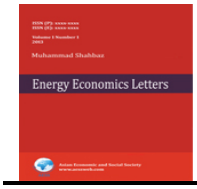

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THE ENVIRONMENTAL KUZNETS CURVE AND GLOBALIZATION: THE EMPIRICAL EVIDENCE FOR PORTUGAL, SPAIN, GREECE AND IRELAND

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ABSTRACT

The main objective of this manuscript is to investagte the relationship between environmental Kuznets curve (ECK) in the presence of globalization for Portugal, Spain, Greece and Ireland for the period of 1980-2010. Using a panel data, the results show that linear and non-linear real income per capita (GDP_t and GDP_t^2) are according to the perspectives of inverted-U shaped between economic growth and CO_2 emissions. The findings support the theory that in general, there is a positive correlation between of energy consumption with CO_2 emissions.

Keywords: Carbon dioxide (CO2), environmental Kuznets curve (EKC), energy consumption, and globalization.
JEL classification: C32, F18, Q56.

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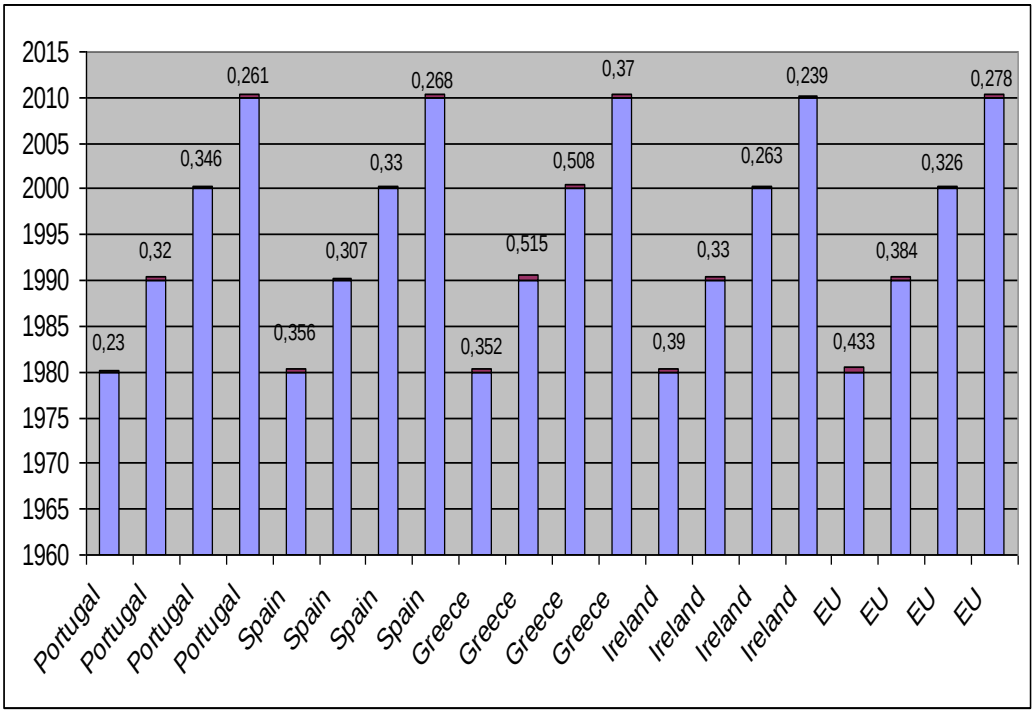
1. INTRODUCTION

In recent years, the environmental Kuznets curve has become an important issue in the economics literature. This paper tests the link between environmental Kuznets curve and globalization. We examine this link for Portugal, Spain, Greece and Ireland. The period 1980-2010 was chosen on the basis of its providing a sufficient number of observations. The methodology uses a panel data approach. The panel is unbalanced due to the lack of information on some countries in all of the years analyzed. The motivation of this article reports on analyzing the relationship between ECK hypothesis and globalization. Leitão, (2012) demonstrates that current economic and financial crisis in the European Union shows regional disparities are evident in the euro zone, particularly in Portugal, Spain Greece, and Ireland. The current crisis questioned the principles of economic convergence.

This paper contributes in existing literature by investigating the EKC hypothesis. Our contribution presents two ways. First, we present a review of recent literature. Empirically, we conduct a panel unit root test ADF Fisher Chi-square, and the Fixed effects estimator to assess the EKC hypothesis. The manuscript also examines the relationship among CO_2 emissions, GDP, quadratic GDP, and energy consumption for these countries.

Figure-1. Carbon Intensity using Purchasing Power Parities in percentage



Source: U.S. Energy Information Administration dataset

According to U.S Energy Information Administration, in 2010, 27.8% of carbon emissions was emitted by European Union countries. In 2010, Portugal uses 26.1% in carbon intensity, i.e. the amount of carbon dioxide emitted for each unit of GDP. Ireland has less value in terms of carbon intensity (23.9%). Indeed Greece is the most pollutant (37%). The distribution of carbon intensity is reported in Figure 1.

