The Impact of Crude Oil Prices on Macroeconomic Factors in Korea*

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Abstract

Purpose - The purpose of this study is to examine how Korea's macroeconomic factors, such as GDP, CPI, Export, Import, Unemployment rate and USD/KRW exchange rate, are affected by the oil price shocks.

Design/methodology/approach - This study used monthly and quarterly time-series data of each variable for the period 1983 to 2022, consisting of two sub-periods, to employ Granger causality test and GARCH method in order to identify the role of the oil price movement in macroeconomic factors in Korea.

Findings - Korea's currency rate to the US dollar is negatively correlated with the price change of crude oil while the GDP change is positively correlated with the price change of crude oil with strong relationship between Export and Import in particular. The exchange rate and GDP growth are believed to be not correlated with the oil price change for the pre-GFC period. According to the Granger causality test, the price change in crude oil has a causal impact on CPI, Export and Import while other factors are relatively slightly affected. Transmission effect from the oil price to Export is found and there also exists volatility spillover from oil price to economic variables under examination. Comparing two sub-periods, CPI and Export volatility responds negatively to shocks in the oil price for the pre-GFC period while volatility of CPI and Unemployment reacts positively to the oil price shocks for the post-GFC period.

Research implications or Originality - The findings of this study could be helpful for both domestic and international investors to build their portfolio for the risk management since rising WTI price can be interpreted as a result of global economic growth and ensuing increase in the worldwide demand of the crude oil. Consequently, the national output is expected to increase and the currency is also expected to be strong in the long run.

Ⅰ. Introduction

Recent movement of oil price has been extremely volatile following the outbreak of COVID-19 pandemic in late 2019 and the war between Russia and Ukraine of early 2022. Since the COVID-19 pandemic broke out in late December 2019, oil price has plunged to below $10 per barrel on April 21, 2020 from approximately U$60 in December, the price before the Covid-19, owing to the fear of worldwide economic contraction. As the panic of COVID-19 lessened, oil price has recovered rapidly because of the expectation that the global economy

will regain momentum and global crude oil demand will increase. However, due to the war between Russia and Ukraine intensifying in early 2022, the oil price went up to higher level than what it was before the outbreak of the coronavirus. The price of crude oil hit $139 per barrel at one point on March 7, its highest point since 2012 due to market turmoil caused by ultimate Russia's invasion of Ukraine.

The crude oil has been the key source of global economic growth since the oil crises broke out in the 1970s, though the significance of oil as the energy source has lessened due to the alternative energy development including solar energy, biomass energy, hydroelectric energy, wind energy, etc. (Yoon, 2015). Consequently crude oil price is vital information in economic terms (Kang, 2014). If oil price is higher, the economic conditions in oil exporting countries are beneficial while oil importing countries suffer from higher cost.

Dramatic movement of crude oil price following COVID-19 pandemic and the war between Russia and Ukraine recapture attention in the impact of oil shocks on the economy. The effect of oil price shocks on the economy has become a key issue in the literature since the occurrence of the worst energy crises in 1970s.

Theoretically, higher oil price causes inflation, lowering the quantity of real balances in the system and ultimately leading to lower output growth (Ferderer, 1996). Oil price rise also redistribute income between net oil importers and exporters, resulting in lower aggregate demand (Cunado and Perez de Gracia, 2003). On the supply side, higher oil price increases production costs under circumstances where there is no substitution possibility between factors of production. Accordingly, the productivity of capital and labor falls and potential output declines, implying lower wages and lower potential outputs, should labor supply be withdrawn as a result (Cunado and Perez de Gracia, 2005).

A large number of literature has examined the effects of crude oil price on macroeconomic factors since the pioneering work of Hamilton (1983), which presented significant correlation between oil price changes and the US gross national product (GNP) growth over the period 1948-72 and posited that oil shocks were a contributing factor in the U.S. recessions before 1972. This seminal work was followed by Mork (1989), Ferderer (1996), Cunado and Perez de Garcia (2003 and 2005) and Bachmeier (2008), to name a few among many. Mork (1989) extended the work of Hamilton (1983), which was implemented in the research period of upward oil price movements. He tried to find whether the correlation also exists in periods of downward price movements. No significant effects of oil price decrease on the US GNP were identified, differently from the effects of price increases.

