Journal of Economics and Business Issues

How Economic Policy Uncertainty Affect Carbon Emissions: A Case Of G-7 Countries[1]

Emrah Doğan [2], Cengizhan Güler [3]

[2] İstanbul Gelişim University; emdogan@gelisim.edu.tr; Orcid: 0000-0001-9870-5719
[3] İstanbul Gelişim University; ceguler@gelisim.edu.tr; Orcid: 0000-0002-9059-3676
* Correspondence: emdogan@gelisim.edu.tr

Abstract: In today's world, environmental problems, which have rapidly increased in the last few years, have become one of the leading problems both in developing and developed countries. As it is known, the increase in CO2 emissions causes global warming in the background of the climate change problem. In this study, it is aimed to investigate the effects of uncertain economical policy on CO2 emissions in G-7 economies. This was tried to be determined by the panel data set containing the data between 1997-2015 and the Parks-Kmenta Estimator. In examining the relationship between economic policy uncertainty and CO2 emissions, the variables of energy consumption and real GDP were also included in the study. Estimation results show that energy consumption and real GDP have a statistically significant and positive impact on CO2 emissions. However, economic policy uncertainty has a statistically significant and negative effect on CO2 emissions.

Keywords: CO2 Emission, Uncertain Economical Policy, Panel Data

Citation: Doğan, E. & Güler, C. (**2021**) How Economic Policy Uncertainty Affect Carbon Emissions: A Case Of G-7 Countries. *Journal Of Economic and Business Issues, 1(1)*, 32-38.

Received: 24/06/2021
Accepted: 28/07/2021
Published: 31/07/2021

1. Introduction

The problem of global warming is now one of the major issues affecting both the environmental and economic performance of all economies. However, the economic policy uncertainties observed in the global economy are another important factor that has caused concern about climate change in recent years. In this context, it is of great importance to evaluate the relationship between CO2 emission, which is considered as the main cause of global warming, and economic policy uncertainty.

World economies that are intertwined through globalization continue their existence with more factors, unlike closed economies. For this reason, the dynamic structures of economies that open up to the outside world become more complex and policies are developed accordingly. The complexity created by the combination of multiple factors on the axis of interacting economies can also create a number of uncertainties in economic policy. The concept of economic policy uncertainty (EPU) can affect economies in many ways. The main effects of economic policy uncertainty could be sum up as reduction of investment and declines in foreign trade (Novy and Taylor, 2020). On the other hand, economic policy uncertainty can affect governments, firms and individuals. The uncertainty that arises in this context can be caused by both political reasons such as the UK leaving European Union, economic reasons such as 2008 Financial Crisis and 2011 European Debt Crisis . In the broadest sense, EPU can be defined as the effects of unexpected changes on the economic system and how these effects will then affect the policies to be created through monetary and fiscal policy, individual and corporate behavior (Abel, 1983).

As the impact of the EPU factor on energy consumption and carbon emissions increases, predictability decreases and asymmetric effects may occur. In this context, renewable energy investments and policies that reduce carbon emissions may also be affected by asymmetric effects (Algharabali & Al-Thaqeb, 2019). In other words, Investments and policies that aim to reduce both energy consumption and carbon emissions are negatively affected by high uncertainty. One of the main reasons for this effect is that investments in renewable energy sources or energy saving systems require large resources (Pirgaip & Dincergok, 2020). Another explanation for the effect of economic policy uncertainty on CO2 emissions is related to energy consumption. As it is known, the consumption and investment of energy-intensive products in economies are quite high in modern economies. From this point of view, higher economic policy uncertainty will reduce the consumption of energy-

[1] This study is the revised and edited version of the paper entitled "Does economic policy uncertainty affect carbon emissions? Empirical evidence from G-7 countries", presented at the GUICEFM 5th International Conference on Economics and Finance.

intensive products. Consequently, the decrease of energy consumption will be seen in environmentally intensive or fossil-based products, and this will reduce CO2 emissions (Wang , Xiao and Lu, 2020).

