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Co_2 Emissions and Income Distributiony

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Abstract

In this paper we examine CO2 emissions since 1960 with data disaggregated by levels of income. Higher levels of persistence are observed in high income countries and some degrees of mean reversion, thus implying transitory shocks are observed in the lower middle and low income countries. Policy implications are derived from the results obtained.

Keywords: CO_2 emissions • Income level • Persistence

Introduction

This short note deals with the analysis of the CO_2 emissions and its evolution across time by using data disaggregated by income levels. We use fractionally integrated methods which allow us to determine the degree of dependence of the series in a more general way than the standard methods based on integer degrees of differentiation. Moreover, by knowing if the degree of integration of the series is either smaller than one or alternatively equal to or higher than 1 we can determine if random shocks in the series will have transitory or permanent effects.

A Review of the Literature

Initial empirical studies linking economic growth and environmental quality started in the early '90s, when data on various pollutants become available through the Global Environmental Monitoring System (GEMS) and other sources such as the OECD environmental data compendium, with the support of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 that lead to the Kyoto protocol in 1997.

For malized the connection between these two variables introducing the concept of the environmental curve (EKC) hypothesis [1,2]. For most environmental indicators, economic growth produces initially a phase of deterioration, which is followed by an improvement. This structure generates an inverted U-shaped relation between the level of environmental degradation and income growth. Among others provide extensive reviews of this issue [3-6].

Cointegration tests seem to be the technique most used in the analysis of this relationship. Among others have studied the long run relation between the economic activity and CO_2 emissions [6-12]. However, all these studies assume that the individual series are nonstationary, with shocks having permanent effects and, more in particular, consider CO_2 emissions to be I(1) or integrated of order 1. We depart from this strong assumption by permitting the emissions to be I(d) where d may be any real value. In this context of fractional integration, there are few studies on the analysis of environmental issues. Among the few we can cite all of them finding evidence of orders of integration away from 0 and 1[13-16].

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Data and Results

The data we use are CO_2 emissions (metric tons per capita), annually, for the time period 1960 – 2014 and for four aggregated data grouped into: i) high income countries, ii) upper middle income countries, iii) lower middle income countries and iv) low income countries.

$$y_t = a + b_t + x_t \left(1-L\right)^d x_t = u_t$$

t=0,1,........................ (1)

and y_t are the observed data (CO_2 emissions); a and b are unknown parameters and they corresponding to a constant and a linear time trend respectively, while x_t is I(d), where d may be any real value, and u_t is short memory or I(0), expressed in terms of both uncorrelated and auto correlated (Bloomfield) errors[17].

In the table we display the estimates of d (and the 95% confidence bands) under the presumption that u_t is white noise (Table 1). We display in panel (i) the results for three set-ups in relation with the deterministic terms: i) no (i.e., a=b=0 in (1)), ii) including a constant (b=0 in (1)), and iii) with a constant and a linear trend (a and b unknown), marking in bold in the panel the selected specification for each series. This selection is made according to the significance of the estimated coefficients above. Panel (ii) reports the remaining coefficients of these selected models.

The first noticeable fact observed in table is that the time trend is only required for lower middle income countries, and the values of d are significantly higher than 1 for high income and upper middle income countries (1.28 and 1.64 respectively) the I(1) null hypothesis of d=1 cannot be rejected for lower middle income countries, and this hypothesis is rejected in favour of d<1 (i.e., mean reversion) in the case of low income countries (Table 1). Thus, according

Table 1. Estimated coefficients with uncorrelated disturbances.

Countries	No components	A constant	A linear trend
High income	0.97 (0.81, 1.19)	*1.28 (1.11, 1.53)	1.26 (1.10, 1.50)
Upper middle income	0.96 (0.84, 1.13)	*1.62 (1.36, 1.99)	1.60 (1.38, 1.95)
Lower middle income	0.95 (0.78, 1.20)	0.94 (0.81, 1.19)	*0.93 (0.76, 1.20)
Low income	0.91 (0.75, 1.13)	*0.82 (0.69, 0.99)	0.83 (0.72, 0.99)
Countries	**Diff. parameter**	**Constant**	**Time trend**
High income	1.28 (1.11, 1.53)	7.3111 (28.68)	---
Upper middle income	1.62 (1.36, 1.99)	1.8000 (20.35)	---
Lower middle income	0.93 (0.76, 1.20)	0.3541 (12.74)	0.0202 (6.92)
Low income	0.82 (0.69, 0.99)	0.2420 (10.05)	---

* The significant cases in relation with the deterministic terms.

Table 2. Estimated coefficients with auto correlated disturbances.

Countries	No components	A constant	A linear trend
High income	0.90 (0.56, 1.28)	*1.02 (0.53, 1.43)	1.02 (0.71, 1.37)
Upper middle income	1.04 (0.79, 1.35)	1.16 (0.71, 1.76)	*1.18 (0.81, 1.70)
Lower middle income	0.71 (0.37, 1.09)	0.79 (0.60, 1.03)	*0.53 (0.10, 0.99)
Low income	0.88 (0.50, 1.30)	*1.08 (0.79, 1.52)	1.07 (0.80, 1.41)
Countries	**Diff. parameter**	**Constant**	**Time trend**
High income	1.02 (0.53, 1.43)	7.3680 (27.73)	---
Upper middle income	1.18 (0.81, 1.70)	1.6729 (16.04)	0.0814 (2.99)
Lower middle income	0.53 (0.10, 0.99)	0.3501 (16.19)	0.0195 (24.96)
Low income	1.08 (0.79, 1.52)	0.2260 (9.41)	---

* The significant cases in relation with the deterministic terms.

to these results, shocks in the emissions will have permanent effects in all cases except for low income countries, with shocks having then transitory effects. This transitory nature of the shocks in the low income countries is good in the case of negative shocks increasing the level of emissions, however, if that shock produces a reduction in the emissions, strong policies should be adopted in the poor countries to make this change permanent, unlike what happens in the remaining cases.

Table shows the results under the assumption of auto correlated errors (Table 2). We see here that the trend is significant in both middle income (upper and lower) countries, and mean reversion is obtained now in the case of the lower middle income countries; however, for the low income countries, the hypothesis of I(1) cannot be rejected.

Conclusion

This note analyzes CO_2 emissions disaggregated by levels of income. Using I(d) techniques, our results indicate that for high income and upper middle income countries, the degree of integration of the series is 1 or higher than 1. However, for lower middle and low income countries, this degree of integration is smaller than 1 and thus implying mean reverting behavior. These results are important because they show that in the event of a random (negative) shock that increases the level of emissions, stronger actions must be conducted in the rich countries, since the series will not revert by themselves to the original trends. On the contrary, if the shock is positive, producing a reduction in the level of emissions, stronger actions should be conducted in the poor countries since the series, in these cases, will tend to revert by themselves to their original levels.

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