

Causal effect of pandemic COVID-19, gold and oil prices on United States economic policy uncertainty: Evidence from ARDL method

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Abstract

The United States is the most significant economic power in the world. Therefore changes in economic indicators or economic policy of the United States will affect the whole world economy like the global financial crisis 2007-08. The first innovative study examines the effect of United States Coronavirus (COVID-19), oil, and gold prices on United States economic policy uncertainty. Autoregressive Distributed Lag Model(ARDL) is employed to get the long and short-run co-integration results. The outcome shows that (USCOVID_19 and OIL) significantly co-integrated in both the short and long run with United State Economic Policy of Uncertainty(USEPU) at a significant level. USCOVID-19 is positively short and long-run co-integrated, while oil is negatively short and long-run co-integrated with the economic uncertainty level of the USEPU. Only one variable of gold has no short and long-run co-integrated with USEPU.

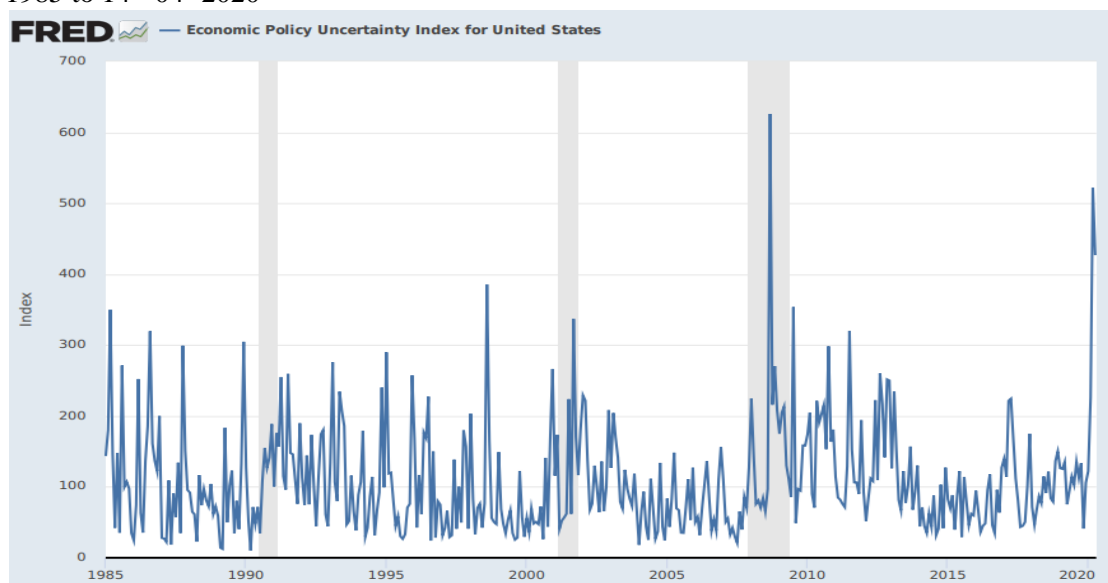
Keywords: *USCOVID-19, United States economic policy (USCOVID-19), gold price, oil price*

Introduction

The recent outbreak of respiratory disease named Novel Coronavirus COVID-19 in Wuhan city has injected severe devastation in the human lives and also soaring economic costs. According to World Health Organization (WHO) latest update, COVID-19 is unstoppable, and novel viruses will never end and declared an emergency to make a vacation to cure the infected person due to COVID-19. World Health Organization (WHO), stated that daily monitors the serve atmosphere created by novel COVID-19 and noted the figures since January 21, 2020, declared the COVID-19 a pandemic due to infecting an enormous number of humans in almost every part of the world. The US tops the list of the most infected people as the numbers have grown exponentially, and the latest count is 468,895 individuals which started on January 21, 2020 (WHO). The US alone accounts for almost 29% of the infected people in the World (Alqahtani, & Martinez, 2020). The covid-19 pandemic creates uncertainty in virtually every aspect: lethality related to the virus, the infectiousness, the capability of the healthcare system to handle the extraordinary challenge, the ultimate