Therefore, the EPU factor emerges as an important factor to ensure the transition from energy-dependent and carbon emission producing economies to a more sustainable economy. In this context, this study examined the relationship between CO2 emission, which is an important determinant of climate change, and economic policy uncertainty for the G-7 economies. This was analyzed by using the data between 1997-2015 and with the help of Parks-Kmenta Estimator. This study aims to contribute to the literature in the context of identifying the relationships between CO2 emission and economic policy uncertainty.

This study first presents the results of the studies related to the topic in the literature. Then the data set, the methodology, the empirical results of the study are presented. Finally, the emprical results obtained in the study are evaluated and recommendations are made.

2. Literature Review:

There are few studies in the literature on the effects of economic policy uncertainty on CO2 emissions. Of these few studies mentioned, Adams et al. (2020) investigated the effects of energy consumption, geopolitical risk, and economic uncertainty on carbon emissions for the years 1996-2017 using resource-rich economies as examples. The study used PMG-ARDL as the estimation method, and the long-run relationship was found as a result of cointegration tests. In the first model, a linear relationship between carbon emission and energy consumption was found using three different models. A 1% increase in energy consumption also causes a 1% increase in carbon emission. The effect of the EPU factor on carbon emission was determined to be 0.012% in the long term and 0.002% in the short term. No significant effect of geopolitical risk was found. In the second model, where geopolitical risk is excluded, the coefficients of the positive relationship between energy consumption and carbon emission are determined to be 1.03% in the long run and 1.05% in the short run. In this context, the effect of the EPU factor on carbon emission was determined to be 0.011% in the long run and 0.002% in the short run. In the third model, where the EPU factor was excluded, a linear relationship between energy consumption and carbon emission was found, similar to the first model. The results of the analysis performed for geopolitical risks are similar to the first model.

In another study by Adedoyin & Zakari (2020), which examined the effect of economic policy uncertainty on economic growth, energy consumption and carbon emissions, United Kingdom was chosen as the sample group. The UK, which started phasing out European Union from 2016, is considered a good sample for uncertainty analysis in the study. In the study where the ARDL bound test was used, the data was analyzed between the years 1985-2017. In the study where the direction of causality was also investigated, unidirectional causality was found for carbon emission from EPU factor. As a result of the models built with different variables in ARDL bound test, it was found that EPU factor affects carbon emission in both short term and long term. It was found that carbon emission decreases in the short term but increases in the long term. In the study which found that energy use has a negative effect on carbon emission reduction, it was found that policy makers should also give preference to environmentally friendly sources in energy use.

In the study by Pirgaip & Dincergok (2020) which examined EPU, energy consumption and carbon emissions for G7 countries, the years 1998-2018 were used as the data set. In the study where Panel Granger causality analysis was used, different causality aspects were identified based on the countries. Unidirectional causality was obtained from the EPU factor on energy consumption for Japan and carbon emissions in the United States and Germany. Unidirectional causality for both energy consumption and carbon emissions from the EPU factor was found in Canada. While unidirectional causality from carbon emissions to EPU factor was found for Italy, bidirectional causality was found between EPU and carbon emissions. Furthermore, a unidirectional causality from energy consumption to carbon emission was also found in America.

Another study in the literature, Abbasi & Adedoyin (2021) examined the effects of energy use, economic policy uncertainty, and economic growth in China between 1970 and 2018. The results of the study show that energy use and economic growth have statistically significant long- and short-term positive effects on CO2 emissions. However, the authors concluded that economic policy uncertainty has a statistically insignificant effect on CO2 emissions due to corporate sustainability policies.

