IMPACT OF GEOPOLITICAL RISK AND ECONOMIC POLICY UNCERTAINTY ON OIL PRICE

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Abstract: ***Geopolitical events and economic uncertainty, such as war, civil turmoil, massive terrorist acts, can cause significant fluctuations and swings in oil prices, which contributed to increased volatility of the international oil prices. We use the GARCH and MGARCH model to assess the impact of geopolitical risk and economic policy uncertainty on volatility of oil prices, and the spillover effects between oil prices, with the Geopolitical Risk and Economic Policy Uncertainty as exogenous shock. We exploit an unique time series data set of Geopolitical Risk index recording monthly intervals of oil prices from January 2002 to December 2022. Our findings have two-folds. First, both geopolitical risk and economic policy uncertainty affect oil price's volatility. Second, there exists stronger short-persistent spillover effect between different returns of different oil prices in monthly scope.***

• Keywords: *geopolitics, geopolitical risk, economic policy uncertainty, oil prices.*

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1. Introduction

In an increasingly integrated world economy, globalized markets are strongly influenced by major political events such as elections, coups, civil strife, as well as intra and interstate conflict and war, mega terrorist attacks etc. Among other economic effects, political conflicts can bring about noteworthy changes and shifts in oil as well as other energy's prices, especially when the country is one of major players in the market. This caused the oil prices to fluctuated, which is caused a disruption in supply or a rise in preventive demand. Further conflict leads to increased uncertainty and instability that deeply affect the market.

Recently global markets witnessed the Russo - Ukrainian conflict, in which Russia, one of the world's leading crude oil and natural gas producers was involved. On the 24th of February 2022, Russia openly sent troops into Ukraine's separatist-controlled territories and announced the beginning of a "special military operation" (UN, 2022) in Ukraine three days later. This geopolitical tension led to sanctions imposed on Russia by the Western countries, which was consequen in bans on weapons exports, oil extraction technology exports and access to financial markets (Nitsevich, V.F, 2020). Economic data shows some movements in global oil price data, however, the complete economic consequences of Russo - Ukrainian conflict on the oil price may not be fully known until the crisis ends.

Therefore, the aim of this paper is to investigate the causal effects of Geopolitical Risk (GPR) and Economic Policy Uncertainty (EPU) on the volatility of crude oil prices. Geopolitical risk (GPR) would identify situations in which power struggles over territories cannot be resolved peacefully. Thus, GPR would be defined as the risks associated with geopolitical events that possess detrimental impacts on the global context and peaceful course of international relations, such as wars, terrorist assault, political tension between states (Caldara, Dario, and Matteo Iacoviello (2018)). For example, the terrorist attack on 9/11, or the Russo-Ukrainian conflicts that would be discussed later, would fall into this definition. The economic policy uncertainty index (EPU) measures the degree of economic uncertainty resulting from changes in economic policies (Baker et al., 2013) we can understand that EPU would capture events related to business and financial cycle, and uplift greatly during time of financial volatility and policy uncertainty. Last, we would establish the dynamics between different crude oil prices and how geopolitical events and economic policy affect those dynamics.

To do that, we use the monthly price of Western Texas Intermediate (WTI), and OPEC basket price, as well as the international crude oil price. Our main empirics are as follows. First, both geopolitical risk and economic policy uncertainty affect oil price's volatility. Second, there exists stronger short-persistent spillover effect between different returns of different oil prices in monthly scope. We contribute to the literature a more insightful analysis of the causal effects of Geopolitical risk and economic uncertainty on oil prices.

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2. Literature review

In general, most empirical research shows that geopolitical uncertainty has a mixed impact on energy prices due to several reasons. The research of Smales, L. A (2021), which employing daily data of Geopolitical risk Index (GPR) Geopolitical Risk Act Index (GPRA), Geopolitical Risk Threat Index (GPRT), Economic Policy Uncertainty (EPU), CBOE Implied Volatility Index (VIX), Western Texas Intermediate Crude oil price (WTI) and SP500 oil price from Jan 1986 - May 2018, shows that geopolitical risk has a key role in determining both oil price and stock market volatility. The increase in geopolitical risk is associated with positive oil returns and negative stock returns, which is consistent with geopolitical risk being more intricately linked to supply disruption. The impact of geopolitical risk is greater for oil prices because some geopolitical events may have a direct effect on oil production but may not receive much global media coverage. The study uses a dynamic conditional correlation (DCC) model to analyse the magnitude of the effect of geopolitical risk on oil-stock return correlation and short- and long-term volatility persistence for oil and stock prices, together with spillover effects that run from oil to stock returns.

