



# Environmental taxes and economic growth: Evidence from panel causality tests



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## ABSTRACT

The aim of this study is to determine the causal relationship between environmental taxes and economic growth, using different measures of environmental taxes with GDP as well as adjusted net savings. A panel of European countries and a separate panel of OECD countries are used from 1995 to 2006 and the standard Granger non-causality approach is applied. The results suggest some evidence of long-run causality running from economic growth to increased revenue from the environmental taxes, with also some evidence of short-run causality in the reverse direction. The inclusion of population and a proxy for economic subsidies had little effect on the long-run relationship, although the proxy for subsidies did have some short-run effect on growth.

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## 1. Introduction

Over the recent past, European Union (EU) member states in particular and other countries in general have set voluntary targets for the reduction in pollution and emission of greenhouse gases, which have facilitated the sometimes controversial use of environmental taxes across the world, especially in the EU. As a result of recent concerns relating to the harmful effects of global warming, policy makers have become increasingly interested in the use of environmental taxation as a means of combating the problem, in order to meet targets set at the 1997 Kyoto protocol to reduce greenhouse gases.

Also, during the 1990s, beginning with the Scandinavian countries, there has been a number of attempts to introduce Environmental Tax Reform (ETR) in EU member states. This has involved shifting the burden of taxation away from factors of production to pollution and the users of natural resources, summarised as a move from economic 'goods' to environmental 'bads'. Again, one of the main ways in which EU governments have attempted to do this is through the use of energy taxes, in order to encourage a reduction in carbon emissions.

The aim of this paper is to determine the direction of causality in the long and short run between economic growth and environmentally orientated taxes using two separate datasets for the EU and the Organization for Economic Co-operation and Development (OECD) countries.

The novel element to this paper is the use of Granger causality tests to test for the causal relationship between environmental taxes and various measures of economic growth, within the context of a panel dataset, which the authors believe to be the first time this has been attempted. This could potentially be important as it has been hoped that increases in environmental taxes would not only improve the environment but also increase economic growth, at a time when economies are struggling to grow. For the OECD dataset, this allows us to not only include the US in the study, but also use the adjusted net saving (ANS) measure of economic performance, which includes a measure of the environment, instead of gross domestic product (GDP). Other factors are also considered as determinants of both growth and taxes, such as population and environmental subsidies. This paper attempts to contribute to the debate on the effects of environmental taxes on the economy, by using the EU and OECD panel datasets to determine, using standard panel Granger non-causality tests, if there is any causal link between environmental taxes and economic growth.<sup>1</sup>

Following the introduction, the methodology used in this study is outlined and the form that ETR has taken in the EU member states

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<sup>1</sup> This study uses GDP and adjusted net saving to represent economic growth. An alternative approach used in many simulation studies is to use unemployment, which is usually highly correlated with GDP. This study has not used unemployment data as in some countries such as the UK there is a strong argument that it underestimates the true value, as many who are long-term unemployed are on alternative benefits instead, so they do not appear on unemployment lists.

discussed. The data and results are then examined and finally we suggest some conclusions and policy implications of the study.

### 1.1. Previous literature of taxation and economic growth

Granger causality tests have been extensively used to determine the direction in which causal relations lie between a set of variables. However as far as we know, they have not been used on economic growth and environmental taxes. As Granger (1988) suggested that if there is cointegration between a set of  $I(1)$  variables, then there must be causation in one direction at least. This is because the presence of cointegration implies that an error correction model can be formed, in which the error correction term has a significant effect on the dependent variable. However the causality approach has been used to determine causal relations between energy consumption, energy prices and economic growth (Constantini and Martini, 2010).<sup>2</sup>

To date most of the taxes particularly environmental ones and the growth literature have been theory based, either using environmental taxes in an endogenous growth framework as in Bovenberg and De Mooij (1997) or as a general measure of environmental policy as in Ricci (2007). The empirical literature on this issue has mainly concentrated on the use of simulation exercises rather than the use of econometric modelling, due to the lack of suitable macro-data so far. There have also been parallel studies which have empirically assessed the effects of personal and corporate taxes on economic growth, such as Lee and Gordon (2005). However these studies have not used causality tests to determine the relationship between taxes and economic growth. They have tended to be panel regressions and in general they find that increasing taxes reduces economic growth. A further study by Kneller et al. (1999) also shows that in general taxes reduce economic growth although they suggest only distortionary taxes reduce growth; these would include corporate and income taxes.