mortality rate in the world, how much time is required to develop effective vaccines, the effectiveness and duration of lockdown and social distancing, the most crucial factor is that economic impact of the COVID 19 and policy responses. Closure of production units and heavy restrictions on travel is the major component of the imbalance between supply and demand equilibrium of commodities, and the equity market of most countries heavily suffered due to this imbalance (Albulescu, 2020; Nishiura et al., 2020; Remuzzi, & Remuzzi, 2020). In March 2020, the unemployment rate in the United States jumped at 4.4%, considered the highest rate since August 2017 because coronavirus COVID-19 crisis threw the number of a million people out of work (Tosepu, Gunawan, Effendy, Lestari, Bahar, & Asfian, 2020). Therefore the significant impact of the novel Covid-19 on international labor, equity market, and commodity prices has been observed. According to (Albulescu, 2020), natural disaster dramatically and certainly decreases trading activities and ultimately hinders the performance of stock markets. In this paper, the authors attempted to answer the question of how do commodities (Oil and gold) and natural disasters, including coronavirus symmetrically correlated with the United economic policy uncertainty?

Figure 1: Taking the monthly value (averages of daily values) index USEPU from 01 -01 - 1985 to 14 - 04- 2020



Note: Graph has been downloaded from the FRED

Initially, the United States government takes no extraordinary actions regarding the Covid-19, and Trump stated that the situation is very much under control in our country. Still, the financial equity market badly reacts due to the response of this crisis (Remuzzi, & Remuzzi, 2020). COVID-19 is the sixth type of coronavirus; five other types (MERSCOV, HCOV-OC43, HCOV-HKU, SARS-COV, HCOV-229E, HCOV-NL63) are already existing (Godil, Sarwat, Sharif & Jermisittiparsert, 2020). The efficient and early diagnosis of coronavirus COVID-19 might help to control the death rates and infection levels. The United States economic policy uncertainty index crossed 5000 figures and shows a leptokurtic trend, which is quite similar to the global financial crisis 2007-2008. At last, the United States government announced a natural emergency in their country and imposes a lockdown on the whole country and their economy (Nishiura et al., 2020).

Economic policy uncertainty (EPU) is an essential phenomenon as it hinders economic activities (Lolić & Sorić, 2017) for policymakers. EPU further leads to soaring volatility in stock markets and risk premium, more importantly, when the economic situation is slow

down (Khan et al., 2021b; Bachmann, Elstner & Sims, 2013). EPU has gained much attention, especially after the Global Financial Crises (GFC). Economic policies need frequent adjustments (Bekiros, Gupta, & Kyei, 2016), and it affects Central Banks and government actions (Bekiros, Gupta, & Kyei, 2016). In an uncertain environment, economic agents become reluctant to invest in the economy (Sum, 2012) and highly in favor to hold any monetary assets to protect themselves from future risks due to policy uncertainty (Alqahtani, & Martinez, 2020; Čižmešija, Lolić & Sorić, 2017). Some studies investigated the relationship between gold, oil, equity markets, and economic policy uncertainty. The economics literature (Irani et al., 2021; Nishiura et al., 2020; Castelnovo, & Tran, 2017; Hood, Kamesaka, Nofsinger, & Tamura, 2013) proves that oil price leads to fluctuating economic policy uncertainty and on the hand affect the equity market as well. According to Raza, Shahzad, Tiwari, and Shahbaz (2016), the stock market and economic policy uncertainty affect others inversely. The higher degree of commercial risk further increases the financing cost (Hood, Kamesaka, Nofsinger, & Tamura, 2013) decreases in investment level, and causes an economic slowdown. Similarly, gold has remained one of the most significant and safe haven commodities to have an impact on economic policy (Linnerooth-Bayer & Amendola, 2000).

Thus, it is of immense significance to accurately forecast EPU, as it assists in examining the trade cycles and in making appropriate investment decisions in the particular country's economy (Alqahtani, & Martinez, 2020; Pal & Mitra, 2015; Bloom, 2009). Most of the finance variables and financial information are co-integrated and contingent with each other, especially after increased globalization and liberalization. The question of what may cause policy uncertainty becomes even more critical in present crises caused by COVID-19? So far, we know very little how COVID-19 disasters, along with oil and gold, have an impact on US policy-induced economic uncertainty. Therefore, the present study will address this gap and try to find the effects of COVID-19, along with oil and gold, on economic policy uncertainty. A natural disaster is directly linked with economic uncertainty because in the period of natural disasters it hinders economic growth. During COVID-19 natural disaster, all commodities, including oil and gold prices, equity market prices are greatly affected, and United States economic uncertainty also showed the peaking trends. This present study is the first study to investigate the asymmetric effects of COVID-19, oil, and gold prices on United States economic uncertainty by employing the autoregressive distributed lag (ARDL) model introduced by Pesaran et al. (2001). This method is better as compared to other models because it helps to find linear short and long-run co-integration between the variables of the study (Khan et al., 2021a, Sarwar et al., 2021). Importantly, our model does not assume that all variables should be stationary at level, it could be stationary at level, first different or a mixture of both mentioned (Haddood, & Irani, 2021; Caggiano, Castelnovo, & Groshenny, 2014; Choi, & Hammoudeh, 2010; Bloom, 2009) to inquire long term effects between target variables regardless of the integration order of the concerned variables. Due to the series of advantages, this study used ARDL to determine the linear co-integration relationship between United States economic policy uncertainty, COVID-19, oil, and gold prices.

