan, Singapore, and Korea, potentially reflecting broader economic recessions during those periods. As explained above, this result may result from a deflationary and recessionist environment (considering Japan's struggle with deflation, this result is an expected result for Japan). These results also prove that oil price shocks significantly affect top oil-importing developed and developing countries' unemployment rates.

5. CONCLUSION

To clarify the much-debated issue of whether oil price shocks negatively affect the GDP, prices, and unemployment rate, the causal relationship between oil price shocks and fundamental macroeconomic indicators is researched in this study. Data from five developed countries (e.g., Germany, Italy) and five developing countries (e.g., Turkiye, China) are used for this purpose. Selections are made based on the top 20 oil importers' list.

Using the Hatemi-J asymmetric causality test, it is obtained that a decrease in oil prices causes an increase in GDP in China, Indonesia, and Turkiye. On the other hand, for developed countries, negative oil price shocks have no significant positive impact on GDP. Positive oil price shocks have statistically significant effects on negative GDP shocks in Germany (as reached by Bjørnland, 2000) and Italy. In conclusion, while negative shocks are effective (positively affect) in developing countries' GDP, positive shocks are effective (negatively affect) in developed countries' GDP. This difference may result from the capacity utilization rate difference between developed and developing countries. Since capacity utilization is higher in developed countries than in developing ones, an increase in oil prices negatively affects developed countries' production while a decrease in oil prices positively affects production in developing countries. In terms of its inflationary effect, it was found that an increase in oil prices caused an increase in consumer prices in Poland and Turkiye. Furthermore, a decrease in oil prices causes a decline in consumer prices in Indonesia. For the developed countries, positive oil price shocks cause an increase in CPI in Germany (as obtained by Filis and Chatziantoniou, 2014) and Singapore. Also, negative oil price shocks lead to a decrease in CPI in South Korea, likely due to reduced energy costs. These results prove that the pass-through effect of oil price shocks is generally weak and incomplete for the sample countries. Lastly, an increase in oil prices causes an increase in unemployment in China and Turkiye (confirming Doğrul and Sotaş's (2010) results). Moreover, a decrease in oil prices causes an increase in unemployment in Indonesia and Poland. From the developed countries' side, an increase in oil prices causes an increase in unemployment in Germany and Singapore. On the other hand, a decrease in oil prices causes a decline in unemployment in Germany. Lastly, the decrease in oil prices seems to have caused the increase in unemployment in Italy, Japan, Singapore, and Korea. Considering that the decreases in oil prices may have occurred when countries are facing recession (considering the drop in oil prices in global recessions), it can be thought that an increase in unemployment could be the result of such an economic environment.

When the results are generally evaluated, it is seen that oil price shocks do not have a significant effect on the macroeconomic variables of all the sample countries. Considering that many of these countries are increasing their investment and usage in renewable energy, these results are acceptable. For example, by 2023, China is a leading country in renewable energy and energy storage technologies, as well as in nuclear energy alongside Japan and South Korea. Inside the developed countries, the most negatively affected countries are Germany and Singapore. Oil is the most important primary energy source in Germany and according to the Federal Institute for Geosciences and Natural Resources (BGR), about 98 percent of Germany's primary mineral oil consumption had to be imported in 2022 (Wettengel, 2024). The importance of oil import can be explained by a recent example that is after the invasion of Ukraine by Russia. Sanctions imposed on Russia, one of Germany's top oil suppliers, and the cut in oil and natural gas imports from Russia cost the German economy about €100 billion ($107 billion), or about 2.5% of its GDP as Marcel Fratzscher, head of the German Institute for Economic Research (DIW) indicates. Moreover, according to the German Chamber of Industry and Commerce (DIHK), the impact on the economy as a whole translates to a loss of wealth of around €2,000 for every individual in Germany (Nia, 2023). In 2023, the economy contracted by 0.26 % as it is expected. Therefore, considering Germany's high dependence on oil imports and the high share of crude oil in its energy consumption composition, the negative effects of oil price shocks on the German economy seem inevitable. Despite being one of Asia's largest petroleum refining centers, with a daily capacity of 1.3 million barrels, Singapore is a 100% net importer of oil and does not produce any crude oil (Chang and Wong, 2003: 1151). Therefore, these results are acceptable for Singapore too. Inside the developing countries, the most negatively affected country is identified as Turkiye. Considering that Türkiye is 90% dependent on crude oil imports, these effects of oil price shocks on output, unemployment and inflation are not surprising. (TR, Ministry of Energy and Natural Resources, 2024).

As a result, these countries should turn towards alternative energy resources with investment and supportive policies. At this point, industrial transformation is of great importance. Policies that can be implemented include moving away from fossil fuels and adopting renewable energy in the industrial and transportation sectors. Another policy that must be implemented is continuously conducting R&D studies on renewable energy technologies. On the other hand, considering the negative effects (contraction and inflation) on the economy caused by the interruption of oil from Germany's largest supplier after the sanctions imposed on Russia, other precautions that can be taken include not being dependent on a single country in terms of suppliers and keeping a wide range of supplier countries. Additionally, Krebs and Weber (2024) drew attention to the effects of oil price shocks on Germany's output and inflation and suggested price controls to avoid the negative effects of the shocks. These countries' investments in renewable energy have dramatically increased in recent years. It is expected that with an increase in the usage of alternative energy resources, these negative effects of the oil price shocks will be eliminated.

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