In contrast, Zhang et al., (2020) used the DCC-GARCH model to measure the dynamic conditional correlation between US EPU and West Texas Intermediate (WTI) crude oil returns based on historical data from February 1985 to May 2019, and then used the network connectedness method to analyze the impact of various US EPU indices on WTI returns over time and frequency. The empirical findings reveal, first, that during the sample period, all US EPU indices and WTI returns are negatively correlated. Second, at the frequency bands of 1-6 months and 6-12 months, all EPU indices can have a significant impact on WTI returns, whereas at the frequency band of 12-24 months, only monetary policy uncertainty, regulation policy uncertainty, and national security policy uncertainty can have a significant impact on WTI returns. Lastly, it appears that the impact of US EPU indices on WTI returns is amplified by significant international events, such as the global fiscal crisis.

Kannadhasan, M. and Das, D. (2019) explores the extent to which Asian emerging stock markets respond to international economic policy uncertainty and geopolitical risk. The author used quantile regression analysis to study the impact of economic policy uncertainty and geopolitical risk on the stock markets of nine Asian countries. The study found that the response of stock markets to both economic policy uncertainty and geopolitical risk is significant and negative, but the magnitude of the impact varies across different quantiles. The results indicate that lower quantiles are more sensitive to economic policy uncertainty and geopolitical risk than higher quantiles.

Caldara, D. and Iacoviello, M. (2018) have used geopolitical risk as a factor for the vector autoregressive model (VAR) to measure the relationship between geopolitical risk and stock returns, capital movement and real activities on the market. From the result of their research, the author concluded that high geopolitical risk leads to a decline in real activity, lower stock returns, and movements in capital flows away from emerging economies and towards advanced economies, with threat of adverse geopolitical events mostly drives the adverse effects of geopolitical risk (Noguera-Santaella, J., 2016).

Futhermore, There are several studies suggest that geopolitical events as well as economic uncertainty would play a key role in increasing the prices of crude oils, or its volatility (Yong Jiang et al., 2022, Selmi et al., 2020).

Regarding the use of oil prices as a factor to consider for businesses and policymakers, Trung Q. and Trang T.(2020) has pointed out that increased oil prices would lead to increased production cost, as well as increasing negative macroeconomics conditions, which would lead to detrimental impact on firms' performance. As a result, as aforementioned, possessing a model that is capable of tracking the fluctuation of oil prices would be suitable for businesses and policymakers to monitor and respond appropriately to protect their operation or devise successful policy to better control the economy, respectively.

To sum up, given the results of previous study, we would base our methodology on that of Smales, L. A. (2021). Firstly, we would employ the OLS model to explore the impact on growth of oil prices, as well as using different quantiles of GPR index. Secondly, the univariate GARCH model with GARCH (1,1) and ARCH (1,1) specifications are used to prove this for all four oil prices. Lastly, in order to model the dynamics between different oil price benchmarks around the world and the role of GPR and EPU in that relationship, we would use the DCC MGARCH model as suggested by Smales, L. A. (2021).

3. Methodology and data

3.1. Empirical models

In this paper, we use GARCH (1,1) (Bollerslev, 1986) and EGARCH (1,1) (Nelson, 1991) to explore the effect of GPR and EPU on the volatility of international crude oil prices. The ARCH (p,q) model is as follows:

$$X_t = e_t \sigma_t$$

$$\sigma_t^2 = \omega + \alpha_1 X_{t-1}^2 + \cdots + \alpha_p X_{t-p}^2$$

Tim Bollerslev (1986) continued to extend the ARCH into Generalized autoregressive conditional heteroskedasticity (GARCH). GARCH (p,q) model is specified as follows:

$$X_t = e_t \sigma_t$$

$$\sigma_t^2 = \omega + \alpha_1 X_{t-1}^2 + \cdots + \alpha_p X_{t-p}^2 + \beta_1 \sigma_{t-1}^2 + \cdots + \beta_p \sigma_{t-q}^2$$

