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**Article**

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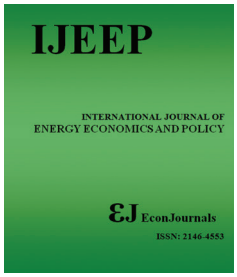

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# Relationship between Geopolitical Risk in Major Oil Producing Countries and Oil Price

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**ABSTRACT**

This study has applied Granger causality tests and dynamic ordinary least squares (DOLS) models to examine the relationship between geopolitical risk in major oil-producing countries and the crude oil price before and after the 2008 financial crisis. The granger causality tests show that the geopolitical risk of Saudi Arabia, Russia, the United States and China granger cause changes in crude oil prices. The DOLS models show that the series in the model are cointegrated. The coefficients for the geopolitical index of Canada, Russia and China are significant before the 2008 financial crisis sample period. However, the DOLS model shows that the coefficients for all geopolitical indexes are insignificant after the 2008 financial crisis sample period. The general public and investors generally precept major oil exporters like Russia and Saudi Arabia as the major players in the oil market. However, after the 2008 financial crisis, the discrepancy in the economic needs of the major oil-producing countries has reduced their ability to co-operate crude oil prices. This study also discovered that China plays a significant role in the oil market.

**Keywords:** Oil Prices, Oil Production, Granger Causality Test, Dynamic Ordinary Least Squares Model, Geopolitical Risks
**JEL Classifications:** Q41, Q02, F51, H56

## 1. INTRODUCTION

According to the U.S. Energy Information Administration (2021), the world's top five largest oil producers in 2020 are the United States, Saudi Arabia, Russia, Canada and China respectively. These five predominant oil-producing countries occupied over 50% of the total global oil production in 2020. The oil production in these five countries is significant to the oil supply and the world oil price (U.S Energy Information Administration, 2021). As such, I contribute to the growing literature on the effect of geopolitical risk on oil price by examining the association between the variables in major oil-producing countries. While most previous literature focuses on evaluating the relationship between the world geopolitical risk and the world oil price, no previous literature examines how the geopolitical risk in major oil producers affects the world oil price. Consequently, in this essay, I would like to evaluate the effect of geopolitical events in major oil-producing countries on the world oil price by examining the relationship between the country-specific geopolitical risk index of the top five oil-producing countries and the world crude oil price by conducting granger causality test and dynamic ordinary least squares (DOLS) analysis.

## 2. LITERATURE REVIEW

Geopolitical risk is defined as the risk associated with wars, terrorist acts, and tensions between states that affect the normal and peaceful course of international relations (Caldara and Iacoviello, 2018). The consequence of geopolitical events on the commodity market has long been realised by economists and has been a popular research field over the past decades across the globe.

Mitsas et al. (2022) have observed that geopolitical risk dramatically raises the price of most commodity futures, including oil, gold, platinum, and silver, as a consequence of the supply shock from geopolitical events. Ding et al. (2021) have also discovered

that commodity price would typically drove up by the increase in geopolitical risk as commodities are commonly used by investors as a hedging tool against geopolitical uncertainty. Nevertheless, the effect of geopolitically risk typically has a stronger effect in the short run while the commodities' price tends to return to a stable level over a longer period.

On the other hand, Murray (2018) has used the S&P Goldman Sachs Commodity Index and the geopolitical risk index to examine the relationship between geopolitical risk and the commodity price using granger causality and vector autoregressive analysis. Surprisingly, there is no granger causality between the general commodity price index and the geopolitical risk. The only granger causality found is between the geopolitical risk index and the price of livestock commodities. Nevertheless, by completing separate tests for the time period prior and after the global financial crisis in 2008, he observed the difference between the granger causality effect prior and after the crisis. While geopolitical risk has a granger causality on both the price of livestock and precious metal commodities, there is no evidence of any granger causality on any categories of commodities after the global financial crisis, suggesting the global financial crisis in 2008 may have eliminated the causality between geopolitical risk and commodities'price.