From an empirical point of view, lots of papers have produced explanations for the fact that oil price behavior plays a substantial role in economic activity (for example, Hamilton (1983), Mork (1989), Cunado and Perez de Gracia (2003, 2005), Barski and Killian (2004), Cologni and Manera (2009), Cunado, Jo, and Perez de Gracia (2015), Morana (2017), Kim et al. (2017) and Lorusso and Pieroni (2018)).

The impact of oil shocks on the economy is understood to be different in oil importers and oil exporters since an oil price rise is considered to be beneficial for oil exporting countries and damaging for oil importing countries, and vice versa. Korea is among big oil importers ranking 4th in the world only after China, the US and India in 2020.[6] Nevertheless, few studies have been carried out on the issue as regards Korea. Kang (2014) investigated that West Texas

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6) Refer to "Crude Oil Imports by Country 2020 Plus Average Unit Prices",
   (https://www.worldstopexports.com/crude-oil-imports-by-country/).

Intermediate (WTI) oil price shocks affect Korea's macroeconomic variables including Certificate of Deposit (CD) rate, Consumer Price Index (CPI), Producer Price Index (PPI), Industrial Production Index (IPI) and USD/KRW rate applying Vector Autoregression (VAR) method over the period 2000-2015 to find that before the 1998 Asian financial crisis, the shock of oil price has a very weak impact on the Korean macro-economy while after the crisis, WTI price positively affect CD, CPI and PPI, implying that the increase of WTI price leads to increase CD rate, CPI and PPI. Kim and You (2016) used monthly data of oil price, CD rates, CPI, IP, USD/KRW rate for the period 1991-2013 to examine the impacts of oil shocks on macro-economic variables and confirmed that oil price affects interest rate, inflation and exchange rate, showing the asymmetric responses to oil price rises and declines.

These studies, including other studies on Korean issue, showed effects of oil price shocks on the economy with mixed findings. However, most of existing studies employed relatively short research period with monthly or quarterly data with insufficient sample size and have not reflected recent dramatic fluctuations of crude oil. This study, therefore, included recent data spanning from 1983 to 2022 to examine how macroeconomic factors in Korea are affected by the oil price movement. Considering data availability, monthly data for prices of WTI crude oil futures and major macroeconomic indices such as CPI, Unemployment rate, Export, Import and USD/KRW exchange rate are used for the period from January 1990 to March 2022. For GDP data series, quarterly data are used for the period from 2nd quarter 1983 to 1st quarter 2022. For the comparative analysis, research period is divided into two sub-periods, that is, the period leading up to the 2008 global financial crisis (pre-GFC period) and the period there-after including the COVID-19 pandemic (post-GFC period). The pre-GFC period shows steady upward movement of oil prices while the post-GFC period can be characterized as the period of remarkable price fluctuations (see Figure 1 and 2).

The remainder of this paper is organized as follows. Section 2 describes the data and descriptive statistics. Section 3 reports the empirical results and Section 4 concludes the paper and provides implications.

II. Data Analysis

The data employed in this study consist of WTI crude oil futures and major macroeconomic factors such as CPI, Unemployment rate, Export, Import and USD/KRW. All data are the montly closing data for the period January 1990 to March 2022, corresponding to 491 observations each. For the analysis of GDP, quarterly data was used for the period 1983-2022 with 156 observation along with same size of crude oil data. WTI crude oil futures data was collected from Investing.com and macroeconomic factors were obtained from ECOS, Economic statistics of the Bank of Korea. The monthly or quarterly changes of data, denoted by R_t in the equation (1) below, are calculated as percentage change of a variable from one period to another:

$$R_t = (\frac{P_t - P_{t-1}}{P_{t-1}}) \times 100 \tag{1}$$

where R_t is the percentage change in day t, and P_t and P_{t-1} are closing data at time t and $t-1$, respectively.

Figure 1 exhibits the movement of WTI crude oil futures price and Korea's macroeconomic

factors such as CPI, Export, Import, Unemployment rate and USD/KRW exchange rate during the research period from January 1990 to March 2022 and Figure 2 illustrates the trend of WTI crude oil futures price and Korea's GDP for the period from the 2nd quarterly to the 1st quarter 2022. The numbers represent a thousand dollars for Export and Import, and one billion won for GDP, respectively.

