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Economic growth and the environment in China: Empirical evidence using prefecture level data

Sanghoon Lee [a,*], Dae-Won Oh [b]

[a] Department of Economics, Hannam University, 70 Hannamro, Daedeokhu,Daejeon 306-791 Republic of Korea
[b] Department of Chinese Studies and Economics, Hannam University,70 HannamroDaedeokhu,Daejeon 306-791 Republic of Korea

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ABSTRACT

This paper addresses the issue of the relationship between economic growth and environmental quality in China. The main hypothesis to be examined in the study is the environmental Kuznets curve hypothesis, which postulates an inverse U-shaped relationship between pollutions and income. The empirical analysis uses prefecture level panel data of China over the period 2003–2010, and employs fixed effects model and a sample split method. The empirical results tend to confirm the inverse U-shaped relationship as well as the N-shaped relationship between income and pollution.

1. Background

Is economic growth good for environmental quality? It seems that economic growth requires more natural resources and thus gives rise to more environmental pollution. However, it is not necessarily the case that economic growth inflicts damage on the environment. This issue has been discussed in previous research on the relationship between trade and environment (for a review of the literature, see Beghin & Potier, 1997; Ferrantino, 1997).

In their seminal work, Grossman and Krueger (1991) suggest three effects of trade liberalization on environmental quality: i) the scale effect refers to the simple intuition that economic growth demands for energy and thus increases harmful pollutants; ii) the composition effect indicates that since trade liberalization allows developing countries to specialize in the sectors of comparative advantage such as labor-intensive and pollution-producing industries, free trade would be hazardous to the environment in developing countries; and iii) the technique effect implies that international trade can facilitate diffusion of clean technology and thus developing countries can reduce pollution per unit of output.

Given that trade can generate an increase in income levels, the studies of the relationship between trade and environment provide insight into the question of how economic growth affects the environment (for a literature review of the trade, growth, and environment link, see Copeland & Taylor, 2004). The most famous theory about the relationship between economic growth and the

* Corresponding author.
E-mail addresses: sanghoonlee@hannam.ac.kr (S. Lee), odw@hnu.kr (D.-W. Oh).

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environment is the hypothesis of environmental Kuznets curve proposed by Grossman and Krueger (1995) and Selden and Song (1994). The environmental Kuznets curve refers to an inverse U-shaped relationship between environmental pollution and income, which argues that environmental pollution increases with income at low levels of income and decreases with income at high levels of income (for a survey, see Bo, 2011; Dinda, 2004).

Although a few empirical studies such as Hettige, Mani, and Wheeler (2000) reject the environmental Kuznets curve hypothesis, many empirical studies tend to confirm the hypothesis (for example, see Andreoni & Levinson, 2001; Cole, 2003; Grossman & Krueger, 1995; Lamla, 2009; Zaim & Taskin, 2000). However, the robustness of the findings is open to doubt (for a review, see Stern, 2004). The environmental Kuznets curve is observed in a sample of high-income countries but not in a global sample (Stern & Common, 2001) and the empirical results are often different across econometric techniques (Halkos, 2003). In addition, if the estimated turning point is far above acceptable income levels, the environmental benefits of economic growth does not exist in real economies (List & Gallet, 1999).

We may also need to consider an alternative model, an N-shaped curve, explaining the relationship between income and pollution. This model suggests that the inverse U-shaped relationship exists initially, but beyond a certain income level, the relationship turns positive. There are some possible explanations for the cubic relationship: i) the recovery effect indicates that when oil prices are low, the government does not have to be sensitive to the pressure to promote energy efficiency (Friedl & Getzner, 2003, pp.145–146) and ii) the scale effects implies that demand for resources increases as economy grows, and it cannot eventually be offset by technology and regulation (Poon, Casas, & He, 2006, p.574). This N-shaped pattern is empirically confirmed by Day and Grafton (2003) and Friedl and Getzner (2003).