For precious metals, one key sub-category of commodity, Yilanci and Kilci (2021) discovered the causality effect from geopolitical risk to the price of precious metals, including gold, silver, platinum and palladium, and suggested the occurrence of the causality effect as the consequence of the hedging properties of precious metals against raising risk on stock and bond market during economic uncertainty.

Cryptocurrencies, for instance, Bitcoins, are not traditional commodities, but the rising trading volume has made them one of the most popular commodities nowadays. Kyriazis (2021) has examined the effect of the change in the level of the geopolitical risk on cryptocurrencies and surprisingly discovered that the level of geopolitical risk has an extremely strong predictive power on the price and volatility of cryptocurrencies, notably Bitcoins, suggesting cryptocurrencies as a better hedging tool than traditional commodities like gold and silver.

For energy, which is another predominant sub-category of commodities, Liu et al. (2021) discovered that geopolitical risk would positively impact energy volatility significantly in the long run, and one standard deviation increase in the geopolitical risk would raise the volatility of crude oil, heating oil and natural gas by 13.24%, 28.01% and 15.30% respectively. They also discovered that the geopolitical threat rather than the actual geopolitical event is the reason for the impact of geopolitical risk on energy volatility. While geopolitical risk has a uniform impact on the volatility of energy commodities, Gursoy (2021) has examined the relationship between geopolitical risk and the price of non-renewable energy using the Lee-Strazicich Unit Root Test and the Hatemi-J Asymmetric Causality Analysis and discovered the price of oil as the only energy commodity in a one-way positive symmetrical causality relationship with geopolitical risk, suggesting the uniqueness of oil price in being affected by the change in geopolitical risk.

For oil, Kyrazis (2021); Mitsa et al. (2022); Gursoy (2021); Su et al. (2019); Duan et al. (2021) have all discovered the positive relationship between the level of geopolitical risk and the oil price based upon qualitative evidence from different econometric methods. Selmi et al. (2020) stated that a strong positive relationship between geopolitical risk and the oil price is anticipated, especially when major oil exporters or importers are at war. When major oil exporters get into wars, the world oil supply increases uncertainly. As the world oil demand rises with an uncertain supply, oil producers who are incapable of producing enough oil have to guarantee that sufficient oil is stockpiled to cover operations, resulting in the oil price rise. Additionally, Su et al. (2019) have also discovered that high geopolitical risk would raise the oil price as a consequence of the shortage in supply, in particular when geopolitical events occur in oil-exporting countries.

Li et al. (2020) have identified three predominant channels of how geopolitical risk affects the world crude oil prices. The first important channel they identified is the impact on oil production and demand by geopolitical events, which would significantly affect the oil price, consistent with the rationale suggested by Su et al. (2019) and Selmi et al. (2020). The second channel they pointed out is the effect on investor sentiment by geopolitical risk as the hedging properties of commodities and financial speculation by investors would significantly impact the oil price. The third channel they identified is the impact on energy conversion by geopolitical risks, which would affect the crude oil price to a large extent. Consistent with other commodities, Duan et al. (2021) have also suggested through wavelet-based analysis that the effect of geopolitical risk on the oil price solely occurred in the short and medium run, while geopolitical events would not affect the oil price in the long run.

In addition to the price, Liu et al. (2019) have examined the effect of geopolitical events on oil volatility by adding geopolitical risk to the GARCH-MIDAS-GPRS model, discovering that geopolitical risk would significantly impact the oil volatility, in particular for oil future. Huang et al. (2021) have used nonlinear Granger causality tests and a DCC-MVGARCH model based on high-frequency data to examine the correlation between geopolitical risk and oil prices and further discovered that geopolitical risk mainly affects the oil market by affecting its volatility rather than its return.