Literature review

After an increase in globalization and trade among different countries, the international financial markets are more vulnerable to internal and external shocks. Particularly any type of shock hitting the United States economy has worldwide effects. Emerging countries are suffering from these shocks a lot because the United States is the largest economy in the world. The United States stands first among the globe who suffers from coronavirus (COVID-19), and their economies bear much loss, ultimately soaring uncertainty in United States

economics policies. Numbers of studies (Alqahtani, & Martinez, 2020; Ayittey, Ayittey, Chiwero, Kamasah, J&Dzuvor, 2020; Raza, Shah & Shahbaz, 2018; Čižmešija, Lolić&Sorić, 2017; Hood, Kamesaka, Nofsinger, & Tamura, 2013; Pal & Mitra, 2015; Bloom, 2009;) are conducted to explain the type of association between commodity (oil and gold) prices and economic policy uncertainty (EPU). Ayittey et al. (2020) conducted their study to investigate the spillover relationship between oil price and GCC countries' economic policy uncertainty. Raza, Shah, and Shahbaz (2018) analyze the correlation between United States economic policy uncertainty and oil price. The data is collected from 2000 to 2017 and employs dynamic conditional correlations (DCC) to get the result. The result of the study indicates that positive correlations exist between U.S economic policy uncertainty and oil price. Enamul Hoque, Soo Wah, and Zaidi (2019) examined the dynamic relationship between geopolitical risk, oil price shocks, global economic policy uncertainty, and Malaysian equity price by using the VAR method and found an insignificant relationship. Another study (Čižmešija, Lolić&Sorić, 2017) is conducted to investigate the type of association between gold prices and EPU by employing the Granger causality (linear) test and causality-in-quantiles approach. The data was collected from China, Canada, Germany, Korea, France, the United Kingdom, and the United States for January 1995 to March 2017. The result reveals that economic policy uncertainty causes a change in gold price (Kannadhasan, & Das, 2019). A study explores the relationship between 23 commodity prices and the economic policy uncertainty of the US. Kuncoro (2017) pointed out that economic policy uncertainty is a significant predictor to accurately forecast the prices of oil, on the other hand, Caggiano, Castelnuovo, and Groshenny (2014) reveal that economic policy uncertainty affects oil return in some specific periods.

Numerous studies (Barro, Ursúa, and Weng, 2020; Horpestad, Lyócsa, Molnár, & Olsen, 2019; Kuncoro, 2017; Bachmann, Elstner&Sims, 2013; Linnerooth-Bayer & Amendola, 2000) are tried to investigate the relationship between natural disasters, commodities, and economic policy uncertainty. Bachmann, Elstner, and Sims (2013) investigate to explore the dynamic relationship between democracy policy, oil prices, and natural disasters. Atsalakis, Bouri, and Pasiouras (2020) try to investigate the type of relationship between GDP, and natural disaster and results prove that natural disaster reduces the economic growth of a country. Pal and Mitra (2015) examined the correlation between gold and uncertainty and applied causality tests based upon quantiles. Čižmešija, Lolić, and Sorić (2017) reveal that prices of oil volatility have short term and significant impact on uncertainty. So, results concluded that by changing the price of oil, economic policy uncertainty also changed. Another study (Bloom, 2009) basic aim of the study to explore the correlation between the equity market and natural disaster by implementing a GARCH model. The data was collected from 1980 to 2003 in Australia. The estimate reveals that there is an insignificant relationship between natural disasters and the equity market. Few studies tried to investigate the causes of economic policy uncertainty, and additionally our study used novel coronavirus and commodities data. Our study used the linear autoregressive distributed lag (ARDL) model to investigate the long-short run co-integration relationship between economic policy uncertainty, coronavirus, and commodities.