Let us ask again: Is economic growth good for the environment? In this paper we revisit this issue by using newly available Chinese regional data. We examine whether the environmental Kuznets curve and the N-shaped curve exist in a developing country context. Since China has experienced rapid economic growth as well as environmental degradation in the last two decades, the study based on the data of China is especially relevant to the issue of the economy–environment relationship.

2. China

Since the 1980s, China has achieved rapid economic growth, followed by strong growth in energy consumption and thus pollution emissions (Guan, Hubacek, Weber, Peters, & Reiner, 2008). This section briefly discusses the unique feature of China's economic development and then reviews empirical studies of economy and environment in China.

China's economy has shown uneven regional growth. Economic growth has been more rapid in the coastal regions of eastern China than in the other regions since the Chinese economic reform in 1978. Several factors are likely to cause the differences in regional development. First, the regional disparity may be due to different paces of development of private firms. Second, different regions have experienced different changes in industrial structure, which can lead to the regional disparity. Third, coastal areas have received the concerted support of the central government (De Groot, Withagen, & Minliang, 2004).

China has adopted the policies of shifting to manufacturing and attracting investment flows from abroad. During the Chinese economic reform that began in 1978, the government set up special economic zones in the coastal area in which foreign firms can receive tax privileges. This leads to influx of foreign investment into the coastal area, which also makes the coastal regions grow faster than the other regions.

The rapid growth of Chinese economy and its significant regional differences can be attributed, at least in part, to the exogenous government policies. Feng, Hubacek, and Guan (2009) use comparative analysis of the development of five regions in China and show that significant differences exist between regions due to differential policies in China. Thus, the Chinese experience offers researchers a good opportunity to study the relationship between economic growth and the environment while possibly controlling for endogeneity.

Previous empirical studies of the environmental Kuznets curve hypothesis using data of China provide inconclusive evidence. Some studies clearly confirm the environmental Kuznets curve hypothesis: Roumasset, Burnett, and Wang (2008) conduct a regression analysis for NO_x, SO_2, and TSP, and the result is mostly consistent with the environmental Kuznets curve hypothesis though SO_2 emission seems to be just reaching the flat portion of its inverse-U curve. Song, Zheng, and Tong (2008) find the inverse U-shaped relationship between economic growth and environmental pollutants such as waste gas, waste water, and solid wastes. He (2009) finds the inverse U-shaped relationship for per capita SO_2 emission and the increasing tendency for SO_2 emission density, and explains that a fast population expansion would slow down the increasing tendency of per capita SO_2 emission. Govindaraju and Tang (2013) confirm the environmental Kuznets curve hypothesis by conducting Granger causality test.

In contrast, there exist empirical studies showing the positive effect of income on environment: free trade mitigates environmental damage via income growth (Dean, 2002) and faster economic development tends to reduce air pollution emissions by enhanced regulation and policy enforcement (Zeng & Eastin, 2007). Cole, Elliot, and Zhang (2011) find the environmental Kuznets curve for water pollution, but the turning point is beyond the acceptable range. For air pollutants, they report positive relationships and insignificant relationships. Other studies yield mixed results. Shen (2006) provides the evidence supporting an inverse U-shaped relationship for water pollution and a U-shaped relationship for SO_2.De Groot et al. (2004) report a negative relationship between income and water pollution, while showing mixed results for air pollution: an environmental Kuznets curve for waste gas emission in levels, a positive relationship for per capita waste gas, and a negative relationship for gas emission per unit of output.

The cubic (i.e., N-shaped) relationship is also found. Brajer, Mead, and Xiao (2008) find evidence for both a quadratic and a cubic environmental Kuznets curve for SO_2 emission in China. In their following paper, Brajer, Mead, and Xiao (2011) examine three individual pollutants as well as three comprehensive measures of air pollution and also find the inverse U-shaped relationship and the N-shaped relationship.