Most literature examined the relationship between geopolitical risk and oil price using global data. However, Selmi et al. (2020) have pointed out that the consequence of geopolitical risk on the oil price is countries-specific and different countries tend to be affected by the level of geopolitical risk differently. Ozcelebi and Tokmakcioglu (2020) have employed the time-varying parameter structural vector autoregression models to examine the asymmetric impacts of the geopolitical risk on the world oil price based on the county-specific GPR index of four BRIC countries, which are Russia, China, India and Brazil. While the tests indicate the change in the level of geopolitical risk would result in a subsequent change in the world oil price in the same direction for all four countries, the magnitude of the effect is not identical. It is suggested the correlation between the geopolitical risk and oil price is highest in China and lowest in

India. Additionally, Ozcelebi and Tokmakcioglu have also identified that the difference between the impact of geopolitical events on the oil price is not notable among oil-exporting and importing countries. Demier et al. (2019) have also examined the impact of geopolitical risk on different regional markets, including Dubai and Tapis, and discovered that the impact of geopolitical events on the oil price is not uniform in different regional markets. The research results in specific regional markets are not capable of being applied to others. Nevertheless, they also pointed out that geopolitical risk mostly affects the volatility of the oil price rather than the oil price itself.

Salisu et al. (2021) have further contributed to the effect of geopolitical risk in the oil market by examining the effect of geopolitical threat and real act on the oil market separately. They surprisingly discovered that increase in geopolitical risk is not necessarily resulting in higher tail risk in the oil market. While threat did increase the tail risk, real acts would decrease the tail risk in the oil market.

## 3. DATA

This study evaluates the relationship between geopolitical risk and oil price. In this study, the monthly country-specific geopolitical risk index created by Caldara, Dario and Matteo Iacoviello (2022) is used as the proxy for the geopolitical risk in the five major oils producing countries, namely the United States, Saudi Arabia, Russia, Canada and China. The data was downloaded from https://www.matteoiacoviello.com/gpr.htm on April 10, 2022. The geopolitical risk index tracks the sum of newspaper articles reviewing rising geopolitical risks divided by the sum of all published newspaper articles per month based upon automated text searches on the electronic archives of 10 newspapers from the United States and Canada, which are the Chicago Tribune, the Daily Telegraph, the Financial Times, the Globe and Mail, the Guardian, the Los Angeles Times, the New York Times, USA Today, the Wall Street Journal, and The Washington Post. Crude oil futures serve as the proxy for the crude oil price. West Texas Intermediate (WTI) Crude Oil futures are used as the proxy for the crude oil price, and the monthly data is downloaded from www.investing.com. The study's timeframe is selected between January 1985 to February 2022 according to the availability of country-specific geopolitical risk indexes.

Table 1 reported the descriptive statistics of all variables. Comparing the mean of the country-specific geopolitical risk index, the geopolitical risk index of the United States is significantly greater than other countries. However, it only reflects that geopolitical risk events are mentioned at a higher frequency in the newspaper in the United States, rather than indicating that the United States has a higher geopolitical risk than the other four nations. The kurtosis values of the geopolitical risk index of Canada, Russia, Saudi Arabia and the United States are extremely high, indicating that their distribution is more peaked than the normal distribution and tends to have heavy tails. China is the only one of the top five oil-producing nations that has a geopolitical risk index of normal kurtosis value, indicating the geopolitical risk index of China has a distribution that is closer to the normal distribution. Considering the standard deviation and sample variance of the geopolitical risk index of the five nations, the United States has significantly higher values compared to the other four nations, indicating that the geopolitical risk of the United States is less stable than other top oil-producing countries. All five country-specific geopolitical risk indexes have shown a positively skewed distribution, indicating that most of the values are crowded around the left tail of the distribution.

## 4. METHODOLOGY

Murray (2018) has identified that the positive relationship between commodities' price and geopolitical risk was eliminated after the occurrence of the global financial crisis in 2008. This study works with three basic time series, the period prior to the 2008 global financial crisis between January 1985 to June 2008, the period after the 2008 global financial crisis from January 2009 to February 2022 and the full sample period between January 1985 to February 2022. Consequently, the time series before and after the global financial crisis are evaluated in order to identify the effect of the global financial crisis on the relationship between oil price and geopolitical risk.