The price of WTI crude oil continued to rise for the research period to the peak of $140 per barrel in mid 2008 during the time of the global financial crisis before plummeting and recovering. The price repeated rises and falls afterwards before the outbreak of COVID-19 in December 2019. As the COVID-19 broke out in late 2020, the crude oil price fluctuated significantly along with the recent conflict between Russia and Ukraine. CPI, GDP, Export and Import showed steady rise over time. Korean won was extremely volatile, with its value declining sharply in response to the two financial crises, that is, the 1997 Asian currency crisis and the 2008 global financial crisis. Unemployment rate was significantly high during the 1997 Asian currency crisis, showing the severity of the crisis and its impact on Korean people.

Fig. 1. Trend of Monthly Variables
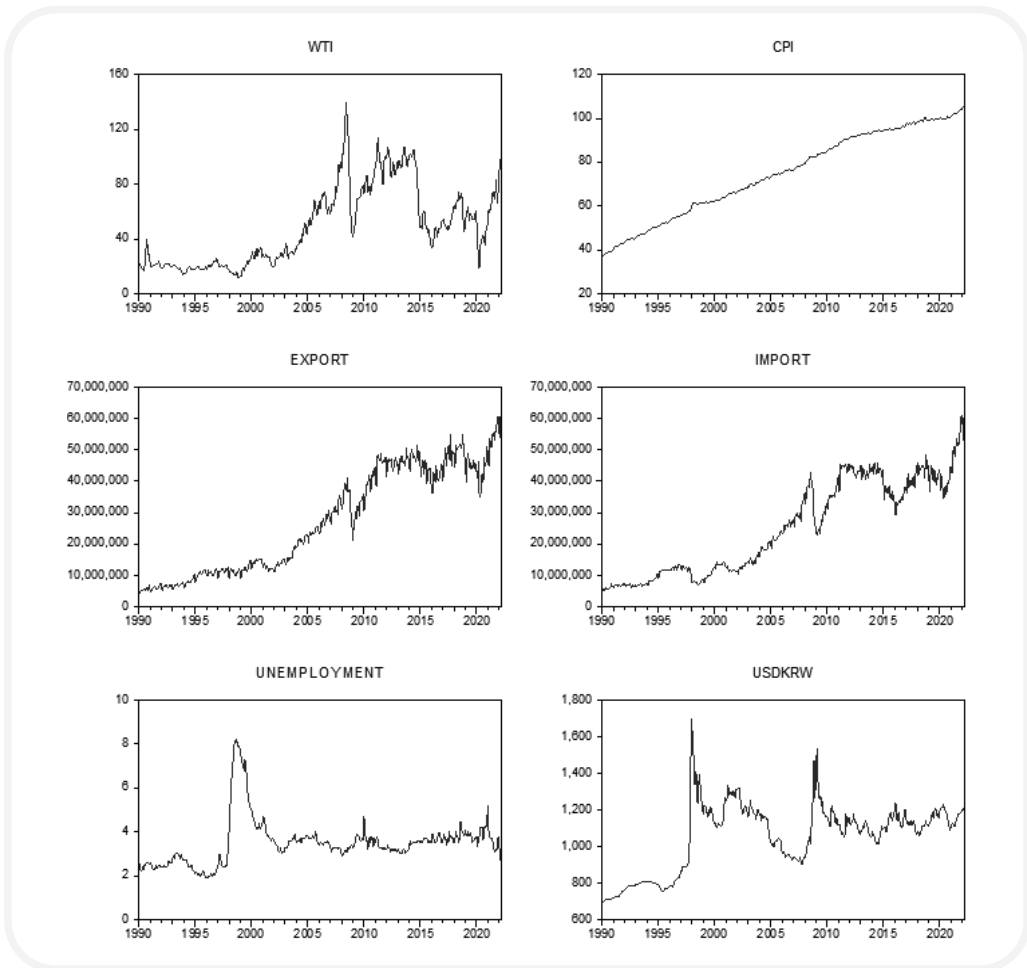
The analysis has been done for the period leading to the global financial crisis spanning from the start of the sample period until June, 2008 and the period thereafter to compare the effect of the oil price movement on the Korea's macroeconomic factors between the pre-GFC period and the post-GFC period, which represent the period of upward oil price movement and the period of volatile price movement of oil, respectively.