In 1991, Nelson developed the Exponential autoregressive conditional heteroskedasticity (EGARCH) in order to overcome a weakness of the original GARCH model when handling time series models, which is accounting for asymmetric effects between positive and negative asset returns. The EGARCH (p,q) model is as follows:

$$x_t = \mu + a_t$$

$$ln\sigma_t^2 = \alpha_0 + \sum_{i=1}^{p} \alpha_i (|\epsilon_{t-i}| + \gamma_i \epsilon_{t-i}) + \sum_{j=1}^{q} \beta_j \ln \alpha_{t-j}^2$$

Last but not least, we apply the multivariate GARCH (MGARCH) model to examine the volatility dynamics between different global oil prices indexes, with GPR and EPU as the exogenous shocks. The specification is the dynamic conditional correlation (DCC) (Smales, 2021). The MGARCH model also lets us account for the volatility spillover between oil prices, with the GPR and EPU as influencing factors.

3.2. Data

In this research, the authors first collected the monthly GPR, as well as the sub-index of Geopolitical Risk Threat Index (GPRT) and (Geopolitical Risk Act Index) GPRA from Caldara and Iacoviello (2018)'s website[1]. The GPR index can be used to measure adverse geopolitical events as well as the risk accompanied by them. Subsequently, measuring the impact of different geopolitical categories, particularly threats and acts, can have significant implications, as well as an effective indicator of the specific sources for the impact on the dependent variables, particularly global oil prices in this study (Caldara, D. and Iacoviello, M., 2018).

Regarding the crude oil price for the analysis of this study, we exploited the monthly price of Western Texas Intermediate (WTI), and OPEC basket price, as well as the international crude oil price. The choice of these prices is made due to the fact that these are the main oil benchmarks worldwide, utilized as guidelines for pricing of crude oil across nation

The data for energy prices would be collected from the World Bank Pink sheet, while EPU is collected from policyuncertainty.com, which is set up by Baker et al (2013) to measure EPU at global and country-specific levels.

Regarding the global crude oil prices, we collected them from the World Bank Pink Sheet released in February 2023, with global average crude oil price, WTI price and BRENT price[2]. OPEC Basket price is released by OPEC via website OPEC.org[3], the website of OPEC itself. We would use the data range of January 2003 until December 2022 for this study.

While returns can be calculated for the oil prices as first log difference, EPU having 0 in the time series data requests us to use the monthly change or delta in the analysis (EPUt=EPUt-EPUt-1,). On the other hand, due to the non-linear relationship between oil prices and GPR, we would estimate the impact of absolute value of GPR at different quantiles.

4. Empirical Result

4.1. Univariate GARCH model

We employ the univariate GARCH model in order to estimate the impact of the change of GPR and EPU as exogenous shock on the returns of different oil prices volatility, with the specification of GARCH (1,1) and EGARCH (1,1).

From the results above for GARCH (1,1) specification, we can conclude that GPR would have a positive impact on the returns of global average oil price and the WTI, while having negative impact onto the returns of BRENT and OPEC oil prices. On the other hand, EPU index would have a statistically negative impact on the return of oil prices for all four prices benchmarks apart from the WTI. Additionally, using the conditional variance equations, it is clear that monthly changes in GPR index would have statistically significant negative impact on the volatility of oil prices except for OPEC, with high statistically significant at 1% level of confidence. EPU is also shown to have a significant positive impact on the volatility of oil prices. Moreover, with both ARCH and GARCH term being significant, it is implied that the impact onto the volatility of oil prices is both long-run and short-run persistence.

