COVID-19 Outbreak and US Economic Policy Uncertainty: An ARDL Approach

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Abstract

The outbreak of COVID-19 is generating shock waves to financial markets and the real economy all over the world and the depth of the recession coming ahead depends on policy response. This paper investigates the impact of COVID-19 (measured by the number of new cases and deaths) and brent oil prices on the economic policy uncertainty of the United States. I use daily data from 1 January to 25 August 2020 and I use an Autoregressive Distributed Lag (ARDL) model to estimate the relation of COVID-19, oil price dynamics and policy uncertainty. The findings indicate that new infection cases in the US have a significant effect on the US EPU, while there is no significant impact of death cases on economic policy uncertainty. Further, there is an inverse relation between brent oil prices and policy uncertainty meaning that economic policy uncertainty will increase as brent oil prices decrease.

Keywords: COVID-19, EPU, oil prices

JEL codes: E52, E61, F62, G01

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1. Introduction

As of 30 August 2020, the global outbreak of Corona Virus (COVID-19) has invaded 21 countries and territories with a total of 25, 849,887 confirmed cases and a death toll of 859,132 deaths. (Worldmeter, 2020). Wuhan is the first city in Central China where the virus originated and on January 23 the whole city went on lockdown. On 30 January, the World Health Organization declared the corona virus outbreak a Global Public Health Emergency, the cases of the virus surpassed the cases of SARS [2]and CDS [3]reported the first case confirmed in the US. On 31 January, the first 2 cases were reported in the UK and Russia, the first case in Sweden and Spain and Canada reported its 4th cases. US airlines suspended the flights and in the same day the U.S State Department issued a ban of Level 4: Do not travel to China (the highest level of alert). Currently, the European countries and the US are yet coping with the COVID-19. The outbreak is generating fear and anxiety among people, not only because of the increase of new cases but the virus is imposing restrictions on their daily routine and on their domestic/international traveling. Further, the virus is increasing the uncertainty about the future while is affecting severely the real side of the economy. Likewise, the COVID-19 uncertainty is amplified more by the delayed reaction of authorities. The pandemic found the countries and especially their health systems unprepared; most of them are still on lockdown while others are imposing restrictions that change daily and forbid the entrance of travelers into the country. As of now, United States is the first country in the world for the number of new cases and deaths. In order to preserve the financial markets and support the economy, Federal Reserve has initiated a series of tools. The first reaction began in 28-th February 2020 with the speech from the Chair Jerome H.Powell who ensured the agents that the fundamentals of the U.S economy were strong. The action began on 15 March when the main central banks, the Bank of Canada, the Bank of England, the Bank of Japan, the European Central Bank, the Federal Reserve, and the Swiss National Bank took a coordinated action to enhance the provision of US dollar through swap lines. They have agreed to reduce the price of the US swap agreements by 25 basis points so the new rate will be the overnight index swap plus 25 basis points. In the same day, further measures were announced to support the business and the households. The series of actions include discount window, intraday credit, bank capital and liquidity buffers and reserve requirements. On 17 March 2020, Federal Reserve Board announced the establishment of the Primary Dealer Credit Facility and the Commercial Paper Funding Facility to support the flow of the market and the credit to business and households. Additional support was provided to business and households by establishing the Money Market Mutual Fund Liquidity Facility. Temporary swap arrangements were established with the Reserve Bank of Australia, the Banco Central do Brasil, the Danmarks Nationalbank (Denmark), the Bank of Korea, the Banco de Mexico, the Norges Bank (Norway), the Reserve Bank of New Zealand, the Monetary Authority of Singapore, and the Sveriges Riksbank (Sweden) to reduce the constraints in the US dollar liquidity markets. On 23 March 2020, the Board announced extensive measures such as purchase of Treasury securities and agency mortgage-backed securities and credit to employers, consumers, business and municipalities. On 27 March in order to support the overall economy and to allow banks to continue lending, the Federal bank regulatory agencies announced a new method of measuring the risk of counterparty derivatives