Fig. 2. Trend of Quarterly WTI and GDP
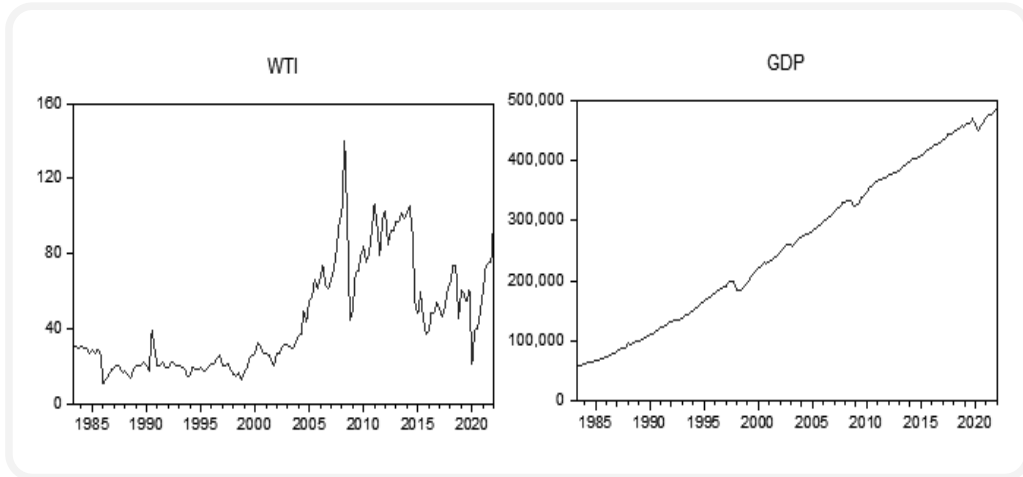
The descriptive statistics for monthly and quarterly changes are presented in table 1. Mean values of all variables are all positive for the sample period with changes in WTI crude oil, Export and Import higher than other variables. Crude oil price is most volatile, followed by Export and Import while inflation and exchange rate have relatively lower volatility.

Only Export have negative skewness with distributions skewed to the right, meaning that the tail on the left side of the probability density function is longer or fatter than the right side. All kurtosis coefficients are greater than three, indicating all the data exhibited the leptokurtosis characteristic with fat-tailed distributions. According to the Jarque-Bera test, the null hypothesis of normal distribution is also rejected, confirming the results of skewness and kurtosis analysis. The monthly changes of variables under study do not follow a normal distribution. For the quarterly data analysis, WTI crude oil changes show negative mean values and higher volatility.

Table 1. Descriptive Statistics for Change (%) of Variables

MONTHLY	WTI	CPI	EXPORT	IMPORT	UNEMPLOYMENT	USD/KRW
Mean	0.96672	0.27933	1.08282	0.91826	0.20310	0.21772
Median	1.07	0.25	0.77	0.798	0	0.02803
Maximum	88.38	2.53	24.97	25.1757	32.26	44.93373
Minimum	-54.24	-0.74	-36.26	-26.7555	-25	-15.18677
Std. Dev.	10.84649	0.45338	9.65165	7.65183	6.11900	3.86811
Skewness	1.17694	1.04932	-0.39527	0.23104	0.73535	4.32305
Kurtosis	15.49048	6.45121	4.26983	3.73212	7.85912	51.78669

Jarque-Bera	2605.038	263.0816	36.07827	12.08595	415.6053	39585.2
(Probability)	0	0	0	0.00237	0	0
Observations	387	387	387	387	387	387

QUARTERLY	WTI	GDP
Mean	-1.90696	1.41737
Median	2.38293	1.315
Maximum	56.79575	7.7
Minimum	-198.145	-6.82
Std. Dev.	28.04776	1.51350
Skewness	-3.82821	-0.6995
Kurtosis	24.17249	10.03917
Jarque-Bera	3294.818	334.7968
(Probability)	0	0
Observations	156	156

Notes: This table summarizes the descriptive statistics of the market index (KOSPI and KOSDAQ) and the 10 sampling stocks.

Table 2 reports the correlation coefficients between the pairs of variables. WTI oil price is negatively correlated with exchange rate and positively correlated with GDP, with no significant relationship with other variables. However, it is found that exchange rate and GDP growth are not correlated with the price change of oil during the oil price upward movement period which is the pre-GFC period. This is in contrast to the post-GFC period, where exchange rate and GDP growth have strong relationship with the oil price change.

For other variables, CPI showed strong relationship with other macroeconomic factors but import. Export and Import are significantly correlated and negative correlation between Import and exchange rate are shown. Rising exchange rate is strongly linked to upward inflation and downward Import.