Granger causality test and DOLS are conducted to evaluate the relationship between the country-specific geopolitical risk indexes of the top five oil-producing countries and the crude oil price,

According to Granger (1969), a variable (country-specific geopolitical risk index of a certain nation) is said to granger cause another variable (crude oil price) if past and present values of the index aid in forecasting the crude oil price. Following the standardised procedure from Ghosh (2002); Oxley and Greasley (1998); Obadi and Korecek (2018); Foresti (2006), Augmented

**Table 1: Descriptive statistics**

| | GPR_CAN | GPR_RU | GPR_SA | GPR_USA | GPR_CHN | WTI |
|---|---|---|---|---|---|---|
| Mean | 0.223 | 0.760 | 0.216 | 2.304 | 0.400 | 44.635 |
| Standard error | 0.008 | 0.020 | 0.016 | 0.059 | 0.012 | 1.362 |
| Median | 0.181 | 0.666 | 0.130 | 2.058 | 0.333 | 32.610 |
| Standard deviation | 0.160 | 0.428 | 0.348 | 1.249 | 0.249 | 28.762 |
| Sample variance | 0.026 | 0.183 | 0.121 | 1.561 | 0.062 | 827.276 |
| Kurtosis | 29.917 | 13.072 | 56.102 | 31.162 | 2.664 | -0.401 |
| Skewness | 4.331 | 2.461 | 6.727 | 4.594 | 1.512 | 0.836 |
| Minimum | 0.057 | 0.205 | 0.017 | 0.751 | 0.070 | 10.420 |
| Maximum | 1.724 | 4.345 | 3.572 | 13.229 | 1.521 | 140.000 |
| Observations | 446.000 | 446.000 | 446.000 | 446.000 | 446.000 | 446.000 |

"GPR_CAN," "GPR_RU," "GPR_SA"," GPR_USA"," GPR_CHN"," WTI" represent the country-specific geopolitical risk index of Canada, Russia, Saudi Arabia, the United States, China and the WTI crude oil futures respectively. WTI: West texas intermediate

Dickey Fuller Unit Root Tests are performed to ensure the stationarity of the series in order to meet the prerequisites of conducting granger causality tests. For the Augmented Dicky Fuller Unit Root Test, if the null hypothesis is rejected, it represents that there is a unit root present, and the data series is stationary. According to the result of the unit root test, the first difference form of the oil price, which is stationary, is used to replace the non-stationary oil price series in performing the granger causality test.

The granger causality test would be carried out as:

$$WTI_t = \alpha_0 + \alpha_1 WTI_{t-1} + \alpha_2 WTI_{t-2} + \beta_1 GPR_{t-1} + \beta_2 GPR_{t-2} + \varepsilon_t \quad (1a)$$

$$GPR_t = \alpha_0 + \alpha_1 GPR_{t-1} + \alpha_2 GPR_{t-2} + \beta_1 WTI_{t-1} + \beta_2 WTI_{t-2} + u_t \quad (1b)$$

F-test statistics would be used to test the hypothesises. Equation 1a refers to the hypothesis that the country-specific geopolitical risk index of that particular nation is said to granger cause the crude oil price. Equation 1b refers to the hypothesis that the crude oil price is said to granger cause the country-specific geopolitical risk index of that certain nation.

In addition to testing the granger causality, DOLS is also carried out to examine the long-run cointegration relationship between the country-specific geopolitical risk indexes of the five predominant oil-producing countries and the crude oil price. The crude oil price is the dependent variable, and the five country-specific geopolitical risk indexes are the independent variables. Dynamic Ordinary Least Squares estimates regression models based on cointegrated variables and solve the bias of regression caused by the asymptotic endogeneity and serial correlation (Saikkonen, 1992; Stock and Watson, 1993). The equation is shown below:

$$WTI_t = \alpha + \beta_1 (GPR\_CAN)_t + \beta_2 (GPR\_RU)_t + \beta_3 (GPR\_SA)_t + \beta_4 (GPR\_USA)_t + \beta_5 (GPR\_CHN)_t + \varepsilon_t \quad (2)$$

Where t = time period

A cointegration test is performed following the standardised procedure to validate the model. In this study, the Hansen Parameter Instability cointegration test initiated by Hansen (1992) is conducted to test the null hypothesis of cointegration.

