Decoupling and Environmental Kuznets Curve for municipal solid waste generation: Evidence from India
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ABSTRACT

Discussion during the recent years on the dissociation of the positive relationship between economic growth and resource utilization is called Environmental Kuznets Curve (EKC). Environmental Kuznets Curve is a hypothetical relationship between various indicators of environmental degradation and income per capita. Economic conditions may have a very important role in determining the emergence of the downward sloping part of the EKC. This implies that the environmental impact indicator is an inverted U-shape with respect to income per capita. In developing countries, the Burden and seriousness of environmental problems are no longer in no doubt. The aim of this paper is to investigate the empirical evidence of de-linking of economic growth and municipal solid waste generation from the data of continuous years of developing countries such as India.

Keywords: Economic growth, Municipal solid waste, Environmental Kuznets Curve, De-linking.

1. Introduction

Environmental Kuznets Curve is a hypothesis that states the resource utilization or pollution initially increases with the per capita income and then eventually declines because the willingness to pay for environmental quality increases with income and this characteristic form an inverted U-shaped relationship between pollution emission and affluence (Figure 1). Research works on linking of EKC to materials and municipal waste are less as compared to air pollution and GHG emission. As noted (Kaurosakis¹), most evidences on the determinants of municipal waste generation (collection) are based on US microeconomic studies carried out at the local community level. Wang et al.² also found evidence in favor of a negative elasticity by focusing on US stocks of hazardous waste as an environmental impact indicator and by using a country-based cross sectional data set.

No relationship between EKC and municipal solid waste was found in Europe (Mazzanti and Zoboli³). Mazzanti⁴ stated “de-linking relation between Economic, Municipal solid waste and Environment” and also noted that “it has been shown to apply to a selected set of pollutants only,” but some economists “have conjectured that the curve applies to environmental quality generally”. Empirical evidences on de-linking related to environmental waste indicators are very scarce. No turning point in EKC was found (Cole et al.⁵) with environmental indicators such as per capita municipal waste, which monotonically increase with income from the period of 1975-1990 in 13 OECD countries.
This paper focuses mainly on the evidence of decoupling between economic growth and municipal solid waste generation in developing countries such as India, in which relevant data are more readily available. India is an interesting subject of study because of its large territory and rapid economic growth. India also serves as kinds of improvement or opportunities that could be pursued in other developing countries. This paper analyzes the course of GDP per capita with municipal solid waste generation from 1947 to onwards to 2004 and detects the turning point of decoupling of economic growth and municipal solid waste generation.

2. Materials and Method

| Year | Waste generation (ton per capita per year) | Gross Domestic Saving (% of GDP at current market prices) |
|------|------------------------------------------|----------------------------------------------------------|
| 1947 | 0.107                                    | 18.5                                                     |
| 1971 | 0.136                                    | 20.2                                                     |
| 1981 | 0.156                                    | 21.7                                                     |
| 1991 | 0.167                                    | 22.8                                                     |
| 1995 | 0.167                                    | 24.4                                                     |
| 1997 | 0.178                                    | 23.8                                                     |
| 2000 | 0.17                                     | 23.7                                                     |
| 2004 | 0.161                                    | 29.8                                                     |

Source: (ADB, 2006; World Bank, 1999; IPCC, 2006; Eai club; India stat)

The nation wide data of India on municipal solid waste generated per capita (tons) and Gross Domestic Saving (percent of GDP at current market prices) from the period of 1947-2004
was collected from different available data sources (ADB, 2006; World Bank, 1999; IPCC, 2006; EAI and India stat), (Table 1). And also analyzed the temporal course of municipal solid waste generation with gross domestic saving in the period of 1947-2004

3. Results and Discussion

Several empirical studies of 1980s and 1990s give an optimistic view in industrialized countries many pollution indicators decreased despite a growing per capita income, while in less developed countries economic growth yielded increasing pollution. Therefore, economic progress with less environmental impact seems to be possible. The idea that economic growth is ultimately beneficial for the environment, therefore, to maintain the economic growth is necessary, because the surest way to improve the environment is to become rich (Beckerman⁹). This viewpoint implies that environmental problems are a temporary phenomenon, since economic growth and technological innovation will resolve these problem in due time.

Figure 2: Time series of municipal solid waste generation

Figure 2 shows the trend of municipal solid waste generation in India over the studied period from 1947 to 2004. It shows that a turning point was found in 1997. It is possible to make only one statement if an economic indicator would keep growing during the same period: the presumption that economic growth can be conformed to environmental improvement has been proven. Indeed, gross domestic savings increased monotonously from 1947 to 2004. Figure 3 shows the relationship of municipal solid waste generation and gross domestic savings during studied period in India which shows decoupling and the turning point around at 26.7 percent of GDP of gross domestic savings. After reaching the turning point, slope went downward very slowly.

In this analysis, we used gross domestic savings (GDS) percentage to GDP instead of GDP as the indicator of economic growth because it may be more sensitive one of financial capacity to pay for environmental improvement. GDS generally has a high correlation to GDP, however in the course of industrialization in developing countries. GDP increases earlier than GDS due to intensive for industrial production. Consequently, GDS percentage to GDP increases later after sufficient investment recovery from the industrial production has
accumulated, and then a portion of savings could be used for environmental countermeasures. The high curve fitness in Figure 3 supports the validity of GDS percentage to GDP as the indicator of EKC.

\[ y = -0.0012x^2 + 0.0641x - 0.6561 \]

**Figure 3:** Relationship of municipal solid waste generation and gross domestic savings

Wooldridge\textsuperscript{10} reported a non-logarithmic form for analysis of serial correlation and defined turning point with respect to waste generation and GDP per capita. In this article, not sufficient samples were available to conduct similar moving correlation analysis. Robustness of the inverted U-shape curve obtained in this work is critical because only two samples exist after the turning point. However, correlations of the former and the latter half of samples differed significantly indicating, at least, that correlation between gross domestic savings and waste generation rate became week after 1995. Therefore a cautious conclusion of the result can be that a sign of decoupling between economic growth and municipal solid waste generation was detected. It will take a decade or more to confirm the validity of this result.

Cole \textit{et al.}\textsuperscript{5} pointed out that the U-shape form of EKC has been raised mainly for emission externalities. According to the result of this study, a specific policy is worked out. The key policy is that even if such a curve characterized past growth, there is no reason for developing countries passively to accept “historical determinism” along their future development path. In effect, lower-income countries could learn from the experience of wealthier nations and adopt policies that permitted them to “tunnel effect” through the curve (Munasinghe\textsuperscript{11}).

4. Conclusion

This study clearly demonstrated that dissociation of economic growth and environmental degradation based on the concept of Environmental Kuznets Curve. In this article, a historical change in municipal solid waste generation of India showed a monotonous increase before 1997 but saturated or slightly decreased after that point. Municipal solid waste generation per capita depicted a clear inverted U-shape curve against gross domestic savings percentage to GDP and it suggested a sign of decoupling between economic growth and municipal solid waste generation in Indian nation-wide data set.
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