Ecological Economics 91 (2013) 48–56

Contents lists available at SciVerse ScienceDirect

Ecological Economics

journal homepage: www.elsevier.com/locate/ecolecon

Analysis

The effect of government expenditure on the environment: An empirical investigation

George E. Halkos *, Epameinondas A. Paizanos

Laboratory of Operations Research, Department of Economics, University of Thessaly, Korai 43, 38333 Volos, Greece

ARTICLE INFO

Article history:
Received 17 July 2012
Received in revised form 23 March 2013
Accepted 7 April 2013
Available online 11 May 2013

JEL classification:
E60
Q53
Q54
Q56

Keywords:
Government expenditure
Environment
Direct effects
Indirect effects

ABSTRACT

This paper examines the impact of government spending on the environment using a panel of 77 countries for the time period 1980–2000. We estimate both the direct and indirect effects of government spending on pollution. The indirect effect in particular operates through the impact of government spending on income and the subsequent effect of the income level on pollution. To take into account the dynamic nature and the potential endogeneity in the relationships examined, appropriate econometric methods are used. For SO_2, government spending is estimated to have a negative direct impact on per capita emissions, while the direct effect is insignificant on CO_2 pollution. The indirect effect on SO_2 is negative for low income levels and becomes positive as income increases, while it remains negative for CO_2 for the most part of the sample range. The resultant total effects follow the patterns of the indirect effects, which dominate their respective direct ones for each pollutant. Policy implications from the results vary depending on the income level of the considered countries.
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1. Introduction

Government expenditure has recently expanded in many countries to alleviate the adverse effects of the 2008–2009 economic crises. A large fraction of GDP is spent by governments affecting a variety of economic variables and prosperity in particular. Recent studies suggest that government expenditure is an important determinant of environmental quality (Bernauer and Koubi, 2006; Frederik and Lundström, 2001; Lopez et al., 2011). The mechanisms through which prosperity, government expenditure and environment interact with each other are investigated in theoretical papers by Heyes (2000), Lawn (2003) and Sim (2006). However, despite the important influence that public spending may have on the environment, this relationship has not been studied extensively in the literature.

The effect of government spending on the environment may be distinguished between direct and indirect effects. On the one hand, higher government expenditure is more likely to include redistributive transfers, which result to increased income equality and thus to higher demand for environmental quality. Moreover, if the environment is a luxury public good, it is likely that it will only be demanded when the demand for other public goods has been satisfied, i.e. at large levels of government size (Frederik and Lundström, 2001). In a related study, Lopez et al. (2011) identify four mechanisms by which the level and composition of fiscal spending may affect pollution levels,[1] namely the scale (increased environmental pressures due to more economic growth), composition (increased human capital intensive activities instead of physical capital intensive industries that harm the environment more), technique (due to higher labor efficiency) and income (where increased income raises the demand for improved environmental quality) effects.

On the other hand, government size has been found to reduce prosperity (Bajo-Rubio, 2000; Bergh and Karlsson, 2010; Folster and Henrekson, 2001; Ghali, 1998) which may in turn lead to lower pollution at some levels and to higher pollution at others, depending on the shape of the Environmental Kuznets Curve (EKC), as shown by Grossman and Krueger (1995). Therefore, the total effect of government expenditure on the environment cannot be determined a priori.

Given this background and following a similar empirical strategy to that used by Welsch (2004) and Cole (2007),[2] our purpose is to investigate first how government expenditure affects pollution at given

* Corresponding author at: Department of Economics, University of Thessaly, Korai 43, Volos 38333, Greece. Tel.: +30 24210 74920; fax: +30 24210 74772.
E-mail address: halkos@uth.gr (G.E. Halkos).*URL:* http://www.halkos.gr/ (G.E. Halkos).

[1] In particular, they examine the effect of the share of public goods in total government expenditure on pollution.

[2] In particular, they examined the effect of corruption on pollution, also distinguishing between direct and indirect effects.

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http://dx.doi.org/10.1016/j.ecolecon.2013.04.002

income levels and other control variables, in particular to estimate a direct effect that mainly captures the composition effect and part of the technique effect, as defined in Lopez et al. (2011) and described in the Methodology section of this study; and then to examine the effect of government expenditure on the environment through the government expenditure impact on income (indirect effect) and to add the indirect effect to the direct effect to obtain the total effect.

The majority of the studies examining the government size–growth relationship find a negative impact of the former on the latter. Increasing public expenditure may deteriorate economic growth by crowding-out the private sector, due to government inefficiencies, distortions of the tax and incentives systems and interventions to free markets (Afonso and Furceri, 2008; Bajo-Rubio, 2000; Barro, 1991). In addition, the share of government expenditure dedicated to productivity increase in the private sector is typically smaller in countries with big governments (Folster and Henrekson, 2001). Furthermore, related papers by Bergh and Karlsson (2010) and Afonso and Jalles (2011) find that government size correlates negatively with growth. At the same time, government expenditure may also have a positive effect on economic performance, due to positive externalities, by harmonizing conflicts between private and social interests, providing a socially optimal direction for growth as well as offsetting market failures (Ghali, 1998).