[2] Severe acute respiratory syndrome (SARS)
[3] Centers for Disease Control and Prevention

contracts and provided a new optional extension of the regulatory capital transition for the new credit loss accounting standard. On 1 April the leverage ratio was eased to remove the strains in the Treasury market. On 9 April 2020, the Board took actions to provide $2.3 trillion in loans to support the economy. The main aim of the funding was to assist the household and the employers and bolster the ability of the state and the local government to deliver the crucial services. Decision of extensions of the existing tools were taken during this time framework and the recent decision was the one of 26 August 2020 of Governor Bowman. Hence, as one of the biggest countries depending on oil, the dynamics of oil and the rapid propagation of COVID-19 will increase the economic policy uncertainty of the USA. Therefore, I provide a comprehensive analysis of the COVID-19 and the economic policy uncertainty (EPU) of the US. Moreover, I investigate the impact of oil price on economic policy uncertainty on both short-run and long-run framework. Recent studies have been focused of the impact of economic policy uncertainty on firm performance such as (Iqbal, Gan, & Nadeem, 2020) and (Wu, Zhang, & Zhang, 2020), financial volatility (Tiwari, Jana, & Roubaud, 2019),economic activity (Nyamela, Plakandaras, & Gupta, 2019).

The results show that there is a positive impact of infection new cases on economic policy uncertainty. However, even though there is a positive impact of death cases, its impact is not significant. There is a negative relation between brent oil prices and policy uncertainty, meaning that as the prices of oil decrease the uncertainty is increased. The sign and the magnitude of the error term indicate that my model is robust and properly defined. The residual diagnostic tests such as Breuch-Pagan Test, ARCH Test, Cusum Test and Cusum of Squares Test further confirm my findings. However, I fail to pass the Jarque-Bera Test for normality of the residuals. My results support the findings of (Aloui, Gupta, & Miller, 2016), (Hailemariam, Smyth, & Zhang, 2019), (Albulescu, 2020) and (Sun, Chen, & Wang, 2020). However, different from (Albulescu, 2020), I find a positive and significant effect of infection new cases on economic policy uncertainty.

The outline of the paper is as follows: Section 2 includes the literature review, Section 3 defines the methodology, Section 4 describes the results while Section 5 concludes.

2. Literature review

In this section I present the recent literature of the impact of COVID-19 on the economic policy uncertainty of U.S. (Al-Awadhi, Alsaifi, Al-Awadhi , & Alhammadi, 2020), (Zaremba, Kizys, Aharon, & Demir, 2020) and (Zhang, Hu, & Ji, 2020) focus on the impact of COVID-19 on the real side of the economy.

(Al-Awadhi, Alsaifi, Al-Awadhi , & Alhammadi, 2020) state that the number of cases and death is negatively related to stock markets. (Zaremba, Kizys, Aharon, & Demir, 2020) investigate the impact of non-pharmaceutical policy responses to COVID-19 on stock market volatility. The authors reveal for a significant impact of government interventions on stock market volatility. (Zhang, Hu, & Ji, 2020) report that the uncertainty is generating volatile and unpredictable stock markets.

(Albulescu, 2020), (Dietrich, Kuester, Müller, & Schoenle, 2020), (Ding, Levine , Lin, & Xie, 2020), (Conlon & McGee, 2020), (Corbet, Hou, & Hu, 2020), (Sharif, Aloui, & Yarovaya, 2020) focus on the response of market instruments due to COVID-19.

(Albulescu, 2020) investigates the impact of the virus and the crude oil prices in the economic policy uncertainty of the US. The findings show that new cases and the death ratio do not have a significant effect on the US EPU, however, there is negative relationship between oil prices and uncertainty. Moreover, the new cases and death ratio outside China, have a positive influence on the uncertainty of US.

(Dietrich, Kuester, Müller, & Schoenle, 2020) ran a survey household for the economic expectations of COVID-19 pandemic and the result suggest that the pandemic enhances the uncertainty and inflation is expected to increase. Further, the authors state that monetary policy response is crucial in the short-run economic impact of pandemic.

(Ding, Levine , Lin, & Xie, 2020) evaluate the connection between firms' characteristics and stock price reactions due to COVID19. The authors found that the reduction was smooth in those firms that had strong pre-finances, less exposure through supply chains and customer locations, more CSR activities and less entrenched activities. Further, the corporates with less financial ownership perform better and the stock prices of firms with larger hedge fund ownership performed worse.

(Corbet, Hou, & Hu, 2020) and (Conlon & McGee, 2020)confirm that gold and cryptocurrencies instead of hedges or safe heavens in the time of financial disruption are contagion amplifiers. (Corbet, Hou, & Hu, 2020) argues that companies with a name "corona" have gone through vast reputational damage even though they did not have any connection to COVID outbreak.