In the study by authors Anser, Apergis & Syed (2021), which examined 10 different countries with the most carbon emissions, the time interval between 1990and 2015 was determined by choosing the PMG-ARDL analysis method. The results of the econometric methods suggest that the EPU factor increases carbon emissions in the short and long term. In the short run, a 1% increase in EPU is associated with a 0.11% increase in carbon emissions, while the long run coefficient is 0.12%. In this context, the long and short term effects were found to level off. Similar to this study, Danish, Ulucak & Khan (2020) found that the impact of EPU on carbon emissions was positive.

In another study, the direction of causality between EPU and carbon emissions was investigated by authors Liu, Jiang & Zhou (2019) using both linear and non-linear Granger causality test and Brock, Dechert and Scheinkman (BDS) test. As a result of the Granger causality test applied linearly, no evidence of causality was found for the identified sectors. As a result of the analysis performed using the nonlinear version of the Granger causality test, no relationship was found. However, when looking at the results of the BDS -test, which is a non-linear method, a sectoral relationship between EPU and carbon emissions was found. Since no relationship was found using the Granger causality tests, a new parametric Granger causality test was applied. Examining the results obtained using the above econometric methods, it is found that EPU affects carbon emissions in general, except for partial causality changes for specific sectors.

In the study conducted by authors Chen, Shen & Wang (2021), 15 different countries were included in the sample group and the years 1997-2019 were set as the time interval. As a result of the analysis conducted for the set time interval with the selection of fixed and random effects as the econometric method, it was found that EPUs have a negative effect on carbon emissions.

3. Model, Dataset and Methodology:

3.1. Data set:

In the study, the effects of economic uncertainty on CO2 emissions in G7 countries are analyzed. In this context, the study covers the period 1997-2015, depending on the availability of data. Information on the data used in the study is given in Table 1.

Table 1. Variables and Their Descriptions

Variables	Defining Variables	Source From	Expected Sign
CO_2	Carbon Dioxide Emissions (Kiloton (kt))	World Bank	
EPU	Economic Policy Uncertainty Index	https://www.policyuncertainty.com	+(-)
Energy	Energy Consumption (Kg of oil per capita)	World Bank	+
GDP	Real GDP Per Capita (Constant 2010 US$))	World Bank -WDI	+
EPU*Energy	Interaction Term	Author(s)	+(-)

In the study, following Pirgaip & Dincergok (2020), Wang , Xiao & Lu(2020), Abbasi & Adedoyin (2021), the control variables of energy consumption, Real Gross Domestic Product per capita (GDP) were used in addition to economic policy uncertainty and CO2 emission variable which is the main research subject of the study (Table 1). Moreover, all variables in Table 1 were included in the analysis after their logarithmic transformation.

3.2. Methodology:

In the G7 economies, the impact of economic uncertainty on CO2 emissions has been analyzed using Parks-Kmenta Estimator. Parks-Kmenta Estimator provides effective estimates in the presence of at least one of the variables heteroskedasticity, autocorrelation and cross-sectional dependence. Parks (1967) developed an algorithm to predict a linear regression model in the case of correlation in addition to the existence of variance in the error terms of the model discussed. Kmenta (1986) pioneered the widespread use of this model by pointing out some of its existing shortcomings. The model developed by Parks-Kmenta makes it possible to obtain resistant standard errors without touching the parameter estimates. In this way, it allows to obtain effective and consistent results even in the presence of variance, autocorrelation and cross-sectional dependence in the model to be estimated. Only in such a case, the model to be estimated can have an appropriate regression structure. Accordingly, the model structure created by Parks-Kmenta,

$$y_{i,t} = \alpha_i + \sum_{k=2}^{k} \alpha k \; x_{kit} + u_{it} \quad (1)$$

The constant term and slope parameters given in Equation 1 are fixed for all units and require less restriction compared to least squares (LSS), and they are created with the help of the generalized least squares (GEKK) method. GEKK method obtains estimates with the assumption that the variance covariance matrix () for the error terms is known. However, since this matrix is not known in the estimations, the Flexible Generalized Least Squares method is preferred. When evaluated in this context, it is necessary to obtain consistent predictive values of the variance covariance matrix (Ω) in order to estimate the α coefficients in equation # 1 (Kmenta, 1986: 615).