Table 1: Univariate GARCH model

GARCH		PETRO		WTI		BRENT		OPEC	
		EGARCH	GARCH	EGARCH	GARCH	EGARCH	GARCH	EGARCH	
Mean	dGPR	0.0055	0.0203	0.0074	0.0206	-0.0007	0.0223	-0.0251	-0.0235
	dEPU	-0.0311*	-0.036**	-0.0299	-0.0398**	-0.0339**	-0.042**	-0.0465**	-0.0494***
	cons	1.3148**	1.3163**	1.4707***	1.1069**	1.2486**	0.9392*	0.7884	0.5429
Var	dGPR	-0.0228***	-0.0031	-0.0203***	-0.0009	-0.0239***	0.0002	-0.0206	0.0035
	dEPU	0.0292***	0.01***	0.0297***	0.0111***	0.0269***	0.0093***	0.0332***	0.0125***
	ARCH (1)	0.3178***		0.2663***		0.3241***		0.3476***	
	GARCH (1)	0.3415***		0.3544***		0.322***		0.4484***	
	EARCH (1)		0.1471		-0.1802**		-0.1011		-0.1387
	EGARCH (1)		0.0023***		0.7837***		0.7963***		0.8113***

Source: *Compiled by authors.*

4.2. Multivariate GARCH model

Furthermore, we utilized the DCC specifications of multivariate GARCH (MGARCH) models to examine the volatility dynamics between international crude oil prices, with GPR and EPU as exogenous shocks as specified to be the prefered specification in the result of the paper of Smales (2021).

Using the DCC specifications, we observe bi-directional effects between all four types of oil prices.

To begin with, although a rise in WTI and BRENT would be detrimental for the world average oil price, an

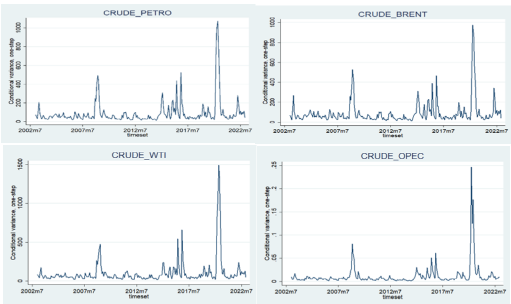
[1] https://www.policyuncertainty.com/gpr.html

[2] We download data from World Bank Commodity Markets, retrived on 30 Jan 2024 from https://www.worldbank.org/en/research/commodity-markets

[3] https://www.opec.org/opec_web/en/

increase in OPEC's return would lead to an increase in global oil prices. On the other hand, when the average global oil price rises, so will the profits on various types of oil pricing. There is a negative bidirectional connection between WTI and BRENT, and these oil prices are having a negative effect on the returns of other oil prices, as well as possessing a mean-reverting nature. Nevertheless, OPEC oil price is proven to be the driving force behind the increase in returns of other prices, subsequently the average global price as well. However, both GPR and EPU indexes are shown to have statistically insignificant impact on this spillover effect. Comparing the ARCH (1) and GARCH (1) terms, we also found that the volatility effect between oil prices has a stronger short-term variance tendency rather than long-run volatility persistence.

Figure 1. Volatility of oil prices



Source: Compiled by authors.

Table 2: Multivariate GARCH Model (DCC)

DCC	Coeff	Std. Err.	DCC	Coeff	Std. Err.
m11	1.3725***	0.472	m12	1.3351**	0.559
m21	-0.6179***	0.168	m22	-0.5974***	0.208
m31	-0.9498***	0.344	m32	-0.934**	0.400
m41	0.605***	0.048	m42	0.6028***	0.057
m51	-0.0042	0.013	m52	-0.0048	0.015
m61	-0.0083	0.011	m62	-0.0105	0.012
m13	1.5484***	0.497	m14	3.3901***	0.725
m23	-0.6554***	0.176	m24	-1.2583***	0.281
m33	-1.0993***	0.362	m34	-1.9977***	0.497
m43	0.6036***	0.049	m44	0.0821	0.077
m53	-0.0058	0.014	m54	-0.0283	0.019
m63	-0.0053	0.011	m64	-0.0195	0.017
m13	1.5484***	0.497	m14	3.3901***	0.725
m23	-0.6554***	0.176	m24	-1.2583***	0.281
m33	-1.0993***	0.362	m34	-1.9977***	0.497
m43	0.6036***	0.049	m44	0.0821	0.077
m53	-0.0058	0.014	m54	-0.0283	0.019
m63	-0.0053	0.011	m64	-0.0195	0.017
arch1	0.3812***	0.061	garch1	0.0627*	0.033
arch2	0.3468***	0.069	garch2	0.1927***	0.065
arch3	0.3993***	0.071	garch3	-0.0173	0.026
arch4	0.2621***	0.087	garch4	0.3228***	0.110

Sources: Calculated by authors

Conclusion

Using GARCH approach to examine the influence of geopolitical risks and economic policy uncertainty on global energy price from January 2003 to December 2022, we find the following conclusion: Firstly, Global oil price is negatively impact on the volatility of oil prices except for OPEC, while EPU is also shown to have a significant positive impact on the volatility of oil prices. Furthermore, the impact on volatility of oil prices has both a long term and short-run volatility tendency. Lastly, there exists a short-persistent bi-directional spill-over effect between global average oil prices in monthly scopes. However, GPR and EPU indexes are found to have weak impact on these spill-over relationships.

