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The Effect of External Debt on Emissions from Coal Consumption: Evidence from Turkey

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ABSTRACT

This paper analyzes the effect of external debt on emissions from coal consumption per capita for Turkey for the period from 1970 to 2020 through gross domestic per capita and square of gross domestic per capita. Results confirm that coal Kuznets curve for Turkey but the effect of external debt on emissions from coal consumption per capita is insignificant and negative. Further causality is not analyzed since the main of the study is to analyze the effect of external debt on emissions from coal consumption. Although the effect of external debt on emissions is insignificant and negative, Turkey's investments for clean energy sources to diversify its energy resources should be continued.

Keywords: External Debt, Environmental Kuznets Curve, Economic Growth, Coal, Developing Countries
JEL Classifications: Q4, Q5, O5

1. INTRODUCTION

Turkey had an ongoing economic growth following to the opening to the international markets after 1980. Turkey's economy had continued growth alongside its external debt grew. Turkey's energy consumption also increased alongside its economic growth. Economic growth of Turkey required increasing levels of energy from fossil fuel resources. Turkey's economic growth also required financial resources from external debt resources Turkey provided its needs. Following 1990s, Turkey started big investments for its infrastructure including construction of new houses for its citizens. The aim of this study is to analyze the use of external debt on Turkey's emissions from coal consumption. Coal is still among Turkey's main energy resources. Annual carbon emissions from coal consumption and GDP per capita levels are on increase following 1980s till today (Figures 1 and 2). Although external debt levels fluctuate, the general tendency is on the increase (Figure 3). Analysis of external debt levels and environmental degradation relationship is limited in the literature and this study aims to contribute to this area by analyzing the effect of external debt on emissions from coal consumption for a developing country which is Turkey.

Turkey is a country which is found in 1923. It owned a significant debt from Ottoman Empire which Turkey finished paying during 1950s. By 1980, Turkey started to open to international markets. By 1990, Turkey started big investments projects for its infrastructure. Since economic model turned from agriculture to industry, people moved from villages to cities. Overall development increased the energy needs of Turkey. One of the main resources Turkey used to meet this need is coal consumption.

Use of external debt is limited in the literature. For related studies in the literature, Katircioglu and Celebi (2018) confirmed that external debt levels had no significant effect on carbon dioxide emissions for Turkey in the long run. A similar study carried out by Beşe et al. (2021) confirmed that external debt had a significant effect on carbon dioxide emissions for China. Bese et al. (2021) confirmed that external debt did not have a significant effect on emissions for Brazil and Turkey. Akam et al. (2021) confirmed

Figure 1: Annual CO_2 emissions per capita from coal

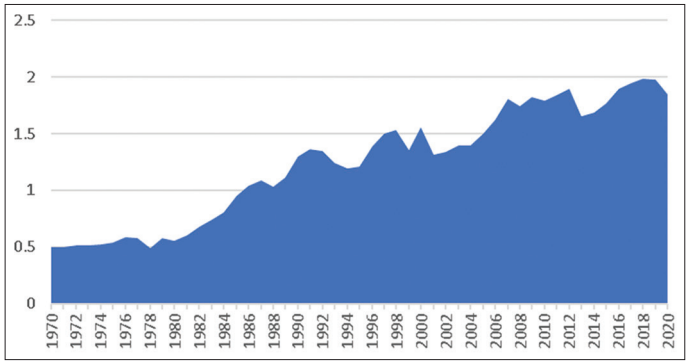


Figure 2: GDP per capita

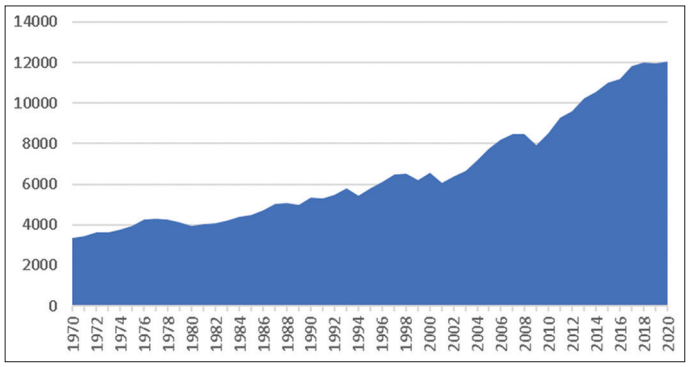
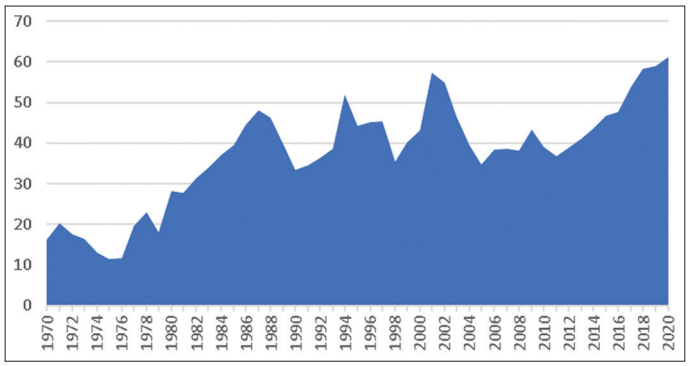