2.1 Table related to summary of Literature Review

Research Studies	Sample Countries	Data	Aims/Objective	Key conclusions
Atsalakis, et al. (2020)	One hundred (100)eco	1979–2010	This research paper require examining the type of relationship between	The study finding reveals that there is a negative relationship

	nomies		percent changes in economic growth level due to natural disasters.	between percent changes in economic growth and natural disaster, especially in lower quantile.
Alqahtani and Martinez (2020)	GCC countries	2004–2008	The paper tries to examine the relationship between the GCC equity market and economic policy uncertainty.	The study result pointed out that among all uncertainty indexes, the effect of the united states economic policy index is more pronounced.
Ayitney et al. (2020)	China	Review paper	The present study wanted to analyze the situation that how to create the balance of the economy and minimize the loss in the COVID-19 period.	One of the major determinants identified by the study in order to reduce loss in china during coronavirus pandemic is the efficient and correct disclosure of information.
Godil, et al. (2020)	Global database	1997 – 2019	The current study investigates the nature of the relationship between EPU, prices of gold, the oil price in both (Islamic and conventional) markets risk.	The paper implies that Islamic stock better has quite better capability in the period of high economic uncertainty period and higher oil price period.
Meninno and Wolff (2020)	Italy	1 March – 11 March 2020	The study wanted to investigate the number of deaths and the spreading pattern of coronavirus (COVID – 19) in Italy.	Italy government should need to give intensive care and treatment of 11% of patients in order to reduce the death level.
Barro, Ursúa, and Weng(2020)	Japan	29 Jan – 31 Jan 2020	The study examines the level of ascertainment of coronavirus (COVID – 19) in 2020.	The death level increased due to COVID – 19 from 0.3 to 0.6%.
Hoque, Wah and Zaidi (2019)	Malaysia	2009 – 2017	The paper tries to investigate the (linear) volatility between, Global EPU index, geopolitical risk, and oil price and equity market price by using	The result reveals that oil prices and the Global EPU index are the most important risk factors.

			ARDL method.	
Lin, Liang, and Tsai (2019)	World wide data	2007 – 2018	The paper investigated linear asymmetric linear causality between OVX, Brent oil price, and VIX by employing a non-linear autoregressive distributed lag (NARDL) model.	The result depicts that oil price has bidirectional relationship exist with OVX in the short term, and long term co-integration present in all variable used in this paper.
Pal and Mitra. (2019)	US and world index	1995 – 2018	The paper examines the nature of relations between oil prices, EPU, and automobile sector returns.	The study proves that oil prices the ultimate reason and effect both automobile sector earning and EPU.
Raza, Shah, and Shahbaz, (2018)	World wide dataset	1995 – 2017	The present study explores the causality relationship between EPU and gold price by using linear (Granger causality) and non parametric (Quantiles causality) both approaches.	The study findings prove that gold prices causing a change in EPU.
Čižmešija, Lolić, and Sorić (2017)	Germany , Spain, UK, Italy, and the USA	1990-2015	The research paper has aimed to analyze the type of causal effects between EPU and GDP (economic activity) by employing Granger causality.	The results confirm that short term bidirectional causality exists between GDP and economic policy uncertainty index.
Caggiano, , Castelnovo , and Groshenny (2014)	Global database	1997 - 2012	The current paper proposes to check the non-linear relationship oil, gasoline, and natural gas by employing ARDL.	The result of the study found an insignificant relationship between all variables of the study.
Hood, Kamesaka, Nofsinger, and amura (2013)	Japan	2008 - 2012	The current study aimed to check the portfolio investors and fund managers' response to Japan's natural disaster.	The finding shows that Nikki market certainty goes down after earth quick which shows that investors show panic behavior and reduce their investment from Japan equity market.
Linnerooth-Baye and Amendola	All continent s of the	1990 - 1995	The paper aimed to analyze the relationship between natural disasters, GDP,	The conclusion told us that Natural disaster has an

(2000)	world	equity market, and global change.	inverse relationship with GDP, equity market, and increase the probability of loss.
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Methodology