The key finding of this paper is that GPR indexes as well as GPRA and GPRT can have impact on crude oil prices. This can be of practical applications for both businesses and policymakers.

Firstly, given that we have established the impact on each level of threats, investors and regulators can utilize both GPR and EPU to monitor the level of risk and certainty of it, and pay particular attention to the quantiles in which GPR and EPU would have the most influence on the volatility of oil prices. Moreover, policymakers in government offices can create counter measure against spiking oil prices ahead of the energy shock thanks to measuring the progress of GPR on a monthly or daily basis, which can assist them in predict the trajectory of oil prices and devise appropriate strategy to counter it.

Secondly, high GPR would lead to increased crude oil prices. Oil-importing nations, thus, can use this index as a method to forecast oil prices based on current global geopolitical events, which can help them to negotiate to reduce import costs and avoid inflation in the national economy. In contrast, oil-producing countries can alter their oil supply to obtain the best production size and profit. This is vital as importing governments cannot afford a high OP, and rising oil prices may spark conflicts or wars.

To sum up, government personnels as well as business owners can observe the index of GPR and EPU as effective metrics to forecast the future direction of oil prices and devise appropriate policies or maintain high business performance respectively whilst adapting to global energy price fluctuation throughout the conflict events.

References:

Baker, S.R., Bloom, N. and Davis, S.J. (2016). Measuring Economic Policy Uncertainty. SSRN Electronic Journal, 131(4). doi:https://doi.org/10.2139/ssrn.2198490.

Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity Journal of Econometrics, 31(3), pp.307-327.

Caldara, D. and Iacoviello, M. (2018). Measuring Geopolitical Risk. International Finance Discussion Paper, 2018(1222), pp.1-66. doi:10.17016/ifdp.2018.1222.

Kannadhasan, M. and Das, D. (2019). Do Asian emerging stock markets react to international economic policy uncertainty and geopolitical risk alike? A quantile regression approach. Finance Research Letters.

UN, 2022, Meetings Coverage and Press Releases, Russian Federation Announces 'Special Military Operation' in Ukraine as Security Council Meets in Eleventh-Hour Effort to Avoid Full-Scale Conflict https://press.un.org/en/2022/sc14803.doc.htm

Nelson, D.B. (1991). Conditional Heteroskedasticity in Asset Returns: A New Approach. Econometrica, 59(2), pp.347-370. doi:https://doi.org/10.2307/2938260.

Noguera-Santaella, J. (2016). Geopolitics and the oil price. Economic Modelling, 52, pp.301-309.

Selmi, R., Bouoiyour, J., & Miftah, A. (2020). Oil price Jumps and the Uncertainty of Oil Supplies in a Geopolitical Perspective: The Role of OPEC's Spare Capacity. International Economics.

Smales, L. A. (2021). Geopolitical risk and volatility spillovers in oil and stock markets. The Quarterly Review of Economics and Finance, 80, 358-366.

Jiang, Y., Ren, Y. S., Yang, X. G., Ma, C. Q., & Weber, O. (2024). The relationship between geopolitical risk and crude oil prices: evidence from nonlinear and frequency domain causality tests. Spanish Journal of Finance and Accounting/Revista Española de Financiación y Contabilidad, 53(2), 123-145

Zhang, Y.-J. and Yan, X.-X. (2020). The impact of US economic policy uncertainty on WTI crude oil returns in different time and frequency domains. International Review of Economics & Finance, 69, pp.750-768.

Nitsevich, V. F., et al. (2020). Western sanctions and their consequences for Russia. Proceeding of the International Science and Technology Conference" FarEastCon-2018" Volume 1 (pp. 65-79). Springer International Publishing.