## 5. EMPIRICAL RESULTS AND DISCUSSION

### 5.1. Augmented Dickey-fuller Test

Table 2 presents the results of the Augmented Dicky Fuller Test. The country-specific geopolitical risk indexes are stationary, but the crude oil price is non-stationary. As a result, the stationary first difference in oil price is used instead in granger causality test.

### 5.2. Granger Causality

Table 3 presents the pairwise granger causality tests for the observations in the full sample period between January 1985 and February 2022. In the full sample period, both the country-specific geopolitical risk indexes of China and Saudi Arabia would granger cause the oil price at the 5% significance level. In the full sample period, out of the five major oil-producing countries, surprisingly, only the geopolitical risk of Saudi Arabia and China are influential to the crude oil price, suggesting that the geopolitical risk of major oil-producing nations may not be instrumental to the crude oil price. In fact, while China, the United States, Saudi Arabia, Canada and Russia are predominant oil producers, only Saudi Arabia and Russia are predominant oil exporters, suggesting that major oil-producing countries may not be significant to the oil supply as many of them tend to self-consume their oil production, for instance, China and the United States. While Saudi Arabia is the second biggest oil-producing nation behind the United States, Saudi Arabia is the biggest net oil-exporting nation, so its significant impact on the oil supply rationalises the enormous influence of its geopolitical risk. China has seldom been included in the discussion of the oil price, and most people neglect the influence of China in the oil market. In addition to being one of the top oil-producing nations, China is also one of the biggest net oil importers due to the high oil demand in China, rationalising the strong influence of the geopolitical risk in China on the oil price. The result also suggests that both the geopolitical risk of predominant oil importers and exporters are significant to the oil price, so the geopolitical situation in net oil importers like China should also be strongly considered in the oil market analysis.

Table 4 presents the pairwise granger causality tests of the observations prior to the global financial crisis in 2008. Table 5

**Table 2 : Augmented dickey-fuller test**

| Variable | ADF | Test |
|---|---|---|
| | t-stat | P-value |
| *GPR-CAN* | –9.430286 | 0 |
| *GPR-RU* | –6.485417 | 0 |
| *GPR-SA* | –6.103759 | 0 |
| *GPR-USA* | –6.662178 | 0 |
| *GPR-CHN* | –3.222129 | 0.0194 |
| *WTI* | –1.973224 | 0.2988 |
| *DWTI* | –16.99153 | 0 |

*DWTI* is the first difference form of *WTI*

**Table 3: Pairwise granger causality tests (Full sample period)**

| Pairwise granger causality tests | | | |
|---|---|---|---|
| Sample: 1985M01 2022M02 | | | |
| Lags: 2 | | | |
| DWTI (first difference in oil price) | | | |
| **Null Hypothesis:** | **Obs** | **F-Statistic** | **Prob.** |
| GPR_SA does not granger cause DWTI** | 443 | 4.42469 | 0.0125 |
| DWTI does not granger cause GPR_SA | | 0.15096 | 0.8599 |
| GPR_CHN does not granger cause DWTI** | 443 | 4.5288 | 0.0113 |
| DWTI does not granger cause GPR_CHN* | | 2.8027 | 0.0617 |
| GPR_CAN does not granger cause DWTI | 443 | 0.98449 | 0.3745 |
| DWTI does not granger cause GPR_CAN | | 0.59429 | 0.5524 |
| GPR_RU does not granger cause DWTI | 443 | 1.85698 | 0.1574 |
| DWTI does not granger cause GPR_RU | | 1.35937 | 0.2579 |
| GPR_USA does not granger cause DWTI | 443 | 1.23845 | 0.2908 |
| DWTI does not granger cause GPR_USA | | 0.86371 | 0.4223 |

