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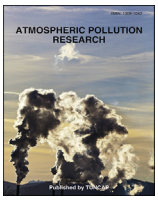

Original Article

Collaboration between central and state government and environmental quality: Evidences from Indian cities

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ABSTRACT

Within the context of coordination level between state and central government, we develop an econometric model to estimate the association between income and ambient air pollution, considering the societal preferences jointly influenced by the citizens and the government. We obtain empirical evidence supporting our hypothesis that state level coalition government can effectively improve quality of environment by means of reducing ambient air pollution level. This impact can be increased or decreased based on the societal preferences of the citizens, based on the area of inhabitance and irrespective of the choice of pollutants.

1. Introduction

The association between income and environmental quality in the form Environmental Kuznets Curve (EKC) has been the research interest for the ecological economists for long. Even if we leave aside the contextual evidences of EKC hypothesis, the existing body of literature on this hypothesis has touched upon several significant aspects including need for environmental quality with rise in the level of income, technological efficiency in determining and maintaining environmental quality, and impact of the stage of development process on environmental quality (for a detailed literature survey, see Dinda, 2004). The existing literature on these aspects majorly focuses on the inverted U-shaped form of EKC, and the hypothesis is formed based on this form only, as indicated by Grossman and Krueger (1991). Depending on acceptance or rejection of this inverted U-shape, the association between income and environmental quality can be determined with contextual interventions.

In accordance with the explanation of the turnaround point of EKC hypothesis, once the per capita income level reaches a certain point, environmental degradation starts to diminish because of rising environmental demand and awareness level among the citizens. Even though this argument seems valid prima facie, it focuses presumably on the consequential symptoms rather than the original cause itself. Increase in per capita income may not possibly result in an increase in the level of environmental awareness in an automatic fashion, as it may have been triggered by any third mediating factor, which is not explicitly described in the explanation of EKC hypothesis. One such possible construct may be presence of social sustainability aspect triggered by economic growth. Moreover, considering the democratic political statute of a nation like India, these factors may bring forth other significant aspects when they interact with the political regime of the nation. This has been observed by several researchers. Yearley et al. (2003) have used community mapping exercises in urban centers of three cities in UK, and they have found that the participation of native citizens in the environmental policy making can enhance the efficiency of the local government, in a democratic setting. Sneddon et al. (2006) has demonstrated the importance of political structures and public participation in determining the shape of politics regarding environmental policies. Cole et al. (2005) have analyzed the manufacturing sector of UK during 1990–1998, and they have found that both formal and informal regulatory pressures can effectively demonstrate the air pollution abatement initiatives.

India is a democratic nation with federal structure and the effectiveness of any policy implementation depends largely on the

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level of coordination within the organs of the federal structure; i.e. between state and central government. There lies the same need of coordination in case of pollution abatement policy implementation as well. In this paper, we propose an econometric model to measure the impact of coordination between central and state government on environmental quality. This model distinctively analyses societal preferences as explanatory variables for determining environmental quality. The interaction of these variables with the center-state coordination has been considered as another set of explanatory variables. We hypothesize that state level center-state coordination can effectively implement pollution abatement policies at city level, which may not be possible if the state government is not in coordination with the central government.

Rest of the paper is organized as follows. Section 2 describes an emission profile of India, Section 3 proposes a framework for empirical estimation for Indian cities, Section 4 presents data and analysis, and finally, Section 5 concludes the paper.

2. Emission profile of India

Due to rapid growth in industrialization, India has experienced a significant growth in the fossil fuel consumption. Adverse effects of this growth have been seen in the growth of ambient air pollution. During the last decade, CO_2 emission has gone up by 72%, SO_2 emission has gone up by 54%, and NO_2 emission has gone up by 42% (Lu et al., 2011; Haq et al., 2015), whereas the particulate matter (PM10) gone up only by 31% and carbon monoxide (CO) by 10% (Masih et al., 2010; Worden et al., 2013). Therefore, keeping in view the importance and growth pattern of the pollutants, we have considered SO_2 and NO_2 emissions for our study.

If we look at the emission affecting tropospheric region, then the NO_2 should be considered as the primary pollutant in this case, as 79% of the tropospheric atmosphere consists of nitrogen (N_2). It is majorly responsible for creation of ground-level ozone, a primary component of smog (Bower et al., 1994; Shi and Harrison, 1997). It is also responsible for creation of various nitrate compounds, which add to the level of respiratory particulate matters in the lower atmosphere (Dockery et al., 1989; Monn et al., 1997; Barnett et al., 2005). Owing to these reasons, rise in the level of NO_2 emission can cause serious damage to ambient atmosphere.

