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The Environmental Kuznets Curve or Pollution Haven Hypothesis or Both of Them?

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ABSTRACT

In debates on the effect of globalization and the environment, several possible effects have been hypothesized. One of them is environmental Kuznets curve (EKC) and the other one is pollution haven hypothesis (PHH). The Environmental Kuznets Curve (EKC) hypothesizes that environmental quality is initially degraded with increasing economic wealth, until reaching some turning point where environmental quality improves with increases in wealth. On the other hand, the PHH is fundamentally a theory that suggests that high regulation countries will lose all the 'dirty industries' and poor countries will get them all. In this paper, the existence of Kuznet curve and pollution haven hypothesis is investigated by dynamic panel data analysis for high and middle-low income OECD countries in Europe & Central Asia. 1993-2004. It is observed that the values of GDP and Trade have a significant and negative impact on both the CO_2 rate of Middle- low and high income of OECD countries.

Keywords: *Environmental Kuznets curve, Pollution haven hypothesis, Dynamic panel data*

1. INTRODUCTION

In recent years, interest in the relationship between trade liberalization and the environment followed as a result of the pioneering work by Gene Grossman and Alan Krueger (1993), which consequently caused a growing literature on what has come to be well-known as the Environmental Kuznets Curve (EKC). The EKC hypothesizes an inverse-U-shaped relationship between a country's per-capita income and its level of environmental quality: increased incomes are associated with an increase in pollution in poor countries, but a decline in pollution in rich countries. The inverted-U linkage reflects the changing power of three impacts on the environment, the scale, the composition, and the technique effect (Bousquet and Favard, 2005).

In the first place, growth displays a *scale effect* on the environment because increases in economic activity generate more pollution. The second one with economic growth, technical progress could enhance cleaner technologies; this is known as the *technique effect*. In the third place, *the composition effect* refers to the changing composition of an economy that may occur following an episode of trade liberalization as countries increasingly specialize in activities in which they enjoy a comparative advantage. It is this composition effect that is of most relevance to the EKC and is the mechanism through which the pollution haven hypothesis would affect pollution. One exact criticism leveled at the EKC is that, in its simplest form, it does not give an explanation for trade patterns which themselves may at least partially explain a reduction in

pollution in high income economies, with the reverse occurring in low income economies. The so-called pollution haven hypothesis (PHH) could potentially generate such trade patterns. The pollution haven hypothesis states that differences in environmental regulations between developed and developing countries may be compounding this general shift away from manufacturing in the developed world and causing developing countries to specialize in the most pollution intensive manufacturing sectors (Cole, 2004).

Numerous theoretical and empirical studies have considered the broad relationship between economic development and environmental quality. This hypothesis was tested by Grossman and Krueger (1994), Shafik and Bandyopadahyay (1992), Panayotou (1993), and Selden and Song (1994). They found that pollution levels increase as a country develops, but start to decrease as rising income passes beyond a threshold level. Contrary to these findings, Hettige *et al*., (2000) carried out a variety of econometric estimations with a parametric functional form for 12 countries data set over the period 1989-1995 which collected from direct observations of industrial water pollution, measured by biological oxygen demand at the plant level. Their consequences reject the EKC hypothesis and demonstrate that industrial water pollution rises rapidly for middle income and remains unchanged thereafter. Moreover, on the basis of cross-sectional data for CO_2 emissions by a nonparametric approach to examine the environmental efficiency Taskin and Zaim (2000) computed environmental efficiency indices for low-and high income countries between 1975 and 1990. The linkage between the environmental efficiency index and GDP per capita exhibited a U shape followed by an inverted U, i.e., the EKC hypothesis holds only for countries with sufficiently high GDP per capita (more than $5000). Focacci (2005) examined the EKC hypothesis for three developing countries, namely, Brazil, China and India, and found that it did not hold for such countries. Paudel *et al*., (2005) utilized semi parametric and parametric models to investigate the EKC for three types of water pollution, namely, nitrogen, phosphorus and dissolved oxygen (DO), and indicated that the EKC for nitrogen was significantly found, but not for phosphorus or DO. Azomahou *et al*., (2006) examined the empirical relation between CO_2 emissions per capita and GDP per capita during the period 1960-1996, using a panel of 100 countries. Relying on the nonparametric poolability test of Baltagi *et al*., 1996, they found the evidence of structural stability of the relationship. They then specified a nonparametric panel data model with country-specific effects. Estimation results demonstrated that this relationship is upward sloping. Using a panel data set for 20 years (1981-2001), Barua and Hubacek (2009) applied both the Generalised Least Square (GLS) and Arellano-Bond Generalised Method of Moments (GMM A-B) econometric methods. They did not find evidence in support of the EKC hypothesis. Overall, they found that the decline in pollution during the process of economic growth was only temporary, as it tended to rise with further income growth. Population density, livestock population and literacy were found to have strong effects on the water quality of the rivers of India.