On the other hand, in the Parks Kmenta estimator, in order to have an appropriate regression structure for the model, the N, which is expressed as the cross section dimension in the panel data; If the time dimension is smaller than T, it is possible for the model to have an appropriate regression structure. Because the Parks Kmenta estimator is not flexible if N> T. In other words, it is possible to reach more effective and consistent results with the help of its estimator in the case of T> N (Tatoğlu, 2013: 277). In this context, the Parks-Kmenta estimator was preferred in order to reach more accurate results since T> N is valid.

3.3. Empirical Findings:

In this part of the study, equation #2 is estimated and evidence on the impact of economic uncertainty on CO2 emissions in G-7 countries is included.

$$LOGCO2it = \alpha i + \beta 1\ EPUit + \beta 2\ ENERGYit + \beta 3 LOGGDPit + \beta 4\ EPU{*}ENERGYit\ \varepsilon it \quad (2)$$

Descriptive statistics of the variables in the study were obtained prior to the model estimation given in Equation 2, and these statistics are given in Table 2.

Table 2. Descriptive Statistics

Variables	**Mean**	**Std. Dev.**	**Min**	**Max**
CO2	1327827	1723985	303275.6	5789727
EPU	120.3573	51.00706	37.6	305.43
ENERGY	111.3694	42.27856	60.32299	236.1749
GDP	41457.45	4626.691	32489.21	52168.13

In order to determine the effects of economic uncertainty on CO2 emissions in the G-7 economies, it is first necessary to examine the cross-sectional dependence for the countries that make up the panel data. It also requires to examine whether there is a heteroskedasticity and autocorrelation problem in the panel data used. This is because panel data analysis assumes that the error term has constant variance as a function of units, no autocorrelation, and independence in the cross-section. Otherwise, the variance-covariance matrix cannot be the unit matrix. For this reason, it is only possible to obtain reliable results if the model is estimated with resistant estimators that take these problems into account and eliminate them. In this regard, a cross-sectional dependence test was first conducted. In the sample related to the panel data set in the study, T, which represents the number of observations over time, is greater than N, which represents the sum of cross-sections in the panel data. Therefore, the cross-sectional dependence test developed by Breusch and Pagan (1980) was preferred in the study LM. The corresponding results obtained from the cross-sectional dependence test are given in Table 3.

According to the test results given in Table 3, the H0 hypothesis which states that there is no cross-sectional dependence in the G-7 economies is rejected. Therefore, this result can be interpreted as cross-sectional dependence among the units that make up the panel. After the test of cross-sectional dependence, a modified Wald Test was conducted to determine whether the heteroskedasticity problem was observed, which can cause errors and discrepancies in the model estimation results. Then, the Wooldridge autocorrelation test was performed to determine the autocorrelation problem in the model, and the test results were expressed in Table 3.

Table 3. Test Results for Cross Section Dependence, Heteroskedasticity and Autocorrelation

Test	**Test Statistics**
Modified Wald Test	335.72 (0.00)
Wooldridge autocorrelation test	72.472 (0.00)
LM test	103.63 (0.00)

Note: () refers to the probability values of the Test Statistics.

As can be seen from the test results in Table 3, it can be said that there is both heteroskedasticity and autocorrelation problem in the model because the H0 hypothesis was rejected in both tests. In this context, when the test results obtained in this context is evaluated, the Parks-Kmenta estimator is an appropriate method to obtain more efficient and consistent results due to the presence of cross-sectional dependence, heteroskedasticity, autocorrelation and when T> N status is valid. Therefore, equation 2 was estimated by using the Parks-Kmenta -estimator and these results are reported in Table 4.