(Sharif, Aloui, & Yarovaya, 2020) investigate the connection between COVID-19, oil prices, stock market, geopolitical risk and economic policy uncertainty in the US. They approach confirms the impact of COVID-19 and oil price shock on the geopolitical risk, economic uncertainty and stock market volatility. The effect of COVID-19 seems to be higher in the geopolitical risk rather than on policy uncertainty.

There is vast literature on the relation between economic policy uncertainty and oil prices. (Kang & Ratti, 2013) found that demand and oil production shocks are strongly related to economic policy uncertainty. (Antonakakis, Chatziantoniou, & Filis, 2014) found an inverse correlation between the shock of oil prices and the US economic recessions. (Alexopoulos & Cohen, 2015) and (Demir & Ersan, 2017) confirm the significant impact of oil prices on economic activity. In addition, (Aloui, Gupta, & Miller, 2016)found that oil prices and economic policy uncertainty have a negative relationship except of the short run. (Berger & Uddin, 2016)suggest that the volatility of oil prices has a significant effect on uncertainty. (Kang, Ratti, & Vespignani, 2017) and (Chen, Sun, & Li, 2020) state that uncertainty is influenced by the shocks of oil prices while (Ma, Wahab, Liu, & Liu, 2018) reveal that economic policy uncertainty can be a good indicator in predicting the oil prices. (Hailemariam, Smyth, & Zhang, 2019) noted a negative relationship between 2 main variables and this relation depends on the global aggregate demand.

However, the existing literature on the impact of oil prices and the outbreak of corona virus on the economic policy uncertainty, especially in the US are few. Therefore, I try to fill the gap by addressing the impact of COVID-19 on the US-economic policy uncertainty.