The approach to environmental taxation in the EU has concentrated on the use of taxes to improve the environment, whilst using the revenue raised to reduce the distortionary taxation on labour and production. This policy is often regarded as producing a double effect whereby the environment is improved and at the same time the economy benefits through the reduction in these distortionary taxes (Bosquet (2000)). However other studies (Myles, 2000) argue that for it to occur, the tax system must be inefficient, in which case a better policy would be to improve the system, rather than tax the pollutants. Nevertheless, Fisher and Van Marrewijk (1998) illustrated a theoretical model which suggests that pollution taxes can result in economic improvement.

Other studies have suggested further justifications for a positive causal effect from environmental policies to economic growth. Ricci (2007) suggested a number of ways in which measures to improve the environment can enhance economic growth, such as the prospect of a better environment may encourage saving. Pautrel (2009) indicated that when the reduced effects of pollution on health are taken into account, the effects of the environmental policy can be positive on the economy. Causality could also run in the opposite direction from GDP to taxes, as a rise in the income and wealth of a country increases the ability and inclination of a country to pay for higher environmental taxes.

The main empirical work on environmental taxation and economic growth has centred around the use of simulations on the impact of ETR on the environment, use of natural resources and the wider economy, although Leiter et al. (2011) have also used the same EU environmental tax data as a determinant of investment. In their study they found that environmental tax revenue, as an example of an environmental regulation, has a positive but diminishing effect on investment. Also, studies like those of Patuelli et al. (2005) and Anger et al. (2010)

**Table 1**  
Description of Variables.

Variable	Description
Y	Real GDP per capita
Taxt	Total environment taxes to total taxes (%)
Taxy	Total environment taxes to GDP (%)
Trantax	Transport taxes to total taxes (%)
Trantaxy	Transport taxes to GDP (%)
ANS	Adjusted net saving
Dtax	Diesel tax
Gtax	Gas tax
Populat	Population
RE	Renewable energy (% of energy from renewable sources)

focused on a meta-analytical approach in analyzing the effects of environmental taxes on the economy, which involves the use of regression techniques to determine the effects from simulation studies. As far as we know there have been no econometric studies in general or Granger non-causality studies in particular on the relationship between environmental taxes and economic growth.

## 2. Materials and methods

### 2.1. Environmental tax data

The measure of environmental tax revenue is based on the internationally recognised definition used by the Statistical Office of the European Union (Eurostat) and accepted by the main international bodies, such as the OECD. An environmental tax is defined as any tax, which has a physical unit as a base and for which there is evidence that it has a specific effect on the environment.<sup>3</sup> In this study the EU data are environmental tax revenue as a proportion of GDP and total tax revenue, which is used as a proxy for the tax rate (Table 1).

The data used in this study are annual, with 12 years and runs from 1995 to 2006, starting in 1995 as these are the earliest data available for the environmental tax measures. Specifically, the environmental tax revenue data are predominantly comprised of taxes on transport and energy products, such as the duty charged on hydrocarbons in the transport sector, as well as the industrial sector. It also includes the fossil fuel levy, which is a tax on electricity generated using fossil fuels. A recently introduced tax is the climate change levy, including petroleum, gasoline, coal and electricity. Further related tax sources include vehicle excise duty, the value added tax (VAT) applied to petroleum and the air passenger duty, which applies to air travel within the European Economic Area (EEA), but at a lower rate with countries outside the EEA. The transport taxes relate to the ownership and use of motor vehicles, which makes it comparable to the OECD data. However taxes on aeroplane flights are also included. The taxes refer to both recurrent and one-off taxes, such as road tax and sales of equipment respectively.

In European areas, the transport and energy taxes initially served as an energy security measure; however, in recent years the trend has shifted towards an environmental one (Davoust, 2008). There are about 375 environmentally related taxes in the OECD and about 90% of the revenues received from these taxes relate to motor vehicle fuels and motor vehicles (OECD, 2006). Among the EU 27 member states, the energy tax represents 75% of the environmental taxes of which 80% of this tax are from fuel taxes found in the transport sector (Eurostat, 2009). There is large variation in the fuel tax burden among the EU member states, in particular with regard to the proportion of transport taxes. In the transportation sector, two commonly used fuels

<sup>2</sup> The definition of Granger causality is that if variable  $X$  Granger causes variable  $Y$ , then past values of  $X$  contain information that can be helpful in predicting  $Y$  above the information contained in past values of  $Y$  alone.

<sup>3</sup> As recognised in other studies, there is some debate over what counts as a tax, in particular the use of earmarked sources of revenue. For the benefit of this study we rely on the definitions used by Eurostat, which is common across all the countries in the study. As noted earlier this is a macro based study using aggregated data for both taxes, pollution and energy consumption, thus, data on a more disaggregated level are not currently available.

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