*Significant at 10%, **Significant at 5%

**Table 4: Pairwise granger causality tests (Period prior to the 2008 global financial crisis)**

| Pairwise granger causality tests | | | |
|---|---|---|---|
| Sample: 1985M01 2008M06 | | | |
| Lags: 2 | | | |
| DWTI (first difference in oil price) | | | |
| **Null hypothesis:** | **Obs** | **F-Statistic** | **Prob.** |
| GPR_SA does not granger cause DWTI** | 279 | 5.57018 | 0.0043 |
| DWTI does not granger cause GPR_SA | | 0.24008 | 0.7867 |
| GPR_CHN does not granger cause DWTI* | 279 | 2.94836 | 0.0541 |
| DWTI does not granger cause GPR_CHN | | 1.2629 | 0.2845 |
| GPR_CAN does not granger cause DWTI | 279 | 1.30345 | 0.2733 |
| DWTI does not granger cause GPR_CAN | | 0.02322 | 0.9771 |
| GPR_RU does not granger cause DWTI** | 279 | 4.39683 | 0.0132 |
| DWTI does not granger cause GPR_RU | | 0.38973 | 0.6776 |
| GPR_USA does not granger cause DWTI | 279 | 0.75715 | 0.47 |
| DWTI does not granger cause GPR_USA | | 0.17573 | 0.8389 |

*Significant at 10%, **Significant at 5%

**Table 5: Pairwise granger causality tests (period after the 2008 global financial crisis)**

| Pairwise granger causality tests | | | |
|---|---|---|---|
| Sample: 2009M01 2022M02 | | | |
| Lags: 2 | | | |
| DWTI (first difference of oil price) | | | |
| **Null Hypothesis:** | **Obs** | **F-Statistic** | **Prob.** |
| GPR_SA does not granger cause DWTI** | 158 | 4.08071 | 0.0188 |
| DWTI does not granger cause GPR_SA | | 0.10064 | 0.9043 |
| GPR_CHN does not granger cause DWTI | 158 | 1.98038 | 0.1415 |
| DWTI does not granger cause GPR_CHN | | 1.82069 | 0.1654 |
| GPR_CAN does not granger cause DWTI | 158 | 2.0201 | 0.1362 |
| DWTI does not granger cause GPR_CAN | | 1.17441 | 0.3118 |
| GPR_RU does not granger cause DWTI | 158 | 0.70498 | 0.4957 |
| DWTI does not granger cause GPR_RU | | 1.39393 | 0.2512 |
| GPR_USA does not granger cause DWTI** | 158 | 4.84344 | 0.0091 |
| DWTI does not granger cause GPR_USA | | 1.69987 | 0.1861 |

*Significant at 10%, **Significant at 5%

presents the pairwise granger causality tests of the observations after the global financial crisis in 2008. Prior to the global financial crisis in 2008, Russia and Saudi Arabia were the only two nations in which their geopolitical risk indexes granger caused the oil price at the 5% significance level. At the 10% significance level, China would also granger cause the oil price. After the global financial crisis, Saudi Arabia and the United States are the only two nations where their geopolitical risk indexes granger cause the oil price at the 5% significance level.

While the geopolitical risk of China has been influential to the crude oil price prior to the 2008 global financial crisis, it has not been that influential since the crisis occurred. In fact, even though China's oil demand has reclaimed its upward trend after the 2008 global financial crisis, Matsumoto (2012) stated that the oil demand of China has decreased significantly from the second half of 2008 to early 2009. He also stated that China's oil demand started to decelerate in 2011 due to the slower economic growth in China. While China remains one of the biggest oil importers across the globe, China's oil demand has decreased during the financial crisis and decelerated after the crisis due to slower economic growth, lowering China's influence on the oil price, rationalising why the geopolitical risk of China did not granger cause the oil price after the financial crisis.