2. LITERATURE REVIEW

In this section we present a survey of the environmental Kuznets curve literature (EKC) and CO_2 emissions. A meta-analysis on the link between CO_2 emissions and ECK demonstrates that there is a large number of empirical studies. Grossman and Krueger, (1995) was one of the first empirical studies to consider the realtionship between environmental quality and economic growth. They showed a negative association between emissions of carbon dioxide and per capita income. Moomaw and Unruh, (1997) considered the relationship between CO_2 and per capita income developed countries (OECD countries). They found an inverted U-shaped for the period 1970 and 1980.

Latter on, for variable GDP (squared) per capita, the literature (Halicioglu, 2009 and Jalil and Mahmud, 2009) considers that this proxy has a negative impact on economic growth. Kraft and Kraft (1978), Yoo and Kwak (2010), and Reynolds and Kolodzieji, (2008) considered that energy promotes economic growth. However, Yuan et al. (2007), Odhiambo (2009), and Halicioglu (2009) found a different relationship i.e. a negative association. Sharma, (2011) examines the determinants of carbon dioxide emissions with panel data. The author consider a sample with 69 countries cover the period 1985-2005. This research shows that there is a negative correlation between urbanization and CO_2 emissions. The study of Sharma, (2010) also concluded that trade, and energy have a negative effects on the CO_2 emissions.

Ozturk and Acaravci, (2011) analyses the CO_2 emissions, energy consumption, and economic growth in Turkey for the period 1968-2005. The empirical results of this study shows that EKC hypothesis at causal framework by using a linear logarithmic model is not valid in Turkish case. Shahbaz et al. (2011) examine the cointegration between electric consumption, economic growth, and employment in Portugal. The study of Shahbaz et al. (2011) cover the period 1971 to 2009. This emprical work shows that electricity consumption, economic growth, and employment in Portugal are cointegrated and there is bi-directional Granger causality between the three variables in the long-run.

Tiwari, (2011) shows a dynamic correlation between coal consumption, economic growth, trade and CO_2 emissions. This study concluded that in India there is environmental Kuznets curve (EKC) in long run as well as in short run. Altunbas

and Kapusuzoglu, (2001) examine the causality between energy consumption and economic growth in United Kingdom cover the period 1987 and 2007. This study indicated no cointegration relationship between the variables of energy consumption and GDP, i.e. there is no long-term relationship between the variables. Leitão, (2011) analyses the United States environmental impacts on agriculture intra-industry trade (IIT), using a panel data. The research indicates that that there is a negative correlation between carbon dioxide emissions and intra- industry trade.

3. ECONOMETRIC MODEL

This study uses a panel data. In the static panel, we estimated by means of pooled OLS, fixed effects (FE) and random effects (RE). The F statistics test the null hypothesis of the same specific effects for all individuals. If we accept the null hypothesis, we can use the OLS estimator. The Hausman test can decide which model is better: random effects (RE) or fixed effects (FE).

3.1. Explanatory Variables

According to the literature (Grossman and Krueger 1995 and Halicioglu 2009, Martínez-Zarzoso and Maruotti 2011, and Shahbaz et al. 2013), we test the following hypotheses:

Hypothesis 1: The linear real income per capita is positively correlated with CO_2 emissions.

Hypothesis 1a: The non- linear real income per capita is negatively correlated with CO_2 emissions.

Hypothesis 2: There is a positive correlation between of energy consumption with CO_2 emissions.

The studies of Martínez-Zarzoso and Maruotti (2011), Wihardi (2010) show that energy consumption is positively correlated with CO2 emissions.

Hypothesis 3: Globalization is a main engine that provides a way to enhance production intensively by utilizing abundant domestic resources efficiently.

Agenor (2003), Dreher, 2006; Dreher, Gaston (2008) show globalization leads to greater integration of economies and Societies.

3.2. Model Specification

The standard equation of EKC can be written as:

$$CO_{2t} = \beta_0 + \beta_1 GDP_t + \beta_2 GDP_t^2 + \beta_3 KOF_t + \beta_4 Energy_t + \delta t + \eta_i + \varepsilon_{it} \quad (1)$$

The dependent variable is the carbon dioxid emissions of four countries: Portugal, Spain, Greece and Ireland for the period of 1980-2010. The data is obtained from world development indicators (CD-ROM, 2012). All the variables are in the logarithm form; ηi is the unobserved time-invariant specific effects; δt captures a common deterministic trend; ε_{it} is a random disturbance assumed to be normal, and identical distributed (IID) with E (ε_{it})=0; Var (ε_{it}) $= \sigma^2 \succ 0$.

where CO_{2t} is carbon dioxide emission metric tons per capita. The data includes carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring; $Energy_t$ is energy consumption per capita; GDP_t (GDP_t^2) is real GDP (squared) per capita; the index of globalization (KOF_t) proposed by Dreher (2006) represents three dimension of globalization: economic; social and political (see Dreher, 2006; Dreher, Gaston (2008).