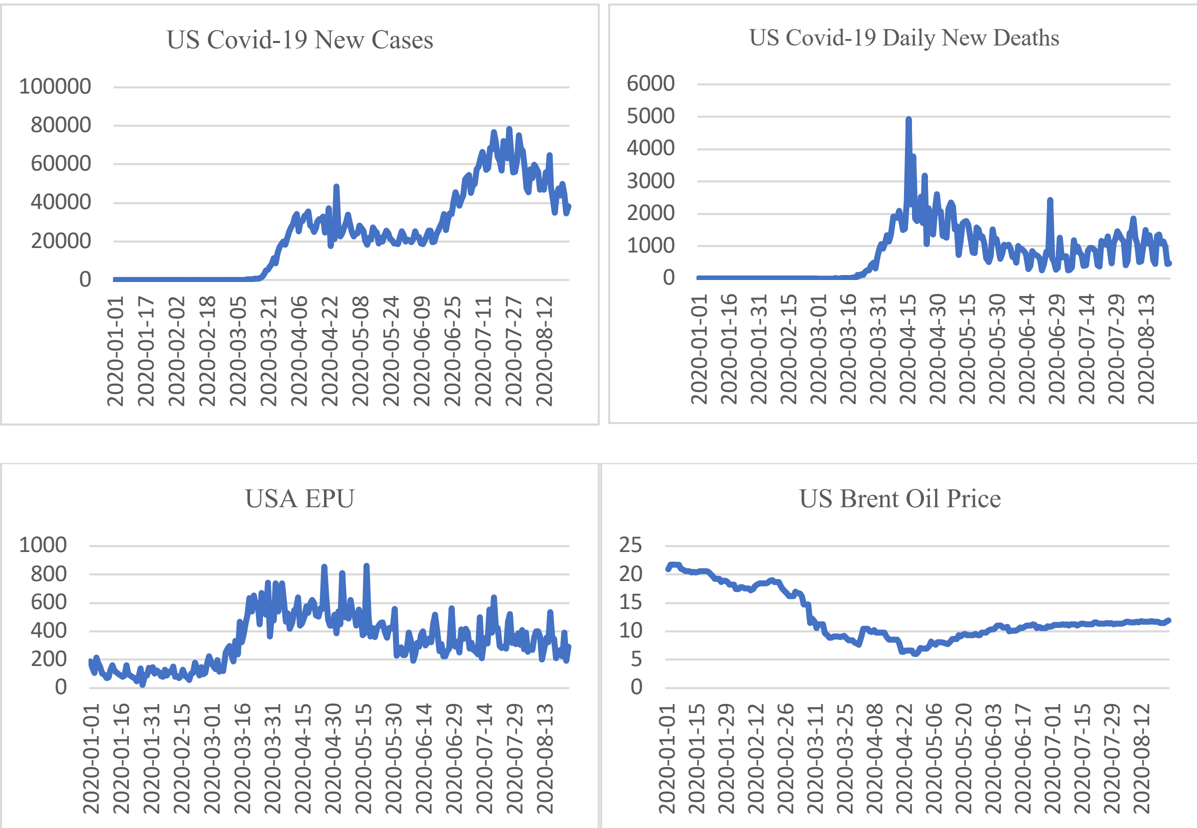
3. Methodology

3.1 Data and variables

In this study, I will attempt to measure the impact of COVID-19 on economic policy uncertainty. Therefore, EPU index is my dependent variable. I include COVID-19 daily new cases and deaths as independent variables. I include Brent oil too, to assess the impact of COVID-19 and oil price on economic policy uncertainty. The source for COVID-19 data for US is worldmeter.com. The data for EPU index is available from policyuncertainty.com.[4] Finally, the data for Brent oil is collected from investing.com. I use daily data and the study period ranges from 1 January 2020, to 25 August 2020.

Figure 1 below indicates daily new cases and deaths in the US, the economic policy uncertainty and brent oil prices. It is obvious that as the infection is increased, policy uncertainty is increased while oil prices have seen a sudden drop which has started in middle February.

Figure 1 Time series trend of US COVID-19 Daily New Cases, US COVID-19 New Deaths, US EPU and US Brent Oil Price



Source: Author's estimation

3.2 Autoregressive-Distributed Lag (ARDL) model

I use Autoregressive-Distributed Lag (ARDL) model proposed by (Pesaran, Shin, & Smith, 2001) to investigate the relation among variables. ARDL model is superior to other approaches of cointegration. (Mah, 2000) states that the approaches of cointegration used by (Engle & Granger, 1987), (Johansen, 1988) and (Johansen & Juselius, 1990) are not genuine in the case

[4] Data are extracted on 25 August 2020 from http://www.policyuncertainty.com/us_daily.html

of small sample size. Moreover, (Kremers, Ericsson, & Dolado, 1992) argue that in the case of small sample sizes there cannot be established cointegration among I(1) variables.

Therefore, ARDL is vastly used among researchers. (Pesaran & Pesaran, 1997) indicate that it does not impose restrictions under the variables in consideration for their order of integration, hence, the ARDL model can be applied irrespective of the order of integration. ARDL does not have endogeneity problem, as it is free of residual correlation. (Pesaran & Pesaran, 1997) and (Pesaran, Shin, & Smith, 2001) state that ARDL can be used even when the explanatory variables are endogenous. Hence, I use ARDL model in this study in order to get the short-run and long-run parameters. The equation used in this study isbelow:

$$\Delta EPU_t = c + \delta_{EPU} EPU_{t-1} + \delta_{COVIDNC} COVNC_t + \delta_{COVND} COVND_t + \delta_{BOIL} BOIL_{t-1} + \sum_{i=1}^{p} \alpha_i \, \Delta EPU_{t-i} + \sum_{i=1}^{p} \beta_i \, \Delta COVNC_{t-i} + \sum_{i=1}^{p} \mu_i \, \Delta COVND_{t-i} + \sum_{i=1}^{p} \gamma_i \, \Delta BOIL_{t-i} + \theta ECT_{t-i} + \epsilon_t \quad (1)$$

Note: Δ and δ indicate the short and long run respectively, i indicates the number of lags, ECT represents the error correction term while ϵ_t denotes the error term.

4. Results

4.1 Descriptive statistics

The summary statistics of the variables included in my study are reported in Table 1. I have a total number of 237 observations from 1 January 2020 to 25 August 2020. The average of the economic policy uncertainty (EPU) is 331, with the lowest being 22.25 and the highest 861. For the new cases of COVID-19, the average is 24223 while the average of new death is 748, brent oil has a mean of 12.44 and a standard deviation of 4.25. Further, the variables are skewed to the right and is only the variable of COVID new death that exhibits excess kurtosis.