Comparing the period before and after the 2008 global financial crisis, it is surprising to see the influence of Russia's geopolitical risk on the oil price disappear. While the recent 2022 surge in oil price may prove that Russia's control over oil price is still high, statistics show that the geopolitical risk of Saudi Arabia and the United States should be the two nations that influence the oil price the most in recent years.

Since the 2008 global financial crisis, the geopolitical risk of the United States has been increasingly influential to the oil price as a consequence of the significant rise in oil production in the United States. From 2009 to 2019, the United States has doubled its share of world oil production from 8.91% to 17.9% by increasing its oil production at a much quicker rate than its main competitors, for instance, Russia and Saudi Arabia (Kutlu, 2020).

## 5.3 DOLS

Table 6 presents the result of Hansen Parameter Instability test for the three Dynamic Ordinary Least Squares Models. All three cointegration tests failed to reject the cointegration null hypothesis, validating that the series are cointegrated.

Table 7 presents the results for the three dynamic ordinary least squares (DOLS) models for the full sample period, the period prior to the 2008 global financial crisis, and the period after the 2008 global financial crisis, respectively. In DOLS models, the observation is consistent with Murray (2018), in which the statistically significant relationship between geopolitical risk and the oil price has all been eliminated after the 2008 global financial crisis, proving the significance of 2008 global financial crisis in affecting the effect of geopolitical risk on the commodity market.

In the full sample period, the coefficient for geopolitical risk indexes of China and Canada are significant at the 5% significance level, while the coefficient for the geopolitical risk index of Russia is significant at 10% significance level. For the period prior to the 2008 global financial crisis, the coefficient for the geopolitical risk indexes of China and Russia are significant at the 5% significance level. The DOLS model shows that Saudi Arabia failed to establish a long-run relationship with the oil price in all three sample periods. It seems that the geopolitical risk in Saudi Arabia tends to cause the failure of OPEC in manipulating the oil price in the long run.

Canada and Russia are both major net oil-exporting nations across the globe, and the geopolitical risk of both nations tends to have a negative relationship with the oil price, referring that a higher level of geopolitical risk in these nations would tend to lower the oil price. This result differs from the public perception that higher geopolitical risk in oil-exporting countries tends to impact the world oil supply and raise the oil price. One possible explanation is that high geopolitical risk may cause the countries to increase the supply and export of oil so as to improve trade surplus and accumulate foreign reserves to define the increasing geopolitical risk. Nevertheless, the high geopolitical risk does not always refer to wars or terrorist acts. Consequently, while war would affect

**Table 6: Hansen parameter instability**

| | Lc statistic | Stochastic Trends (m) | Deterministic Trends (k) | Excluded Trends (p2) | Prob.* |
|---|---|---|---|---|---|
| 1985M01 to 2022M02 | 0.001785 | 5 | 0 | 0 | >0.2 |
| 1985M01 to 2008m06 | 0.002753 | 5 | 0 | 0 | >0.2 |
| 2009M01 to 2022M02 | 0.007552 | 5 | 0 | 0 | >0.2 |