Table 4. Parks-Kmenta Model Estimation Results

Variables	Coefficients	
LOGEPU	-0.133 (-1.87)*	
LOGENERGY	0.762 (10.06)***	
LOGGDP	1.799 (20.33)***	
LOGEPU*LOGENERGY	0.296 (2.01)**	
C	-9.119 (-10.28)****	
Number of Observations: 133	Wald Statistics: 3766.73	Prob:0.00

Note: Values in parentheses are z statistics values. It also shows the significance levels of * 0.10, ** 0.05 and *** 0.01.

Economic policy uncertainty, which is the first variable treated according to the Parks-Kmenta estimation results given in Table 4, affects carbon dioxide emissions in a statistically significant and negative way. The results can be evaluated that the increase in economic policy uncertainty has a decreasing effect on carbon dioxide emissions. On the other hand, energy consumption and real GDP, among the variables discussed in the study, were found to have a significant effect on CO2 emissions. As the results show, energy consumption and real GDP increase the growth of CO2 emissions in G-7 countries by 0.762% and 1.799% respectively. The last variable discussed in the study is the interaction variable which indicates the extent to which economic policy uncertainty and energy consumption together affect CO2 emissions. According to Azman-Sain (2010), the fact of statistically significant variable means that the marginal effect of the variable under study on the dependent variable depends on the level of the other variable. In this context, the result regarding the interaction coefficient also shows that economic policy uncertainty and the level of energy consumption positively affect the growth of CO2 emissions.

4. Conclusion:

In today's world, environmental problems, which have increased rapidly in recent years, have become one of the leading problems in developing and emerging countries. Climate change, which is one of the most important of these problems, has led to political and policy uncertainties, as well as concerns about its potential to affect the economic performance of countries. As is well known, the increase in CO2 emissions leads to global warming in the background of the climate change problem. In other words, the increase in CO2 emissions is the driving force of the problem of global warming and climate change. Therefore, it is important to take necessary policy measures by analyzing the factors that cause increase in CO2 emissions.

This study attempts to examine the impact of economic policy uncertainty on CO2 emissions in G-7 countries. This was attempted to determine by using the panel data set which contains the data between 1997-2015 and the Parks-Kmenta Estimator. According to the results of the study, it was found that economic policy uncertainty, whose effect on CO2 emission was examined, has a statistically significant negative effect on CO2 emission. This result can be evaluated as; economic policy uncertainty reduces the level of CO2 emissions. In other words, an increase in economic policy uncertainty in the G-7 countries leads to a decrease in the consumption of energy and environmentally harmful products. This decrease in consumption leads to a decrease in CO2 emissions. This effect can be interpreted as the consumption effect of economic policy uncertainties, as found by Wang and Lu (2020). On the other hand, the effect of the increase in energy consumption, one of the variables used as a control variable in the study, on CO2 emissions is statistically significant and positive. This result can be interpreted that an increase in energy consumption, i.e., higher energy consumption, leads to higher CO2 emissions. In other words, this result shows that the increase in fossil fuel consumption has caused this increase. Similar to energy consumption, the increase in real GDP has a statistically significant and positive effect on CO2 emissions. This empirical result confirms that there is a relationship between economic growth and CO2 emissions. Therefore, it can be evaluated as the growth of non-renewable energy sources, together with the income increases observed in the G-7 economies, increases CO2 emissions.

In light of the findings of this study, the rapid increase in energy consumption by G-7 economies and the increase in CO2 emissions by policy makers highlights the need to promote the use of more environmentally friendly energy resources. This should include a structural shift towards environmentally friendly production, especially in manufacturing processes. It is therefore of great importance to prevent the increase in CO2 emissions through fiscal or similar measures, in particular by increasing incentives for investment from fossil fuels to clean energy. If this happens, it will be possible to reduce CO2 emissions. Another finding of the study is that economic policy uncertainty about the consumption effect provides important implications for CO2 emissions and hence global warming. Evaluating in this context, the results of the study should provide guidance to policy makers and researchers. This study and future studies will enable countries to make more effective decisions in designing their economic policies by analyzing the impact of EPU factor on carbon emission for different sample groups.