Table 2. Correlation Analysis

	WTI	CPI	EXPORT	IMPORT	UNEMPLOYMENT	USD/KRW
Entire Period						
WTI	1					
CPI	0.01908	1				
EXPORT	0.04800	-0.10401**	1			
IMPORT	0.00505	-0.07003	0.64634***	1		
UNEMPLOYMENT	-0.01214	0.11618**	-0.02030	-0.04706	1	
USD/KRW	-0.13066**	0.14991***	-0.02079	-0.12111**	0.01720	1
GDP	0.19096**					
Pre-GFC Period						
WTI	1					
CPI	-0.04917	1				
EXPORT	0.03947	-0.147**	1			
IMPORT	0.01345	-0.10467	0.60606***	1		
UNEMPLOYMENT	-0.05275	0.17834***	-0.07031	-0.12575*	1	
USD/KRW	-0.0765	0.24165***	0.06136	-0.08155	0.07209	1
GDP	0.10012					
Post-GFC Period						

WTI						
CPI	0.11122	1				
EXPORT	0.05474	-0.04999	1			
IMPORT	-0.00791	-0.03771	0.71245***	1		
UNEMPLOYMENT	0.01701	0.03498	0.04011	0003941	1	
USD/KRW	-0.20288***	-0.06416	-0.17752**	-0.19306**	-0.0531	1
GDP	0.35870***					

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

III. Empirical Results

The analysis with non-stationary variables gives rise to spurious regression due to the violation of the assumptions of standard regression analysis. Unit root tests identify whether a series is stationary or not. The augmented Dickey and Fuller (ADF) (Dickey, Fuller, 1981), and Philips-Perron (PP) test (Philips, Perron, 1988). The ADF statistics is a preferred alternative because it considered superior for time series with autoregressive structure and more reliable, since it ensured white noise residuals in the regression (Patra, Poshakwale, 2006). This study used the ADF for unit root tests for the level data and percentage change of each variable and the results are reported in Table 3. According to the results, the unit root hypothesis is rejected for both monthly and quarterly changes of variables indicating the stationarity of the variables under analysis.

Table 3. ADF Unit Root Test

MONTHLY	Level	Percentage Change
WTI	-1.99787	-17.0578***
CPI	-2.35691	-3.18377**
EXPORT	-0.20623	-4.47202***
IMPORT	-0.09342	-5.28922***
UNEMPLOYMENT	-3.92442***	-19.9195***
USD/KRW	-2.85597*	-18.6269***
QUARTERLY		
WTI	-1.94338	-13.6149***
GDP	0.84380	-9.60642***

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively, based on MacKinnon (1996) one-sided p-values.

The Granger causality test is employed to examine whether a time series variable of WTI oil price changes has a causal impact on each of the Korea's macroeconomic factors under study, which was proposed by Granger (1969). To test the null hypothesis that one variable does not Granger-cause another, Granger causality tests for the impact of WTI crude oil price changes on the economic variables in Korea are implemented and F-statistics of the each time series are reported in Table 4. WTI oil price changes have a causal impact on all economic factors in Korea in particular with CPI, Export and Import affected by the WTI oil price changes.

To compare two sub-periods, changes in oil price have a causal impact on all factors except for Unemployment and exchange rate during the post-GFC period while only CPI and Import are affected by the oil price changes over the pre-GFC period.

Table 4. Granger Causality Test

Null Hypothesis	Obs	F-Statistics	Prob.
Entire Period			
WTI does not Granger Cause CPI	385	12.4546***	6.00E-06
WTI does not Granger Cause EXPORT	385	15.9249***	2.00E-07
WTI does not Granger Cause IMPORT	385	27.9257***	5.00E-12
WTI does not Granger Cause UNEMPLOYMENT	385	2.69336*	0.0689
WTI does not Granger Cause USDKRW	385	2.69493*	0.0688
WTI does not Granger Cause GDP	154	2.65746*	0.0734
Pre-GFC Period			
WTI does not Granger Cause CPI	220	4.27602**	0.0151
WTI does not Granger Cause EXPORT	220	2.30129	0.1026
WTI does not Granger Cause IMPORT	220	11.6364***	2.00E-05
WTI does not Granger Cause UNEMPLOYMENT	220	0.75369	0.4719
WTI does not Granger Cause USDKRW	220	0.11171	0.8944
WTI does not Granger Cause GDP	99	1.56788	0.2139
Post-GFC Period			
WTI does not Granger Cause CPI	164	4.74345***	0.0100
WTI does not Granger Cause EXPORT	164	17.3765***	1.00E-07
WTI does not Granger Cause IMPORT	164	19.678***	2.00E-08
WTI does not Granger Cause UNEMPLOYMENT	164	1.80575	0.1677
WTI does not Granger Cause USDKRW	164	2.03091	0.1346
WTI does not Granger Cause GDP	54	16.426***	3.00E-06