The paper aims to explore the long-term relationship between pandemic United States policy uncertainty, COVID-19, oil, and gold prices. Therefore our study is going to apply the autoregressive distributed lag model (ARDL) presented by Pesaran et al. (2001). Unlike all other traditional approaches, the current methodology can be applied either the target variable is stationary at first different or level (maybe a combination of both). The simple equation for our current study is given

$$\Delta USEPU_t = \gamma_0 + \gamma_1 USEPU_{t-1} + \gamma_2 USCOVID - 19_{t-1} + \gamma_3 GOLD_{t-1} + \gamma_4 OIL_{t-1} + \sum_{i=1}^V \delta_i \Delta USEPU_{t-i} + \sum_{i=1}^K \beta_i \Delta USCOVID - 19_{t-i} + \sum_{i=1}^P \phi_i \Delta GOLD_{t-i} + \sum_{i=1}^G \delta_i \Delta OIL_{t-i} + u_t$$

Data and results discussion

Daily data of United States economic policy uncertainty (USEPU), United states coronavirus (USCOVID-19) is measured by the total number of infected people in the United States, gold prices, and oil prices are used for the period of 22 January 2020 to 17 May 2020. All the data are collected from the WHO, FRED, and Yahoo finance. We have chosen this period because economic policy uncertainty is historically high during the COVID-19 period. The uncertainty trend present in the introduction section shows that during COVID-19 economic policy is trending like global financial crisis which is an alarming situation for the United States.

Table 4.1: Descriptive statistics

	US_EPU	USCOVID_19	GOLD	OIL
	343.6082	360528.5	1647.221	33.53429
Median	400.3500	16510.00	1648.900	28.52000
Maximum	824.9800	1467884.	1768.900	56.74000
Minimum	22.25000	1.000000	1482.300	-37.63
Std. Dev.	221.3987	486453.0	70.72505	16.38141
Skewness	0.149025	1.002209	-0.2074	-0.75208
Kurtosis	1.728436	2.482403	2.268447	5.230708

Table 4.1 shows descriptive statistics from 22 January 2020 to 17 May 2020. USCOVID-19 has the highest average and dispersion values 360528.5, 486453.0, respectively, which means that the United States coronavirus cases suddenly increased. Most of the variables US-EPU,

USCOVID-19, and GOLD) show symmetrical behavior and mesokurtic behavior the variables except for OIL, which has a little high peak (5.230708) and variables -0.75 skewness values show that oil price is negatively skewed. The high standard deviation of Covid-19 and United states EPU explains that increasing the COVID-19 cases and spreading the covid-19 news leads to an increase the economic policy uncertainty. Investors are uncertain about the investment in the united states because a large amount of industrial units shutdown has been observed during COVID-19.

Table 4.2: Correlations coefficient matrix

	US_EPU	USCOVID_19	GOLD	OIL
US_EPU	1	0.656895	0.524479	-0.84074
USCOVID_19	0.656895	1	0.743298	-0.60454
GOLD	0.524479	0.743298	1	-0.52778
OIL	-0.84074	-0.60454	-0.52778	1

Table 4.2 shows the coefficient of Pearson correlations of all concerned variables that are used in our study. The study variables are mostly positively correlated with each other except oil price, which is negatively correlated with all other independent plus dependent variables. The correlation coefficient between US-EPU and USCOVID-19 is 0.656895, which means that both variables are highly positively correlated with each other’s by changing the value of one variable; another variable value is much improved in the same direction. Similarly, high correlations (0.524479) are present between USCOVID-19 and GOLD. We have also noticed a high correlation between gold and COVID-19 with a coefficient of (0.524479). This positive correlation shows that even during the health crisis period (COVID-19) the prices of gold showed an increasing trend. Our results prove the safe-haven role of gold during the crisis period. In other words, gold prices are increasing during financial crises and pandemic crises.

Table 4.3: Time series unit root test (ADF) at the level and first difference

Variables	Level	First difference (LLC)
US_EPU	-1.23734(0.6548)	-14.2895(0.0001)***
USCOVID_19	-3.01258(0.0461)**	
GOLD	-1.6295(0.4631)	-8.06598(0.0000)***
OIL	-1.8905(0.3352)	-13.7492(0.0001)***

Note: ***, ** indicate the p-value 1% and 5% null hypothesis criteria for unit root

Table 4.4: Bound test for linear co-integration

Dependent (Poblem) variable	F-statistics	K	Lower-Bound value (90%)	Upper	End conclusion
				Bound value (90%)	
United States economic policy uncertainty (USEPU)	7.80230	2	3.77	5.61	Cointegration

Table 4.3 shows the p values of the time series unit root test of all variables at the first difference and unit root. The null hypothesis (Ho) of a time series unit root is that there is the

presence of a unit root. Still, in our study, the H_0 hypothesis of all variable are rejected at the level except the variable USCOVID (stationary at level). Therefore, we transform all target variables used in this study is the first difference. The study results depict that all variables (including dependent and independent variables) are stationary at first difference. After identification of the order of co-integration, it is necessary to identify where any type of long-term co-integration exists between variables of our study. Table 4.4 shows that long-run co-integration exists in both lower and upper bound.