Figure 3: External debt as percentage of gross national income



that external debt had a significant effect on emissions for a panel of thirty-three heavily poor indebted countries. They also confirmed bidirectional causality between external debt and CO_2 emissions, and economic growth and external debt. They suggested consumption of clean energy sources and strong institutional quality to limit the negative effects of external debt on the environment. For policy suggestions, they suggested that energy efficiency and environmentally friendly technologies should be increased, more percentage of external debt to be used for renewable energy creation, investment in low carbon technologies should be increased, and sustainable energy and energy efficiency should be increased by investing in renewable energy structure.

Akam et al. (2022) studied the effect of external debt on ecological footprint for the period 1970-2018. They examined the effect of external debt through energy, environment and growth nexus for SANE countries which are South Africa, Algeria, Nigeria, and Egypt. They examined the effect of external debt on ecological footprint under the EKC hypothesis. For panel country results, economic growth and energy use negatively affect the environment. For single country results, the EKC hypothesis is confirmed for South Africa. The use of external debt increases the ecological footprint in Algeria and South Africa, but it does not increase the ecological footprint in Egypt and Nigeria. The use of external debt to satisfy the growing population energy needs in SANE countries negatively affect the environment since investment in renewable energy is not enough. Another result of the study is that external debt causes ecological footprint in Nigeria. They recommended policy suggestions such as reducing the dependence on fossil fuel energy, investing in clean and modern technologies, investing in efficient production and environment sustainability, providing tax incentives for clean industries, and imposing tax charge for the dirty industries. Sadiq et al. (2022) examined the effect of external debt on HDI (Human Development Index) and CO_2 emissions for Brazil, Russia, India, China and South Africa. They analyzed the effect of external debt on the environment via energy use and economic growth. They confirmed the negative effect of external debt on HDI and CO_2 emissions. They suggested that government should increase spending for green energy and clean production, and to increase research and development to achieve the desired environmental targets. They also suggested that government should invest in low carbon technologies, alternative energy technologies, and government should support new projects to encourage firms to get rid of obsolete technologies and to facilitate sustainable production via environmental awareness industry wide. The results for the relationship between external debt and emissions are different for studies and further contribution needed for the literature.

2. METHODOLOGY, DATA AND RESULTS

The variables analyzed in this study are annual carbon emissions from coal consumption per capita (CC), external debt stocks as percent of gross national income (EXD), gross domestic per capita as constant 2015 US$ (GDP), and square of gross domestic per capita as constant 2015 US$ (GDP2). World Bank website is used to retrieve the data.

Autoregressive distributed lag model (ARDL) by Pesaran et al. (2001) is used to analyze the cointegration between the variables. A structural break is also added to the model. The stationary levels of the variables are examined by Zivot and Andrews (1992) structural break unit root test. Akaike information criteria is used in this model for the lag selection. First stationary levels of the variables are determined with a structural break. Determined structural breaks are 1981 for coal consumption, 1989 for external debt, 2002 for GDP and GDP2 (Table 1). 1981 is used since it is the only structural break that satisfied stability requirements.

Second, ARDL model is run. Lag lengths are chosen according to Akaike Information Criteria (Figure 4). Before bounds test is run, stability tests for ARDL model are run. Stability tests which are Ramsey Reset, Breusch-Pagan-Godfrey, Arch, White, Breusch-

Godfrey Serial Correlation LM and Normality tests show that ARDL model satisfy the stability requirements (Table 2). Cusum and Cusum of Squares test results show that ARDL model satisfy the stability requirements (Figures 5 and 6).