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

In order to assess the spillover effects between crude oil futures price changes and the changes in each macroeconomic variable of Korea, the generalized autoregressive conditional heteroskedasticity (GARCH) is estimated. The GARCH model was developed to identify conditional variances (Bollerslev, 1986). The variance of the variable, dependent variable, is modeled as a function of its past values and independent variables. The GARCH (1,1) model for data series Y_i is estimated in the mean equation (2) and variance equation (3) below. The α and β in the equation represent ARCH and GARCH parameters, respectively.

$$Y_t = \alpha + \beta_k \sum_{k=1}^{n} Y_{t-n} + \epsilon_t \qquad (2)$$

$$\sigma_t^2 = \omega + \alpha \epsilon_{t-1}^2 + \beta \sigma_{t-1}^2 \qquad (3)$$

To identify returns spillover effects of changes in WTI oil price over changes in macroeconomic variables, WTI oil price is applied as an independent variable to the above mean equation . In order to explore volatility spillover effect from oil market to stock markets, volatility of price changes in WTI crude oil is incorporated as an independent variable in variance equation as follows:

$$R_{i,t} = c_1 + c_2 R_{WTI,t} + \epsilon_t \qquad (4)$$

$$\sigma_{i,t}^2 = c_3 + c_4 \epsilon_{i,t-1}^2 + c_5 \sigma_{i,t-1}^2 + c_6 \epsilon_{WTI,t}^2 \qquad (5)$$

where c_1 and c_2 in the mean equation (4) represent constant coefficient, coefficient of WTI oil price changes, while c_3, c_4, c_5 and c_6 in the variance equation (5) denote constant coefficient,

coefficients of the ARCH term (ϵ^2_{t-1}), the GARCH term (σ^2_{t-1}) and shocks of oil market, respectively. The mean equation provides information about impacts of oil price changes on each variable changes. The variance equation is to forecast this period's conditional variance of each variable by forming a weighted average of a long term average (the constant), information about volatility observed in the previous period (ARCH term), the predicted variance from last period (GARCH term) and volatility of oil price changes, respectively (Yoon, 2014).

Table 5 demonstrates coefficient estimates of the mean equation and variance equation. Only Export changes are slightly affected by the price changes of oil with other macroeconomic factors in Korea not influenced by the oil shocks. Estimates of ARCH and GARCH coefficients represented by $c4$ and $c5$, which capture past shock dependence and volatility persistence respectively, are statistically significant in changes of all Korea's macroeconomic factors. High GARCH coefficient indicates that current volatility is significantly affected by past volatility of its own. With regard to volatility transfer from oil price to other economic variables under examination (see coefficient $c6$), it is observed that volatility of only CPI and GDP responds negatively to shocks in the oil price.

To compare the upward price movement period (pre-GFC period) with volatile price movement period (post-GFC period), CPI is the only factor affected strongly by the price changes of oil for both the sub-periods, in contrast to the result of the entire period analysis. Regarding volatility transfer from oil price to other economic factors, volatility of CPI and Export responds negatively to shocks in the oil price for the pre-GFC period while volatility of CPI, Unemployment and exchange rate responds to the oil price shocks for the post-GFC period.

In addition, the ARCH LM test are also implemented and its results are reported in the bottom panel in Table 5. The Lagrange multiplier (LM) method tests autoregressive conditional heteroskedasticity (ARCH) in the residuals (Engle, 1982). Two test statistics are shown in Table 5. The F-statistic is an omitted variable test for the joint significance of all lagged squared residuals. The Obs*R2 statistic is Engle's LM test statistic, computed as the number of observations times the R2 from the test regression. The test results indicate that there is no ARCH effect only in CPI and USD/KRW exchange rate, confirming that the GARCH(1,1) model employed in the study is correctly specified in such variables Export, Import, Unemployment and GDP. (QMS, 2009).