References

1. Abbasi, K. R., & Adedoyin, F. F. (2021). Do energy use and economic policy uncertainty affect CO2 emissions in China? Empirical evidence from the dynamic ARDL simulation approach. Environmental Science and Pollution Research, 28(18), 23323-23335.
2. Abel, A. B. (1983). Optimal investment under uncertainty. The American Economic Review, 73(1), 228-233.
3. Adams, S., Adedoyin, F., Olaniran, E., & Bekun, F. V. (2020). Energy consumption, economic policy uncertainty and carbon emissions; causality evidence from resource rich economies. Economic Analysis and Policy, 68, 179-190.

4. Al-Thaqeb, S. A., & Algharabali, B. G. (2019). Economic policy uncertainty: A literature review. The Journal of Economic Asymmetries, 20, e00133.
5. Anser, M. K., Apergis, N., & Syed, Q. R. (2021). Impact of economic policy uncertainty on CO 2 emissions: evidence from top ten carbon emitter countries. Environmental Science and Pollution Research, 1-10.
6. Antonakakis, N., Chatziantoniou, I., & Filis, G. (2014). Dynamic spillovers of oil price shocks and economic policy uncertainty. Energy Economics, 44, 433-447.
7. Azman-Saini, W. N. W., Baharumshah, A. Z., ve Law, S. H. (2010). Foreign direct investment, economic freedom and economic growth: International evidence. Economic Modelling, 27(5), 1079-1089.
8. Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. The quarterly journal of economics, 131(4), 1593-1636.
9. Breusch, T. S ve Pagan, A. R. (1980), The Lagrange Multiplier Test and its applications to model specification tests in econometrics", Review of Economic Studies, 47, 239-53.
10. Chen, Y., Shen, X., & Wang, L. (2021). The heterogeneity research of the impact of epu on environmental pollution: Empirical evidence based on 15 countries. Sustainability, 13(8), 4166.
11. Gozgor, G., & Ongan, S. (2017). Economic policy uncertainty and tourism demand: empirical evidence from the USA. International Journal of Tourism Research, 19(1), 99-106.
12. Jiang, Y., Zhou, Z., & Liu, C. (2019). Does economic policy uncertainty matter for carbon emission? Evidence from US sector level data. Environmental Science and Pollution Research, 26(24), 24380-24394.
13. Kmenta, J. (1986). Elements of Econometrics, New York: The MacMillan Company
14. Krol, R. (2014). Economic policy uncertainty and exchange rate volatility. International Finance, 17(2), 241-256.
15. Liu, L., & Zhang, T. (2015). Economic policy uncertainty and stock market volatility. Finance Research Letters, 15, 99-105.
16. Novy, D., & Taylor, A. M. (2020). Trade and uncertainty. Review of Economics and Statistics, 102(4), 749-765.
17. Parks, R. (1967), Efficient Estimation of a System of Regression Equations When Disturbances Are Both Serially and Contemporaneously Correlated, Journal of the American Statistical Association, 62: 500–509.
18. Pirgaip, B., & Dinçergök, B. (2020). Economic policy uncertainty, energy consumption and carbon emissions in G7 countries: evidence from a panel Granger causality analysis. Environmental Science and Pollution Research, 27, 30050-30066.
19. Tatoğlu, F. Yerdelen (2013). Panel Veri Ekonometrisi (2. Baskı). İstanbul: Beta Yayınevi.
20. Ulucak, R., & Khan, S. U. D. (2020). Relationship between energy intensity and CO2 emissions: Does economic policy matter?. Sustainable Development, 28(5), 1457-1464.
21. Wang, Q., Xiao, K., & Lu, Z. (2020). Does Economic Policy Uncertainty Affect CO2 Emissions? Empirical Evidence from the United States. Sustainability, 12(21), 9108.