Environmental Impact of Economic Variables:

Carbon Emission Case Study

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Abstract: *This paper investigates environmental impact of economic variables. The paper also examines the relationship between CO_2 emissions and economic growth GDP, employment, urbanization, energy use, manufacturing value added, fossil fuel energy consumption, trade openness. The data were taken from the World Development Indicators (World Bank) for 25 countries during the period from 2004 to 2014.* We find that the measure of GDP, employment, energy use, manufacturing value added, fossil fuel energy consumption, trade openness matters.

Keywords: *Carbon dioxide emissions, GDP, urbanization, KEC, trade openness.*

I. Introduction

In the recent years many studies highlighted the importance and possible threat of anthropogenic climate change by rising levels of carbon dioxide (CO_2) in the atmosphere. CO_2 is considered to be the main contributor to global warming. CO_2emissions have grown radically in the past century because of human activities. So there is a systematic relationship between economic growth and environmental quality, the relationship known as the Environmental Kuznets Curve (EKC). Economic activity promotes wealth creation but has negative effects on the environment. In the next paragraphs we will review some of previous studies related to the effect of CO_2 emissions and economic growth GDP, population, urbanization, energy use, trade openness.

Soytas et al.(2007) study the long run Granger causality between carbon emissions, energy use, and income in the US, also accounting for labor and investment in capital. They find no evidence of a causal link between income and carbon emissions, and income and energy consumption, but confirm that energy use is the main source of emissions. Akbostanci et al. (2006) apply both time series and panel data techniques to test for EKC hypothesis for carbon emissions in Turkey. Their results do not confirm EKC, but imply an N-shaped link between income and emissions. Using energy consumption as an indicator of environmental degradation and employing simple OLS in levels. Cole and Neumayer (2004) considered 86 countries during the period 1975-1998 and they found a positive link between CO_2 emissions and a set of explanatory variables including population, urbanization rate, energy intensity and smaller household sizes. Pao and Tsai (2010) finds a cointegration relationship between CO_2 emissions, real income and energy consumption for Brazil, Russia, India, China and South Africa (BRICS) countries by using panel cointegration and Granger causality tests. Long run estimation results show that there is a positive link between energy consumption and carbon emissions. The empirical results also show that the EKC hypothesis is valid, and unidirectional causality runs from economic growth and carbon emissions to energy consumption for BRICS countries. Shahbaz et al.(2014) finds a long run relationship between CO_2 emissions, real income, energy consumption and trade openness by applying the ARDL approach. The empirical results indicate the existence of the EKC hypothesis in Tunisia, and energy consumption and trade openness positively affect carbon emissions in the long run, and there is long run bidirectional causality between energy consumption and carbon emissions, and between trade openness and carbon emissions. Kais Saidi and Sami Hammami (2015) investigate the impact of economic growth and CO_2 emissions on energy consumption for a global

panel of 58 countries. They used dynamic panel data model estimated by means of the Generalized Method of Moments (GMM) for the period 1990–2012. Thy found that the empirical evidence indicates significant positive impact of CO_2 emissions on energy consumption for four global panels. Economic growth has a positive impact on energy consumption and statistically significant only for the four panel. Ang (2008) one of the earlier works in this category, analyzes the dynamics of CO_2 emissions, energy consumption and real income for Malaysia over the period 1971–1999 by using the multivariate VECM. The empirical results show that there is long run bidirectional causality between economic growth and energy consumption, and unidirectional causality running from pollution to economic growth in the long run. Shyamal and Rabindra (2004) using a decomposition method, examined the factors that influenced the changes in the level of energy-related CO_2 emissions. They found that emissions of CO_2 in the industrial sector showed a decreasing trend due to improved energy efficiency and fuel switching. However, the effect of the pollution coefficient and energy intensity on CO_2 emissions in the agricultural sector was almost negligible. Maddison and Rehdanz (2008) find strong evidence for bidirectional causal relationship between per capita GDP and per capita CO_2 emissions except for Asia. In case of Asia, there is no evidence of CO_2 per capita caused by GDP per capita. As most of the paper found relationships between CO_2 emissions and some explanatory variables such as, per capita GDP, unemployment, population, energy consumption. In this paper, we investigates the relationships between CO_2 and economic growth real GDP, employment, urbanization, energy use, manufacturing value added, fossil fuel energy consumption, trade openness. We finds that the measure of real GDP, employment, energy use, manufacturing value added, fossil fuel energy consumption, trade openness matters and economically significant. The rest of the paper is organized as follow. Section 2 presents the theoretical framework and specifies the model. Section