Table 1 Descriptive statistics

	EPU	COVNC	COVND	BRENTOIL
Mean	331.15	24223.24	748.01	12.44
Median	318.64	22593.00	652.00	11.25
Maximum	861.10	78427.00	4928.00	21.73
Minimum	22.25	0.00	0.00	6.01
Std. Dev.	181.14	22069.6	780.22	4.25
Skewness	0.36	0.53	1.36	0.78
Kurtosis	2.50	2.24	6.29	2.34
Jarque-Bera	7.74	16.74	180.83	28.74
Probability	0.02	0.00	0.00	0.00
Observations	237	237	237	237

Source: Author's calculations

4.2. Unit root test

I follow the work of (Dickey & Fuller, 1979) and (Dickey & Fuller, 1981) and I perform the augmented Dickey-Fuller (ADF) test. The results for the test are presented in Table 2**Error! Reference source not found.**.The first column defines the model with an intercept and without trend; the second represents the model with an intercept and trend; and the third without an intercept and trend. Table 2 shows that some of the variables are stationary at levels and all variables are stationary at first difference. However, there is no variable which is stationary at second difference I(2).

Table 2 Unit root test

Level	T_u	T_t	T	Difference	T_u	T_t	T
EPU	3.12**	3.24*	1.32	ΔEPU	15.38***	15.37***	15.41***
COVNC	1.48	2.68	0.52	ΔCOVNC	20.30***	20.26***	20.32***
COVND	3.26**	3.50**	2.20**	ΔCOVND	23.84***	23.80***	23.89***
BRENTOIL	2.11	0.90	2.07**	ΔBRENTOIL	14.37***	14.71***	14.26***

Source: Author's calculations
Note: *, **,*** denotes 10% , 5% and 1% level of significance.

4.3 Correlation

The correlation matrix of the variables is shown in Table 3. Both COVID variables show a positive correlation with the economic policy uncertainty while there is a negative effect of brent oil prices on policy uncertainty. As expected, there is a positive correlation between COVID new case and new death, as new cases are discovered it highly expected that the number of dead people will increase.

Table 3 Correlation matrix

	EPU	COVNC	COVND	BRENTOIL
EPU	1			
COVNC	0.41	1		
COVND	0.57	0.51	1	
BRENTOIL	-0.81	-0.53	-0.66	1

Source: Author's calculations

4.4 Bound test

I perform the Bound cointegration test proposed by (Pesaran, Shin, & Smith, 2001) to test if there is any long-run relationship between variables. According to the bound test, I will know whether I will perform an ARDL, an ECM or a VECM model. The null hypothesis is H_0: $\lambda_1 = \lambda_2 = \lambda_3 = 0$ meaning that there is no long-run relationship against the alternative is H_1: $\lambda_1 \neq 0$, $\lambda_2 \neq 0$, $\lambda_3 \neq 0$. The F-statistics is calculated with the lower and upper bound and then decide if the relationship between variables is short or long-run. If the F-statistics calculated is greater than the critical value for the upper bound I(1), I conclude that there is cointegration, presence of long-run relationship and I proceed on estimating a VECM or ECM model. If the calculated F-statistics is lower than the lower bound, I accept the null and I specify a model only for the short-run. The results in Table 4 indicate that the F-statistics is higher than the upper bound meaning that there exists a long-run relationship among variables.

Table 4 Bound Test

F-statistics	Critical Values		Conclusion
	Lower bound (I(0))	Upper Bound(I(1))	
8.83	4.29	5.611	Long-run relationship

Source: Author's calculations

4.5 Lag Length Criteria

Before I proceed with the estimation, I have to define the order of lags of the variables. Defining the appropriate number of lags requires the estimation of an unrestricted VAR model.[5] Following (Hendry & Krolzig, 2001), I define the lags for my model in Table 5:

Table 5 Lag-length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-51.07358	NA	0.094517	0.478901	0.538693	0.503020
1	-37.46055	26.63419	0.084699	0.369222	0.443963	0.399371
2	-31.91170	10.80819	0.081415	0.329667	0.419356*	0.365846*

Source: Author's calculations
Note: *, **,*** denotes 10% , 5% and 1% level of significance.

4.6 ARDL analysis

I estimate an ARDL model, which results for the long run are defined in Table 6. The findings show that new cases of COVID-19 have a positive and significant effect in the economic policy uncertainty of US, meaning that an increase of the cases increases the uncertainty. There is a positive impact of new deaths too, even though the effect is not significant. Moreover, there is a negative relation of brent oil prices and economic uncertainty, meaning that as the prices decline the economic uncertainty increases. My results are similar to those of (Aloui, Gupta, & Miller, 2016), (Hailemariam, Smyth, & Zhang, 2019), (Albulescu, 2020) and (Sun, Chen, & Wang, 2020). The error term is negative and significant which confirms that my results are robust, and my model is properly defined.