Figure 4: Akaike information criteria

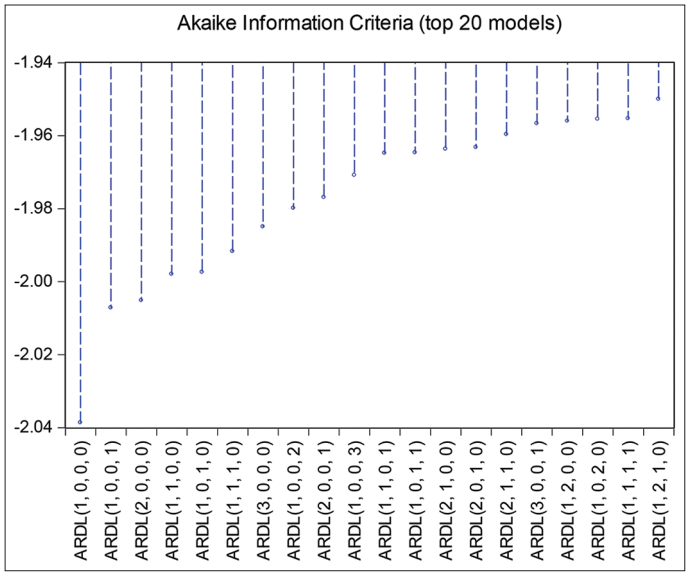


Figure 5: CUSUM test results

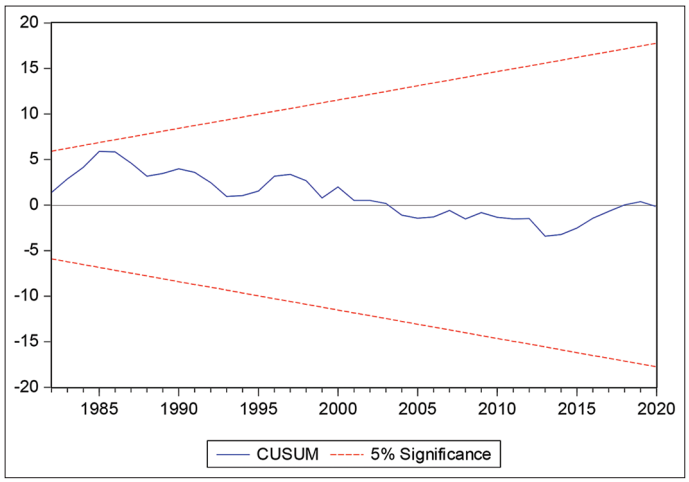
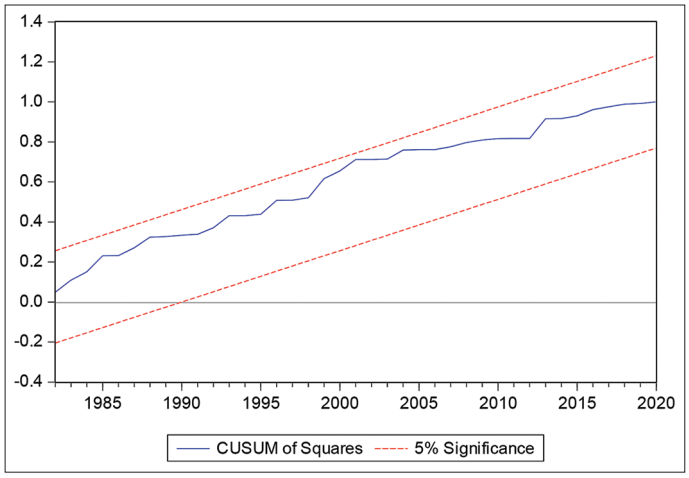


Figure 6: CUSUM of squares test results



Bounds test results show that F-statistic is significant at 10% level with a value of 3.97 (Table 3). Since bounds test results are significant, ARDL model is run for short run and long run coefficients (Table 4). In the short run, the effects of GDP, GDP and EXD on emissions are insignificant. The structural break 1981 has significant effect on emissions both in the long run and short run. This result is compatible with the reality happened after 1980.

Table 1: Zivot-Andrew structural break test results

Level			
Variable	**Break**	**t-stat**	**Result**
CC	1985	–4.11	Unit Root
GDP	2010	–0.3.43	Unit Root
GDP2	2010	–3.48	Unit Root
EXD	2003	–3.85	Unit Root
First difference			
Variable	**Break**	**t-stat**	**Result**
CC	1981	–7.51*	Stationary
GDP	2002	–6.83*	Stationary
GDP2	2002	–6.97	Stationary
EXD	1989	–6.19	Stationary

Table 2: Stability tests for ARDL model

Test	F-Statistic	Probability	Jarque-Bera
Ramsey Reset	0.196444	0.6598	-
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.575606	0.7183	-
Heteroskedasticity Test: ARCH	0.233892	0.6309	-
Heteroskedasticity Test: White	0.415566	0.8354	-
Breusch-Godfrey Serial Correlation LM Test	0.170326	0.6819	-
Normality Test	-	0.086474	4.895812