4. EMPIRICAL RESULTS

In the following tables, we present the results of panel unit root test ADF-Fischer Chi square in Table-1.

Table-1. Panel unit root test results: ($LnCO_2$) ADF-Fischer Chi square regression

ADF-Fischer Chi square	Intercept and trend Statistic	Probability
Inverse chi-squared	19.68	0.00
Inverse normal	-2.69	0.00
Inverse logit	-2.66	0.00
Modified inv. Chi-squared	2.91	0.00

Fixed effects estimates are reported in Table-2. The general performance of our model is satisfactory. Our analysis pretends to evaluate the signs of the coefficients and their significance. All explanatory variables are statistically significant at 1% ($LnGDP_t$, and $LnGDP_t^2$), and 5% level ($LnKOF$, and $LnEnergy$). Linear and non-linear real income per capita (GDP_t and GDP_t^2) are according to the perspectives of inverted-U shaped between economic growth and CO_2 emissions. These results are according to previous studies (Song et al. 2008; Halicioglu 2009; Fodha and Zaghdoud 2010; Lean and Smyth 2010; Shahbaz et al. 2012, Tiwari et al. 2013).

Table-1a. Panel unit root test results :($LnKOF_t$) ADF-Fischer Chi square Regression

ADF-Fischer Chi square	Intercept and trend Statistic	Probability
Inverse chi-squared	23.76	0.00
Inverse normal	-2.33	0.00
Inverse logit	-2.81	0.00
Modified inv. chi-squared	3.93	0.00

Table-1b. Panel unit root test results: ($LnEnergy_t$) ADF-Fischer Chi square Regression

ADF-Fischer Chi square	Intercept and trend Statistic	Probability
Inverse chi-squared	38.72	0.00
Inverse normal	-4.19	0.00
Inverse logit	-5.29	0.00
Modified inv. Chi-squared	7.68	0.00

Table-2. Fixed Effects

Dependent variable : $LnCO_2$

Independent Variables	Coefficient	Expect Signs
$LnGDP_t$	0.02 (12.50)***	(+)
$LnGDP_t^2$	-0.27 (-9.46)***	(-)
$LnKOF_t$	0.01 (2.01)**	(+)
$LnEnergy_t$	0.14 (19.6)**	(+)
Constant	4.05 (15.42)***	
Adj. R^2	0.79	
N	113	

T-statistics (heteroskedasticity corrected) are in round brackets.
Note: ***/** – statistically significant, respectively at the 1%, 5%,levels.

The coefficient of globalization ($LnKOF_t$) is consistent with theoretical predictions, i.e a positive impact on carbon dioxide emissions. Following the studies of Ang (2008), Halicioglu (2009), Jalil and Mahmud (2009), the study also includes the variable energy consumption ($LnEnergy_t$). Our results are in the line the empirical studies.

5. CONCLUSIONS

The present study has important policy implications for Portugal, Spain, Greece and Ireland. The objective of this study was to analyze the link between carbon

emissions, economic growth, energy consumption, and globalization. Econometrics estimations support the hypothesis formulated. Our results are robust with the theoretical models. The variables (LnGDP) and squared GDP per capita ($LnGDP^2$) used to evaluate ECK hypothesis are according to the perspectives of inverted-U shaped between economic growth and CO_2 emissions. These results are in line with previous studies (Shahbaz et al. 2013; Shahbaz et al. 2012, and Tiwari et al. 2013). Martínez-Zarzoso and Maruotti (2011), Wihardi (2010) also show that energy consumption is positively correlated with CO2 emissions.

According to the literature we expected a positive sign to globalization. It is usual that the literature attributes a positive sign to globalization; i.e globalization is a main engine that provides a way to enhance production intensively by utilizing abundant domestic resources efficiently.

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Appendix

Table-3. Correlations between variables

Variables	$LnCO_2$	$LnGDP_t$	$LnGDP_t^2$	$LnKOF_t$	$LnEnergy_t$
$LnCO_2$	1.00				
$LnGDP_t$	0.66	1.00			
$LnGDP_t^2$	0.55	0.95	1.00		
$LnKOF_t$	0.39	0.03	0.07	1.00	
$LnEnergy_t$	0.14	0.36	0.40	0.18	1.00

Figure-2. Panel data line plot: Co2 emissions