**Table 7: Dynamic ordinary least squares (DOLS)**

| Sample period | Dependent variable: WTI | | | | | |
|---|---|---|---|---|---|---|
| | | GPR_CAN | GPR_RU | GPR_SA | GPR_USA | GPR_CHN |
| | $\alpha$ | $\beta_1$ | $\beta_2$ | $\beta_3$ | $\beta_4$ | $\beta_5$ |
| 1985M01 to 2022M02 | 40.9236** | –105.012** | –17.6951* | 7.3603 | 6.9084 | 56.7344** |
| | (4.465772) | (–2.038009) | (–1.673641) | (0.573798) | (1.049211) | (4.389495) |
| 1985M01 to 2008m06 | 25.7476** | 19.7042 | –22.2733** | 9.0025 | –3.4208 | 74.8887** |
| | (2.834975) | (0.450546) | (–2.131507) | (0.965078) | (–0.611491) | (3.417242) |
| 2009M01 to 2022M02 | 97.7796** | –65.7414 | 3.19229 | –31.5489 | –0.4096 | –19.7273 |
| | (3.923413) | (–0.663845) | (0.163172) | (–0.769618) | (–0.020723) | (–0.939955) |
| | $R^2$ | *Adjusted* $R^2$ | *S.E.* | | | |
| 1985M01 to 2022M02 | 0.3248 | 0.2928 | 24.16157 | | | |
| 1985M01 to 2008m06 | 0.3650 | 0.3160 | 17.18181 | | | |
| 2009M01 to 2022M02 | 0.1925 | 0.0738 | 21.0133 | | | |

**, *Denote 5% and 10% significance levels correspondingly, t-statistics is indicated in parenthesis

the oil supply and demand in the nation, a high geopolitical risk in major oil-exporting countries should not always be interpreted as an adverse impact on the world oil supply and resulting in a rise in the oil price.

As one of the largest net oil importers globally, China is influential in the oil price during the full sample period and prior to the 2008 global financial crisis. According to the models, China's influence on the oil market disappeared after the 2008 global financial crisis due to decelerated oil demand from slower economic growth, which is consistent with the result of the granger causality tests. The result from the models indicates that the geopolitical risk of China has established a long-run relationship with the oil price in the two sample periods, referring that higher geopolitical risk in China would tend to raise the oil price, indicating that higher geopolitical risk in China would raise the oil demand of China. The increase in the geopolitical risk of China usually comes from territory conflict with neighbouring nations and also the relationship with the United States in recent years. A potential military conflict with neighbouring nations, which would raise the geopolitical risk, would raise China's oil demand and the oil price as China is one of the major oil importers. While the relationship between China and the United States is at its all-time low, China is purchasing more oil from the United States despite the high price to fulfil the trade deal signed between the two nations. Consequently, the increase in geopolitical risk in China has actually raised its oil demand and thus established a long-run relationship with the oil.

## 6. CONCLUSION

The granger causality tests show that Saudi Arabia and China's geopolitical risk influences the crude oil price in the full sample period. The geopolitical risk of Saudi Arabia, Russia and China granger cause change in oil prices before 2008 financial crisis sample period. After the 2008 financial crisis sample period Saudi Arabia and USA granger cause the change in crude oil prices. The DOLS models show the series in the model are cointegrated. The coefficients for the geopolitical index of Canada, Russia and China are significant for the full sample period. Before 2008 financial crisis sample period, the coefficients for the geopolitical index of Canada, Russia and China are significant. However, the DOLS model shows that the coefficients for all geopolitical indexes are insignificant after the 2008 financial crisis sample period.

The general public and investors generally precept major oil exporters like Russia and Saudi Arabia as the major players in the oil market. However, after the 2008 financial crisis, the major oil-producing countries' discrepancy in economic needs has reduced their influential power. Thus, the geopolitical risk of major production countries does not significantly affect crude oil prices. With reference to Murray (2018) 's research on the effect of 2008 global financial crisis on the relationship between commodities' price and geopolitical risk, this study would also like to confirm that the relationship between oil price and geopolitical risk has changed after the 2008 global financial crisis.

This study has discovered the significance of China in the oil market, which is different to the general public's perception. Nevertheless, this study indicated that China, as one of the major crude oil-producing nations and one of the biggest net oil importers, has a strong relationship between its geopolitical risk and oil price both in the short run and the long run based on the results from granger causality tests and the DOLS models respectively. On the other hand, while granger causality tests have indicated the short-run effect of the geopolitical risk of Saudi Arabia in the oil price, the dynamic ordinary least squares models have indicated that the geopolitical risk of Saudi Arabia has failed to establish a long-term relationship with the oil price.

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