Table 3: Bounds test results

Test statistic	Value	K
F-statistic	3.970785	3
Critical value bounds		
Significance (%)	**I0 Bound**	**I1 Bound**
10	2.72	3.77
5	3.23	4.35
2.5	3.69	4.89
1	4.29	5.61

Table 4: ARDL model results

Short-run coefficients				
Variable	**Coefficient**	**SE**	**t-statistic**	**Prob.**
D (LGDP)	4.336269	2.4620	1.761231	0.08
D (LGDP2)	–0.228353	0.1356	–1.683688	0.09
D (EXD)	–0.002005	0.0015	–1.300101	0.20
D (D1981)	0.199489	0.0483	4.125270	0.001
CointEq (–1)	–0.377428	0.0999	–3.777756	0.001
Long-run coefficients				
Variable	**Coefficient**	**SE**	**t-statistic**	**Prob.**
LGDP	11.489001	4.7756	2.405743	0.02
LGDP2	–0.605024	0.2693	–2.246556	0.02
EXD	–0.005311	0.0047	–1.113233	0.27
D1981	0.528548	0.1720	3.071481	0.004
C	–54.146943	21.1093	–2.565066	0.014

The coefficients of GDP and GDP2 show that there is inverted-U relationship between economic growth and emissions from coal consumption. The coefficient of external debt is negative and insignificant in the long run.

3. DISCUSSION AND CONCLUSIONS

Results of this study show that Turkey's opening to international markets after 1980 has a significant effect on emissions both in the short and long run. Economic growth has insignificant effect in the short run, but the effect of economic growth becomes significant in the long run. The relationship between economic growth and emissions from coal consumption is inverted U shaped which means first emissions increase as economic growth increases but after a certain point, emissions start to decrease.

The effect of external debt on coal consumption is not examined in the literature before. It carries importance since coal is still one of the most used fossil fuels in the world. For Turkey case, Turkey aims to modernize its infrastructure and diversify its energy supply through foreign debt. The general analysis in this study shows that the efforts to reduce coal consumption through investments in energy sector by foreign debt is not enough. Turkey should increase its efforts to reduce coal consumption for the future.

The results are general and more detailed analysis may be carried out in the future studies to examine the details for the relationship between emissions from coal consumption and external debt levels. Also, this study takes into consideration a developing country which is Turkey. Different single country analysis can be carried out and panel data studies can be established as well. The effect of external debt on emissions is insignificant in the long run which means Turkey's external debt spending did not increase the emissions from coal consumption in the long run.

For policy recommendations, Turkey should increase consumption of clean energy sources and invest in low carbon technologies. Turkey should invest more in renewable energy structure to increase energy efficiency and environmental awareness. Funding for research and development should be increased to improve environmental programs. Turkish government should support industries to improve their technologies from obsolete and dirty ones to clean and environmentally friendly technologies. Strong incentives should be provided for industries to start up renewable energy investments. Current investments still include energy production from coal resources. Tax should be imposed for dirty technologies to further encourage firms to invest in clean and environmentally friendly technologies.

REFERENCES

Akam, D., Nathaniel, S.P., Muili, H.A., Eze, S.N. (2022), The relationship between external debt and ecological footprint in SANE countries: Insights from Kónya panel causality approach. Environmental Science and Pollution Research, 29(13), 19496-19507.

Akam, D., Owolabi, O., Nathaniel, S.P. (2021), Linking external debt and renewable energy to environmental sustainability in heavily indebted poor countries : New insights from advanced panel estimators. Environmental Science and Pollution Research, 28, 65300-65312.

Beşe, E., Friday, H.S., Ozden, C. (2021), The effect of external debt on emissions : Evidence from China. International Journal of Energy Economics and Policy, 11(1), 440-447.

Bese, E., Friday, H.S., Spencer, M. (2021), Analysis of the relationship between income growth and, coal consumption and emissions from nonlinear perspective. Journal of Academy of Business and Economics, 21(1), 55-77.

Katircioglu, S., Celebi, A. (2018), Testing the role of external debt in environmental degradation : Empirical evidence from Turkey. Environmental Science and Pollution Research, 25, 8843-8852.

Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.

Sadiq, M., Shinwari, R., Usman, M., Ozturk, I., Maghyereh, A.I. (2022), Linking nuclear energy, human development and carbon emission in BRICS region: Do external debt and financial globalization protect the environment? Nuclear Engineering and Technology, 54(9), 3299-3309.

Zivot, E., Andrews, D.W.K. (1992), Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. Journal of Business and Economic Statistics, 10(3), 25-44.