The estimated sign of the direct effect of government size on pollution is ambiguous in the empirical literature. Frederik and Lundström (2001) investigate the effect of political and economic freedom on the level of CO_2 emissions and find that the effect of government size on levels of pollution differs according to the initial government size. They suggest that increased economic freedom, in terms of lower government size, decreases CO_2 emissions when the size of government is small but increases emissions when the size is large.

According to Bernauer and Koubi (2006) an increase in the government spending share of GDP is associated with more air pollution and this relationship is not affected by the quality of the government. However, they do not consider quadratic or cubic terms of income in their analysis and they ascribe their finding to the ambiguous hypothesis that higher income leads to both bigger government and better air quality.

Recently, Lopez et al. (2011) provide a theoretical basis for determining the effect of government expenditure on pollution. Specifically, they stress the importance and estimate empirically the effect of fiscal spending composition on the environment. They argue that a reallocation of government spending composition towards social and public goods reduces pollution. Moreover, they find that increasing total government size, without changing its orientation, has a non-positive impact on environmental quality. However, in a related study, Lopez and Palacios (2010) examine the role of government expenditure and environmental taxes on environmental quality in Europe and report total government expenditure as a negative and significant determinant of air pollution, even after controlling for the composition of public expenditure.

To the best of our knowledge the present paper is the first that distinguishes between the direct and indirect effects of fiscal spending on the environment. For that reason, a two-equation model was jointly estimated, employing a sample of 77 countries covering the period 1980–2000 for two air pollutants (sulfur dioxide, SO_2 and carbon dioxide, CO_2). In estimating the proposed model we take into account the dynamic nature of the relationships examined, by employing appropriate econometric methods for the estimation of dynamic panels for the first time in this area of research. Furthermore, appropriate GMM estimation methods are used to mitigate potential reverse causality biases of the explanatory variables.

The remainder of the paper is organized as follows: Section 2 presents the data used in the analysis and Section 3 discusses the proposed econometric models. The empirical results are reported in Section 4 while the final section concludes the paper.

2. Data

Our sample consists of 77 countries[3] with a full set of SO_2, CO_2, share of government expenditure, GDP/c and other explanatory variables information for the period 1980–2000. The analysis takes place up to the year 2000 because of limited availability of data on SO_2 after this period. Consequently, for reasons of comparability we also perform the analysis of CO_2 for the same time period. The database consists of 1617 observations per variable.[4]

To avoid dependence of results on geographic location characteristics and atmospheric conditions, emissions of the two pollutants were used rather than their concentrations. An important distinction between the two pollutants that has to do with their atmospheric life characteristics is their geographical range of effect (Cole, 2007). Considering that two-thirds of SO_2 moves away from the atmosphere within 10 days after its emission, its impact is mainly local or regional and thus, historically, sulfur dioxide has been subject to regulation. In contrast, CO_2 has not been regulated by governments, since its atmospheric life varies from 50 to 200 years and hence its impact is global.

The sources of pollution vary by pollutant. The main sources of SO_2 emissions are electricity generation and industrial processes. On the other hand, apart from energy transformation and industry, an important source of CO_2 emissions is transport. Apparently SO_2 pollution is characterized as production-generated, while CO_2 emissions are a mix between production and consumption-generated pollution. This distinction is important since the mechanism by which government expenditure size affects consumption pollution is likely to differ compared to production pollution. SO_2 emissions can be decreased by reducing consumption of fossil fuels (especially high-sulfur content coal), by using smoke-scrubbing equipment in power plants and by increasing energy efficiency. However, in consumption related pollutants the use and influence of environmental policies are more difficult, since the main tool to reduce these is the implementation of environmental taxes, which are often avoided as they are not politically popular.

3. Methodology

The proposed model consists of two equations jointly estimated, one being a conventional cubic formulation of the EKC augmented by the share of government expenditure over income and the second expressing income as a function of government expenditure and other factors. Specifically,

$$\ln(P/c)_{it} = \mu_i + \zeta_t + \beta_1 \ln Govshare_{it} + \beta_2 \ln(GDP/c)_{it} + \beta_3(\ln(GDP/c))^2_{it} + \\ +\beta_4(\ln(GDP/c))^3_{it} + \beta_5 X_{it} + \varepsilon_{it} \tag{1}$$

$$\ln(GDP/c)_{it} = \gamma_i + \delta_t + \alpha_1 \ln Govshare_{it} + a_2 \ln Z_{it} + u_{it} \tag{2}$$

where subscripts i and t represent country and time respectively and all variables are expressed in natural logarithms, unless otherwise stated.

The income variable and its powers in (1) control for scale effects. To control for income effect we use the household final consumption expenditure, while total private investment is used as a proxy for capital stock. Institutional factors reflecting pollution regulation are taken into account by using a measure of democracy level, however

[3] Albania, Algeria, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Bulgaria, Canada, Cape Verde, Chile, China, Colombia, Cuba, Denmark, Djibouti, Dominican Rep, Equador, Egypt, El Salvador, Finland, France, Germany, Ghana, Greece, Guatemala, Honduras, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Lebanon, Liberia, Mauritius, Mexico, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Nicaragua, Nigeria, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Romania, Sierra Leone, South Africa, South Korea, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Thailand, Togo, Trinidad, Tunisia, Turkey, Uganda, United Kingdom, United States, Uruguay, Venezuela.

[4] Table A1 of the Appendix A provides data sources and descriptions for all variables.

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