Table 6 Long-run coefficients

Variable	Coefficient	Prob.
COVNC	0.03	0.01**
COVND	0.04	0.11
LBRENTOIL	-0.72	0.10*
$\mathbf{ECT_t}$	-0.76	0.00***

Source: Author's calculations

In the short run framework, indicated in Table 7 there is a significant impact of the previous economic policy uncertainty on the current policy uncertainty. The number of new cases is significant in the short run too, indicating that as the cases of infections increase, it enhances the policy uncertainty. There is a negative impact of new death cases and brent oil prices on policy uncertainty, but for both variables the influence is not significant.

Table 7 Short-run coefficients

Variable	Coefficient	Prob.

[5] The number of lags based on Schwarz Criterion and Hannan-Quin Criterion is 2 (two lags) however while estimating the model with 2 lags, the second lag for the variables is not significant therefore, I had to reduce the number of lags to one lag.

D(LEPU(-1))	-0.46	0.00***
D(COVNC(-1))	0.02	0.01***
D(COVND(-1))	-0.001	0.24
D(LBRENTOIL(-1))	-0.25	0.62

Source: Author's calculations

4.7 Diagnostic tests

I perform the residual diagnostic tests (normality test, serial correlation and heteroskedasticity test) and the results are shown in Table 8. The findings show that Jarque Bera test for normality is rejected. The Breusch-Godfrey test of serial correlation has a null hypothesis of no serial correlation in the residuals. I fail to reject the null hypothesis that the residuals are serially correlated. The ARCH test for heteroskedasticity has a null hypothesis of no ARCH effects. I fail to reject the null hypothesis of no heteroskedasticity. The Cusum Test in Figure 2 and Figure 3 show that my model satisfies the stability condition since the model lies within the 5% confidence band.

Table 8 Residual Diagnostic Test

Normality test (JB)	0.00**
Serial Correlation	0.91
ARCH	0.42

Source: Author's calculations
Note: *, **,*** denotes 10% , 5% and 1% level of significance.

Figure 2 *The Cusum Test for Model Stability*

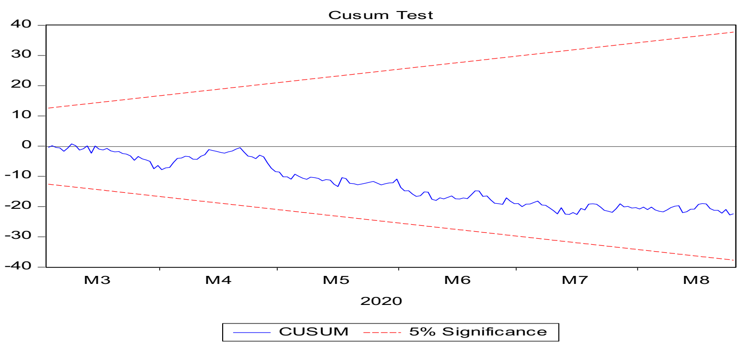
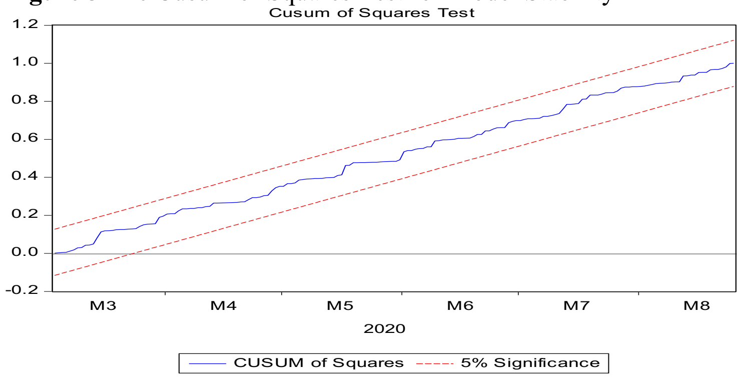


Figure 3 The Cusum of Squares Test for Model Stability



5.Conclusion

The outbreak of COVID-19 is generating shocks to the financial markets and the real economy all over the world. This paper investigates how COVID-19 measured by new cases and death influence the economic policy uncertainty of US. Further, I have included brent oil prices in order to capture the impact of the economic downturn on prices. The results show that as the number of new cases increases it causes an increase on policy uncertainty. There is an inverse relation between oil prices and economic policy uncertainty meaning that as the prices decrease it enhances the uncertainty in the economy. However, there is no significant effect of death cases on economic policy uncertainty.

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