3 describes the empirical analysis. Section 4 discusses the main results and Section 5 concludes.

II. Methodology

In order to investigate the relationship between CO_2 emissions and economic growth real GDP, employment, urbanization, energy use, manufacturing value added, fossil fuel energy consumption, trade openness. We use World Development Indicators (World Bank) to estimated a model for a sample of 25 countries during the period from 2004 to 2014. The countries under analysis are Australia, Brazil, Canada, Costa Rica, Egypt, Germany, Iran, Ireland, Italy, Japan, Mexico, Norway, Poland, Portugal, Russia, Saudi Arabia, Singapore, South Africa, Spain, Sweden, Switzerland, United Kingdom and United States. We take into account dynamic effects, the panel properties of the data We have derived the empirical model by taking logarithms of :

$$\ln C_{it} = \alpha + \beta_1 \ln Y_{it} + \beta_2 \ln E_{it} + \beta_3 \ln U_{it} + \beta_4 \ln En_{it} + \beta_5 \ln M_{it} + \beta_6 \ln F_{it} + \beta_7 \ln T_{it} + \varepsilon \qquad (1)$$

where, i refers to countries and t refers to the different years. C_{it} is the amount of CO_2 emissions (kt), Y_{it} is the real gross domestic product (GDP) (US$), E_{it} is the employment to population ratio, U_{it} is the urban population (% of total), En_{it} is the energy use (kg of oil equivalent per capita), M_{it} is the manufacturing, value added (annual % growth), F_{it} is the fossil fuel energy consumption (% of total), T_{it} is the trade openness (% of GDP), ε is the error term. Equation (1) was first estimated for the all set of countries under analysis (a balanced panel with 275 observations). Table 1 shows the results obtained by using generalized least squares fitted linear model.

Table 1: Determinants of CO_2 emissions GLS

Random-effects GLS regression

logC	Coef.	Std. Err.	z	P> |z|	[95 % Cof. Interval]	
logY	0.7378887	0.0312084	23.64	0	0.6767213	0.799056
logE	-0.8214482	0.2686703	-3.06	0.002	-1.348032	-0.2948641
logU	0.0687418	0.1299645	0.53	0.597	-0.1859839	0.3234676
logEn	0.1849276	0.0618349	2.99	0.003	0.0637333	0.3061219
logM	0.1291301	0.0617199	2.09	0.036	0.0081613	0.250099
logF	2.092678	0.1362421	15.36	0	1.825649	2.359708
logT	-0.7534536	0.0739359	-10.19	0	-0.8983653	-0.6085419
_cons	-12.58475	1.073704	-11.72	0	-14.68917	-10.48033
sigma_u	0			R-sq:	within =	0.9229
sigma_e	0.5154716				between =	0.5438
rho	0				overall =	0.9191

Notes: log denotes natural logs, C denotes CO_2, Y_{it} denotes real gross domestic product , E denotes employment, U denotes urban population, En denotes energy use, M denotes manufacturing, F denotes fossil fuel consumption, T denotes trade openness.