Table 4.5: short-run coefficients of Autoregressive distributed lag (ARDL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(USCOVID_19)	0.000077	0.000038	2.009455	0.048
D(GOLD)	0.370519	0.420297	0.881566	0.3808
D(OIL)	-3.64472	1.492946	-2.44129	0.017
CointEq(-1)	-0.64321	0.116371	-5.52727	0

Table 4.5 contains the coefficient values (short-run) of the ARDL model of all variables used current paper. The null hypothesis of the ARDL model, there is a short-run association (co-integration) between the exogenous variable and target (dependent variables) of the study. Most of the variables (D(USCOVID_19), D(OIL)) reject the null hypothesis of the variables. USCOVID-19 positively short-run positively co-integrated with USEPU. The result pointed out that by increasing the infected cases of coronavirus (USCOVID_19), the US economic policy uncertainty also increased in the short-run period. On the other hand, oil is negatively short-run cointegrated with USEPU; it means oil price suddenly decreases while increasing USEPU during the coronavirus period. In the case of Gold, the null hypothesis is failed to reject, which means there is no short-term co-integration with the dependent variable.

4.6 coefficients of Autoregressive distributed lag (ARDL)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
USCOVID_19	0.00012	0.000059	2.026401	0.0462
GOLD	-0.42452	0.387334	-1.09601	0.2765
OIL	-10.852	1.415759	-7.66517	0.000
C	1367.788	634.0048	2.157379	0.0341

Table 4.6 contains the coefficient values (long run) of the ARDL model of all variables used current paper. The null hypothesis of the ARDL model there is a long-run association (co-integration) between the exogenous variable and target (dependent variables) of the study. Most of the variables used in this study USCOVID-19, and OIL significantly long run co-integrated with USEPU at a significant level of 1% and 5%. USCOVID-19 is positively long run co-integrated with USEPU. It means if a 1% increase in infected cases increases in the United States due to coronavirus, the United States economic uncertainty increased a 0.012 percent increase in the economic uncertainty level of the United States. Oil is negatively long run correlated with USEPU; it means decreasing the value of oil, then increasing in economic uncertainty level of the United States. During the coronavirus period commodities, prices are inversely co-integrated with USEPU. Only one variable gold is not long-run significantly co-integrated with USEPU.

Conclusion and policy implication

Our study focus on exploring the causal co-integration relationship between the United states USCOVID-19, oil, gold, and economic policy uncertainty. The coronavirus infection data is used for the United States from (22 January 2020) to (17 May 2020) and decided to employ Autoregressive distributed lag (ARDL) to get the long and short-run co-integration results.

The study variables are mostly positively correlated with each other except oil price, which is negatively correlated with all other independent plus dependent variables. Then time series unit root reveals that only one variable is stationary (USCOVID-19) at level, so all exogenous and dependent variables are transformed into first different, and now all the variables are integrated. Lastly, our study has decided to employ the Autoregressive distributed lag (ARDL) to get along and short-run linear co-integration coefficient. Most of the variables (D(USCOVID_19), D(OIL)) have short-run linear co-integration except (D(GOLD)), which shows no short-run co-integration. All of the variables used in this study USCOVID-19, and oil significantly long run co-integrated with USEPU at a significant level of 1% and 5%. USCOVID_19 is positively long run co-integrated, while OIL is negatively long run correlated with the economic uncertainty level of the United States (USEPU). Only one variable GOLD has no long-run co-integrated with USEPU. The empirical results especially incorporating the element of novel coronavirus (USCOVID_19), helps policymakers to make policy and to try to maintain stability in their financial sectors. Future research can be extending more uncertainty measures like the fiscal and monetary policy of the United States; moreover, researchers can also use economic policy uncertainty of any other than the United States.

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