Table 5. GARCH Model Estimation

Dependent Variables	CPI	EXPORT	IMPORT	UNEMPLOY	USD/KRW	GDP
Entire Period						
Mean Equation Coefficients						
c1	0.26090***	0.92549*	1.14521***	0.09445	0.22275***	1.09883***
c2	0.00018	0.06668*	-0.01998	0.00482	-5.09E-03	0.00178
Variance Equation Coefficients						
c3	0.05124***	34.6841*	45.7231***	3.26665***	3.15E-02*	0.19892***
c4	0.08708***	0.10732*	0.37165***	0.14909***	0.48688***	0.27998***
c5	0.638423**	0.50767**	-0.0995	0.76921***	0.68619***	0.63631***
c6	-0.00268***	-0.4827	-0.42875	0.01369	5.97E-03	-0.01729***
F-statistic	4.07205**	0.266107	0.042317	0.05370	13.6369***	0.4601
Obs*R²	4.05031**	0.267307	0.042532	0.05397	13.2378***	0.464754
Pre-GFC Period						
Mean Equation Coefficients						
c1	0.36546***	1.30879*	1.42402***	-0.14187	0.16741	1.80270***

c2	0.00436***	0.01509	-0.01468	0.00372	-0.00854	0.00223
Variance Equation Coefficients						
c3	0.13041***	4.38939***	43.47893***	7.53146**	12.2135**	0.33552**
c4	0.15944*	-0.00311	0.40601***	0.28795**	0.17501***	0.56841***
c5	0.25592	0.95539***	-0.05418	0.42732*	0.45399*	0.48322***
c6	-0.00332**	-0.79299**	-0.42693	-0.17824	-0.35533*	-0.02387*
Post-GFC Period						
Mean Equation Coefficients						
c1	0.16402***	0.92302	0.76832	0.41682	0.18300	0.73695
c2	0.00662***	0.06111	-0.05144	-0.01259	-0.02168	0.00289
Variance Equation Coefficients						
c3	0.17813***	27.9265	55.2665***	4.89928**	0.16185***	0.15301
c4	-0.03307	0.20552	0.31691**	0.07297	-0.04304***	-0.00386
c5	-0.56536	0.45262	-0.28975	0.83166***	1.00970***	0.65563
c6	0.00221**	-0.73575	-0.64050	0.37661***	-0.04887**	-0.01310

Notes: ***, ** and * indicate statistical significance at the 1%, 5% and 10%, respectively.

IV. Conclusion

The significant fluctuations in crude oil price due to the outbreak of COVID-19 in late 2019 and Russian invasion of Ukraine in early 2022 have recaptured attention in the relationship between oil price changes and national macroeconomic factors. This paper examines the impacts of the oil price shocks on Korea's major macroeconomic factors using monthly data for futures price movements of WTI crude oil and six national economic factors such as CPI, Export, Import, Unemployment, Korean Won's exchange rate to the US dollar and GDP. Considering the availability of the data, monthly data are used for the period from January 1990 to March 2022. while the quarterly GDP data is used for the period from 2nd quarter 1983 to 1st quarter 2022. The research period has been split into two sub-periods consisting of pre-GFC period and post-GFC period, which is the period before and after June of 2008.

WTI oil price fluctuated sharply in late 2000s due to the 2008 global financial crisis and later the occurrence of the unprecedented COVID-19 pandemic in late 2019 and the war between Russia and Ukraine in early 2022. Korea's currency rate to the US dollar is negatively correlated with the price changes of crude oil while the GDP change is positively correlated with the price change of crude oil, suggesting that the rise in oil price is attributed to strong demand resulting from the global economic growth and the economic performance lead to the strong national currency. For economic variables, particularly strong relationship between Export and Import with the coefficient of as high as 0.6463. For the pre-GFC period, however, exchange rate and GDP growth are not correlated with the price change of oil in contrast to the post-GFC period, where these variables have strong linkage with the oil price changes.

Granger causality tests for the causal effects of the changes in WTI crude oil price on the Korea' macroeconomic factors are implemented. The price changes in crude oil have a causal impact on such economic factors as CPI, Export and Import of Korea while other factors are relatively slightly affected. When compared between two sub-periods, oil price changes have a causal impact on all factors except for Unemployment and exchange rate for the post-GFC period whereas CPI and Import are affected by the oil price changes for the pre-GFC period.