III. EMPIRICAL ANALYSIS

The results obtained by estimating the model in first differences show that the real gross domestic product coefficient is significant at 5% level in the dynamic specification also show the expected signs. The results show a 1% increase in real gross domestic product leads to a 73.78% increase in carbon dioxide emissions. The employment coefficient is significant and show unexpected sign, a 1% increase in employment leads to a 82.14% decrease in carbon dioxide emissions. However, the urban population presents a non significant estimated coefficient and show expected sign. For energy use, the coefficient is significant and show expected sign, a 1% increase in energy use leads to a 18.94% increase in carbon dioxide emissions. Also, for manufacturing, value added , the coefficient is significant and show expected sign, a 1% increase in manufacturing leads to a

12.91% increase in carbon dioxide emissions. The greater impact on CO_2 emissions is fossil fuel energy consumption, a 1% increase in energy use leads to a 209.26 % increase in carbon dioxide emissions. Finally, the trade openness coefficient is significant and show expected sign, a 1% increase in trade openness leads to a 75.34% decrease in carbon dioxide emissions. Therefore, the signs of the coefficients are as expected except for employment also. The explanatory variables are significant except for urban population.

IV. DISCUSSION

The results obtained in the previous section show some of unexpected contribution of some the explanatory variables. One of the important unexpected result came from employment. We expect that as the number of employment increase the carbon dioxide emissions will increase; positive relation between employment and CO_2. In a panel data context, Shi (2003) found a direct relationship between population changes and carbon dioxide emissions in 93 countries over the period 1975-1996. A similar result was obtained by Cole and Neumayer (2004). These authors considered 86 countries during the period 1975-1998 and they found a positive link between CO_2 emissions and a set of explanatory variables including population, urbanization rate, energy intensity and smaller household sizes. Our result shows the opposite, a 1% increase in employment leads to a 82.14% decrease in carbon dioxide emissions. There is some explain for the negative relationship between employment and CO_2. According to Shabbir et al. (2014) examined the relationship between Renewable and Nonrenewable Energy Consumption, Real GDP and CO_2 Emissions, using the Structural VAR Approach method in Pakistan. Their results show that an increase in renewable energy consumption is an effort to substitute it for non-renewable energy consumption, resulting in lower level of CO_2 emissions. When there is an increase in renewable

employment it will decrease the CO_2 emissions. This explanation illustrates the negative relation between employment and carbon dioxide emission. Some unexpected results have also been observed in our model. The urban population is not significant at at 5% level (P-Value= 0.579). Martínez-Zarzoso and Maruotti (2011) analyzed the impact of urbanization on CO_2 emissions from 1975 to 2003, taking into account dynamics and the presence of heterogeneity in the sample of countries. The results show an inverted-U-shaped relationship between urbanization and CO_2 emissions. However, our result shows that there is a positive relation between urban population and CO_2, a 1% increase in energy use leads to a 53% increase in carbon dioxide emissions. This result corresponds with what we expected. To sum up, the environmental impact cause by real GDP, urbanization, energy use, manufacturing value added and fossil fuel energy consumption seems to be positively and high correlated. Although, the environmental impact cause by employment and trade openness negatively correlated.

V. CONCLUSIONS

We have observed the relationship between carbon dioxide emissions and economic growth GDP, employment, urbanization, energy use, manufacturing value added, fossil fuel energy consumption, trade openness for 25 countries during the period 2004-2014. We have applied panel data econometrics and used generalized least squares model. The empirical results show that, the explanatory variables are significant for real GDP, employment, energy use, manufacturing value added and fossil fuel energy consumption and trade openness but presents a non significant estimated coefficient for urbanization. Moreover, the estimated coefficients also show the expected signs for all explanatory variables except employment. The reasons for negative relation between employment and CO_2 emissions can be explain as there is an increase in renewable employment it will decrease the CO_2 emissions. Also, the unexpected results may be due to the fact that the number of periods is not high enough to consistently apply this methodology. In case to investigates environmental impact of economic variables in the long run we need a time series data in order to check whether Environmental Kuznets Curve (EKC) hypothesis is valid or not. In this sense, further research with more data and alternative exogenous variables would contribute to improve the knowledge of the phenomenon under study.

VI. References

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