While the link between income growth and the environment is vital, trade may modify environmental results through a variety of other channels. Trade may promote a relocation of polluting industries from countries with strict environmental policy to those with less inflexible policy. These shifts may in turn increase global pollution or they may have a chilling effect on environmental policy, as countries will be reluctant to tighten environmental regulations because of concerns over international competitiveness (Copeland and Taylor, 2004). Taking the nature

of the trade-composition effect into account, Suri and Chapman (1998) investigated data on 33 countries for the period 1971-1991, using a panel fixed effect model, and found that the export ratio tends to have a positive relationship with energy use whilst the import ratio has a negative relationship. Using detailed data on North–South trade flows for pollution intensive products the evidence for the PHH, Cole (2004) controlling for trade openness, evidence of pollution haven effects is found, although such effects do not appear to be widespread and appear to be relatively small compared to the roles played other explanatory variables.

The purpose of this paper is to empirically examine the whether EKC or PHH or both of them hold for both high income and middle-low income OECD countries in Europe & Central Asia by using dynamic panel data models based on the Generalized Method of Moment estimation (GMM). To this end, the rest of the paper is organized as follows: Section two introduces the data and provides a preliminary analysis of the data subject to empirical analysis. Section three provides the details of the methodology employed in the empirical analysis of the panel unit root and GMM estimation. Section four will present results obtained from GMM analysis of the OECD countries. Finally, section five provides discussions and policy implications derived from the findings of the paper.

2. PRELIMINARY OVERVIEW OF THE DATA AND RESULTS

Before undertaking the econometric analysis of EKC and pollution haven hypothesis, the data employed in the applied work is introduced and main features and preliminary statistical analysis are provided in this section. The data is obtained from World Development Indicators (WDI) online database published by World Bank which includes CO_2 emissions (metric tons per capita) GDP per capita (constant 2000 US$) Trade (% of GDP). In our data set of high income OECD

Table 1
Arellano-Bond Dynamic Panel-Data Estimation-Results

	Middle and low income of OECD countries	*High income OECD countries*
Variables	*Coefficient*	*Coefficient*
$C0_2$ (–1)	0.162975 ***	– 0.074705 ***
	(0.061299)	(0.004880)
GDP	– 0.090635 **	– 0.522231 ***
	(0.040719)	(0.067843)
TRADE	– 0.058267 ***	– 0.217926 ***
	(0.013955)	(0.003808)
Arellano-Bond test AR(1)	– 4.92 ***	– 6.07 ***
Arellano-Bond test AR(2)	– 0.04	0.01
Wald Chi-Square	185.3 ***	202.5 ***
Sargan	44.3	41.6
Number of Countries	12	21

* Coefficient estimates by one step and one year lag. Standard errors in parenthesis and *** and ** indicate significance at $p < 0.01$ and $p < 0.05$, respectively. In a different specification, it is also estimated the model by including year dummies to capture the effect of time trend. The results do not vary.

countries are, Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Slovak Republic, Spain, Sweden, Switzerland, United Kingdom. Middle and low income of OECD countries are Kyrgyz Republic, Tajikistan, Uzbekistan, Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Macedonia, Moldova, Turkmenistan and Ukraine in Europe & Central Asia. 1993- 2004. In order to insert dynamics into the model for CO_2, it is introduced a lagged dependent variable as an explanatory factor to capture persistence effects of the CO_2. However, with this dynamic specification, it is faced that the correlation between the lagged variable and error term. Therefore the estimations with fixed effect (OLS) or random effects (GLS) would not be appropriate since the obtained estimates would be biased. One way suggested by Arellano and Bond (2002) to solve this problem is to estimate dynamic panel data models based on the Generalized Method of Moment estimation (GMM).

In this methodology, it is assumed that there is no second-order autocorrelation in the errors; therefore a test for the previous hypotheses is needed. It is also conducted a test for autocorrelation and Sargan test. In both models, the Sargan test fails to reject the null hypothesis that the over-identifying restrictions are valid. Arellano-Bond test rejects the null hypothesis of no-first autocorrelation in the differenced residuals AR(1), it fails to reject the null hypothesis of no second order autocorrelation in the differenced residuals. Failure to reject the null hypothesis in both tests gives support to model and the Wald test denotes the joint significance of the independent variables. Based on the results from Middle-low and high income of OECD countries models, it is observed that the values of GDP and Trade have a significant and negative impact on both the CO_2 rate of Middle- low and high income of OECD countries. It is found that EKC and PHH hypothesizes holds for both low-middle and high income of OECD countries. These results confirm the studies of Cole (2005).

3. CONCLUSIONS

Numerous studies have arise in order to explain and confirm the observation made by Grossman and Kruger that there may be real an inverted U-shaped relationship between environmental pollution and income. While some studies have found this relationship to hold true for certain pollutants, other studies have rejected this hypothesis based upon empirical observations of certain other pollutants. This paper examines the existence of Kuznet curve and pollution haven hypothesis by dynamic panel data analysis for high and middle-low income OECD countries in Europe & Central Asia. 1993- 2004. It is found that the values of GDP and Trade have a significant and negative impact on both the CO_2 rate of Middle-low and high income of OECD countries. This result could be interpreted as EKC and PHH are valid for only high income of OECD countries.

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