Looking at the emission affecting stratospheric region, SO_2 is considered as one of the two primary pollutants in this case, as the sulphur aerosols formed in this region are majorly caused by SO_2 emission (Friend et al., 1973; Whitby, 1978; Turco et al., 1979; Surratt et al., 2007). Apart from that, SO_2 is soluble in airborne water globules, and thereby, forming sulphurus and sulphuric acid in the form of acid rains (Penkett et al., 1979). Formation of aerosols after reacting with particulate matters can create severe respiratory problems (Brain and Valberg, 1979), and even premature births (Hastwell, 1975). Mainly for these reasons, rise in the level of SO_2 emission can cause serious damage to ambient atmosphere, and the human life.

Central Pollution Control Board of India has already set a number of emission standards, according to which level of SO_2 and NO_2 emissions should not be more than 40 $\mu g/m^3$ in any industrial or residential cities of India. Bharat Stage emission standards are also in place for controlling the vehicular emissions. Presently, Bharat Stage IV has been implemented only across 14 cities[1] in 2010, and Bharat Stage V is yet to be implemented in 2017. Based on the reports of Central Pollution Control Board, Supreme Court of India has passed a directive in 2001 for controlling ambient air pollution in 16 cities across India. However, in spite of these policies in place, SO_2 and NO_2 emissions across several Indian cities are rising.

3. Empirical framework

The proposed empirical framework is based on a reduced form approach, which does not incorporate the feedback effect from environmental degradation to economic growth. Adapting the framework of Panayotou (1997), we assume that effectiveness of any economic policy depends on collaboration between the ruling parties at state and national level, and therefore, the basic model of EKC turns out to be:

$$E_{it} = C_i + \sum_{j=1}^{3} \alpha_j Y_{jt}^{j} + \sum_{k=1}^{3} \alpha_{k+3} Pop_{kt}^{k} + \alpha_7 CG_{it} + \alpha_8 CG_{it} Y_{it} + \alpha_9 t + \varepsilon_{it} \quad (1)$$

where, for city i in year t, E_{it} stands for the level of emission, Y_{it} is the level of income at city level, Pop_{it} is the population, and CG_{it} is the indicator of political collaboration between state and central government. The linear trend variable t is considered as an indicator of technological change over time, α_i are the regression coefficients, ε_{it} is the error term, and C_i is the city level fixed effect. The political collaboration variable CG_{it} has been used both additively and multiplicatively, in order to incorporate the marginal effects on the emission level. This model is the basic point of reference for further analysis. It will be used to analyze the effect of collaborative government on environmental degradation. The direct effects of income and collaborative government have been disjoined by incorporation of CG_{it}, thereby, capturing the movement of environmental degradation in response to policy effectiveness.

To incorporate the social determinants of environmental degradation, Eq. (1) is extended based on societal preferences, which can be exercised involuntarily or via the political system. This condition ensures that in a non-cooperative state level political regime, societal preferences are largely overlooked; whereas, for a collaborative state level political regime, societal preferences are enhanced and complemented by political statute. Therefore, decomposing the model in Eq. (1), the extended EKC model becomes:

$$\begin{aligned} E_{it} = {} & C_i + \sum_{j=1}^{3} \alpha_j Y_{jt}^{j} + \sum_{k=1}^{3} \alpha_{k+3} Pop_{kt}^{k} + \alpha_7 CG_{it} + \alpha_8 CG_{it} Y_{it} \\ & + CG_{it}(\alpha_9 Gen_{it} + \alpha_{10} EC_{it} + \alpha_{11} LR_{it}) + CG_{it} Y_{it}(\alpha_{12} Gen_{it} \\ & + \alpha_{13} EC_{it} + \alpha_{14} LR_{it}) + \alpha_{15} t + \varepsilon_{it} \end{aligned} \quad (2)$$

where, Gen_{it} stands for the gender ratio in terms of number of women per thousand men, EC_{it} is the consumption of electricity, and LR_{it} is the literacy rate. Interaction between collaborative government indicator and the societal preferences may affect the nature of EKC curve, which can bring forth marginal effects in this extended reduced form model.

Once these reduced form models are in place to capture the interaction between collaborative government and the societal preferences for determining environmental quality, the influence of collaborative state government on environmental quality is to be analyzed. From Eq. (1), the association can be explained as $(\partial E_{it}/\partial CG_{it} = \alpha_7 + \alpha_8 Y_{it}) < 0$. Now, this phenomenon can be analyzed by the collaborative government variable (CG_{it}) and environmental emission variable (E_{it}), and by analyzing coefficients in Eq.

[1] National Capital Region, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad, Ahmedabad, Pune, Surat, Kanpur, Lucknow, Sholapur, Jamshedpur and Agra.

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