As for the transmission effects from the oil price to the economic factors, WTI oil price

changes slightly affect Export. Regarding volatility spillover from oil price to economic variables under study, volatility of economic variables is believed to be positively affected by oil price shocks. Comparing two sub-periods, CPI and Export volatility reacts negatively to shocks in the oil price for the pre-GFC period while for the post-GFC period, volatility of CPI, Unemployment and exchange rate responds to the oil price shocks.

The findings suggest that fluctuation of crude oil price plays a role on most of macroeconomic factors in Korea, in particular having relationship with USD/KRW rate and GDP, and also has causal effect on such variables as CPI, Export and Import.

The findings of this study could be helpful for investors to build their portfolio management since rising WTI price can be interpreted as a result of global economic growth, raising the demand of world oil. Consequently, the national output is expected to increase and the currency is also expected to be strong in the long run.

References

Bachmeier, L. (2008) "Monetary Policy and the Transmission of Oil Shocks", *Journal of Macroeconomics*, 30(4), 1738-1755.

Barski, R. B., and L. Killian (2004), "Oil and the Macroeconomy since the 1970s", *Journal of Economic Perspectives*, 18(4), 115-34.

Bollerslev, T. (1986), "Generalized Autoregressive Conditional Heteroskedasticity", *Journal of Econometrics*, 3(3), 307-327.

Cologni, A., and M. Manera (2009), "The Asymmetric Effects of Oil Shocks on Output Growth: A Markov–Switching Analysis for the G-7 Countries", *Economic Modelling*, 26(1), 1–29.

Cunado, J. and F. Perez de Gracia (2003), "Do Oil Price Shocks Matter? Evidence for Some European Countries", *Energy Economics*, 25(2), 137–54.

Cunado, J. and F. Perez de Gracia (2005), "Oil Prices, Economic Activity and Inflation: Evidence for some Asian Countries", *The Quarterly Review of Economics and Finance*, 45(1), 65-83.

Cunado, J., S. Jo and F. Perez de Gracia (2015), "Macroeconomic Impacts of Oil Price Shocks in Asian Economies", *Energy Policy*, 86, 867–79.

Dickey, D. A. and W. A. Fuller (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica*, 49(4), 1057-1072.

Engle, R. F. (1982) "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of UK Inflation" *Econometrica*, 50(4), 987-1008.

Ferderer, J. P. (1996), "Oil Price Volatility and the Macroeconomy", *Journal of Macroeconomics*, 18(1), 1–26.

Granger, C. W. J. (1969), "Investigating Causal Relations by Econometric Models and Cross-spectral Methods" *Econometrica*, 7(3), 424-438.

Hamilton, J. D (1983), "Oil and the Macroeconomy since World War II", *Journal of Political Economy*, 91(2), 228–48.

Hamilton, J. D. (2011), "Nonlinearities and the Macroeconomic Effects of Oil Prices", *Macroeconomic Dynamics*, 15(S3), 364–78.

Kang, S. H. (2014), "The Impact of Oil Price Shock on Macroeconomy Indices in Korea" *Journal of the Korean Data Analysis Society*, 16(1), 267-278. (in Korean).

Kim, S. K and D. S. You (2016), "The Impacts of Oil Price Shocks on Macroeconomic Variables", *Journal of Business Research*, 31(4), 289-312. (in Korean).

Kim, W. J., S. Hammoudeh, J. S. Hyun and R. Gupta (2017), "Oil Price Shocks and China's Economy: Reactions of the Monetary Policy to Oil Price Shocks", *Energy Economics*, 62, 61–69.

Morana, C. (2017), "Macroeconomic and Financial Effects of Oil Price Shocks: Evidence for the Euro Area", *Economic Modelling*, 64, 82–96.

Mork, K. A. (1989), "Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton's Results", *Journal of Political Economy*, 97(3), 740–44.

Patra, T. and S. Poshakwale (2006), "Economic Variables and Stock Market Returns: Evidence from the Athens Stock Exchange", *Applied Financial Economics*, 16(3), 993-1005.

Peter C. B. Philips and Pierre Perron, (1988), "Testing for a Unit Root in Time Series Regression", *Biometrica*, 75(2) 335-346.

QMS (2009), EViews 7 User's Guide II. Quantitative Micro Software.

Yoon, I. H. (2014), "The Study on Stock Market Integration of Countries of Eastern Europe: Focusing on the Visegrad Group Countries" *Journal of the Korean Data Analysis Society*, 16(4), 1997-2009. (in Korean).